CONVERSION FROM STAPLE TO CASH CROP PRODUCTION IN MEXICO AFTER NAFTA: EFFECTS OF PROCAMPO AND CREDIT CONSTRAINTS

BY

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THESIS

Submitted in partial fulfillment of the requirements
for the degree of Master of Science in Agricultural and Consumer Economics
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2010

Urbana, Illinois

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ABSTRACT

In this thesis, I ask whether the Program of Direct Support for the Countryside (PROCAMPO) helped Mexican agricultural producers benefit from the North American Free Trade Agreement (NAFTA). Specifically, I explore the effect of PROCAMPO's decoupled income payments on producers' ability to switch to cash crop production, and whether these payments continue to alleviate credit constraints for poorer producers. Given that World Trade Organization (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, which concentrated on specific regions and *ejidal* lands, I use nation-wide county-level data, allowing me to see the regional distribution of change across Mexico. I use these data to estimate the change in staple crop production as a function of county-level characteristics. This analysis led to several interesting observations. First, I 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 I can see that the creation of new markets is, in general, leading to a reduction in land planted in staples. Third, I find that the effect of PROCAMPO is even larger for *ejido* producers, implying that the benefits are not constrained to larger producers. Last, I find evidence that areas closest to the United States border have seen a greater movement to cash crop production after NAFTA.

To my grandfather

ACKNOWLEDGMENTS

I would like to thank my academic and thesis advisor, Dr. Kathy Baylis, who worked tirelessly to teach me techniques and methods that I know will benefit me in my future career. She spent countless hours with me working on data cleaning and developing my econometric methods. I also truly appreciate the funding with which she provided me during the first year of my studies; the research associated with the funding served as the start of my thesis work. Additionally, I would like to extend my gratitude to the members of my thesis committee, Dr. Alex Winter-Nelson and Dr. Robert Thompson, for their comments and assistance throughout this process.

Special thanks to two doctoral students, Rafael Garduño-Rivera and Jason Barton, who provided extensive assistance. Rafael's knowledge of Spanish made the process of gathering my data much less painful. I also appreciate his guidance on statistical techniques and data management. Jason initiated the process of gathering much of the data that was used in this final work, and for that I am greatly indebted. Pablo Alvarez and Marybel de Soto also provided assistance by collecting some of the data used in this study.

I would like to acknowledge the Canadian Agricultural Trade Policy and Competitiveness Research Network (CATPRN) who provided funding for this research paper. In addition, thank you to Dr. Amy Ando and Dr. John Braden who provided research opportunities and funding during my time at the University of Illinois.

Thank you to Dr. Ron Sands and Dr. Utpal Vasavada at the USDA's Economic Research Service for an enlightening internship opportunity during the summer of 2009.

I am grateful to my family and friends for their encouragement. I would like to extend a special word of thanks to my mother, Jane Henderson, and my husband, Matthew Vande Werken, who support me in all my endeavors.

Lastly, thank you to my grandfather, Dr. Harold Henderson, whose life ambition has always been to help alleviate the plight of the poor. He is the one who inspired me to obtain my degree in this field and I hope to help continue the work that he started.

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ACRONYMS AND ABREVIATIONS

Alianza	Alliance for the Countryside
ASERCA	Support Services for Agricultural Marketing
CADER	Center for the Assistance of Rural Development
CAP	Common Agricultural Policy (for the European Union)
CONASUPO	National Company of Popular Subsistence
FDI	Foreign Direct Investment
GATT	General Agreement on Tariffs and Trade
GDP	Gross Domestic Product
INEGI	National Institute of Statistics, Geography, and Information
OECD	Organisation for Economic Co-operation and Development
NAFTA	North American Free Trade Agreement
PROCAMPO	Program of Direct Support for the Countryside
PROCEDE	Program for Certification of Rights to *Ejido* Lands
PROGRESA	Program for Education, Health, and Nutrition
SAGARPA	Ministry of Agriculture, Livestock, Rural Development, Fisheries, and Food
USDA	United States Department of Agriculture
WTO	World Trade Organization

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 thesis, I 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, I ask whether the decoupled income payments under PROCAMPO (the Program of Direct Support for the Countryside) 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 creation in developing countries worldwide.

1.1. Motivation

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" and are capped, while those that are minimally trade distorting belong in the "green box." Payments that fall into the "green box" category can be unlimited. 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 toward 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

[1] This round of agreements took place under the General Agreement on Tariffs and Trade (GATT) organization. As an

of how moving to decoupled income payments in agriculture can affect farmers in a less developed country. In particular, by examining this program I can see how the poorest agricultural regions in 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. Additionally, since the PROCAMPO program is scheduled to be dismantled in 2012, this study may provide details about how Mexico can best create a new program that benefits both large and small agricultural producers. Payments made for this program account for approximately 35% of the agricultural ministry's annual budget (Zahniser 2004, 8). Therefore, developing an alternative to this program will be important in the coming years.

1.2. Contributions

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 affect 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). I 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]. By contrast, I 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, I obtain information on population, education, infrastructure, and off-farm wages. I also construct a measure 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 me with the ability to

[2] *Ejidos* 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.

generate a broader view of crop changes across the entire country. Generating an econometric model using these data, I am able to see the effects that trade liberalization and the movement from commodity specific price supports to decoupled income payments have had on agriculture at a regional level in Mexico. In addition, I am able to see whether the effects of PROCAMPO were restricted to wealthy regions or whether they also afforded poorer producers agricultural opportunities.

1.3. Hypotheses

I develop several hypotheses in regards to the effects of trade liberalization and decoupled income payments on agricultural production in Mexico. First, I hypothesize that the shift from commodity specific price supports to decoupled income payments will be associated with a conversion to cash crops. Second, 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, I hypothesize that direct payments such as PROCAMPO will aid credit constrained producers to make the often substantial investments needed to switch to cash crop production.

1.4. Overview

First, I detail Mexico's agricultural policy during the past twenty years. This includes 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 I evaluate studies that have been conducted on these policies. Next, I present my conceptual model, which is based on agricultural household theory. This section includes a discussion detailing how my variables fit into the agricultural household construct. Then I describe my data and empirical model and present my results. Finally, I discuss my conclusions, future extensions, and applications.

2. BACKGROUND AND LITERATURE REVIEW

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. Entering into NAFTA signified Mexico's intention to move away from a government supported agricultural market towards greater privatization and competition. The hope was that some of 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.

I would expect that Mexico would have a comparative advantage in the production of cash crops such as vegetables and fruits, whereas I would expect the United States to have a comparative advantage in corn with respect to Mexico. Under the Ricardian theory of comparative advantage, factor mobility is assumed to be costless. This is not the case in practice, and to benefit from trade, producers need access to credit to make changes in crop choice in response to changes in relative prices. Those who were already producing cash crops prior to NAFTA would benefit from trade. PROCAMPO then assists in redistributing the benefits to those who produced staple crops and would be made worse off by this free trade agreement. Mexico's trade in agricultural products with the United States and Canada has steadily grown in the past fifteen years, which is seen as a positive movement towards free trade and development. The full effect of these changes on individual agricultural producers, specifically the rural poor, is more difficult to determine.

This background analysis begins with an overview of Mexico's agricultural policy prior to the mid-1980s. The following section includes a discussion of the Mexican government's move toward trade liberalization. Then I provide details regarding specific agricultural policies that were instituted in the 1990s along with a literature review of studies that have evaluated the programs' effectiveness. These programs, specifically the decoupled income payment system, PROCAMPO, are meant to assist farmers in making the transition out of staple crop production. I also provide an overview of the accessibility of credit to the agricultural market. Finally, I present a timeline of trade liberalization events and other agricultural policies in Table 1.

2.1. Agricultural Policy Prior to NAFTA and Trade Liberalization

CONASUPO and *Banrural*

Prior to the early 1990s, Mexico's agricultural sector was heavily supported by the government. The government provided price supports, bought and distributed commodities, and

provided inputs and credit. CONASUPO (the National Company of Popular Subsistence) was the governmental agency that implemented these agricultural policies. It began in the mid-1960s and lasted through the late-1990s. CONASUPO's goal was to create efficient relationships between producers and consumers. It attempted to protect both parties; it made food affordable for low-income consumers and granted low-income producers the ability to obtain a certain level of livelihood from production (Yunez-Naude 2003, 98). This system of creating artificially high prices for producers and low prices for consumers was a large expense for the government.

Before policy changes, eleven crops were supported by CONASUPO programs: barley, beans, copra, corn, cotton, rice, sesame, sorghum, soybeans, sunflower, and wheat. CONASUPO was responsible for buying these crops from producers, processing them to create consumer goods, and managing retail stores that sold the goods to consumers. This institution played an important role in that it provided both technical training and inputs, including fertilizers, pesticides, and seeds, to agricultural producers. Finally, it is important to note that imports on all the crops subject to CONASUPO price supports were accompanied by strict import licenses, which limited international competition.

Under the system of government-controlled agricultural markets, the government was also involved in providing credit to small scale agricultural producers. This access to credit was provided through the state-run bank, *Banrural*, which was established in 1975. *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. *Ejidatarios* were the recipients of approximately three quarters of the loans issued by *Banrural*. *Ejidal* lands are those that are owned commonly by a community, and they tend to be of poor quality for agricultural production. These types of lands and the policies affecting them directly will be discussed in more detail later.

Access to credit from *Banrural* was limited in several ways. First, only crops with guaranteed price supports through CONASUPO were eligible for financing. This constraint provided an incentive for producers to plant one of the eleven approved staple crops. Another issue was that inputs such as fertilizers and pesticides were often delivered in an untimely manner, which could delay planting and lead to lower yields. Also producers could not choose the type of seed, fertilizer, and pesticides used, as they were provided directly by *Banrural* (Heath 1992, 699). These limitations all caused *Banrural* financing to be less than efficient for the majority of small producers.

Trade Liberalization

In the mid-1980s, Mexico's government started to make the shift towards the liberalization of trade. This move was partly a result of the world market becoming more interdependent through trade. Mexico realized that to achieve sustained growth, they also needed to open their markets to international trade. One of the first steps in this process was joining the General Agreement on Tariffs and Trade (GATT) in 1985. Joining GATT allowed them to focus on increasing their exports to the world market.

Even after joining GATT, Mexico still operated under somewhat restricted trade through the use of tariffs, quotas, and price supports. By entering into NAFTA with the United States and Canada in January 1994, many of these barriers to trade were lifted. Since the implementation of NAFTA, Mexico's exports to the United States have increased substantially. 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 an inflation-adjusted 299% increase (Zahniser 2009, 47). The actual volume of trade as a share of GDP has also increased, from 20% in 1980, to 40% in 1994, and to 70% in 2003 (Randall 2006, 78). These numbers show that Mexico's trade with the United States and Canada has increased, and some Mexicans have benefited from this trade. The full effect of these changes on individual agricultural producers, specifically the rural poor, is more difficult to determine.

The question remains as to who 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). The Gini Coefficient, which measures income distribution, shows that the income disparity between rich and poor in Mexico has diminished slightly since NAFTA but still remains relatively high as compared to other OECD[3]countries (World Bank 2009).

As previously stated, poverty is extremely prevalent in rural Mexico. Therefore, to address the issue of poverty and the effects that international trade may have, Mexico needed to evaluate and modify its agricultural policies. One of the general principles of development and reducing rural poverty is that it is necessary for a portion of workers to leave the farming sector, which allows for the consolidation of land and greater productivity. In 1991, 26.8% of the work force was engaged in agriculture. By 1998, only 20.2% of total employment was in the agricultural sector (Martin 2000,

[3] OECD is the Organisation for Economic Co-Operation and Development, and consists of 31 countries.

10). By the mid-2000s, 15% of workers were employed in agriculture and less than four percent of Mexico's GDP was obtained from agriculture (World Factbook 2009). This shows that in the past fifteen years, people have transitioned out of farm labor to employment in the industrial and service sectors. This transition is necessary for benefits to be gained from free trade.

2.2. Agricultural and Rural Policies Post-NAFTA

In the early to mid-1990s, several changes to the agricultural structure of Mexico were implemented. First, Article 27 was enacted in 1992, granting the right for *ejido* lands to be titled, bought, and sold. Then several programs were created specifically to address the issues that agricultural 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 ASERCA's (Support Services for Agricultural Marketing) Target Income/Market Support Programs, PROCAMPO, and *Alianza por el Campo* (the Alliance for the Countryside, also known as *Alianza*). One additional program that will be discussed is PROGRESA (Program for Education, Health, and Nutrition), which is a social policy but has implications for rural agricultural producers. In many cases the same family could be receiving conditional cash transfers through PROCAMPO and PROGRESA, as well as agricultural assistance through *Alianza*. Therefore the assistance provided by these programs can have a large impact on the overall income of an agricultural family. Finally, I discuss the dismantling of *Banrural* and the creation of *Financiera Rural*, along with its impacts on the credit market for small-scale agricultural producers.

Article 27

In 1992, Article 27 altered the *ejidal* structure allowing for the private ownership of what had previously been collectively held land. *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. These community lands often caused tension among neighbors, especially if clear title and regulations for use of the community lands were not appropriately established. The changes made to the *ejidal* structure in 1992 were in response to political pressure and discontent from within the *ejidal* communities. Previously, the *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 compensated somewhat for the lack of credit from private sources. With Article 27, land rights were granted so

that land could be sold or used for loan collateral. However, the price supports and technical assistance to the *ejidos* were discontinued.

In the early 1990s, *ejidos* constituted almost half of the farmland in Mexico and contained three quarters of the countries agricultural producers (Cord 2001, 2). These *ejido* lands tend to be of poor quality without irrigation and the *ejidatarios* generally have little access to machinery, improved seed, and newer pesticides. Due to the fact that the land was of poor quality, only 5 percent of *ejido* lands were sold after the reforms (Randall 2006, 213). There was also the issue of the ineffectiveness of PROCEDE[4], the program that was supposed to certify the rights of *ejido* members to land. Very few *ejidatarios* actually went through the process of receiving title to their lands. The idea was that if they had clear title of the land they would be more incented to make investments that would increase efficiency and production; however this objective was not fulfilled.

Target Income/Market Support Program

In 1991, Mexico's Ministry of Agriculture (SAGARPA) established the Support and Services for Agricultural Marketing (ASERCA). ASERCA has two main functions, the first being to administer the Target Income/Market Support Program. This program's purpose is to strengthen agricultural trade by building markets between producers and purchasers. This program's objectives include distributing marketing information to agricultural producers in order to increase exports. The Target Income/Market Support Program also assists in creating a market for hedging price risk.

The majority of the support provided by this program specifically targets medium to large producers who are exporting grains and oilseeds. According to the World Bank, approximately 67,000 agricultural producers received support from this program in 2000 with the average amount paid being $5,200 U.S. dollars (Income 2005, 252). Based on this information and the large amount given per producer, I infer that this assistance has gone mainly to large producers. There has also been geographic disparity, shown by the fact that four states, Sinaloa, Sonora, Tamaulipas, and Guanajuato, received over 80% of these funds. (Income 2005, 252) These states have many large agricultural producers as they are further north and are heavily involved in exporting agricultural commodities to the United States and Canada. Therefore I find little evidence that this program helped small-scale producers who have few excess crops to sell in the market or lack the infrastructure, roads, and transportation needed to move their crops to the market.

[4] PROCEDE is the Program for Certification of Rights to *Ejido* Lands.

PROCAMPO

The second main function of ASERCA is to oversee the PROCAMPO program. 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 planted for the three crop-cycles 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 what crop is produced 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. Producers are also allowed to transfer land use to farm livestock, forestry, or any ecological project and still continue to receive payments. Additionally, farmers are able to continue receiving PROCAMPO payments regardless of actual crop yield or sales. The majority of producers only receive one PROCAMPO payment per year; however, since there are two growing seasons, those with access to irrigation may be able to farm all year and receive the second payment (Ruiz-Arranz 2006, 6).

It is important to note that only farmers who could prove that they had farmed one of the nine eligible crops prior to 1993 will receive payments, 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. The payment per hectare in 2003 was approximately 950 pesos ($90 USD). 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 producers' 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 previously. 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 an OECD study, 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 initial criticism of PROCAMPO was that the payments may primarily benefit large producers, who would have been able to transition to cash crop production 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. Therefore a producer 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 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.

Several studies have examined the effects the PROCAMPO program has had on rural agricultural producers. A study conducted by Cord and Wodon, using *ejido* household level data from 1994-1997, found that "participation in PROCAMPO significantly reduces the likelihood that *ejido* households will be poor" (Cord 2001, 1). They also found that PROCAMPO had a positive multiplier effect on household income. Sadoulet and de Janvry conducted a study analyzing both the direct and indirect effects of PROCAMPO on Mexican producers. They specifically looked at the effects of PROCAMPO payments to 958 *ejido* households using data from 1994 and 1997. They concluded that the multiplier effect from PROCAMPO payments was in the range of 1.5 to 2.6 (Sadoulet 2001, 1043). This finding means that for every one peso that a producer receives through this program, he is able to generate 0.5 to 1.6 additional pesos through production activities. Both studies show that these payments have a positive effect on increasing small-scale producers' incomes. However, neither study specifically discusses the use of these funds as transitional support to move toward 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. A 2005 World Bank study estimates that approximately 85% of individuals within *ejidos* received PROCAMPO payments. PROCAMPO payments, along with PROGRESA payments for nutrition and education, account for 15% of the income of the rural poor (Income 2005, 248-249). Yunez-Naude and Taylor estimate that the "termination of PROCAMPO subsidies would have a negative impact on incomes, ranging from a one percent to a four percent loss for most household groups" (Yunez-Naude 2006, 173). These negative impacts will be the greatest in the *ejido* communities of Central and South Mexico. 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 will be necessary.

