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Environmental Shocks, Differentiated Households and Migration: A Study in Thailand

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ENVIRONMENTAL SHOCKS, DIFFERENTIATED HOUSEHOLDS AND MIGRATION: A STUDY IN THAILAND

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1 Introduction

As our climate changes, environmental shocks become more prevalent (Bouwer, 2011). Findings indicate that global climate change poses more of a risk to agriculturally oriented households as shocks negatively impact crop yield (Bachelet et al., 1992; Kim et al., 2013). Evidence of the greater variation in weather patterns due to climate change indicates that households are forced to make difficult decisions that potentially leave them in a worse condition. One of the difficult decisions that many households must make in the wake of climate change is how to cope with an environmental shock to their income.

Studies have shown that migration increases with climate shocks and natural disasters (Halliday, 2006; Gray and Mueller, 2012b,a). Many researchers have argued that migration can help the economies of developing countries. Taylor and Martin (2001) find, at the macroeconomic level, migration can either positively or negatively impact a country's growth pattern. But the microeconomic impacts as well as the determinants of migration are still not well known (Foster and Rosenzweig, 2007). Because of the growing threats associated with global climate change and the uncertainty of the welfare costs of migration, this thesis is about the impacts of environmental shocks on migration in developing countries. To what degree and under what circumstances do households use migration as a coping mechanism when they experience an environmental shock?

The study of shocks in economics is an ongoing and ever-growing area of research. The types of shocks researchers have studied include financial, environmental, price, trade, political, and others. While shocks can be seen as a tool to introduce randomness, economists are particularly interested in how people respond to these shocks and the consequences of shocks causing a variety of responses. Some of the consequences of these shocks can leave vulnerable households in long-term devastation. But even if households are not left in long-term devastation shocks can still affect welfare negatively. Households are usually risk averse

and shocks increase the exposure to risk resulting in welfare loss.

Households in developed countries often account for the risk associated with shocks with formal insurance (Glauber et al., 2002). Evidence shows that insured households are less vulnerable to becoming impoverished than uninsured households (Janzen and Carter, 2013; Janzen et al., 2013). Unfortunately, households in developing countries do not have the economic infrastructure to support formal insurance. Households in developing countries also often times do not have access to formal insurance because they do not have the ability to pay for insurance with their income (Jalan and Ravallion, 1999). As a result, these households must find other methods of dealing with risk.

Households in developing countries use many different methods of managing shocks to their income when they do not have access to insurance. Such households must decide between selling assets, decreasing investment in human capital, diversifying labor patterns, or partaking in risk sharing networks to account for lost income (Dercon, 1998, 2002). Unfortunately, findings indicate that some households using the aforementioned informal coping mechanisms in developing countries may be vulnerable to long-term negative consequences (Hoddinott, 2006; Carter and Maluccio, 2003; Rose, 1999). In many instances such households are left in a chronic state of poverty (Carter et al., 2007; Rodríguez-Meza and González-Vega, 2004). This chronic poverty perpetuates the households' inability to satisfy their basic needs, in turn affecting the human capital of household members, causing them to be further impoverished (Banerjee and Duflo, 2011). Such negative consequences from decisions made by households indicates the importance of studying households when they are confronted with unexpected shocks. Governments, NGOs, and researchers can better act in a way that will ultimately help households better cope in risky environments when they have a clear understanding of the decisions households make.

The focus of this thesis is whether or not households in Thailand use migration as a coping mechanism after being confronted with environmental shocks. There is evidence that

households in other countries utilize migration. Researchers find that households usually increase the number of migrants or the amount of their remittances when confronted with an environmental shock (Martin et al., 2014; Yang and Choi, 2007; Haab, 2004; Halliday, 2012, 2006). This is considered as a form of consumption smoothing. Consumption smoothing is when a household employs methods to yield a stable path of consumption. In this case, households send out migrants after the shock occurs in order to diversify their income with remittances which allows them to potentially have the same amount of income in the next year allowing them to not have to alter their consumption patterns.

The majority of the current research pools households together, looking at the average households response to environmental shocks. While this is a good starting point, it is likely that different households will respond in different ways. For example, Calero et al. (2009) separate households based on the gender of the children in the household, if the household is located in rural or urban areas, and the economic status of the household. They find that school enrollment among girls increases when households use remittances. Because different households may respond in different ways, my contribution to the current literature will come from my examination of which types of households respond to environmental shocks by making migration decisions. My research will look at the differences in decisions made by households with savings and those without savings, as well as those with loans and those without. I will also look at the circumstances that cause households to send migrants away by separating the types of shocks, the gender of the migrant, and the province.

While my results show no clear relationship between negative shocks and migration when households are pooled, there are patterns when households are separated by whether or not they have savings or loans. I find when households will choose alternative coping mechanisms as opposed to migration when they have access to these alternatives. More specifically, households without savings will send migrants away after they experience a shock, implying that they are using migration as a way to deal with environmental shocks. Conversely,

households with savings will have migrants come home when they experience a shock to their income implying that they view having the migrant at home as more beneficial to the household. In the case of loans, I find that households with loans will send migrants away when they experience a shock and households without loans will have the migrant come home. This also implies that households with loans use migration as a coping mechanism when they experience an environmental shock to their income.

In the following thesis,the first section outlines the current literature focused on the impacts of shocks and how households mediate the damage resulting from shocks. The second section describes the dataset I use, the Townsend Thai Project, and the characteristics of the study area. The third section outlines the key variables and what they measure. The fourth section explains econometric methods used in the study. Finally, I provide the results, followed by a discussion of the implications of these results.

2 Literature Review

2.1 Welfare Impacts of Shocks

Economic shocks can be defined as unexpected exogenous changes to an economic model. That is to say that shocks are sudden variations in parts of an economic model that are out of the control of the agents in the model. For example, unpredicted changes in the price of a commodity could affect stock prices or economic activities (Huang et al., 2005; Papapetrou, 2001). In fact, Papapetrou (2001) find that unexpected changes in oil prices are important to explaining stock prices. Shocks are a large focus of economic research as they can affect many different exogenous factors such as macroeconomic variables, trade, prices, environmental conditions, etc. ultimately allowing economists to answer a multitude of questions (Balke and Fomby, 1994; Sadorsky, 1999; Park and Ratti, 2008; Jayachandran, 2006; Huang et al., 2005; Fernández-Villaverde et al., 2011). There are two general categories of shocks; covariate and idiosyncratic. Covariate shocks will affect a group of people who are usually related spatially, [1] while idiosyncratic shocks can affect just one economic agent.[2] This is an important distinction to economists. The two categories of shocks will result in different responses from households. A household that experiences an idiosyncratic shock is likely able to rely on their neighbors for support, while a household who experiences a covariate shock is less likely to do so because their neighbors have experienced the same shock. In both cases, at the microeconomic level, economists can use shocks to explain the economic decisions that households make but the impacts and responses may differ between households as well as the types of shocks.