As discussed in my motivation section, the positive aspect of the PROCAMPO program is that it is less trade-distorting than the system of price supports that had been in place prior to the early 1990s. According to the WTO, direct payments to agricultural producers that are decoupled from production are considered "green box" subsidies and do not distort trade. By moving to this system they are in effect making themselves more available to trade. The government has also reduced its overall support to agriculture over the past twenty years. In 1986-1988, the OECD cited that producer support estimates as a percent of gross receipts was 28%. In 2004-2006, the percentage of support was cut to 21% (OECD 2009). Therefore, overall, the government is supporting agriculture less than it did under the state controlled system.

Alianza por el Campo

Alianza was formed in 1996. It was designed to assist in increasing agricultural and rural infrastructure. 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 to improve the balance of trade. This program is somewhat decentralized in that funds to support the various programs come from both the federal and state governments. A benefit of this structure is that states can specifically pick the programs they think will most benefit the agricultural producers in their state. This system makes it more responsive to farmers needs, similar to the concept of extensions in the United States. *Alianza* has four main programs: agricultural improvement, livestock improvement, rural development, and sanitation. Here are a few of the many specific programs that are in operation: fertile-irrigation, mechanization, kilo per kilo, soybean, cotton, oil palm, coconut palm, citrus, ornamental horticulture, saline soil recovery, pasture land development, better livestock, animal genetic improvement, dairy promotion, integrated livestock development, technology transfer, animal health, and vegetable protection (Suvedi 2000, 4-5).

Cord and Wodon conducted a study examining the effects that *Alianza* payments had on agricultural producers' incomes. Their 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. However, their study was conducted using data from 1994-1997, at which point *Alianza* had only been in existence for one year. This may explain the lack of effect. It often takes several years for information regarding

federal programs to reach the rural producers and for them to understand how to go about applying to receive the payments.

PROGRESA/*Oportunidades*

Although not an explicit agricultural program, the Program for Education, Health, and Nutrition (PROGRESA), which was established in 1997 by the federal government of Mexico, does channel assistance to the rural poor. The goal of the program is to alleviate poverty by providing conditional cash payment transfers to women, provided that they send their children to school and see that they have regular medical visits. By conditioning the payments on children's education, medical check-ups, and improved nutrition they are attempting to improve the human capital of the rural poor. The program is specifically targeted to the poorest households in rural Mexico. Eligibility was first determined by identifying poor communities based on an index that was compiled using factors such as percentage of illiterate adults, access to water, access to drainage, dwelling with a dirt floor, etc. (Ruiz-Arranz 2006, 7). Households were then chosen from within these communities based on household surveys and levels of poverty.

The payments are provided for three different areas: education, health, and nutrition. With respect to education, the government provides scholarships to each child enrolled in school for the purpose of purchasing school equipment. By making payments contingent on school attendance, parents are less likely to keep their children at home as source of farm labor. The program also provides for free basic health care for women and children, which includes prenatal care. Pregnant women and children under the age of two are also provided with access to nutritional supplements. This is extremely important because prenatal malnutrition, as well as in the first 24 months of a child's life, can cause permanent stunting of mental and physical development. For the nutrition part of the program, a direct cash payment is made that allows families to purchase food. As part of this program, mothers are required to attend informational sessions on nutrition. This provides more food for children, enhancing their chances of excelling in school. The important part of this program is that women are recipients of the payments because they are more likely than to use the payments in ways which benefit of their children.

A study conducted by Ruiz-Arranz (2006) looked at the impact of conditional cash transfer programs on food security in rural Mexico. Food security involves the ability to produce enough food and/or have enough income to purchase food. They found that PROGRESA did have a positive effect on food consumption and caloric intake. These payments also led to increased

diversity in the types of foods consumed. This may be due to the fact that a cash payment will incent them to purchase from the market, instead of only eating what they produce.

These payments are very important to the rural poor. A study by the World Bank shows that of households receiving PROGRESA payments, one fifth of their income comes from this program. PROGRESA is now called *Oportunidades*, and in April of 2009 the World Bank provided $1.5 million U.S. dollars to the Mexican government to assist them in expanding the program (World Bank (2), 2009). The main reasons for their continued investment is that studies of the program have shown that the number of individuals from rural areas enrolled in tertiary schools has nearly doubled, anemia in children under two years of age has dropped by 12.8 percent, and children under five years old have 20 percent fewer sick days (World Bank(2), 2009). These are substantial numbers and show the value of investing in programs such as this to combat poverty via supporting education, health, and nutrition.

Privatization of Banking

The privatization of state-owned banks in the early 1990s 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; 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. *Financiera Rural* lends to individual rural producers as well as rural enterprises, financial intermediaries, and informal credit organizations. *Financiera Rural* also claims to provide training and advisory services to assist rural farmers in making better credit decisions. 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 the beneficiaries of these loans have been 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. Agricultural development involves the ability to generate an increased amount of output (crop) per hectare and per worker. Therefore, there is a heavy reliance on access to credit in order to purchase inputs such as fertilizers, pesticides, water (irrigation), and machinery such as tractors. Without access to credit, the majority of the poor,

subsistence agricultural producers are unable to purchase these inputs that can help them modernize and increase their yields per hectare. They are also unable to make the capital investment necessary to transition to cash crop production and fully realize the benefits from trade.

Access to both short-term credit and long-term credit is needed. Short-term credit is necessary for farmers to buy inputs like new varieties of seeds and fertilizers, as the input is needed well before the yield is known. This access to credit helps mitigate some of the risk for the producer. Long-term credit is also often needed to buy machinery or more land, because farmers need flexibility in repaying these loans over a long period of time due to the inherent uncertainty in agriculture. In the long-term, if only the medium-sized and large producers can afford to purchase the inputs, their yields will go up relative to the smaller farmers. The aggregate effect will be to increase the supply and depress the market price of the crop. Therefore, lack of credit may severely hurt the smaller farmers' ability to exist. Providing agricultural credit to the lowest income producers is then necessary for equitable development.

To further complicate the credit situation, in late 1994 the peso was devalued, causing an increase in inflation and led to a severe recession in Mexico, often referred to as the Peso Crisis. Loans from the United States government allowed for Mexico to emerge from this recession in the late 1990s. However the recession may have caused a delay in the benefits that producers saw from the free trade agreement.

2.3. Summary

By providing this background regarding the various agricultural and rural policies that have been enacted since the early 1990s, I hope to provide a foundation for my study. First, I find evidence to support the idea that many agricultural producers are credit constrained. A compelling indication of the current credit constraint is the fact that credit was previously provided by the government, and with the privatization of banking, fewer small scale producers have access to credit. Secondly, the government clearly recognizes this credit constraint, signified by the fact that they moved to issue PROCAMPO payments before planting and provided for the ability to capitalize PROCAMPO payments to use as collateral for loans. I ask whether PROCAMPO helps alleviate this credit constraint so that producers can use these payments to transition from staple crop production to higher value cash crops, which can be sold both in local and international markets.

3. CONCEPTUAL MODEL

3.1. Agricultural Household Models

To consider the forces that affect crop choice, I 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. Additionally, determining the effects of government policies becomes more complex as these policies can affect production levels as well as consumption and the labor supply (Singh 1986, 149). It is important to note that the specifications and assumptions that researchers make in their agricultural household models vary extensively depending on the type of policy they are examining.

The decisions that farm households make regarding what to consume and produce are directly linked, and these decisions are often made simultaneously. Many agricultural households sell as well as consume the goods that they produce. They must choose how to allocate their production resources, including labor and other purchased inputs such as fertilizer and seed. As consumers, they also decide how to allocate income, from farm and off-farm activities, for the consumption of purchased goods and services. This model must also be able to incorporate various types of farm households, including the net-surplus producing farm family, the subsistence farm family, small scale renters, and owner-operated commercial farms (Taylor 2003, 34-35). It is important that the model can reflect all these groups, as it is typical in developing countries to have all four varieties of agricultural households.

Many of the assumptions made in economic modeling do not hold for developing countries. For example, the assumption of perfect markets can alter results significantly as many agricultural producers in Mexico face imperfect markets in which transaction costs are often extremely high. Key, Sadoulet, and de Janvry (2000) used an agricultural household model to determine the effect of transaction costs on production choices made by rural households in Mexico. They created a model that accounts for the different relationships that farm households have with the market, as this relationship determines responsiveness to price. In their model, the household maximizes utility subject to a cash constraint, resource balance constraint, and a production technology constraint. They discussed both proportional and fixed costs and how fluctuations in these costs can cause

households to either leave or enter the market. They found that both types of transactions costs are significant, but that proportional transaction costs are most significant when households are deciding whether to sell in the market (Key 2000, 258).

Taylor, Dyer, and Yunez-Naude (2005) created 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. They noted, however, that these income effects are very small for subsistence producers, as the direct income payments from PROCAMPO and PROGRESA helped offset the negative income effect from the decrease in the price of maize (Taylor 2005, 1681). They also conducted an experiment in which they converted the current PROCAMPO payments to the previous system of price supports. From this simulation they concluded that maize production on commercial farms would have been substantially higher, 12%, whereas subsistence production of maize would have slightly decreased, less than 0.26%.

As stated in consumer theory, the goal of a household is to maximize its utility subject to various constraints. These constraints vary, but can include income, time, land and other productive assets, the price of inputs, the market price of crops, and the price of other purchased goods. As producers, they also make decisions to maximize profits. Taylor and Adelman (2003) proposed that the solution to this model produces a set of "equations for outputs, input demands, consumption demand, and either prices (for household non-tradables) or marketed surplus (for household tradables)" (Taylor 2003, 34-35). Therefore, all endogenous variables are represented as functions of exogenous variables. These exogenous variables may include government policies, prices of various crops, farm equipment, technology, and credit. In addition, the family budget is endogenous in the household model and depends directly on production and farm profits (Taylor 2003, 36).

3.2. Basic Model

In my basic agricultural household model, households choose the level of land(n), labor(l), variable inputs(v), and capital(k) to invest in the production of staples(q_1) and cash crops(q_2). I assume these choices are made to maximize utility from consumption of staple crops and all other goods purchased in the market, x_1 and x_0, respectively. I use x_0 as my numeraire good, with price p_0=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 my household model is:

$$Maximize\ U(x_1, x_0)$$

$$subject\ to:$$

Budget Constraint

$$[q_1^m(p_1 - v_1) + q_2(p_2 - v_2 - m)] + \omega_{t-1} + g + (w \cdot l_z) - k_2 - x_0 \geq \omega_t$$

Production Function – Staple Crops

$$q_1 = f(n_1, l_1, v_1)$$

Production Function – Cash Crops

$$q_2 = j(n_2, l_2, v_2, k_2)$$

Land Constraint

$$n_1 + n_2 \leq n$$

Labor Constraint

$$l_1 + l_2 + l_z \leq l$$

Staple Crop Constraint

$$q_1^m + x_1 \leq q_1$$

If credit constrained the following must also be true:

$$g + \omega_{t-1} + (w \cdot l_z) - v_1 - v_2 - k_2 \geq 0$$

Income from agricultural production consists of the price(p_1, p_2) they receive for the crops they sell in the market minus variable costs(v_1, v_2) and transaction costs of getting the crop to market(m) times the quantity sold in the marketplace. Second, any wealth endowment(ω_{t-1}), which I define as cash carried over from the previous agricultural cycle, government payments(g), including PROCAMPO, PROGRESA, and other market support programs, and off-farm wages $(w \cdot l_z)$ are added to this amount. Lastly, the cost of capital investments necessary to transition to cash crop production(k_2) and the cost of consumption goods(x_0) are subtracted from the household's income. I assume that not all incoming money is spent but that some is saved to be used in the next agricultural cycle(ω_t).

In my model each farm produces only two goods, staple crops and cash crops. Production of each good is a function of land(n_1, n_2), labor(l_1, l_2), and variable input costs(v_1, v_2). Additionally, I assume that capital requirements(k_2) are needed only for cash crop production. In addition, I include three inequality constraints. First, the land planted in staples plus the land planted in cash crops must be less than or equal to the total available agricultural land. Second, the labor used for staple crop production, cash crop production, and earning off-farm wages must be equal or less to the total amount of labor hours possible. Third, 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. Cash crops are being produced primarily for the market and therefore are not being consumed by the household.

Additionally, I assume that producers have some access to credit, and that their credit access is related to their existing wealth or government payments. This access to credit means that the producers have the cash available to make capital investments at the beginning of the agricultural year prior to planting. If I assume that the producers are credit constrained, then the last constraint must be true, which states that current government payments, wealth, and off-farm income minus variable costs and the investment in capital for cash crop production must be greater than or equal to zero. This assumption is based on the discussion of credit in the previous section.[5]

The econometric model I construct is at the county, not agricultural household level. However, I make the assumption that agricultural households within a county are relatively homogenous. Statistics to support this assumption will be discussed in my data section. I 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, $\partial \frac{n_{2i}}{n_i} / \partial g_i > 0$. This supports my hypothesis that PROCAMPO payments assist people in moving from staple crop production to cash crop production. If I assume homogenous counties, then I can sum this up to the county level, $\sum \partial \frac{n_{2i}}{n_i} / \sum \partial g_i > 0$.

This model gives some insight as to how household factors might affect the observed percent of land planted in cash crops versus staple crops. There is very little capital investment in planting staples, as many of these producers have been in agricultural production of crops, such as corn and beans, for generations. There is a cost to purchasing the inputs and machinery necessary to grow certain cash crops. The ability of the household to make this transition depends on many of the factors that are in my model. For example, the prices of staple crops and cash crops, as well as the transaction costs related to transporting them to the market, will affect whether a producer will grow cash crops. The decision to grow cash crops also depends on whether farmers have cash available from the previous agricultural season or incoming cash from off-farm activities that can be added to government payments in order to make an investment prior to planting.

The above model also gives some insight as to determinants of regional crop choice after NAFTA, and how it might be affected by government payments. NAFTA reduced market barriers which directly affected the price that producers would receive for their crops. I assume that after NAFTA was implemented, staple prices decreased due to increased competition from the United

[5] I do not observe credit in my base model, as the data is only available at the state level; therefore, I will examine credit in a separate model.

States and Canadian markets. The removal of government price supports would also cause the price that the farmer received for staple crops to decrease. PROCAMPO was targeted to assist agricultural producers in making crop choice changes by increasing their incomes to offset lower prices during this transition time period. Since PROCAMPO directly affects the agricultural producers in the form of cash payments, its effects should be captured by this model. These direct payments may then lower the cost of transitioning from staple to cash crops, allowing producers who previously did not sell their agricultural goods to now have access to markets.

Alternatively, since NAFTA has opened the United States and Canadian markets, it has created a new market for cash crops, including fruits and vegetables. Please refer to Table A.1 in the Appendix, which shows the prices of corn, staples, and all other crops for 1991, 2001, and 2003. This information was obtained directly from my data and shows that the price of corn and staples decreased from 2001 to 2003, whereas the price for all other crops increased during the same period. Therefore, those producers who have the resources to make the transition out of staples production and have relatively low transaction costs to market could see an increase in income.

To build an empirical model I need data on government payments to agricultural households, including programs that are specifically targeted to the rural poor. Data on farmer characteristics, including infrastructure and education variables, also play a role in my model. To see if there has been a change in crop choice due to various policies, it is necessary to obtain data on agricultural areas planted, volume harvested, and the value of the harvested crops. Since my data is at the county level, I assume that the producers within each county are relatively homogenous and that they are price takers. This model allows me to see what effects external policies, NAFTA and PROCAMPO, have had on counties across Mexico. My model takes into account two of the main activities in which rural households may be involved, including staple and cash crop production. My income sources are agricultural sales, cash transfers (PROCAMPO and PROGRESA), and other government payments.

3.3. Framework for Variable Choice

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. I believe that the following variables help to explain why the choice to move from staple crop production to cash crop production will be made. However, I am constrained by the data available from the Mexican government which will be discussed further in my data section.

My main dependent variable is the percent of agricultural land planted in staples.[6] I chose this as my 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. I define staples as the nine crops that are eligible to receive PROCAMPO payments. These crops include barley, beans, maize, cotton, rice, sorghum, soy, sunflower, and wheat.

My independent variables include those that represent local market demand, transportation costs, transition costs, and the effects of governmental policies. My market demand variables are total population in thousands and wages per worker.[7] 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 me to refer to it as off-farm wages. This measure of income provides me 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 in demand for cash crops should cause the price of cash crops(p_2) to increase, which will provide additional incentives for producers to switch to cash crop production. Even though I mention labor in my model, I do not actually have data on the division of labor. Therefore labor will not be included in the econometric analysis.

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.[8] I would expect that as distance from the border increases, transaction costs(m) 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.[9] This index was created using factor analysis; this allows me to avoid some multicollinearity issues[10] and gives me a proxy for households

[6] This variable was created by dividing the area planted in staples by the total area planted of all crops.
[7] The log of both these variables has been taken because of their initial skewed distribution.
[8] This variable was created by Rafael Garduño-Rivera. Please reference Garduño-Rivera (2009) page 18 for more details.
[9] This variable was created by dividing the number of households that have this infrastructure by the total number of households in the county.
[10] These variables were created by Rafael Garduño-Rivera. Please reference Garduño-Rivera (2009) pages 18-19 for more details.

that are linked to sewage systems. Since sewage is much more common in developed urban areas this allows me to pull out details on how remoteness from markets may affect crop choice. I would expect that an increase in infrastructure would be associated with lower transaction costs(m) as the producers may be close to a market.