An important category of covariate shocks are environmental shocks such as drought,

[1] Groups affected by a covariate shock are not always spatially related. Consider, for example, if a particular stock crashes. The owners of said stock will be affected by the shock but they might not necessarily live close together.

[2] A common example of an idiosyncratic shock is a family with a member who is diagnosed with health issues.

flood, disease in crops, etc. It is imperative that we study environmental shocks for a number of reasons. First, environmental shocks are becoming more prevalent over time because the climate is changing due to the increase in greenhouse gasses in the atmosphere (Hinzman et al., 2005; Parmesan and Yohe, 2003; Walther et al., 2002). Countries that have the capacity to reverse these environmental shocks by decreasing their carbon emissions are those that impact the economically developing countries the most. This is another reason why it is important to study environmental shocks. Some politicians in developed countries will not push for changes to reduce damage from carbon emissions unless they have strong evidence that their country is doing damage. Finally, environmental shocks are important to study as it is sometimes the case that climate change is the root cause of consequences with a much broader impact than damage at the household level. For example, Hsiang et al. (2011) find that during El Niño years[3], relative to La Niña years, the probability of civil conflict in the tropics doubles.

Shocks are also of concern because they are associated with an increase in risk, which generally leads to a decrease in welfare because the majority of individuals are risk averse. Risk aversion, according to Neumann and Morgenstern (1947), can be understood as an individual's willingness to accept less than the expected payoff of a choice with certainty as opposed to accepting the risky choice for a potentially larger sum of money. In other words, an individual is risk averse when they do not seek out risky situations and are, in some cases, willing to pay to not partake in a risky situation (Neumann and Morgenstern, 1947).[4] This theory is known as the expected utility hypothesis. Since the development of the expected utility hypothesis, the concept of risk aversion has changed to better explain the decisions that people make with respect to risk. This new conception of risk aversion is

[3]El Niño is associated the warm phase of the El Niño Southern Oscillation while La Niña refers to the colder years during the cycle.

[4]You could also consider it as the individual preferring a consistent level of consumption. If there is more risk associated with a persons income then they are less likely to be well-off, especially if their consumption decreased due to a shock.

known as prospect theory. According to prospect theory, the individual does not necessarily act in the most rational manner. The individual is prone to assigning personal value to gains and losses therefore replacing probabilities with personal weights (Kahneman and Tversky, 1979).

Behavioral studies have found that the majority of individuals are risk averse (Holt and Laury, 2002; Gould, 1973). Furthermore, studies find that the increase in risk among risk averse individuals decreases the welfare of these groups (Dolmas, 1998; Dionne and Eeckhoudt, 1985; Feldstein, 1973). Similarly, individuals tend to prefer avoiding losses to acquiring gains. In fact, the negative psychological impact of a loss is twice as powerful as the positive psychological impact of gains (Tversky and Kahneman, 1992). For example, Dolmas (1998) finds that the welfare loss from business cycles is actually much larger than what was previously estimated by economists. At the microeconomic level, Feldstein (1973) finds that despite the fact that American households are overinsured when it comes to health insurance, the welfare cost of decreasing the costs of insurance resulting in increased risk would outweigh the welfare gains from the decreased costs of professional healthcare. When households are confronted with increased risk, their welfare is compromised implying that the increased risk from shocks results in an overall welfare loss.

People will purchase insurance in order to mitigate risk. The early ideas of insurance markets can be accredited to Arrow and Debreu (1954), who developed the basic theory behind complete insurance markets. A complete market in economics is one where every possible future state-of-the-world can be constructed and a possible bet can be placed on it. That is to say, the condition that the demand for goods by consumers is equal to the supply of goods by producers in all states-of-the-world is satisfied in a complete market. Consider the example of an insurance company selling tornado insurance to homeowners. In this scenario, there are two states of the world to consider, a home in the mountainous west and a home in the flat plains of the Midwest. The tornado insurance in the mountainous west is a distinct

good from the insurance in the Midwest because the insurance plan is state-contingent, it is a good that depends on the time and state of the world. Now, a complete market will have a set of buyers that are willing to pay for this insurance plan in the west as well as a set of buyers in the Midwest. What makes the market complete is that, in each case, the set of consumers is equal to the set of producers. When the idea of a complete market is applied to insurance it implies that in every state-of-the-world there are a set of consumers and a set of producers that are willing to partake in a particular market[5].

However, Rotchild and Stiglitz (1976) show that the number of consumers is not equal to the number of producers in a market in the presence of asymmetric information. The theory was then tested by Altonji et al. (1992), who found that households in the United States do not distribute consumption independently of the distribution of resources. Similarly, Townsend (1994) concludes that an equilibrium model should be rejected based on tests on villages in southern India. Despite this, there is evidence suggesting that formal insurance in developing countries benefits the household when they experience a shock to their income. For example, Janzen and Carter (2013) find that Kenyan households with more assets that utilized microinsurance [6] before the 2011 drought were 64% less likely to consumption smooth while households with fewer assets were 43% less likely to consumption smooth. Similar findings from Janzen et al. (2013) indicate that insurance programs can help protect vulnerable households from becoming impoverished by providing income to make up for the losses from the households.

In contrast, vulnerable households affected by exogenous shocks that do not have access to insurance are at risk of falling into a chronic state of poverty if they are forced to compromise

[5]I should clarify, at this stage, that my use of the term 'insurance market' implies a formal insurance market much like the one we see in the US when purchasing auto, health or life insurance. Though it might be interesting to consider if a market is complete when informal insurance is accounted for. But that is a potential topic for a different paper.

[6]Microinsurance is a form of insurance that is tailored to poor households in that it offers smaller premiums, simpler coverage, less complicated claims process, and less regulation.

their human capital after an environmental shock. Dercon (2004) finds that rainfall shocks and famine in rural Ethiopia have a substantial negative effect on household consumption growth over many years. Similarly, Carter et al. (2007) indicate that Hurricane Mitch in Honduras and a major drought in Ethiopia had lasting negative effects on households.

Such negative effects are exemplified by Hoddinott (2006) who shows that households in rural Zimbabwe coped with a drought by spending less money on food. As a result, the body mass index of women and children decreased, which implies that households were drawing down on their human capital in order to account for lost income. Though he finds that while the BMIs of the household members were impacted, it was only for a short amount of time that the BMIs were reduced, and then the family members regained their body fat after some time. Any deficiency in nutrition of household members, though, can negatively impact human capital which could lead to long-term negative consequences. A study in South Africa by Carter and Maluccio (2003) show similar results. The authors find that child growth is stunted because of nutritional restrictions after a household is unable to insure against risk, especially during covariate shocks such as flood and drought.

There is also evidence that some households will include their children as laborers when they are faced with a shock in order to account for lost income. Debebe (2010) finds that in rural Ethiopia child labor will help lessen pressure placed upon households when they are faced with idiosyncratic agricultural shocks to their income. There is also evidence from Beegle et al. (2006) to suggest that households will employ child labor when households have less access to credit to help mitigate the effects of shocks to their income. In these cases, the more time children spend at work means less time spent at school, which tends to inhibit the child's productivity later in life.

2.2 Household Coping Mechanisms

Despite the potentially long-term costs of foregoing insurance and the negative welfare impacts of exposure to risk, not all households are able to insure themselves, particularly using formal insurance markets. Jalan and Ravallion (1999) find that in rural China, households in the poorest decile are the least likely to be well-insured, with the result that 40% of an income shock is passed on to their consumption. Conversely, households in the richest decile are much less likely to experience such a shock to their income because they are protected by a good insurance program. They find that households in the richest decile are protected from about 90% of a shock to their income. It is therefore important to understand when and how households use formal or informal ex-ante insurance or ex-post coping mechanisms such as income diversification, consumption smoothing, asset smoothing, etc. An ex-post response means that the household will respond to a shock after it has occurred, while ex-ante means that the household will respond to a shock before it has occurred. Examples of ex-post responses are described above.

In the case of an ex-ante response when households do not have access to insurance, they will look to insure or lower their risk through other means. Dercon (1998) finds households will hold cattle as insurance in western Tanzania. He concludes that despite the fact that cattle are considered to be an inconsistent (e.g. higher-risk) investment, the richest households will keep cattle as a form of insurance, while poorer households are much more likely to partake in low-risk jobs. In developing countries, it is also often difficult to implement and maintain a formal insurance program. Binswanger-Mkhize (2012) concludes that index-based insurance programs[7] in developing countries simply do not have the demand necessary for such programs. He finds that there are better options for farmers when it comes to insuring against risk, such as income diversification and reliance on public safety nets.

[7]Index-based insurance pays all individuals that are geographically related the same amount after they experience a covariate shock as opposed to considering the amount of a payout on a case-by-case basis.

One alternative to formal insurance programs in developing countries is a risk sharing network. These networks are usually formed from social and geographical proximity (Fafchamps and Gubert, 2007). Deaton (1990) finds that households in Côte d'Ivoire will diversify their risk in order to maintain a consistent income or level of consumption. Risk is diversified in the villages of Côte d'Ivoire when households share their income with other households that are less well-off. This allows more households to account for an unexpected loss in income.

Public safety nets are also programs meant to prevent households from experiencing long-term poverty after a shock. For example, a public safety net could be cash transfers, food stamps, public works, fee waivers, etc. Linnerooth-Bayer and Mechler (2007) determine that the public safety nets are a beneficial way for households to insure against the uncertainty resulting from climate change. Yet, it is not always the case that public safety nets are entirely beneficial, as noted by Dercon (2002), who concludes that public safety nets are often beneficial to the households participating in them but that there are negative externalities associated with safety nets. These externalities occur when households covered by the safety net are then able to leave their informal risk sharing network, which causes other households to become more vulnerable.

Another alternative to formal insurance programs is income diversification. Here, households alter the labor patterns of family members in order to minimize the impact of a shock or, in the case of ex-post diversification, to make up for the lost income. For example, Kochar (1999) examines the ability that farmers have to move from farm to off-farm labor when faced with an idiosyncratic shock to their crops. The author finds that households will increase the off-farm hours of work for the male members of the household and further noting that there is evidence of consumption smoothing by shifting hours worked from the farm to off of the farm. Ellis (2000) states that the determinants of income diversification in economically developing countries are "seasonality, risk, labor markets, credit markets, asset strategies and coping strategies." Households have also been found to diversify their income

in the form of remittances in Bangladesh (Martin et al., 2014). That is to say, it is possible that households may use migration as a way to diversify their income sources in order to cope with shocks.

According to early migration models (Harris and Todaro, 1970), the decision to migrate was assumed to be made solely by the migrating individual. Yet, within the framework of the New Economics of Labor Migration, the decision to migrate is modeled as a household's decision to send a migrant to work away from home as a means of diversification (Stark and Bloom, 1985). This has been considered empirically in the context of environmental shocks by Yang and Choi (2007), who find that households in the Philippines use migration to make up for income lost during rain shocks. Also, Ersado et al. (2003) find that households in Zimbabwe that experience drought are more likely to form a dependence on remittances in order to smooth consumption. That is to say, households experiencing shocks to their local income tend to increase their revenue in the form of remittances to make up for the lost income. Households in Bangladesh have been found to also diversify their income in the form of remittances (Martin et al., 2014).

There is also a wide literature on the relationship between environmental shocks and migration. Many findings indicate that the decision to send out migrants depends on the type of shock that the household experiences. Halliday (2006) studies the relationship between an earthquake in El Salvador and the likelihood that a household will send out a migrant in response to this earthquake. He finds that while the 2001 earthquakes spurred a decrease in migration to the US from El Salvador, agricultural shocks in El Salvador increased migration to the US. Mueller et al. (2014) find that flooding in Pakistan did not have an effect on migration decisions, but heat stress did cause households to send more migrants out. Damon and Wisniewski (2014) find that a household's decision to send migrants depends on the type of shock as well as the gender of the potential migrant. In this case, female migrants were more likely to come home after an earthquake, while male migrants were more likely to

leave the house after a loss of livestock. The fact that households are more likely to send out female migrants may come from the fact that females feel a stronger duty to help the household than male migrants. This is discussed further in the study area section.

Similar to the studies above, my thesis will explore the relationship between environmental shocks and migration in Thailand. Some scholars have conducted research on the relationship between environmental shocks and household decisions with respect to migration, largely finding that there is a relationship between the two. Findings also show that households will make different migration decisions depending on the type of environmental shock and the gender of the migrant. But the majority of the research conducted looks at households pooled together as a whole. It is possible that different households will make different migration decisions depending on their other ex-ante insurance or ex-post coping options. It is also possible, as shown above, that decisions will differ based on the differences in types of shocks.

Therefore, my contribution with this thesis is that I will look at differences between households and how these differences affect the households' decision to send out migrants within the framework of the New Economics of Labor Migration.[8] I will look at the differences in migration decisions between households with savings and those without savings. I will also look at the differences between households with loans and those without loans.[9] I will further differentiate households by the province where they are located, the gender of the migrant, and the type of shock. The decision of the household to send out a migrant, in the context of this thesis, will be looked at as an ex-post option, as opposed to an ex-ante option, within a risk management framework. That is to say, the household will experience a shock to their income associated with their lifestyle and will then decide whether or not to send out one or multiple migrants to account for the loss of income or assets due to the

[8]That is, it is the households decision to send out the migrant as opposed to the individuals decision to migrate.