The two variables that I use to capture transition costs from staple to cash crops are literacy and education levels. I believe that those who are literate and have at least a high school education are better able to make the transition to cash crops. Those who are literate tend to have greater access to market information. In addition, they may also 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. My literacy variable shows the percent of people over the age of 15 that are literate in each county. The high school education variable shows the percent of people in a county that have received a high school degree. Based on this discussion I would expect that as education levels increase, the capital investment related to switching to cash crop production(k_2) will decrease.

There are three variables that capture government policies, including PROCAMPO, PROGRESA, and other government payments. I ask whether or not these programs are alleviating the credit constraint of producers, which then enables them to make the transition from 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. The PROGRESA payment per person variable was generated by dividing the total amount of payments to a county by the population of the county.[11] My total other government payments variable is total government payments made to agriculture divided by the number of farms in 1991.[12] 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. My expectation is that all these payments(g) would increase producers' incomes, which would in turn reduce their credit constraint and allow them to transition to cash crop production.

[11] The PROGRESA data does not contain total number of beneficiaries of payments per county and that is why total population was used.
[12] Since I did not have information on how many producers received these payments, I normalized the data using the number of farms in each county in 1991.

Therefore I would expect these programs to allow for producers to move out of staple crop production.

I 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 terms 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, I 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.

Using this model and data, I draw out the effects that NAFTA and PROCAMPO have had on agricultural production in Mexico. Specifically, I demonstrate that decoupled income payments, PROCAMPO, are associated with conversion to cash crops. I also observe that the implementation of NAFTA is associated with greater cash crop production. Lastly, I am interested in seeing the distribution of the conversion to cash crop production across the whole country. I hypothesize that the areas closest to the United States border will see a greater movement to cash crop production after NAFTA.

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.[13] 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. My 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. Please note that I have discounted all payments in pesos by the 2003 Consumer Price Index. All my variables are further described in Table 2.

From this data I formed a panel data set for the years, 1991, 2001, and 2003. To formulate three complete years, I had to move years of data slightly; however, I do not believe this change significantly alters any results. For the PROCAMPO, government payment, and credit data, agricultural year 2000/2001 was mapped to 2001, and 2002/2003 was mapped to 2003. For PROGRESA, agricultural year 2001/2002 was mapped to 2001 and 2003/2004 was mapped to 2003. For the agricultural data, 1991 was left as is, while 2001/2002 was mapped to 2001 and 2002/2003 was mapped to 2003. The economic and infrastructure data actually corresponds to 1989, 1999 and 2004; however these were mapped to 1991, 2001, and 2003. This then gives us complete panel data for three years, 1991, 2001, and 2003.

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, my 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. Therefore eleven states, Baja California Norte, Coahuila, Distrito Federal, Guanajuato, Guerrero, Edo Mexico, Nuevo

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

Leon, Oaxaca, Sinaloa, Sonora, and Tlaxcala, will have all results reported at the district level. Since the size (in square kilometers) for counties and districts varies widely, I weight the results by the agricultural area in each county and district. My 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.

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 my credit model.

I have stated that producers are likely to want to switch crops in response to price changes resulting from NAFTA. These price changes are likely not uniform across the country. To explore this regional variation in price, I use my data to generate the farm gate prices for corn in 1991 and 2003 and tomatoes in 2003 by region relative to the national annual average.[14] These prices can be seen in Table A.2. Some patterns are predictable. For example, in 2003 the price premium for corn is 0.63 pesos in the border region, whereas there is a price premium of 1.29 pesos in the southern region. This greater price premium in the southern region may provide an additional incentive for producers to stay in the production of staple crops, such as corn. I can also see that the price premium for corn has decreased from 1991 to 2003 in the border and northern regions as well as the southern region. In addition, the price premium for tomatoes in the border and northern region is higher than the price premium for corn, which may explain why more producers in these regions have switched to cash crop production. These prices do not account for product quality but do provide evidence of regional differences in price premiums throughout Mexico.

Test of County Homogeneity

As was discussed in my conceptual model section, I am assuming that agricultural households within a county are relatively homogenous, since my data is at the county level. To support my assumption, I use individual census data from 1990 that comprises 10% of the population of Mexico. From this data I obtain the means and standard deviations both within and between counties. Please refer to Table A.3 for the results. I examine wages and education for those

[14] I do not have price data for tomatoes in 1991.

working in agriculture and those 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, my 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 0.7444.

These results have also been projected in histogram form. Figure A.1 is a histogram of the standard deviation of wages between counties. As seen in this histogram, the vast majority of observations are congregated around zero; however a few outliers cause the standard deviations as a whole to be altered. By examining the histogram for the education variable, Figure A.2, I see that the vast majority of the observations are congregated between zero and two. This information allows me to state that individuals who own their land and earn income from agricultural production are relatively homogenous within counties in Mexico.

Additionally, I have access to geographic information such as elevation and climate. Please see Figure A.3 of the Appendix. These maps show the elevation levels and climate throughout the entire country of Mexico. Examining these maps provides further evidence that municipalities are fairly homogenous. Since I know that elevations and climates affect crop choice, it follows that producers within a county will face similar physical constraints. 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

Model Construction

My 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.

% of 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 the United States border*
3) *Transition cost = education*
4) *Policies = PROCAMPO payments, other government payments*

Summary Statistics

To better visualize the spatial distribution of my data across the whole country, I generated maps of all of the key variables. Please reference Figures 1-9. These were created by joining my data to a spatial file of all of Mexico's counties in ESRI's ArcGIS. For the majority of my variables, I created side by side maps, in which the data for 1991 is on the left-hand side and the data for 2003 is on the right-hand side. There are a few figures that are worth discussing in some detail. Figure 1 is my 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 5 shows the percent of people within a county that have a high school education. As shown, these levels are fairly low across the whole country. However, 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. Figure 6 and Figure 7 show the two variables that comprise my infrastructure index, the percent of households with drainage and the percent of households with sanitation. Overall, there has been increased investment in infrastructure from 1991 to 2003, as a much greater percentage of the population now has access to both drainage and sanitation.

My PROCAMPO variable can be seen in Figure 8. Since this program was instituted after NAFTA, I only have data for 2001 and 2003. I have projected the data for 2003. Since I know that each hectare receives the same payment, the PROCAMPO payment per producer shows the farm size distribution across the country. I can see that many of the larger producers are in northern and central Mexico. I have also projected the PROCAMPO data as a percentage of total agricultural area. This shows that PROCAMPO payments are distributed throughout the entire country. I also map PROGRESA and other government payments for 2003. These can be seen in Figure 9. Since the PROGRESA 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. I can also see that the majority of other government payments are going to border states and a few states in central Mexico. For additional details, please reference Table 3 for summary statistics and Table 4 for a correlation matrix of my main variables.

Initial Regression Results

Initially I 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).[15] The results are detailed in Table 5. I find that population, government payments, and distance to the border are positive in all models and wages and high school completion are negative in all models. The only two variables that change signs across models are the infrastructure index and PROCAMPO; reasons for this will be discussed in detail later in this analysis.

I know that an ordinary least squares (OLS) model will not be the most appropriate since my 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 are not significant at the 5% level. The coefficient on the population variable is significant and shows that for a 1% change in the population there is 7.3% increase in staple crop production. The wages per worker and high school education coefficients are both negative, as I would expect them to be. For a 1% increase in wages per worker there is a 3.1% decrease in staple crop production. The two variables that I am 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 effect and leaves me only with variance over time. In my FE model, population, government payments, and distance to the border[16] 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 33.9% increase in staple production. The coefficients on wages per worker, high school education, and PROCAMPO payments are all negative. It is interesting that in the OLS model the coefficient on 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 6.6% decrease in the area planted in staples. A negative sign is what I 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.

[15] I conducted the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity. With the result being chi2(1) = 27.84 and Prob > chi2 =0.0000. Since heteroskedasticity is present I will use robust standard errors for all models.

[16] My 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)

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 me to see effects both over time and between counties. I use this model as I believe that there are differences across counties that have some influence on crop choice. Just like in the OLS and FE models, population, government payments, and distance to the border are positive, and wages and high school education are negative. The PROCAMPO coefficient is negative in this model, so for a 1% increase in PROCAMPO payments there is a 2.4% reduction in area planted in staples. The coefficient on government payments is not statistically significant in this model.

Results from two other models, weighted FE and weighted RE, are also reported. I know that I 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 that are larger in land area will count more in the regression, a feature necessary for obtaining accurate results. I will discuss the weighted models in more detail in the next section.

Main Model Results

Next, I take the model constructed above but add in a NAFTA variable, which is my dummy variable where years after 1994 equal 1. I also constructed three interactions with NAFTA. Specifically, I interact NAFTA with my population, wages per worker, and distance to the border variables. This will allow me to determine if the effects of these variables on staple crop production changes after NAFTA. I then ran both weighted FE and weighted RE models. These results can be seen in Table 6.1.

I will examine the weighted FE in comparison to the weighted RE model with my dependent variable being the percent of agricultural land in staples. The weighted FE model will be what I refer to as my main model in later discussions.[17] For the FE model all my variables are statistically different from zero at the 5% level except for wages and the infrastructure index. For the RE model all of my variables are statistically significant at the 5% level.

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

First, I will discuss my main variable of interest, PROCAMPO payments. The PROCAMPO variable tells an interesting story in that in the FE model the coefficient is negative, and in the RE model it is positive. In the FE model a 1% change in PROCAMPO payments leads to an 8.7% decrease in land planted in staple crops. This result makes intuitive sense as the FE is only accounting for the time effect, 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 1.7% more land planted in staples. Since PROCAMPO is 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, I believe that the RE model is largely picking up the placement of the PROCAMPO program.

The coefficient on the other government payments variable is positive in both models, with an effect of a 3.6-3.7% 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 incented 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.

My variables that proxy for market demand are population and wages per worker. The coefficient on my 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 27%, whereas in the RE model the increase is only 6%. The coefficient on 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 3% reduction in staple crop production, and the RE model reports a 3.3% 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 I examine my variables that represent transition costs, education levels and infrastructure. The FE models show that for a 1% increase in high school education, staple crop production decrease by 2.1%. Since education is often needed for producers to fill out credit forms

and apply for government payments, I would expect that an increase in education would lead to a decrease in staple crop production. My infrastructure variable shows the percent of households within a county that have access to a sewage system. The coefficient on this variable is negative in both the FE and RE models. These coefficients taken together appear to imply that as education and infrastructure increase, staple crop production decreases. Therefore education and infrastructure may decrease transaction costs, which allows producers to more easily transition to cash crop production.

I also added in a NAFTA dummy variable and various interaction terms. I interacted the NAFTA dummy with my population, wages, and distance variable to see if their effect changes after NAFTA. Table 6.2 details the effects of these variables before and after NAFTA. If I first examine my FE model, I see that 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 smaller, but it is not statistically significant. Distance to the border has a greater effect after NAFTA. Prior to NAFTA a 1% increase in distance led to a 1.6% increase in staple crop production. After NAFTA a 1% increase in distance leads to a 5.3% 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.

Similar to the results of my FE model, population does not appear to have much of an effect after NAFTA in my RE model. Additionally, in the RE model 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 United States and Canada. The effect of distance is actually negative before NAFTA, I 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 considered cash crops, such as coffee and citrus. They already produced these prior to NAFTA due to having the correct 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 5% increase in staple crop production. This effect is similar to that reported by the FE model.

Robustness Tests

To determine the robustness of my main results and to examine the distributional effects of PROCAMPO, I ran several different versions of my main model. First, I reduced the number of counties in my model to only include those that contain either a high percentage of *ejidal* lands or receive a high amount of PROGRESA payments. Second, I generated a model which examines the regional effects of PROCAMPO. Third, I ran my main model with revenue per hectare as my dependent variable. Fourth, I ran a regression including data on two other variables, literacy and the existence of cities, which is a dummy variable that is equal to one if a county has a city with over 100,000 people. Fifth, I included the social welfare program, PROGRESA/*Oportunidades*, in the main model. Sixth, in order to further support my assumption that counties are fairly homogenous, I ran the model on my dataset that doesn't include counties that have high standard deviations for wages and education. Lastly, since my dependent variable is a percentage constrained to be between 0 and 1, I ran a Tobit model to see if there was anything that my fixed effects model was not capturing. Details of these robustness tests follow.

Ejidal Lands and PROGRESA Areas

Not only am I concerned with the overall effect of PROCAMPO, I am also interested in its distributional effect across producers. Thus, did PROCAMPO benefit all producers or was its effect largely felt by larger commercial producers in the north? By examining areas that have a high percentage of *ejidal* lands or a high amount of PROGRESA payments I hope to see if the PROCAMPO program has a similar or different effect from the main model.

First, I calculate the percent of agricultural land within a county that is categorized as *ejidal* land. I then keep only the half of the data that has the percentage of *ejidal* lands as greater than the mean. I then run my main model on this smaller set of counties. Please see Figure 10 for a distribution of these select counties in Mexico. The results of my regression are reported in Table 7.1. I 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 I had originally expected. The effect of PROCAMPO payments is larger in this model. In this model, for a 1% increase in PROCAMPO payments, there is a 10% reduction in staple crop production, whereas in my main model it was only an 8.7% reduction. Interestingly, education appears to have a greater affect in this model.

Next, since PROGRESA is targeted at the poorest communities in Mexico, I form a dataset that only includes those counties that have PROGRESA payments per person that are greater than

the mean.[18] Please see Figure 10 for a distribution of these select counties in Mexico. I then run my main model using only these counties. If I look at my education variable in this 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 leads to a 1.8% 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%. The PROCAMPO coefficient is not significant in this model.

If I examine distance from the United States border, I see that before NAFTA if distance increases by 1%, it causes a 5.5% reduction in staple crop production. Possible reasons for this were discussed previously. After NAFTA an increase in distance leads to an 8% increase in staple crops; however, this is not significant. Please refer to Table 7.2 for the before and after NAFTA coefficients for my interaction terms. I believe that I see a positive coefficient after NAFTA when I just look at areas that receive larger PROGRESA payments, as many of the areas closest to the border are no longer included in the model. When comparing relatively poorer counties to other poor counties, distance to the United States border becomes less important as a determining factor in regards to staple crop production, and local market demand may become more important.

If I compare the overall effect of PROCAMPO on *ejidal* lands and the areas with greater PROGRESA payments, I see an interesting result. The *ejidal* model shows a 10% decrease in staple crop production with a 1% increase in PROCAMPO payments. The PROGRESA model shows only a .03% decrease in staple crop production and is statistically insignificant. This shows that *ejidos* may be responding differently to receiving PROCAMPO payments than those who are just poor, as measured by PROGRESA.

Regions

Next, I generated a model where I examine the regional effect of PROCAMPO payments. First, I create dummy variables for four regions in Mexico: border, north, central (includes Mexico City), and south. Then I interact these regional dummies with the PROCAMPO variable. By creating these specifications I hope to see if PROCAMPO affects producers differently in each region in Mexico. The results of interest from this regression can be seen in Table 8. The border and northern regions show similar results for a 1% increase in PROCAMPO; staple crops decrease by 5% and 7%

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

respectively. However, in the central states there is only a 1.7% decrease in staple crop production. Lastly, in the southern region I actually see an 18.6% increase in the land planted in staples for a 1% increase in PROCAMPO payments. This shows that producers in various regions are responding differently to PROCAMPO payments, and that those further from the border are less likely to use an increase in payments to switch out of staple crop production. This result may be in part due to the fact that the price premium on corn is higher in the southern region and that transaction costs to send cash crops to the border are too high to make transitioning out of staples possible.

Agricultural Revenue per Hectare

For comparison purposes I ran a weighted FE model with the dependent variable now being total agricultural revenue and all the independent variables remaining the same as my main model. Since the price of staples should be lower than the price of cash crops, I would expect higher revenue per hectare to be associated with less staple crops. This means that the signs on my coefficients should be opposite of what they were in the previous model. Please reference Table 9. In this 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 coefficient, and for a 1% increase in education there is a 168 peso increase in revenue per hectare.

Literacy and City Dummy

I have data on two variables that were not included in the main model for various reasons. The variables are percent of the population over fifteen years old that are literate and a dummy variable that reports whether a county has at least one city with a population of over 100,000. Please see Figures 11 and 12 for maps of these variables. Weighted FE models were run with these variables included. The results can be seen in Table 10. Adding the literacy variable to the equation produces a positive and significant result. This positive sign may be in part due to the definition of literacy. Many people may have basic literacy, as shown by the fact that the mean of my literacy variable is 0.8134. The high school variable has much more variation, and therefore gives us a better proxy for transition costs than literacy.

The purpose of running the model with a dummy variable for large cities is that I hope to see if it can provide a better proxy for local market demand. By generating a dummy variable, I am able to create a comparison between those counties that have a large city and those which do not. My city variable therefore replaces my population variable in this model. Many of my variables are

very similar in sign and magnitude to the main model. The coefficient on the city variable is worth noting, as the model shows a 14.3% increase in staple crop production if a county has a city with a population over 100,000. This is a similar effect that I see using the population variable. Therefore, I decided to just leave the population and wages in the model to show my market demand, and remove the cities variable in my final model.

PROGRESA

Originally, I planned to include data on PROGRESA payments in my model. My initial speculation was that these payments would increase the amount of cash crops by decreasing the credit constraints faced by producers. However, this is not the case, as the PROGRESA payments per person are positive in most models. Please refer to Table 11. From this I can see that in a FE model a 1% percent increase in PROGRESA payment increases the percentage of land in staple crops by 52%. The positive effect of PROGRESA may be due to the fact that it is specifically targeted at the poorest rural communities in Mexico. Therefore, these funds are going to areas that traditionally have a higher proportion of subsistence farmers and are 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 decreases 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. Since I am only able to speculate about why the PROGRESA variable is having this effect, it was not included in my main model.

Homogeneity Test

I ran this model to further support my assumption that agricultural producers within a county are relatively homogenous. Based on the results provided by the 1991 micro-sample survey, I removed counties from the dataset that had high standard deviations. Specifically, I removed counties that were in the 95^{th} percentile for wages and the 99^{th} percentile for education levels, since these counties are the least homogenous. I then ran my main model with this reduced dataset. See Table A.4 of the Appendix for the results. As I had anticipated, the results change very little from the main model. This model further supports the idea that even those counties that have more heterogeneity do not significantly alter the results.

Tobit

The main reason I ran the Tobit model is to ensure that my dependent variable, which is a percentage, is not altering the predictive abilities of my model. The Tobit model allows for non-normal distributions and mass points at 0 and 1. A histogram showing the distribution of my dependent variable, the percent of agricultural land planted in staples, can be found in Figure A.4 of the Appendix. This shows that there are some mass points at zero and one, but there also is a steady distribution of observations between 0 and 1. The results of running my RE Tobit model can also be found in the Table A.5 of the Appendix. The signs and magnitudes of the coefficients change very little from the weighted RE main model.

Limitations

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

4.3. Model 2: Total Credit

Model Construction

As has been stated, I am 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 I have on credit is only provided at the state level. Please refer to Table 12 for summary statistics. Please also refer to Figure 13 which shows the distribution of my 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 my PROCAMPO payments (Figure 8) to this credit map. I ran my model at the state level with similar variables to my main model except that total credit received in thousands of pesos is my dependent variable. My credit equation is:

Credit = f (Government payments, State characteristics)

1) *Government policies = PROCAMPO, PROGRESA, other government payments*
2) *State characteristics = wages per worker, high school education, infrastructure index*

Model Results

I generate both fixed effects and random effects models using this data. The results can be seen in Table 13. Both models are weighted by total agricultural land in a state and will only compare two years, 2001 and 2003, as I do not have credit data for years prior to NAFTA. In my FE model very little is statistically significant at the 5% level, which is understandable given that I only have two years of credit data. However, the coefficient on my 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 states. 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 my weighted RE model the coefficients on all my variables are significant at the 5% level. Once again, I will first look at the effect of my PROCAMPO variable on credit. For a 1% increase in PROCAMPO payments there is a 0.53% increase in credit. Now that I am not just looking at the time effect, but also comparing states, the effect of PROCAMPO is much smaller. It does have a positive effect on credit, which means both my models support the idea that PROCAMPO may help alleviate credit constraint. Once again, I see negative coefficients for my PROGRESA and other government payments variables. For a 1% increase in PROGRESA there is a 0.88% decrease in credit. Additionally, 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, and technology, and not actually be funds that go to producers. Therefore these payments are not necessarily direct cash payments.

Wages per worker and percent of the population with a high school education are both positive, as I would expect. An increase in both wages and education should positively affect credit. For a 1% increase in wages I see a 0.61% increase in credit, and for a 1% increase in education I see an 11% increase in credit. This is finding is encouraging to see as 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.

5. CONCLUSIONS

In conclusion, there has been, and may continue to be, pressure under the WTO agenda for countries to move to agricultural support systems that include decoupled income payments. Decoupled income payments allow countries to support their agricultural producers without distorting crop production and prices. Further studies are needed to truly ascertain the effects that a decoupled income payment system has on crop choice in developing countries. Additionally, since PROCAMPO is scheduled to be eliminated in 2010, it is important to understand both the strengths and weaknesses of this program in order to create an appropriate agricultural program for the future.

There was much concern and speculation prior to the implementation of NAFTA that opening trade would cause poor farmers in Mexico to be made worse off. The Mexican government attempted to address this problem by implementing the PROCAMPO program. By examining Mexico's transition from a government controlled price-support agricultural system to decoupled income payments, I am able to see that the policy allows even the poorer producers in Mexico to benefit from NAFTA. By examining my map of the distribution of PROCAMPO payments (Figure 8), I see that PROCAMPO payments are distributed throughout the country. Larger producers tend to be located in the northern regions of Mexico, but I can see that even producers in the southern regions are receiving payments. This supports the idea that subsistence producers may actually be better off under the PROCAMPO system than they were under CONASUPO, primarily because a greater number of smaller producers receive financial benefits.

Additionally, by examining the map of my dependent variable, percent of agricultural land planted in staples (Figure 1), I can visually see the distribution of crop change in Mexico from 1991 to 2003. This map provides a view of the regional distribution of this change, and shows that the greatest transition out of staple crop production has been in the northern and central states. Thus, I observe some evidence that those areas closer to the border have certain characteristics that allow for them to more easily switch to cash crop production. Based on the results of my study this transition may be driven in part by transaction costs being greater for counties further from the United States border.

My review of agricultural policies in Mexico during the past twenty years provides evidence that many agricultural producers are credit constrained. This finding is based on my discussion of the movement away from state-provided credit through *Banrural*, to the privatization of banking. The government even addressed this constraint by changing the payment cycle of PROCAMPO so

producers with small agricultural holdings receive payment prior to planting. This change reduces producers' credit constraint and allows them to make investments and crop choice changes prior to planting. The agricultural household model that I generate allows for government payments to reduce credit constraints so that producers are able to make the capital investments necessary for transitioning to cash crop production.

My 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, I observe a correlation between increased PROCAMPO payments and a decrease in the area planted in staples when controlling for county-level fixed effects. In my main model, a 1% increase in PROCAMPO payments leads to an 8.7% decrease in staple crop production. When I examine my 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 (10% reduction in staple crop production). 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 have 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. There is also some evidence that PROCAMPO payments have affected the crop choice changes that are made by producers differently for those in northern and border regions versus those in the south.

I hypothesized that the implementation of NAFTA would be associated with greater cash crop production. I can see that the creation of new markets through NAFTA is, in general, leading to a reduction in land planted in staples. I also see evidence that producers in both *ejidal* lands and poor regions are responding to new market incentives. Additionally, I 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. I find evidence in my 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 broader world-wide application. The effects of decoupled income payments on crop choice in developed regions, such as the United States and the European Union, may differ due to the

presence of fewer credit-constrained producers. Therefore, these payments may have a greater effect on crop choice in developing countries which have a significant number of small, subsistence producers who might not be able to change production without financial assistance. 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. Sadoulet (2001) and Cord (2001) both found that PROCAMPO payments do have a positive effect on increasing income, thereby reducing poverty. In addition, I find evidence that decoupled income payments can reduce agricultural producers' credit constraints. Decoupled income payments may allow 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. Additionally, the Mexican government did not create the "anticipated" PROCAMPO program until 2001. If they had instituted this in the mid-1990s when the program was created, the credit constrained farmers may have been able to see the benefit from crop choice changes earlier.

The regional patterns of changing crop choice leads me to state than an investment in infrastructure, such as roads, may reduce transaction costs and allow producers further from the border to also benefit from expanded markets created by trade agreements. Additionally, there is evidence of the importance of investing in human capital, through education. PROGRESA has only been in effect for just over ten years; therefore the true effects it has on education of adults cannot be evaluated. However, I do find some evidence that additional education can assist producers in making crop choice changes. In general, moving to decoupled income payments should allow for even the smaller producers in developing countries to benefit from international trade.

TABLES AND FIGURES

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

Policy	Year	Description
Established CONASUPO (the National Company of Popular Subsistence)	1965	Governmental agency that set agricultural policies. Involved in creating price supports, buying and distributing commodities, and providing credit.
Established *Banrural*	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).
Established ASERCA (Support and Services for Agricultural Marketing)	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.
Enacted Article 27 (*Ejido* Land Reform)	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.
Established PROCAMPO (Program of Direct Support for the Countryside)	1994	Provides per hectare decoupled income payments to agricultural producers who produced any of nine crops during the 1993/1994 agricultural season.
Established *Alianza para el Campo* (Alliance of the Countryside)	1996	Provide technical assistance for four main program areas: agricultural improvement, livestock improvement, rural development, and sanitation.
Dismantled CONASUPO	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.
Established PROGRESA (Program for Education, Health, and Nutrition)	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*.
Dissolved *Banrural*, Established *Financeria Rural*	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.
Completed implementation phase of NAFTA	2008	Final tariff and quota barriers on culturally sensitive crops such as corn and beans were lifted.
Extended PROCAMPO program until 2012	2008	President Calderon announced that he would extend the PROCAMPO program until 2012.

Table 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
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 (1,000s km)	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
PROGRESA payment per person	independent	total PROGRESA payments (1,000s of pesos) divide by the municipal population	1,000s of pesos

Table 3: Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
% of crop land planted in staples	4293	0.618	0.376	0	1
revenue per hectare for all crops	4293	7.636	10.222	0	172.774
log(population in thousands)	4284	2.876	1.331	0	8.741
log(wages per worker)	4154	2.223	1.068	0	7.363
% of population with a high school education	4267	0.061	0.054	0	0.275
infrastructure index (drainage and sanitation)	4268	0.000	0.847	-2.346	1.291
log(PROCAMPO payment per producer)	4252	1.048	0.895	0	4.064
log(other government payments per farm)	4209	0.400	0.717	0	4.831
log(distance to the US border in 1,000s km)	4155	-0.111	0.854	-6.908	0.870
NAFTA dummy (=1 if year is after 1994)	4293	0.667	0.471	0	1
NAFTA×log(population in thousands)	4284	1.937	1.759	0	8.731
NAFTA×log(wages per worker)	4154	1.510	1.339	0	7.363
NAFTA×log(distance to the US border in 1,000s km)	4155	-0.074	0.700	-6.908	0.870
% of population over 15 years old that is literate	4226	0.813	0.115	0.139	0.979
city dummy (=1 if county has a city over 100,000)	4293	0.047	0.211	0	1
log(PROGRESA payment per person)	4201	0.215	0.216	0	1.626

Table 4: Correlation Matrix

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	% of crop land planted in staples	1															
2	revenue per hectare for all crops	-0.2	1														
3	log(population in thousands)	0.06	0.14	1													
4	log(wages per worker)	-0.1	0.15	0.57	1												
5	% of population with a high school education	-0.2	0.15	0.43	0.41	1											
6	infrastructure index (drainage and sanitation)	-0.2	0.18	0.34	0.42	0.68	1										
7	log(PROCAMPO payment per producer)	-0.1	-0	0.08	0.15	0.37	0.55	1									
8	log(other government payments per farm)	-0.1	-0	0.1	0.12	0.28	0.31	0.42	1								
9	log(distance to the US border in 1,000s km)	0.07	-0	-0.1	-0.2	-0.1	-0.1	-0.2	-0.1	1							
10	NAFTA dummy (=1 if year is after 1994)	-0.1	-0	0.03	0.05	0.42	0.56	0.83	0.4	0	1						
11	NAFTA×log(population in thousands)	-0.1	0.03	0.51	0.3	0.56	0.57	0.71	0.39	-0.1	0.81	1					
12	NAFTA×log(wages per worker)	-0.2	0.05	0.31	0.49	0.56	0.6	0.75	0.4	-0.1	0.8	0.85	1				
13	NAFTA×log(distance to the US border in 1,000s km)	0.11	-0	-0.1	-0.2	-0.1	-0.1	-0.3	-0.2	0.81	-0.1	-0.1	-0.2	1			
14	% of population over 15 years old that is literate	-0.1	0.15	0.27	0.51	0.49	0.61	0.34	0.16	-0.3	0.22	0.29	0.41	-0.2	1		
15	city dummy (=1 if county has a city over 100,000)	-0	0.06	0.52	0.28	0.34	0.2	0.04	0.07	-0.2	-0	0.24	0.13	-0.1	0.21	1	
16	log(PROGRESA payment per person)	-0.1	-0.1	-0.2	-0.2	0.09	0.15	0.44	0.25	0.16	0.72	0.44	0.36	0.14	-0.2	-0.1	1

Table 5: Initial Results

Percent of Agricultural Land in Staples					
	Ordinary Least Squares	**Fixed Effects**	**Weighted Fixed Effects**	**Random Effects**	**Weighted Random Effects**
log(population in thousands)	0.0729***	0.339***	0.469***	0.0650***	0.0772***
	(0.0055)	(0.0477)	(0.116)	(0.00718)	(0.00004)
log(wages per worker)	-0.0314***	-0.0017	-0.0504**	-0.0205***	-0.0480***
	(0.00675)	(0.0101)	(0.0246)	(0.00745)	(0.00006)
% of population with a high school education	-1.801***	-1.650***	-2.162***	-1.628***	-1.764***
	(0.153)	(0.128)	(0.349)	(0.122)	(0.0008)
infrastructure index (drainage and sanitation)	-0.0249**	0.0181	0.0739**	-0.0068	-0.0023***
	(0.0104)	(0.0116)	(0.0302)	(0.0101)	(0.00008)
log(PROCAMPO payment per producer)	0.0235***	-0.0657***	-0.0333***	-0.0238***	0.0128***
	(0.0077)	(0.00708)	(0.0107)	(0.00651)	(0.00004)
log(other government payments per farm)	0.0028	0.0163**	0.0415***	0.0119	0.0433***
	(0.00844)	(0.00793)	(0.0119)	(0.00779)	(0.00004)
log(distance to the US border in 1,000s km)	0.0255***	0.0701***	0.0704***	0.0221**	0.0181***
	(0.00679)	(0.00031)	(0.00031)	(0.00884)	(0.00004)
constant	0.568***	-0.21	-1.087**	0.600***	0.543***
	(0.0192)	(0.14)	(0.512)	(0.0238)	(0.0002)
Observations	4105	4105	4098	4105	4098
Counties		1385	1378	1385	1378
R-squared	0.086	0.149	0.132		

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

Table 6.1: Main Model

Percent of Agricultural Land in Staples		
	Weighted Fixed Effects	**Weighted Random Effects**
log(population in thousands)	0.265**	0.0589***
	(0.131)	(0.000045)
log(wages per worker)	-0.03	-0.0326***
	(0.024)	(0.00007)
% of population with a high school education	-2.049***	-1.764***
	(0.318)	(0.000829)
infrastructure index (drainage and sanitation)	-0.0466	-0.0450***
	(0.0311)	(0.000086)
log(PROCAMPO payment per producer)	-0.0869***	0.0171***
	(0.0303)	(0.000073)
log(other government payments per farm)	0.0374***	0.0355***
	(0.0112)	(0.000039)
log(distance to the US border in 1,000s km)	0.0163***	-0.0466***
	(0.000331)	(0.000046)
NAFTA dummy (=1 if year is after 1994)	0.145*	-0.0390***
	(0.0879)	(0.000241)
NAFTA×log(population in thousands)	0.0067	0.0227***
	(0.0159)	(0.000044)
NAFTA×log(wages per worker)	0.0344	0.0115***
	(0.0302)	(0.000082)
NAFTA×log(distance to the US border in 1,000s km)	0.0692***	0.0965***
	(0.0199)	(0.000048)
constant	-0.337	0.523***
	(0.558)	(0.000221)
Observations	4098	4098
Counties	1378	1378
R-squared	0.197	

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

Table 6.2: 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)	0.265**	0.2719**	0.0589***	0.0816***
	(0.131)	(0.1223)	(0.000045)	(0.000037)
log(wages per worker)	-0.03	0.0045	-0.0326***	-0.0211***
	(0.024)	(0.030064)	(0.000070)	(0.000071)
log(distance to the US border in 1,000s km)	0.0163***	0.0529***	-0.0466***	0.0499***
	(0.00033)	(0.019877)	(0.000046)	(0.000044)

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

Table 7.1: Robustness Model (*Ejidal* Lands and PROGRESA Areas)

Percent of Agricultural Land in Staples		
	Weighted Fixed Effects	
	Ejidal Lands	PROGRESA Areas
log(population in thousands)	0.23	-0.0953
	(0.144)	(0.187)
log(wages per worker)	-0.0167	0.0317
	(0.0287)	(0.0308)
% of population with a high school education	-2.301***	-0.843*
	(0.34)	(0.498)
infrastructure index (drainage and sanitation)	-0.056	-0.0906**
	(0.0366)	(0.044)
log(PROCAMPO payment per producer)	-0.0996***	-0.0003
	(0.0333)	(0.0546)
log(other government payments per farm)	0.0575***	0.0089
	(0.0185)	(0.0144)
log(distance to the US border in 1,000s km)	-0.0345***	-0.0552***
	(0.0007)	(0.0006)
NAFTA dummy (=1 if year is after 1994)	0.127	0.0025
	(0.0983)	(0.102)
NAFTA×log(population in thousands)	0.0318*	0.0579**
	(0.0164)	(0.0241)
NAFTA×log(wages per worker)	-0.0141	0.0001
	(0.0297)	(0.026)
NAFTA×log(distance to the US border in 1,000s km)	0.0656	0.136**
	(0.0485)	(0.0569)
constant	-0.192	0.785
	(0.666)	(0.705)
Observations	2049	2062
Counties	685	690
R-squared	0.27	0.169

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

Table 7.2: *Ejidal* Lands and PROGRESA Areas (Effects Before and After NAFTA)

Percent of Agricultural Land in Staples				
	***Ejidal* Lands**		**PROGRESA Areas**	
	Before NAFTA	**After NAFTA**	**Before NAFTA**	**After NAFTA**
log(population in thousands)	0.23	0.2618*	-0.0953	-0.0374
	(0.144)	(0.1402)	(0.187)	(0.1823)
log(wages per worker)	-0.0167	-0.0309	0.0317	0.0318
	(0.0287)	(0.0374)	(0.0308)	(0.0312)
log(distance to the US border in 1,000s km)	-0.0345***	0.0311	-0.0552***	0.081
	(0.0007)	(0.0485)	(0.0006)	(0.0569)

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

Table 8: Robustness Model (Regions)

Percent of Agricultural Land in Staples	
	Weighted Fixed Effects
log(PROCAMPO payment total)×Border Region	-0.0525*
	(0.0316)
log(PROCAMPO payment total)×North Region	-0.0723***
	(0.0238)
log(PROCAMPO payment total)×Center Region	-0.0169
	(0.0295)
log(PROCAMPO payment total)×South Region	0.186***
	(0.0481)
Observations	4098
States	1378
R-squared	0.272

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.