[9]According to the survey data, loans could be either formal or informal.

shock.

3 Study Area and Dataset

This thesis uses data from the Townsend Thai project. The Townsend Thai project started in 1997 to study household responses to shocks to their income and various policy changes (National Bureau of Economic Research, 1999). In 1998 Thailand experienced a large shock to its economy from Asia's financial crisis which caused its economy to contract by 10.5% (International Monetary Fund, 2000). This spurred the government to implement a set of programs to aid in the re-growth of Thailand's economy and assist households that were experiencing shocks to their income. The International Monetary Fund also provided Thailand with over US$17 billion of financial aid (International Monetary Fund, 2012). As a result of the financial crisis and policy changes, the Townsend Thai survey was formatted to measure household responses to the financial crisis and the effects of the policy changes. The Townsend Thai project is panel data, meaning that it follows the same set of households from 1997 to present day. The length of the time period is useful to researchers because we are better able answer questions that we were unable to with the use of cross-sectional or time-series data. More specifically, it makes it possible to control for unobservable time-invariant characteristics of households.

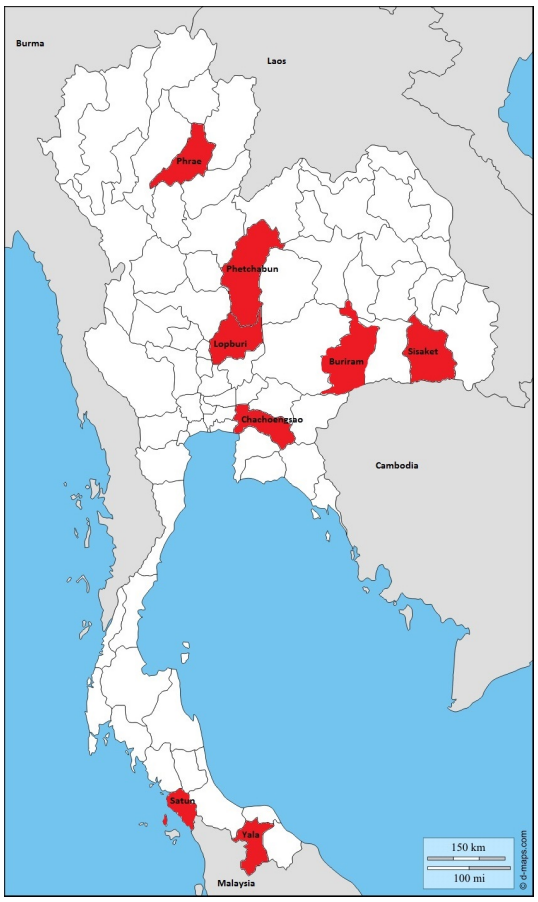

Figure 1: Study Area Provinces

Professor Robert Townsend, a professor of Economics at MIT, spearheaded The Townsend Thai project, which is funded by charitable groups such as the National Institutes of Child Health and Human Development, the National Science Foundation, the Ford Foundation, the John Templeton Foundation and the Bill and Melinda Gate's Foundation **?**. With the help of these groups, the project has developed over time by adding new provinces as well as urban data. This development has helped my thesis as there are more observations over a wider geographic range.

Initially in 1997 the Townsend Thai survey selected four provinces to collect data from; Chachoengsao, Sisaket, Lopburi, and Buriram. In each of the four provinces, 12 districts were randomly selected. Of those districts, fifteen households from four different villages have been surveyed each year from 1997 to present day. The survey is administered by a team of surveyors who visit the villages to ask questions of the household heads and village key informants. The survey is conducted annually, and environmental data are collected monthly, but the publicly available data include only the annual responses from the survey. Therefore this thesis will only use the publicly available annual responses from the survey. In 2004 the project added the province Satun to the survey as it is located in southern Thailand. Then in 2005, the study added the Northern province of Phrae. The figure above shows the location of each of these provinces. They are highlighted.

According to the Townsend Thai project's website, the provinces with farming and fishing as the greatest share of occupational distribution are Phrae, Lopburi, Sisaket and Buriram. Sisaket and Buriram, though, are known for their silk and cotton production as opposed to rice production. Phrae is located in an area with one of the largest teak reserves in Thailand. Yet, there is a ban on teak cutting in Thailand. Satun's economy is predominantly from the rubber plantation, with paddy farming as the second biggest contributor. Though Chachoengsao is known for its rice production, because the western half of the province is in the Bang Pa Kong River, most of the individuals are employed in contracting but it is not

clear what type of contracting people are doing.

Table 1 gives major economic variables and environmental variables by province. From the table, we see that all of the study provinces use the majority of their land for rice production, with the exceptions of Phrae, Satun and Chachoengsao. Buriram and Sisaket have the largest populations of the selected provinces while Satun and Phrae have the smallest populations. The GDP per capita has a wide range from 34 thousand baht (Sisaket) to 285 thousand baht (Chachoengsao). While the provinces of Buriram and Sisaket have some of the largest GDP's relative to the other provinces, they have the lowest two GDP's per capita. They also have the largest rice production out of all of the provinces. It appears that Buriram and Sisaket are the poorest of the selected provinces and among those most dependent on agriculture. This implies that households from these provinces may be less able to cope with shocks as well as more vulnerable to environmental shocks.

In terms of environmental variables, according to Table 1, Sisaket had the lowest number of days of rainfall and the lowest temperature in 2010. That year, Buriram had the lowest annual rainfall, Satun had the highest. Chachoengsao had the lowest average temperature in 2010, while Lopburi had the highest. Those provinces with more extreme climates such as Chachoengsao, Satun, Buriram and Lopburi will be more at risk to environmental shocks.

Table 1: Economic and Environmental Variables by Province

	Lopburi	Chachoengsao	Buriram	Sisaket	Satun	Phrae	Total
Economic Variables							
Population	756,127	679,370	1,559,085	1,452,203	301,467	458,750	67,275,500
Percent Male	50.23	49.04	49.9	50	49.86	48.72	49.21
GDP (2009)	67,741 mn.	203,011 mn.	62,472 mn.	52,578 mn.	25,984 mn.	23,375 mn.	9,041.6 bn.
GDP Per Capita (2009)	87,137	285,290	38,034	34,326	90,103	45,278	135,144
Pct. Farm Land	60.56	27.89	59.58	62.59	37.82	16.2	41.03
Rice Production (ton)	616,554	707,338	1,185,051	1,106,212	16,856	163,345	34,484,955
Rice Yield (kg./rai)	1258	1243	890	853	838	1151	1058
Environmental Variables							
2010 Low (Celsius)	13.3	15.6	12.9	2.0	21.9	13.6	NA
2010 High	41.8	39.0	42.2	41.0	37.0	43.0	NA
2010 Average	28.8	27.3	27.5	28.0	27.9	27.5	NA
2010 Annual Rainfall (mm)	1,085.4	1,713.6	591.5	1,071.5	2,026.4	1,007.5	1277.9
2010 Day of rain	146	145	134	99	185	127	155

Statistics taken from *Thailand Province Data: 2012 - 2013.* Alpha Research (2013)

3.1 Migration in Thailand

Researchers have found that households in Thailand use migration as a way to reduce their likelihood of entering poverty (Osaki, 2003; Jones and Pardthaisong, 1999; Curran and Saguy, 2006). The remittances from migrants become a new income source for the household. This extra liquidity alleviates the pressure of making ends meet. According to the survey data, both male and female migrants stay in Thailand when they migrate the majority of the time.

Another notable aspect of the locations of the migrants is in the early 2000's one of the top locations for all of the provinces is Bangkok, yet in the later years this changes to a multitude of different destinations. Actually, in 2005, one of the top destinations for migrants to travel to is Chaiyaphum. Chaiyaphum is located in the northeastern region of Thailand. The province shares a border with Lopburi. The main economy of Chaiyaphum comes from agriculture, but it is also well known for its silk industry. The other main provinces that migrants are moving to are Tak, Pattani and Nonthaburi. It should be noted that Nonthaburi, though a separate province, is part of the greater metropolitan Bangkok area. In the early years of the dataset, of the top two destinations among migrants, both genders were also staying within their province. This implies either that they might be moving to larger cities in order to find different types of work or that they are moving to different parts of the province but staying in agriculture in order to diversify the locations household members are working. Knodel and Saengtienchai (2007) find that children who migrate to an urban setting and remit improve the lives of their parents. But there is not any information on if the migrant has moved from rural to urban in the survey data. Based on the top occupations of migrants, which is discussed in more detail below, it could be assumed that some migrants are staying in a rural setting but working as a farmer in a different part of the province.

Researchers find that there are differences in gender roles with respect to migration in Thailand. Mills (1997) recalls an interview with a female migrant who states that she decided

to migrate because she wanted to raise money for the family, but she was also inspired to move by the beautiful clothes of her friend who was visiting from the city. In this example, the migrant wants to improve her own lifestyle by moving to an urban setting while also helping her family's livelihood. Similarly, Marie et al. (2010) argue that, in North-eastern Thailand, female migrants have fewer job opportunities and more pressure from their families than their male counterparts.

This lack of opportunity and presence of gender roles cause the female migrants to follow the decisions of the family more often than the male migrants who are more content with their work situation and feel less pressure to come home when the family needs them. Sobieszczyk (2000) also finds that male migrants had more opportunities to migrate abroad because they had a stronger social network of individuals abroad who were willing to help them get their first job. Their female counterparts were less likely to migrate abroad because they, having a weaker social network, relied more on the overseas employers to arrange their first jobs abroad. When considering the cultural effects of migration, Curran and Saguy (2001) find that the gender of the migrant can impact the network that they construct through migration. Yet at the same time the influence of the social networks feeds back and affects the decisions of the migrant.

In fact, according to the survey data, female migrants send a greater amount of money home more often than male migrants. Table 2 shows the average age of the migrant, times money was sent to the household per year, and amount sent to the household per year based on the gender of the migrant. The last two columns of the table give results from the t-test of the means between the two genders. These results show that it is statistically significant that female migrants send more money home more often. It is also the case, according to the survey data, that more females migrate than males on average. This is possibly explained by the counteracting effects of supply and demand. That is, according to the survey data, women are more likely to migrate yet they have fewer opportunities than male migrants, as

stated above.

In terms of occupations, according to the survey data, male migrants work mostly as either factory workers or rice farmers. Male migrants will also work as government officials or policemen. Female migrants also work mostly as factory workers and rice farmers but they might also take jobs in housework. One of the two notable trends over time from the data is the consistency of both male and female migrants working as factory workers or rice farmers. Something else that is notable is that the top two occupations and locations of migrants from Buriram and Sisaket never change. They are always either factory workers or rice farmers. Finally, the top two occupations in Satun and Phrae are much less consistent than the top two occupations of the other provinces.

Table 2: Descriptive Statistics of Male and Female Migrant Remittances Sent Annually

Money Sent to Household from Migrant						
	Male		Female		Ttest	
	mean	sd	mean	sd	b	p
Age	34.68	9.47	34	9.15	.13	.24
Times Money Received	5.83	8.04	7.21	12.89	-1.18	<.001
Amount Received	10110.9	19324.11	13361.68	28310.89	-3235.40	<.001
N	6668		8058		28190	
Money Sent from Household to Migrant						
	Male		Female		Ttest	
	mean	sd	mean	sd	b	p
Age	28.88	8.86	27.88	9.24	.13	.24
Times Money Sent	4.93	13.93	4.2	5.79	.04	.06
Amount Sent	21138.42	42384.27	25420.71	78858.13	-4338.5	.35
N	379		326		28190	

The Table gives the average age, money sent to the migrant, and money received from the migrant based on the gender of the migrant. The table then reports the results of the t-test of differences of these variables.

4 Key Variables

4.1 Dependent Variables

The number of migrants reported by each household is the main variable of interest. The household survey considers migrants as members of the household even though they have moved and are working in a new location for more than six months of the last twelve months. Students studying in different parts of the country and members of the family that moved to get married are not considered to be migrants. Household members are defined as, "all the people who lived and ate in this house for at least 6 months out of the last 12 months and children who are studying away from home and are supported by members of this household.[10]" Those who have moved to get married are not considered members of the household, even if the family member does not marry immediately. Each year, the household reports how many migrants are working in other parts of the country, how much income the migrant remits to the household ,and the gender of each migrant.

When broken down by year and province, the average number of female migrants is higher than the average number of male migrants. After conducting t-tests of these means broken down by province and year, there is either a significantly higher number of women migrants or there is no significant difference between the average number of male and female migrants per province and year. The two exceptions where there are more males than females migrating are Buriram in 2006 and 2007. Other than that, we find that females tend to migrate as often or more often than males. Table 3 gives descriptive statistics of migrants broken by gender in the years 2001, 2005, and 2011. From this table, we see that Chachoengsao, Lopburi, Buriram, and Sisaket tend to send out more migrants than Satun and Phrae. For the most part, the average number of migrants appears to hover around two

[10]Seeing as migrants do not fit within the definition of a household member, the control for number of household members will be the number of migrants plus household members.

migrants per household with the exceptions of Satun and Phrae.