Table 9: Robustness Model (Agricultural Revenue per Hectare)

Agricultural Revenue per Hectare	
	Weighted Fixed Effects
log(population in thousands)	5.392**
	(2.674)
log(wages per worker)	-0.385
	(0.326)
% of population with a high school education	16.83**
	(7.475)
infrastructure index (drainage and sanitation)	-0.278
	(0.713)
log(PROCAMPO payment per producer)	-0.638
	(0.625)
log(other government payments per farm)	0.0154
	(0.314)
log(distance to the US border in 1,000s km)	0.397
	(14.05)
NAFTA dummy (=1 if year is after 1994)	1.272
	(1.74)
NAFTA×log(population in thousands)	-1.104***
	(0.283)
NAFTA×log(wages per worker)	1.006**
	(0.459)
NAFTA×log(distance to the US border in 1,000s km)	0.282
	(0.517)
constant	-14.37
	(11.83)
Observations	4098
Counties	1378
R-squared	0.03

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

Table 10: Robustness Model (Literacy and City Dummy)

Percent of Agricultural Land in Staples		
	Weighted Fixed Effects	
	Literacy	City Dummy
log(population in thousands)	0.183	
	(0.137)	
log(wages per worker)	-0.0377	-0.0341
	(0.0244)	(0.0237)
% of population with a high school education	-2.040***	-1.972***
	(0.32)	(0.329)
infrastructure index (drainage and sanitation)	-0.0873***	-0.0664**
	(0.0335)	(0.0313)
log(PROCAMPO payment per producer)	-0.0665**	-0.101***
	(0.0315)	(0.0297)
log(other government payments per farm)	0.0387***	0.0404***
	(0.0113)	(0.0118)
log(distance to the US border in 1,000s km)	0.0438***	-0.0137***
	(0.0003)	(0.0004)
NAFTA dummy (=1 if year is after 1994)	0.051	0.181**
	(0.0993)	(0.0917)
NAFTA×log(population in thousands)	0.0031	
	(0.0159)	
NAFTA×log(wages per worker)	0.0497	0.0557**
	(0.0311)	(0.0245)
NAFTA×log(distance to the US border in 1,000s km)	0.0675***	0.0669***
	(0.0197)	(0.0199)
% of population over 15 years old that is literate	1.598***	
	(0.535)	
city dummy (=1 if county has a city over 100,000)		0.143***
		(0.0011)
constant	-1.295**	0.800***
	(0.59)	(0.0775)
Observations	4098	4098
Counties	1378	1378
R-squared	0.203	0.187

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

Table 11: Robustness Model (PROGRESA)

Percent of Agricultural Land in Staples	
	Weighted Fixed Effects
log(population in thousands)	0.263**
	(0.129)
log(wages per worker)	-0.0479**
	(0.0238)
% of population with a high school education	-1.915***
	(0.33)
infrastructure index (drainage and sanitation)	-0.0791**
	(0.0346)
log(PROCAMPO payment per producer)	-0.0529*
	(0.0309)
log(other government payments per farm)	0.0384***
	(0.0113)
log(distance to the US border in 1,000s km)	0.0126***
	(0.0003)
NAFTA dummy (=1 if year is after 1994)	-0.167
	(0.103)
NAFTA×log(population in thousands)	0.0074
	(0.0151)
NAFTA×log(wages per worker)	0.0737**
	(0.0308)
NAFTA×log(distance to the US border in 1,000s km)	0.0605***
	(0.0197)
log(PROGRESA payment per person)	0.518***
	(0.111)
constant	-0.294
	(0.552)
Observations	4098
Counties	1378
R-squared	0.219

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

Table 12: State-Level Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
log(credit payment in 1,000s of pesos)	64	10.928	5.145	0	19.849
log(PROCAMPO payment in 1,000s of pesos)	64	12.463	1.274	8.477	14.275
log(PROGRESA payment in 1,000s of pesos)	64	12.370	2.533	0	14.712
log(other government payment in 1,000s of pesos)	64	8.723	5.451	0	14.604
log(wages per worker in 1,000s of pesos)	64	5.955	1.047	4.403	8.000
% of population with a high school education	64	0.143	0.050	0.058	0.261
infrastructure index (drainage and sanitation)	64	0.411	0.604	-1.428	1.319
year dummy (=0 if year is 2001, =1 if year is 2003)	64	0.500	0.504	0	1

Table 13: Credit Model

log(Credit Payment)		
	Weighted Fixed Effects	Weighted Random Effects
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)	(0.00081)
% 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

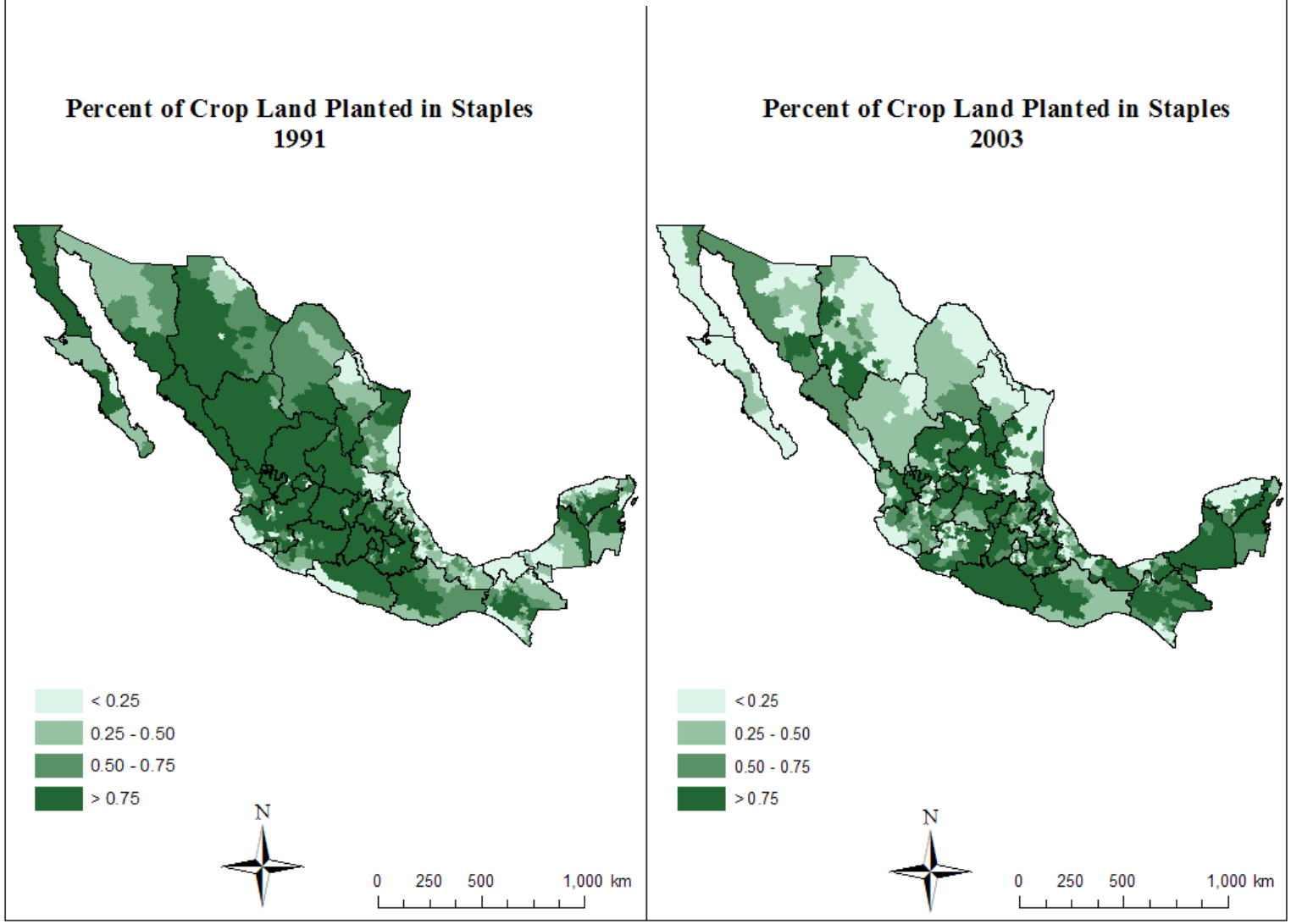

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Figure 2: Revenue per Hectare

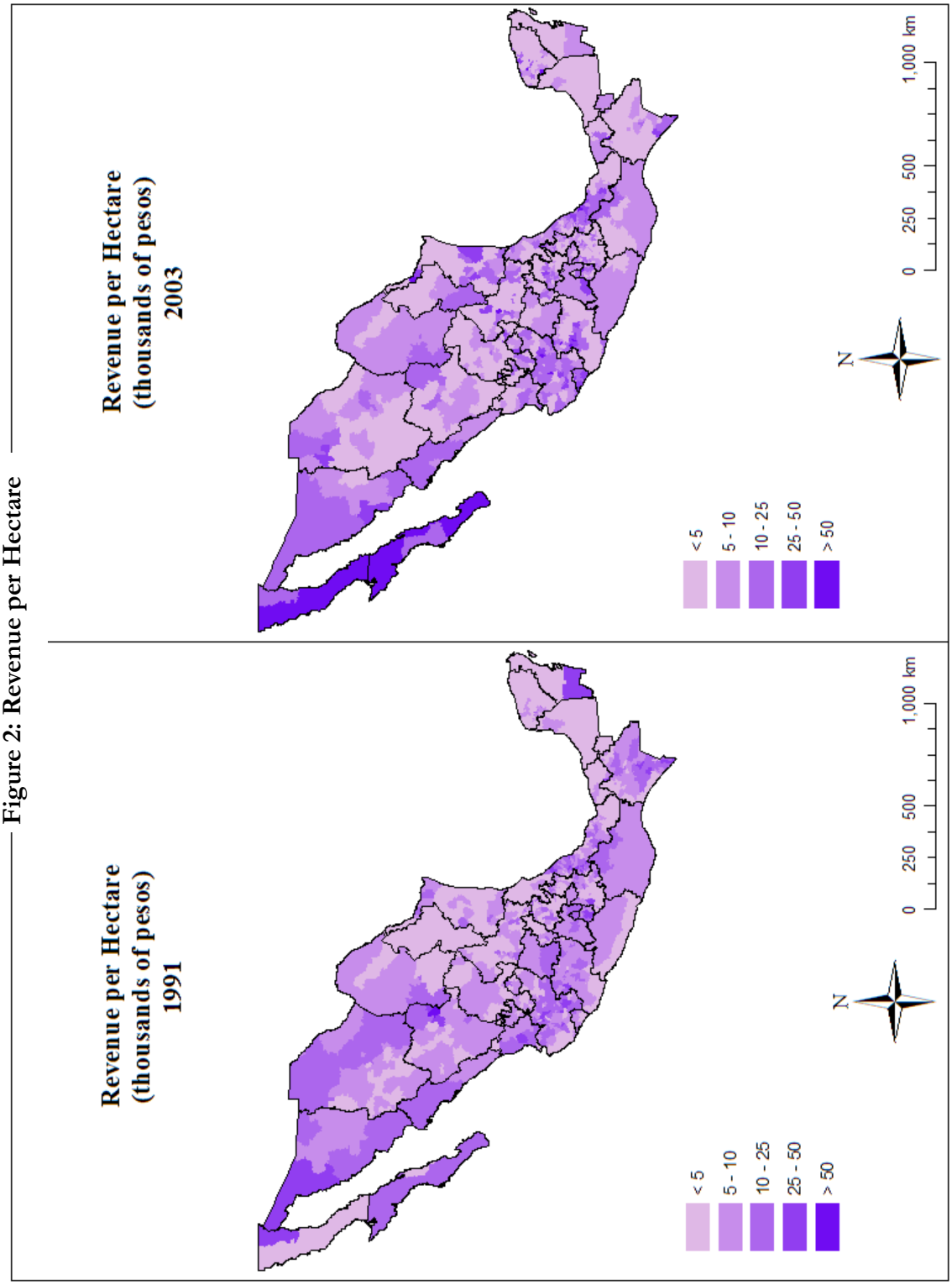
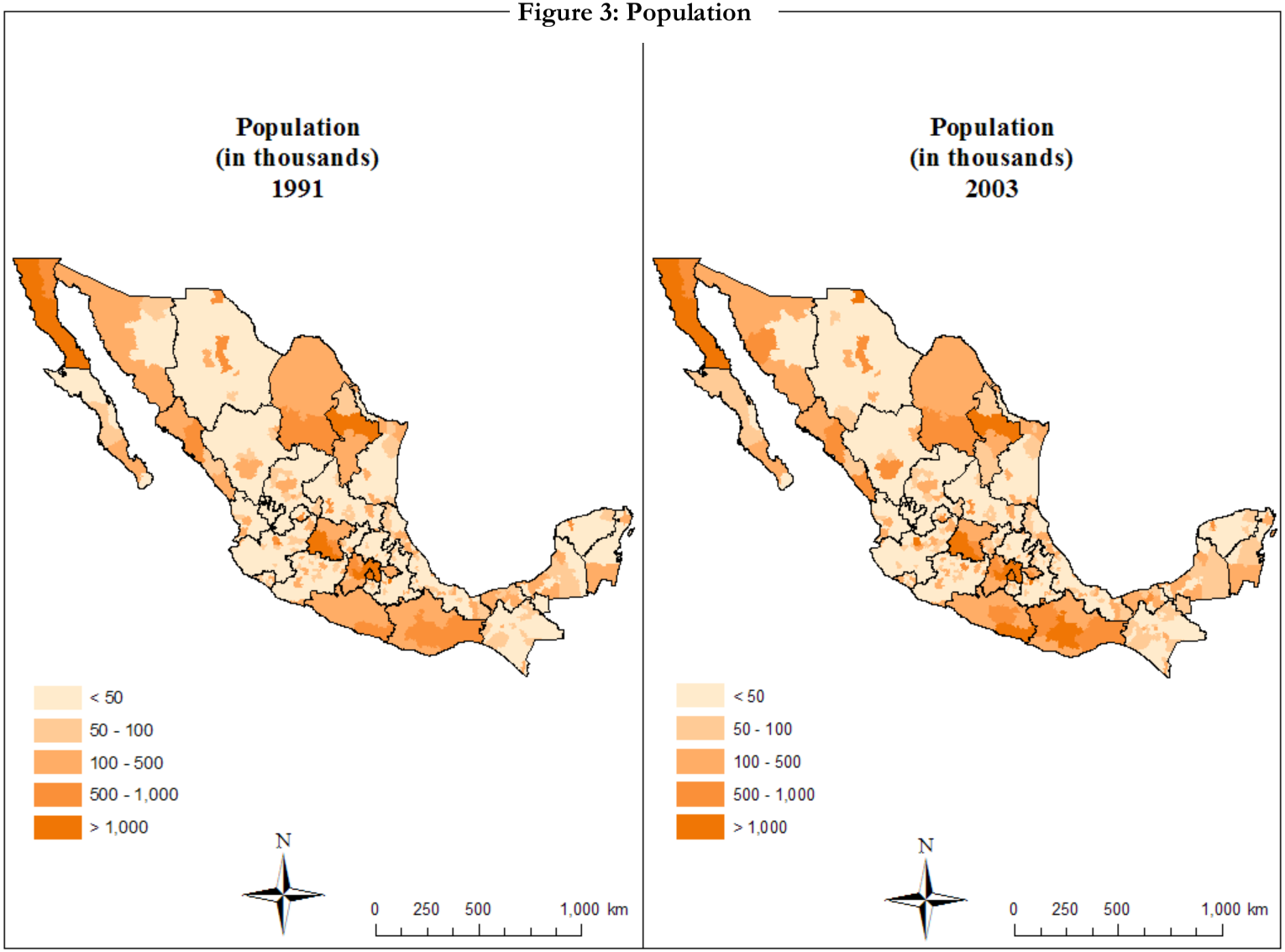