Table 3: Descriptive Statistics of Migrants

	All Migrants				Male Migrants				Female Migrants			
	Min	Median	Mean	Max	Min	Median	Mean	Max	Min	Median	Mean	Max
2001												
Chachoengsao	0	2	2.32	12	0	2	2.44	11	0	1	1.63	10
Lopburi	0	1	1.94	12	0	1	1.77	8	0	1	2.07	12
Buriram	0	2	2.47	11	0	2.5	2.68	11	0	2	2.36	10
Sisaket	0	2	2.56	9	0	2	2.8	9	0	2	2.17	7
Total	0	2	2.32	12	0	2	2.47	11	0	1	2.06	12
2005												
Chachoengsao	0	1	2.05	11	0	1	1.99	8	0	2	2.27	11
Lopburi	0	1	1.74	11	0	1	1.61	11	0	1	2.09	11
Buriram	0	2	2.37	11	0	2	2.33	10	0	2	2.5	11
Sisaket	0	2	2.35	10	0	2	2.43	9	0	2	2.46	10
Satun	0	0	1.28	8	0	0	1.36	7	0	0	1.81	8
Phrae	0	1	1.11	5	0	1	1.24	5	0	1	1.17	5
Total	0	1	1.88	11	0	1	1.97	11	0	2	2.14	11
2011												
Chachoengsao	0	2	2.1	13	0	2	2.1	9	0	2	2.16	9
Lopburi	0	1	1.84	12	0	1	1.74	12	0	1	1.86	8
Buriram	0	2	2.39	11	0	2	2.14	11	0	2	2.55	11
Sisaket	0	2	1.95	10	0	1	1.86	9	0	2	1.86	7
Satun	0	0	0.68	7	0	0	0.47	3	0	0	0.33	1
Phrae	0	0	0.63	6	0	0	0.46	2	0	0	0.5	2
Total	0	1	1.78	13	0	1	1.8	12	0	2	1.98	11

Information taken from the survey data.

4.2 Independent Variables

The explanatory variables that are of the most interest are the environmental shocks as well as the loan and savings dummies. For the creation of the environmental shock variables, the household survey includes a question asking the household head to report if this year, compared to the prior year, was a good year for income. The exact question reads; "Comparing this past year (June [year t-1] - May [year t]) to the year before that (June [year t-2] - May [year t-1]), which was the worst year for the household income?" The surveyor records one of three different responses from the household head; this past year, the year before and income exactly the same in both years. As a follow-up, the household head states why the year they indicated would have been a particularly bad year for their income. Generally, the most frequent responses from households is that their crop yield was affected by an environmental shock such as flooding, drought or low crop yield. These responses are used to determine if a household was affected by an external shock to their income, environmental or otherwise.

It should be noted that the original survey from 1997- 1999 included a different question concerning a comparison of income across years which read, "Of the last 5 years, what was the best year for household income?" Yet this time period in the dataset has been updated to coincide with the aforementioned question and responses. This thesis will only be concerned with the updated versions of the dataset for 1997 to 1999 because it parallels the responses from the 2000- 2011 data.

I generated dummy variables for whether the household reported a shock to its income in a particular year for each of the following different types of shock; flood, drought, low crop yield[11] and health/death. The health/ death dummy variable is a combination of if the household head reported a health shock or a death in the family affecting household income. The health/ death dummy variable will be used to compare with the environmental shock

[11] A large assumption that I make is that low crop yield implies that the household experienced an environmental shock. This may not always be the case.

variables to see if household responses are different in the case of covariate environmental shocks versus idiosyncratic non-environmental shocks. Table 5 gives the number of reported shocks from the years 2001, 2005 and 2011 by province. From the table, the highest reported shocks are drought, flood, and low crop yield. The shock dummy variables were then combined to create a categorical variable.[12]

I then generated dummy variables for a household's use of either a loan or a savings account. Table 4 give the number of households with loans, savings, both loans and savings, and neither loans nor savings. The table is pooled over time and across provinces. A loan is defined as any money or set of goods that anyone in the household owed to, " a commercial bank, the Bank for Agriculture and Agricultural Cooperatives (BAAC), a PCG, a Rice Bank, the Agricultural Cooperative, a government agency, a moneylender, a friend, a relative or any other individual or institution." The surveyor also asked if any household members had, "pawned/mortgaged land to anyone, sold your crops in advance, gotten goods on credit from a store owner or supplier of inputs." The household was defined to have savings if it had any savings in a Commercial Bank, the Agricultural Cooperative, bank account at the BAAC, a production credit group account (PCG), gold, jewelry, cash, rice in storage, and other crops in storage. There was an option for 'other,' but it is unclear if the household would then include community/village banks. These dummies are interacted with the shock categorical variable in order to determine if households use migration as a coping mechanism when they have access to loans and savings and if those decisions are different from households that do not have loans or savings.

Table 4: Tabulated Loans and Savings

		Savings		
		No	Yes	Total
Loans	No	1,339	2,809	4,148
	Yes	2,446	9,430	11,876
	Total	3,785	12,239	16,024

[12]The following categories of this variable are 1- flood, 2- drought, 3- low crop yield, 4- health/death.

Table 5: Household Reported Shocks

	Drought	Flood	Low Crop Yield	Health/ Death	Total
2001					
Chachoengsao	13	1	35	6	55
Lopburi	38	12	17	6	73
Buriram	12	31	10	6	59
Sisaket	10	32	23	1	66
Total	73	76	85	19	253
2005					
Chachoengsao	67	0	40	7	114
Lopburi	82	0	21	6	109
Buriram	23	2	18	9	52
Sisaket	86	0	22	6	114
Satun	9	0	38	2	49
Phrae	3	2	3	4	12
Total	270	4	142	34	450
2011					
Chachoengsao	0	0	5	5	10
Lopburi	1	3	3	7	14
Buriram	36	5	0	4	45
Sisaket	1	1	0	1	3
Satun	0	0	0	1	1
Phrae	0	0	0	0	0
Total	38	9	8	18	73

4.3 Controls

There are a number of other explanatory variables that will be included in the model in order to account for any potential bias in the results. These variables are meant to control for any household characteristics that might affect household migration decisions. The controls chosen for this thesis were influenced by Halliday (2012).

The first of these explanatory variables is the number of members in the household. Again, households members are defined as, "all the people who lived and ate in this house for at least 6 months out of the last 12 months and children who are studying away from home and are supported by members of this household." Table 6 gives the average number of household members[13] in each province in 2001, 2005, and 2011. From this table we see that the average number of members for households in the study, by province, hovers around five to six people. There doesn't appear to be much variation over time for the average number of household members per household.