Figure 3: Population



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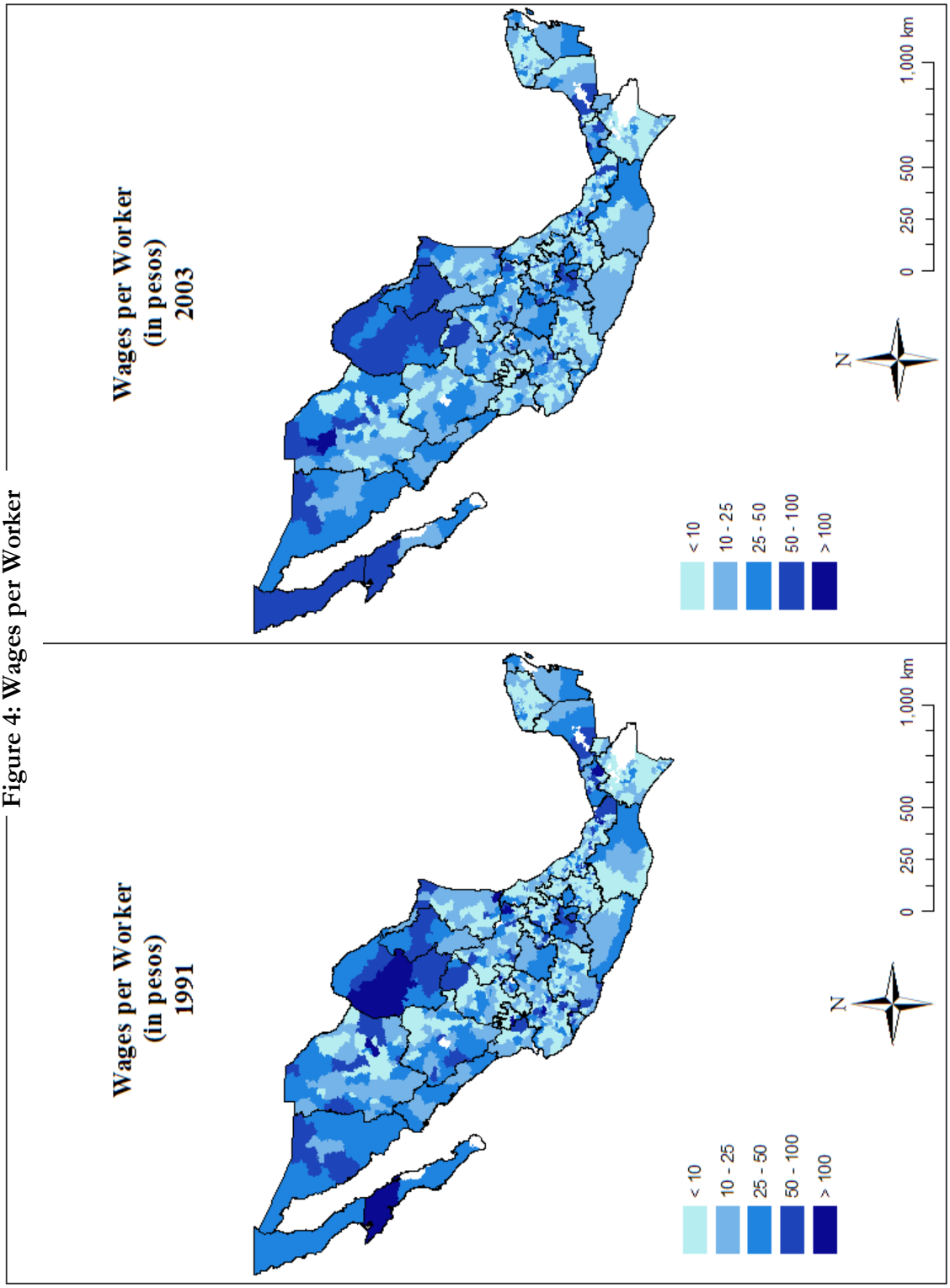

Figure 4: Wages per Worker

Figure 5: Percent of the Population with a High School Education

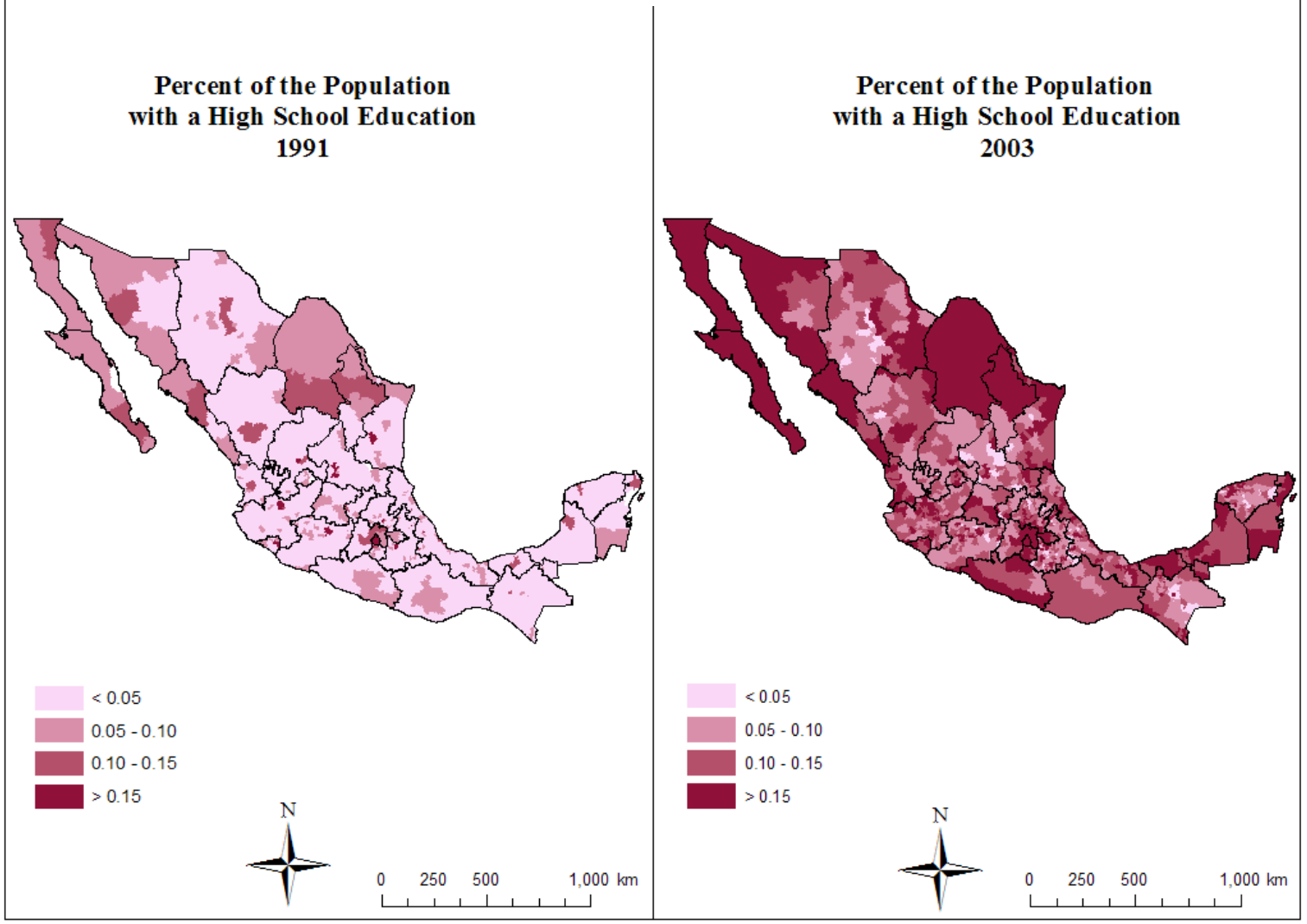

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Figure 6: Percent of Households with Sanitation

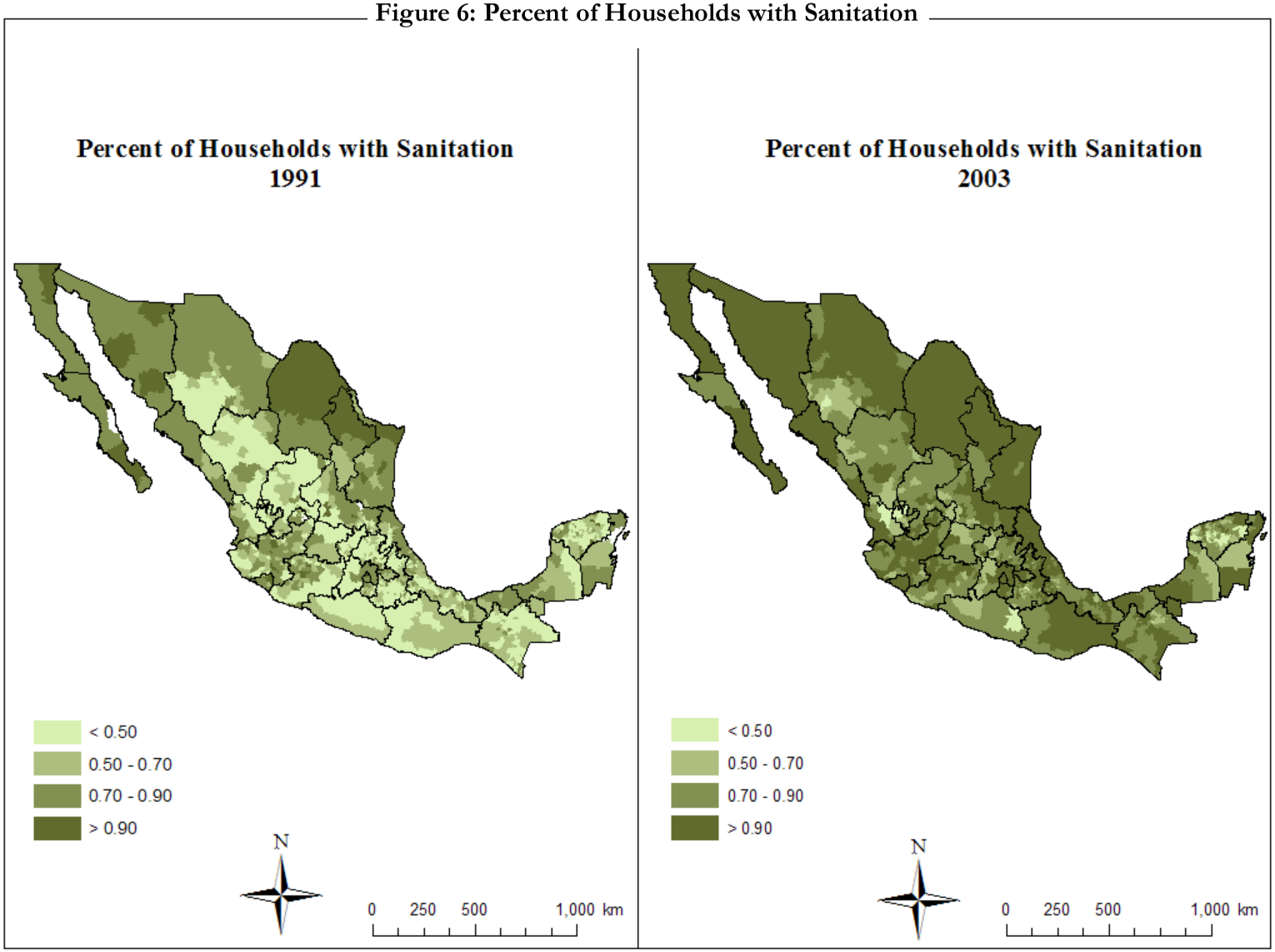

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Figure 7: Percent of Households with Drainage

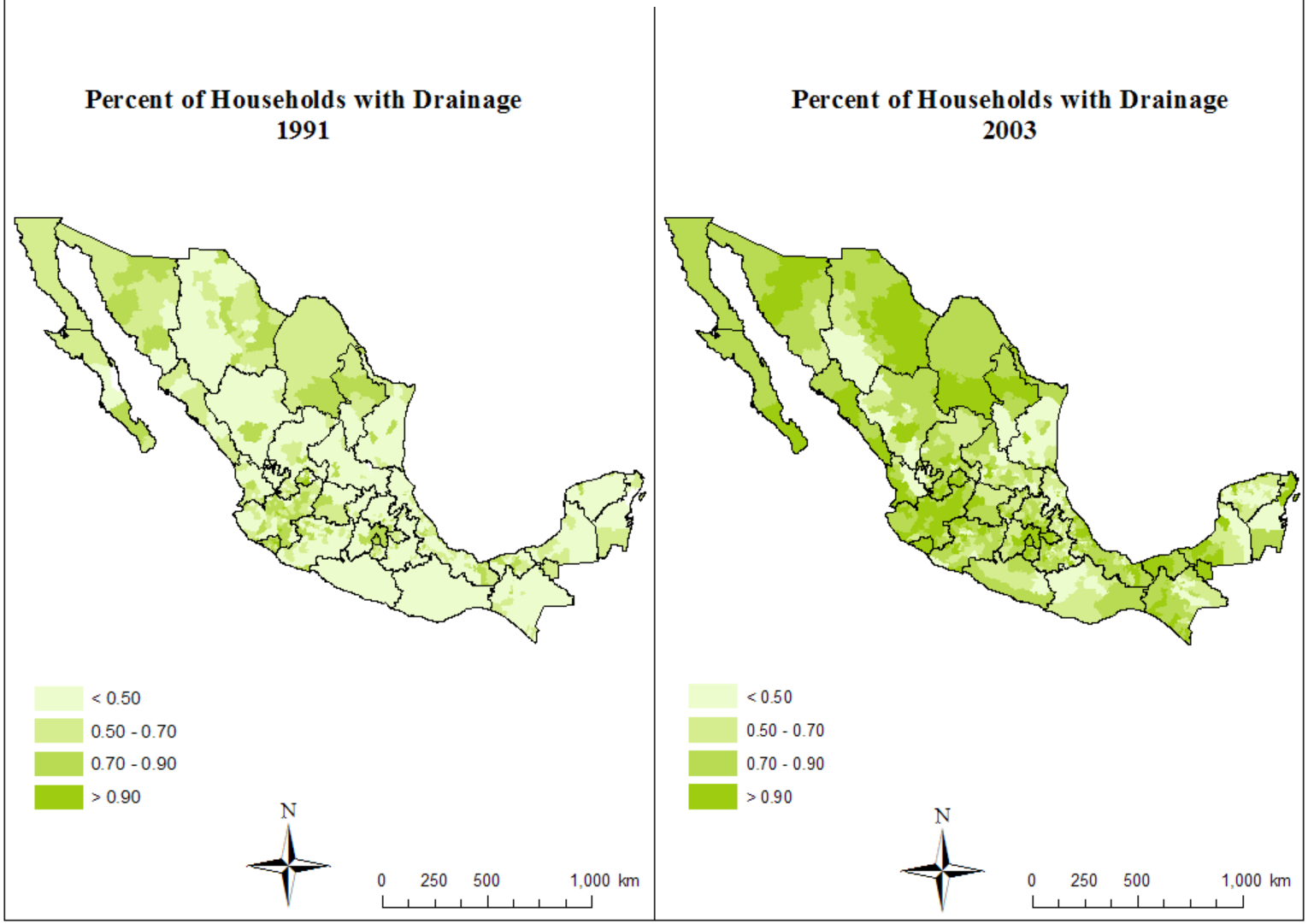

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Figure 8: PROCAMPO Payments

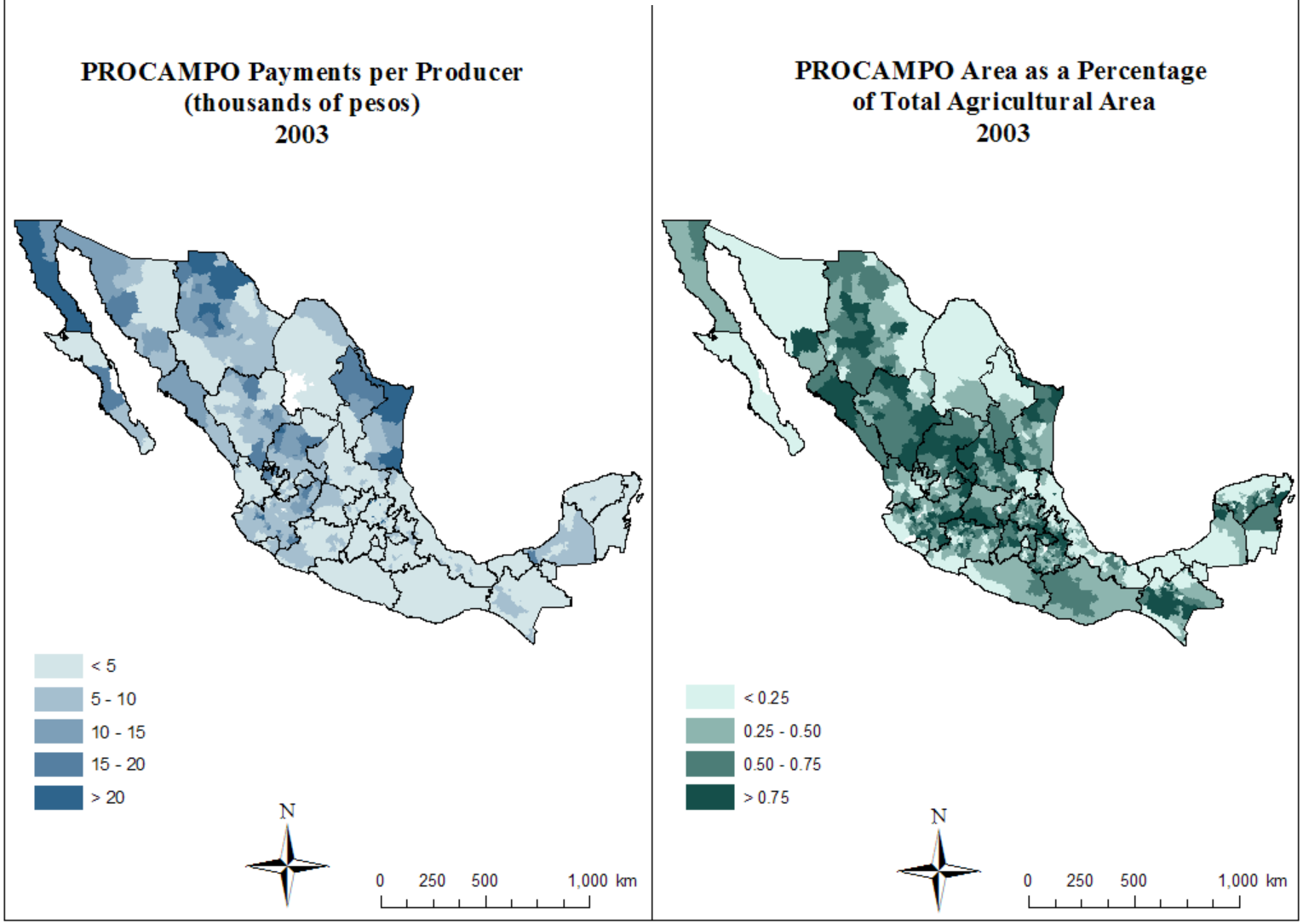

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Figure 9: PROGRESA Areas and Government Payments