The household surveys also report the age of the head of household and the highest grade of education that the household head has completed. These two variables are included in the model as they might also affect how the household makes decisions with respect to sending out migrants under the framework of the New Economics of Labor Migration. Table 6 gives descriptive statistics for the age of the household head and the number of years of education for the household head for the years of 2001, 2005, and 2011. Here, the average age of the household head hovers around 50 and doesn't vary much over the years. The same goes for the average years of education of the household head except in the case of Sisaket which changes from seven years to nine years of education from 2005 to 2011. A set of dummy variables are also included, which indicate the age range of the other household members.

[13]With migrants included in the calculation.

Table 6: Descriptive Statistics of Control Variables

	Household Members				Age of Household Head				Years of School			
	Min	Median	Mean	Max	Min	Median	Mean	Max	Min	Median	Mean	Max
2001												
Chachoengsao	2	6	6.56	20	30	52.5	52.49	111	0	7	6.43	22
Lopburi	2	5	5.99	17	28	53	51.99	86	0	7	7.26	22
Buriram	3	6	6.98	16	33	49	50.79	91	0	7	6.43	22
Sisaket	3	7	7.15	22	34	54	54.41	86	0	7	6.92	22
Total	3	6	6.67	22	31	52	52.41	111	0	7	6.76	22
2005												
Chachoengsao	2	6	6.05	18	31	53	51.4	93	0	7	6.69	22
Lopburi	4	5	5.38	22	42	54	49.24	89	0	7	7.38	22
Buriram	2	6	6.18	16	31	50	48.38	97	0	7	6.58	22
Sisaket	1	6	6.21	19	28	54	52.26	93	0	7	7.07	22
Satun	2	5	5.75	12	28	51	53.24	108	0	7	7.47	22
Phrae	2	4	4.5	12	39	54	51.72	79	0	7	8.53	22
Total	2	6	5.72	22	31	53	50.67	108	0	7	7.18	22
2011												
Chachoengsao	1	6	6.09	19	25	56	56.7	95	0	7	7.18	22
Lopburi	1	5	5.47	14	29	59	58.91	108	0	7	7.84	22
Buriram	3	6	6.39	16	35	54	53.95	84	0	7	7.23	22
Sisaket	1	5	5.7	14	23	54.5	54.45	93	0	7	8.11	22
Satun	2	5	5.12	18	34	51	51.61	87	0	7	9.30	22
Phrae	2	4	3.94	9	41.5	56	53.22	82	0	7	8.39	22
Total	2	5	5.63	19	35	55	55.27	108	0	7	7.84	22

Information taken from survey data.

5 Methods

I estimate the number of migrants a household chooses to send out in response to household reported shocks. The basic model I would estimate is

$$migrants_i = \hat{\beta}_0 + \hat{\beta}_1 householdshocks_i + \epsilon. \tag{1}$$

Yet there are issues with such a simple regression. First, with any simple regression of the number of migrants in response to the household-reported shocks, there is the possibility of endogeneity due to omitted variables. Endogeneity is a common issue in statistics. It occurs when the error term, ϵ, is correlated with the explanatory variable causing the estimated coefficient, $\hat{\beta}$, to not be equal to the true coefficient, β. That is to say, not including controls in the model causes us to assume that household reported shocks are the only thing affecting the number of migrants and that no characteristics from the error term are correlated with household reported shocks. This is not the case as there are many other variables that are correlated with household shocks and will cause the household to make migration decisions. For example, the number of members in the household is correlated with the number of reports of health/death in the household, implying that if the number of household members is not included in the model then the estimated coefficient will be biased. I must also control for time because shocks and migration may both trend over time for unrelated reasons. In order to mitigate this bias controls are included in the model.

$$migrants_{it+1} = \beta_0 + \beta_1 householdshocks_{it} + \beta_2 year_{it} + \beta_{2+n} controls_{it} + \epsilon_{it} \tag{2}$$

This model is known as a pooled ordinary least squares estimation. All of the households from each year have been pooled together as one group and we assume that the coefficients of this model are constant across both time and individual households. The issue with

this model is that there will still be some unobservable differences which remain in the error term. It is possible that some of these unobservable characteristics are correlated with the explanatory variables, leading to the problem of endogeneity. We can solve part of this issue with the use of a fixed effects model that includes within estimators at the household level. This will control for all time-invariant unobservable characteristics that are correlated with the explanatory variables. But even then, we must assume that the time-variant unobservable characteristics are either randomly distributed among households or not correlated with the explanatory variables. Or we must assume that unobservable characteristics are time-invariant.

A fixed effects model is estimated by subtracting the average value of each variable over the time period of the panel from the linear unobserved effects model. In other words,

$$migrants_{it} - \overline{migrants_i} = \beta_1(householdshocks_{it} - \overline{householdshocks_i}) + \beta_2(year_{it} - \overline{year_i}) + \beta_{2+n}(controls_{it} - \overline{controls_i}) + (a_i - \overline{a_i}) + (\epsilon_{it} - \overline{\epsilon_i}) \quad (3)$$

where for some variable x_i,

$$\overline{x_i} = \frac{1}{T}\sum_{t=1}^{T} x_{it}.$$

With this calculation, the unobservable time-invariant individual effect, a_i, is removed from the model. The final fixed effects model becomes,

$$migrants_{it} = \beta_0 + \beta_1 householdshocks_{it} + \beta_3 controls_{it} + \epsilon_{it}. \quad (4)$$

With fixed effects, there are a number of assumptions that need to be satisfied in order to ensure that the model is unbiased. First, each explanatory variable must change over

time with no perfectly linear relationship between explanatory variables. This implies that explanatory variables like province or gender of the household head will not be included in the model as they typically do not change over time.

Another important assumption is that the error term is homoscedastic and serially uncorrelated. That is to say, the error term for each observation cannot have any linear relationship and they cannot be correlated over time. This assumption is satisfied because the model will have robust standard errors. Robust standard errors correct for heterosckedasticity without changing the coefficients of the model. When using robust standard errors they will be very similar to FE standard errors, but they might be larger than the FE standard errors. This may reduce the significance of some estimates, but the assumption of homoscedasticity is fulfilled. If there is no issue with heteroskedasticity in the first place then the robust standard errors will be equal to the original standard errors.

Finally and most importantly, the error term cannot be correlated with the explanatory variables. As stated above, this is referred to as endogeneity and ultimately biases the estimates. I have already discussed some of the issues associated with endogeneity. First, if controls are not included in the model and correlated with the error term then the estimates will be biased. This was mitigated by including controls in the model. Second, there are time-invariant characteristics that could be correlated with the explanatory variable. The use of fixed effects controls for these time-invariant characteristics, but I can still not definitively conclude that all of the unobserved time-variant characteristics that are correlated with shocks are controlled for. It is the case, however, that the environmental shock variables are unlikely to be correlated with time-variant unobservable characteristics. That is, environmental shocks are external to the household so the unobserved changes in characteristics that influence migration are less likely to be correlated with shocks than with other household level variables.