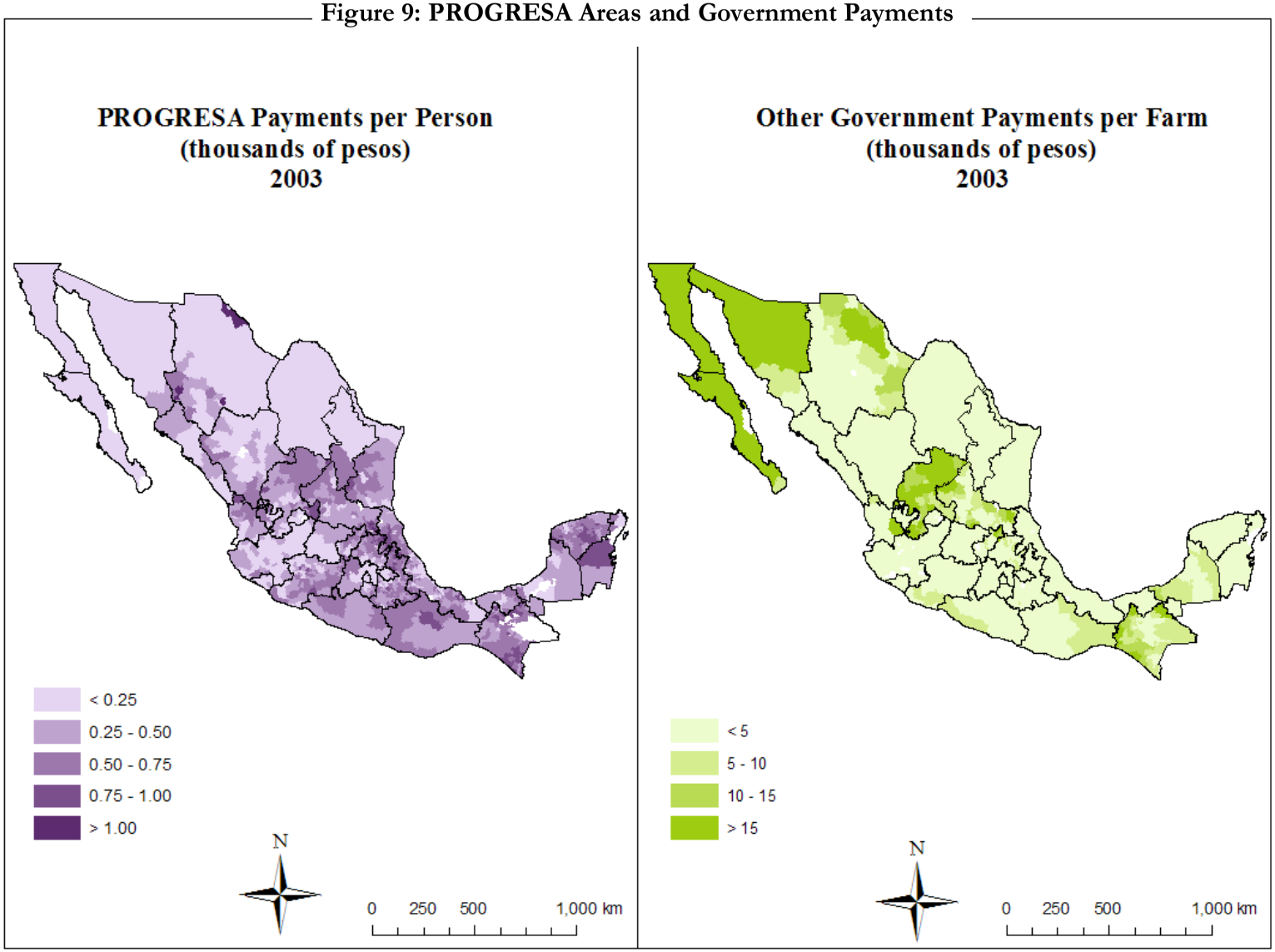

Figure 10: *Ejidal* Lands and PROGRESA Distribution

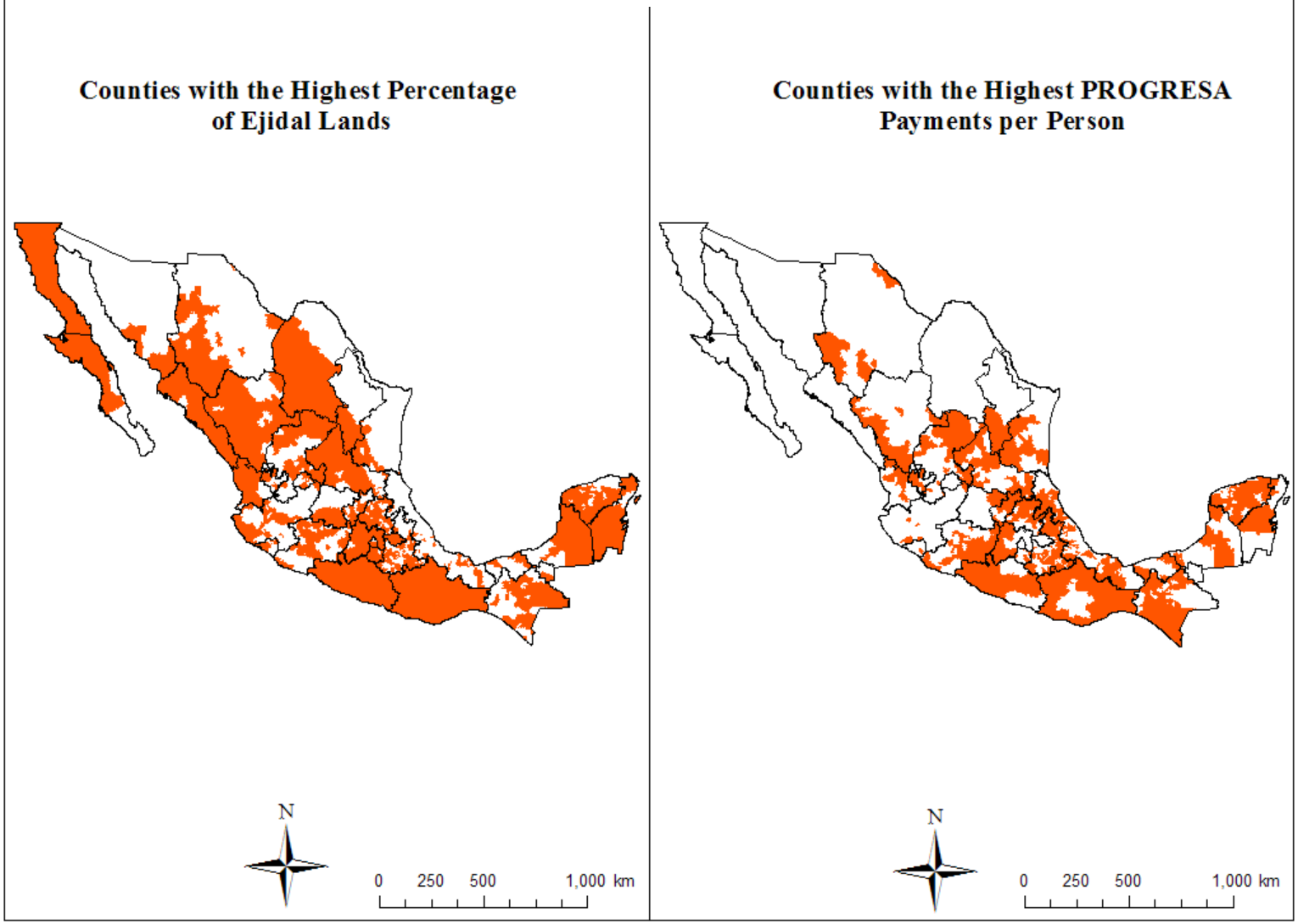

Figure 11: Percent of Population that is Literate

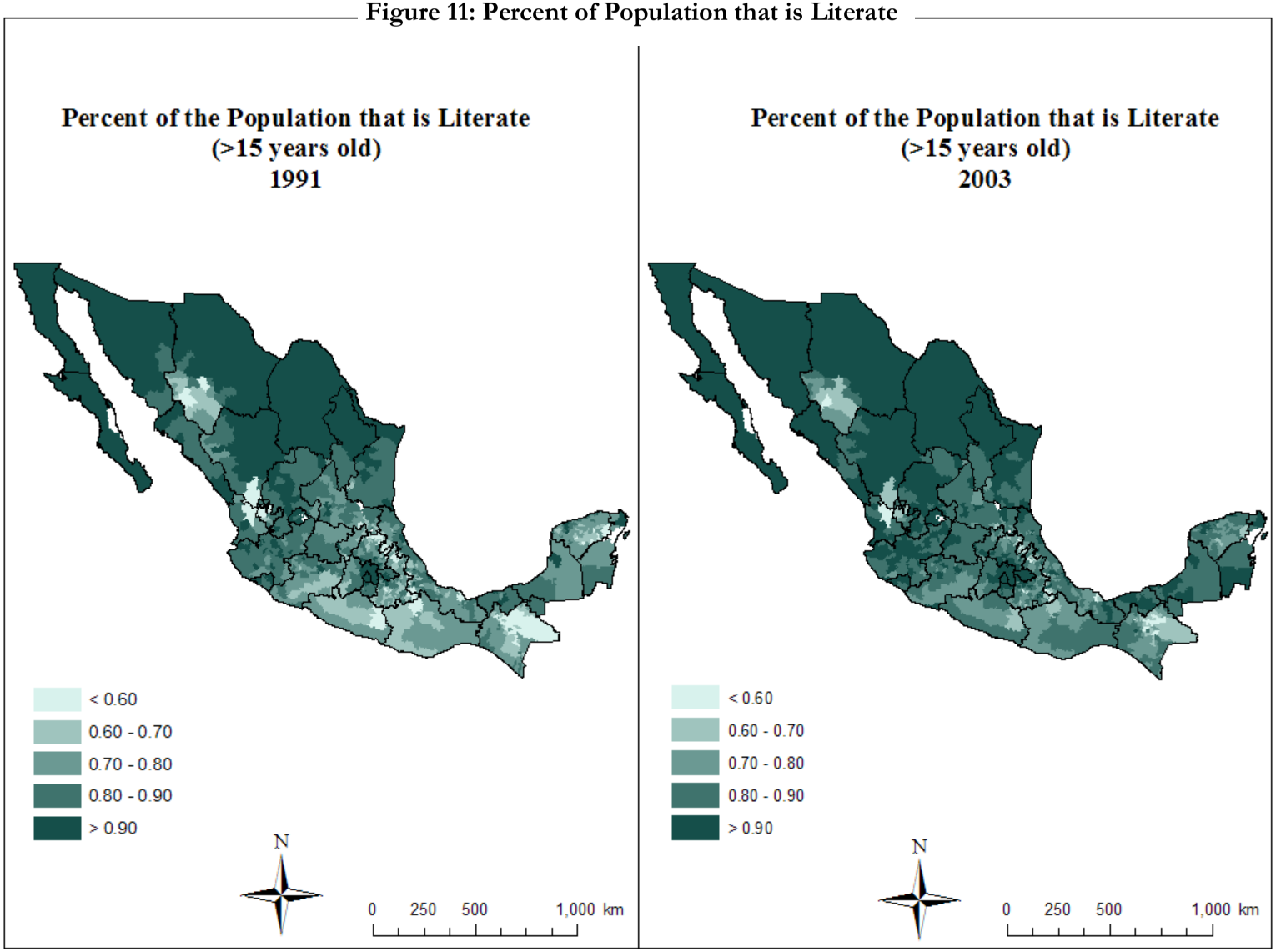

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Figure 12: Counties with a City of over 1000,000 People

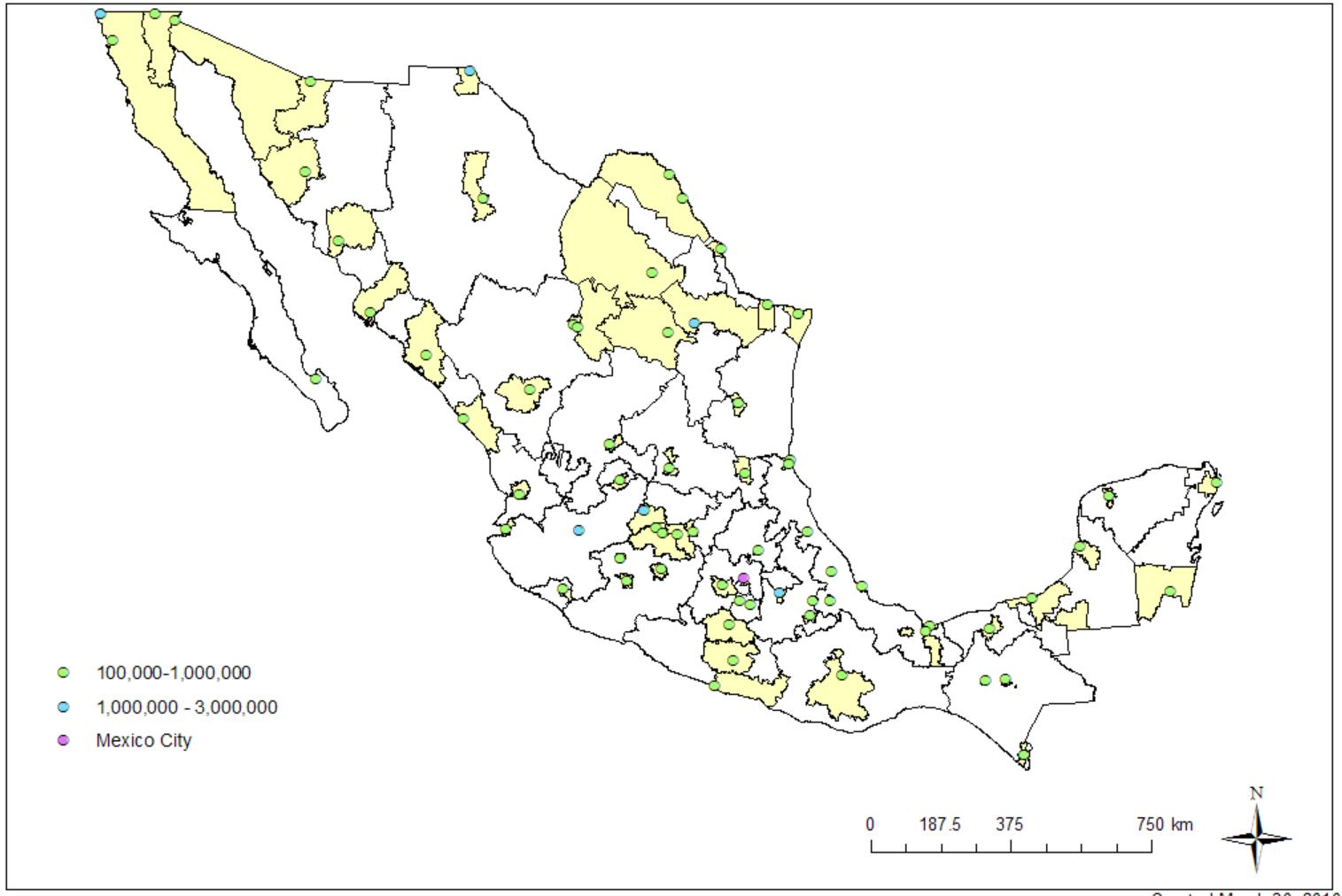
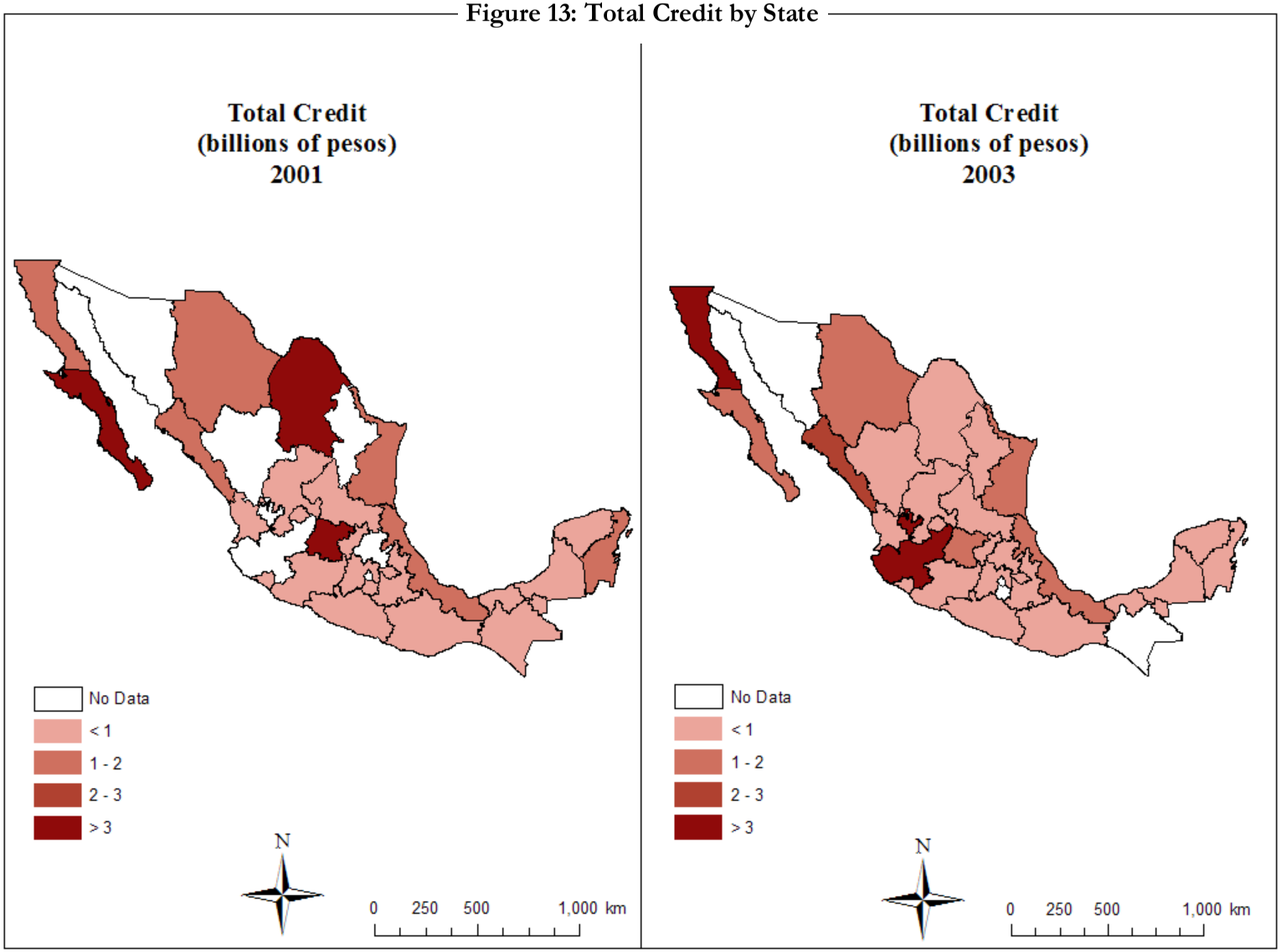


Figure 13: Total Credit by State



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APPENDIX

Table A.1: Average Crop Prices

	1991	2001	2003
Corn Price	6.09	1.74	1.32
Staple Price	6.64	2.20	1.63
Other Price	4.50	0.85	1.66

All prices are in pesos and are deflated using the 2003 CPI

Table A.2: Price Premium

Region	Price Premium		
	Corn		Tomato
	1991	2003	2003
Border	0.97	0.63	0.91
North	0.95	0.89	0.79
Central	0.99	1.11	0.86
Capital	1.02	0.90	2.15
South	1.08	1.29	1.27

All prices are in pesos and are deflated using the 2003 CPI

Table A.3: 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.4: Robustness Model (Homogeneity Test)

Percent of Agricultural Land in Staples	
	Weighted Fixed Effects
log(population in thousands)	0.264**
	(0.132)
log(wages per worker)	-0.0306
	(0.0242)
% of population with a high school education	-1.985***
	(0.318)
infrastructure index (drainage and sanitation)	-0.0514
	(0.0313)
log(PROCAMPO payment per producer)	-0.0898***
	(0.0304)
log(other government payments per farm)	0.0386***
	(0.0115)
log(distance to the US border in 1,000s km)	0.0173***
	(0.0003)
NAFTA dummy (=1 if year is after 1994)	0.154*
	(0.0877)
NAFTA×log(population in thousands)	0.0056
	(0.0159)
NAFTA×log(wages per worker)	0.035
	(0.0303)
NAFTA×log(distance to the US border in 1,000s km)	0.0687***
	(0.0201)
constant	-0.337
	(0.564)
Observations	4038
Counties	1358
R-squared	0.192

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

Table A.5: Robustness Model (Tobit)

Percent of Agricultural Land in Staples	
	Tobit Weighted Random Effects
log(population in thousands)	0.0621***
	(0.000050)
log(wages per worker)	-0.0309***
	(0.000078)
% of population with a high school education	-2.037***
	(0.00093)
infrastructure index (drainage and sanitation)	-0.0476***
	(0.000096)
log(PROCAMPO payment per producer)	0.0288***
	(0.000082)
log(other government payments per farm)	0.0295***
	(0.000044)
log(distance to the US border in 1,000s km)	-0.0487***
	(0.000051)
NAFTA dummy (=1 if year is after 1994)	-0.0421***
	(0.00027)
NAFTA×log(population in thousands)	0.0344***
	(0.00005)
NAFTA×log(wages per worker)	-0.0013***
	(0.000092)
NAFTA×log(distance to the US border in 1,000s km)	0.107***
	(0.000055)
constant	0.514***
	(0.000245)
Observations	4098
Counties	1378

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

Figure A.1: Histogram of the Standard Deviation of Wages

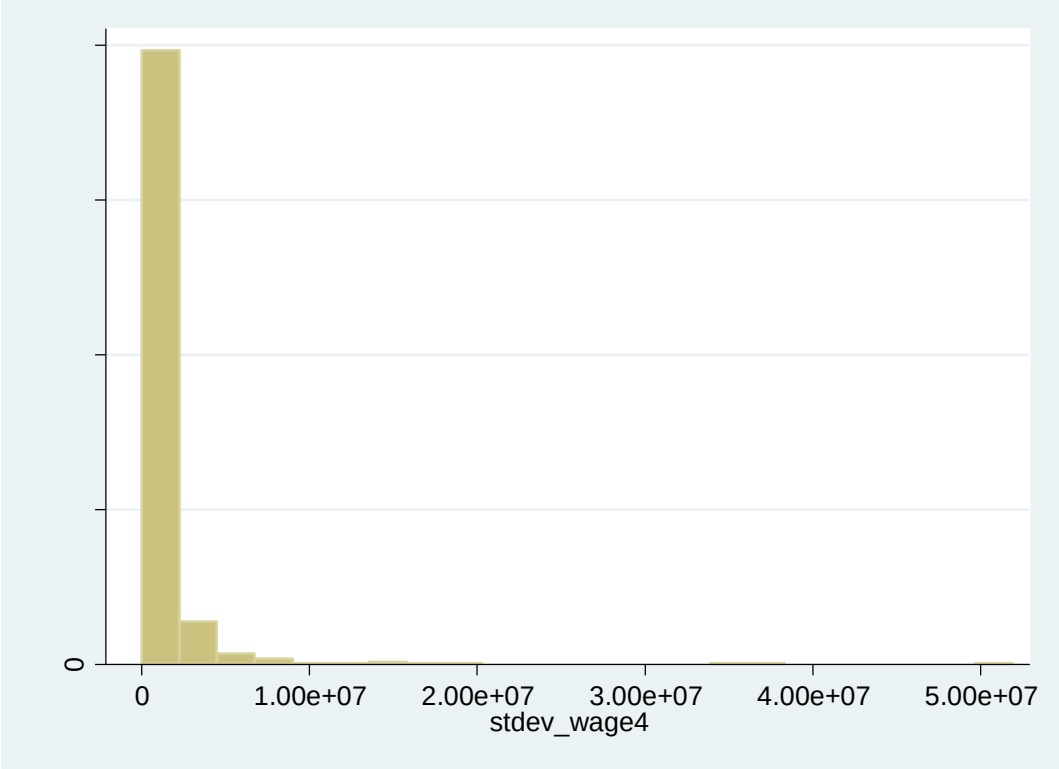

Figure A.2: Histogram of the Standard Deviation of Education

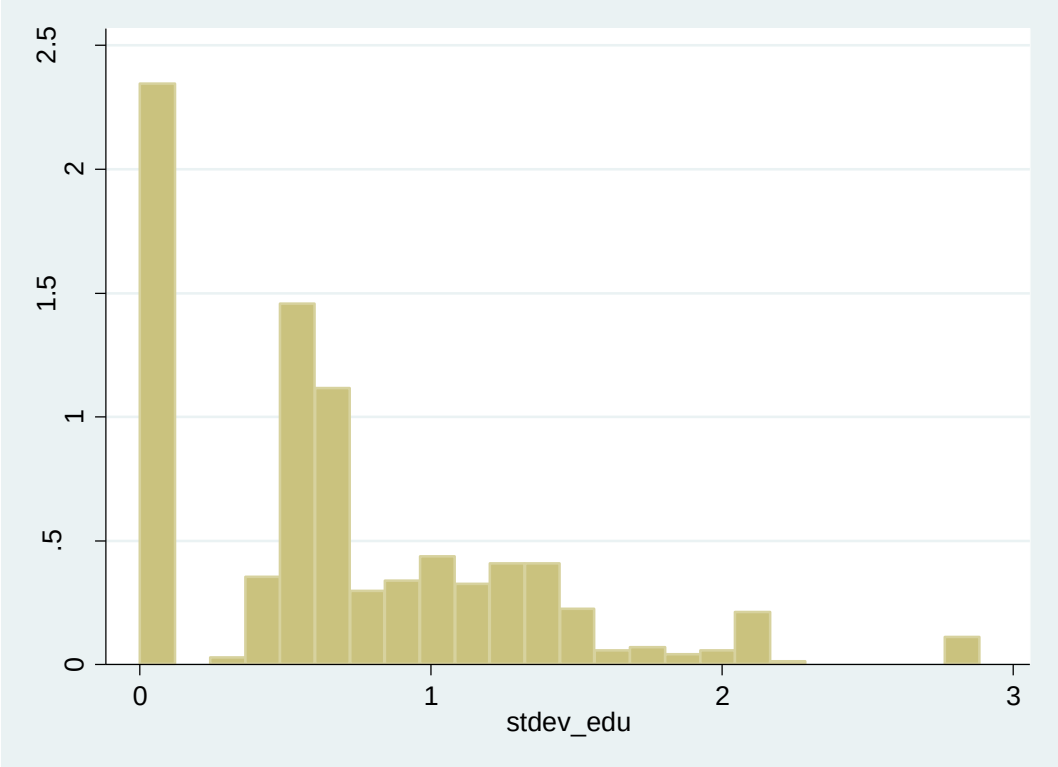

Figure A.3: Elevation and Climate

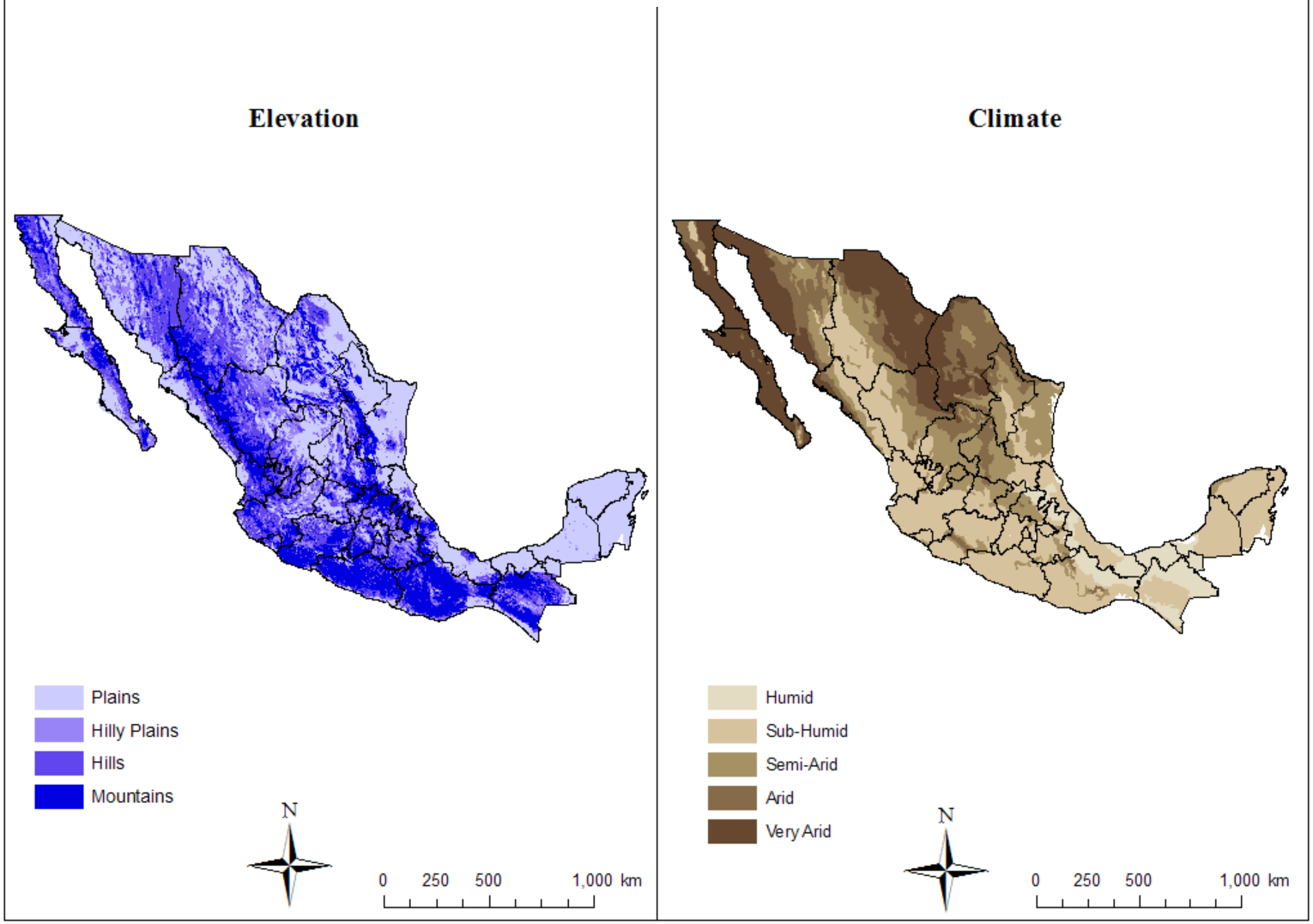

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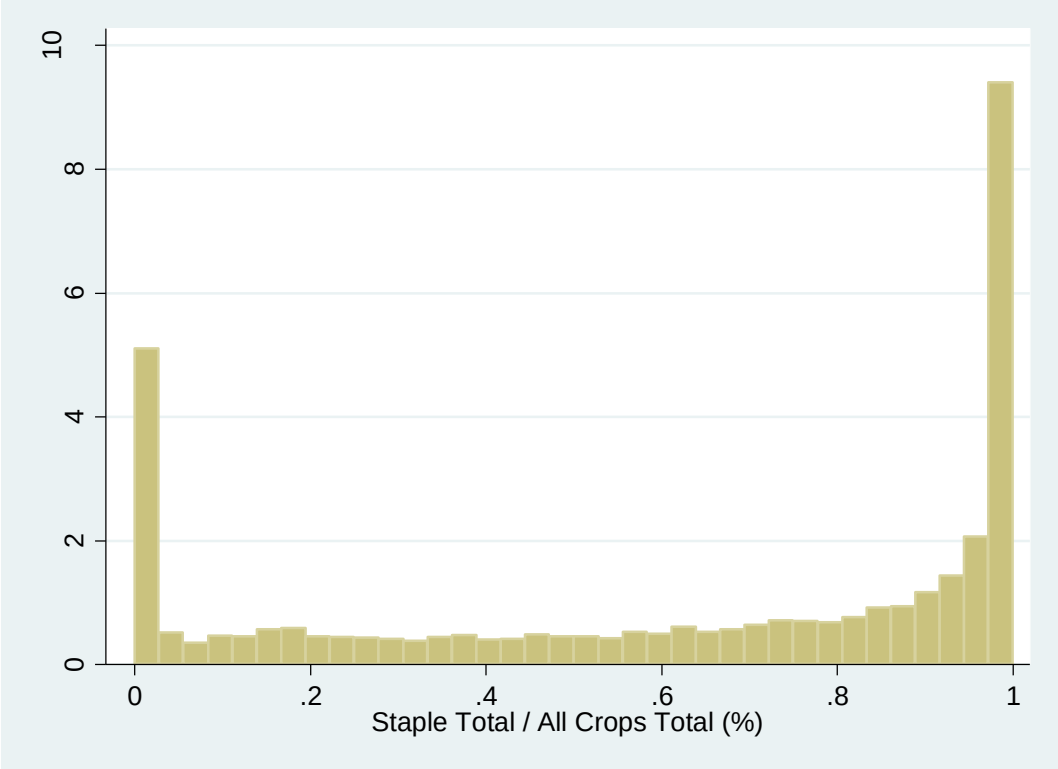
Figure A.4: Histogram of the Percent of Agricultural Land in Staples



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