The model from equation four assumes that all households would do the same thing in the

case of an environmental shock. As pointed out in the literature review, this assumption is false because households use many different coping mechanisms when confronted with shocks. The literature review also indicated that the current research on migration and environmental shocks does not take a detailed enough look at the households. It is important to understand how these differences between households affect their decisions on migration.

Therefore, the model will be split into two models which show the differences between households that have access to either loans or savings and those that do not. In the case of savings, it is possible that the household is not actually saving in anticipation of an environmental shock but, in any case, they still have access to extra liquidity in times that they would need it. Conversely, we do not know exactly why a household has taken out a loan. It is possible that this loan is being used to invest in capital or it is being used to cope with difficult situations. Again, regardless of why it has this loan, the household is in debt and therefore may feel larger constraints on its liquidity when it experiences an environmental shock. This is because household members must cover their cost of living while also paying off a loan. Another interpretation of households having loans should be considered. Loans may be an indicator of a households access to credit. That is to say, households that have loans are financially stable enough to take out more loans if they need to. This implies that the causality could go the other way and the household with loans would not send migrants away to cope with a shock. Here, it is best differentiate between households that have either loans or savings and those that do not when we are trying to understand the differences between these households. The two models are,

$$migrants_{it+1} = \beta_0 + \beta_1 savings_{it-1} * hhd\_shocks_{it} + \beta_2 savings_{it-1} + \beta_3 hhd\_shocks_{it} + \beta_{3+n} controls_{it} + \epsilon_{it} \quad (5)$$

$$migrants_{it+1} = \beta_0 + \beta_1 loans_{it-1} * hhd\_shocks_{it} + \beta_2 loans_{it-1} + \beta_3 hhd\_shocks_{it} + \beta_{3+n} controls_{it} + \epsilon_{it} \quad (6)$$

These models indicate the decisions that households with or without either loans or savings make when they are confronted with an environmental shock. Because there is an interaction in the model all results will be expressed in terms of the marginal effects of a given explanatory variable. With the marginal effects, $\beta_1 + \beta_3$ gives the change in migrants from a household that has a loan/savings account and experiences an environmental shock and β_3 is the impact of an environmental shock on migration if the household does not have savings/loans.[14]

Each of these three types of models will be broken down by male and female migrants to determine the differences in migration decisions with respect to gender. They will also be broken down by province. This will help determine if there is any difference in the decisions that households in separate provinces make. Finally, time lags will be included in the model. This means that for some year, t, I will measure the presence of a savings account in year $t-1$, whether a shock occurs in year t, and the household migration decision in year $t+1$. This is meant to more accurately follow the course of events that might happen when households experience a shock and make a migration decision, and minimize potential reverse causality. That is to say, households will have a savings account or loan in the year before the shock occurs. This may not be exactly in anticipation of the shock occurring but will influence how the households makes coping decisions after the shock has occurred. The coping decision that I am most concerned with is migration in the year after the shock has occurred. That is, migration is an ex-post response to environmental shocks.

[14] *ceteris paribus* in all interpretations.

6 Results

6.1 Fixed Effects with No Interaction

As the research question looks for the effect of environmental shocks on migration, the estimation starts with the most simple, yet reasonable, possible case. Table 7 shows a fixed effects model of the impact of a shock in year t on all migrants in year $t+1$. The first column of this table gives the results of the provinces pooled together. This column shows that there is no significant relationship between environmental shocks and migration decisions. It is possible that these results are due to the differences in geographic location and general characteristics of each of the different provinces. This implies that different results might come from running the same regression on the separate provinces. The rest of the table shows the same regression given each province. The province is listed at the top of the column. When we break down the model by province we find almost no relationships between environmental shocks and migration. The exception to this is drought and migration in Lopburi. When households in Lopburi experience a drought they are likely to reduce the number of migrants. It is still important to see if there are differences in these relationship when migrants are broken into male and female that would not show up in the pooled model. This is because many previous studies have shown the different migration decisions based on the gender of the migrant (Damon and Wisniewski, 2014; Halliday, 2012).

Table 8 and Table 9 estimate the same relationship as Table 7, but break migrants down by sex. The first column of each table shows results for all of the provinces pooled together. Again, it is important to break the regressions down by each province in order to see if there is a different relationship between environmental shocks and migration. These results show that there is mainly no relationship, but where there is one the results show that households with female migrants are more likely to send the migrant away when they report a shock to their income. This is the case in Sisaket and Satun when households report low crop

yield. The relationship between drought and Lopburi is the same as when the migrants are pooled together. There, the households decide to reduce the number of female migrants after experiencing drought.

In the instance of male migrants we find a somewhat similar story to female migrants. There is little to no relationship between environmental shocks and migration. When there are relationships, male migrants come home when the household experiences an environmental shock. This is the case in Phrae when the household reports a flood and Chachoengsao when the household experiences low crop yield. Despite the fact that these results are beginning to show a relationship between environmental shocks and migrations, it is still important to look at different cases. As pointed out in the literature review, different households may make different decisions depending on the other coping mechanisms available to them and their circumstances more generally. It is crucial that we allow for these differences when modeling the relationships. The next two sets of results will include interactions with either savings or loans in order to get a better idea of the types of households that make migration decisions in response to environmental shocks and what kind of decisions they make.

Table 7: Fixed Effects on All Migrants in t+1

	(1) All	(2) Lopburi	(3) Buriram	(4) Phrae	(5) Chachoengsao	(6) Sisaket	(7) Satun
Number of Members	3.6e-02*	1.1e-02	2.4e-02	3.4e-02	7.1e-02	1.1e-02	5.3e-02
	(1.6e-02)	(3.6e-02)	(3.6e-02)	(6.6e-02)	(4.2e-02)	(3.4e-02)	(4.8e-02)
Hhd Head Age	-3.4e-03	-5.2e-03	6.7e-04	-3.7e-02*	-9.4e-03	2.3e-03	-2.1e-02
	(3.5e-03)	(6.6e-03)	(6.9e-03)	(1.7e-02)	(9.8e-03)	(6.9e-03)	(1.1e-02)
Hhd Head School	-1.9e-02	1.3e-03	-4.0e-03	-9.7e-02**	-5.1e-03	-5.3e-02	-5.5e-02
	(1.4e-02)	(2.5e-02)	(3.7e-02)	(3.6e-02)	(3.1e-02)	(3.2e-02)	(3.7e-02)
Farmer	-2.6e-02	-7.3e-03	-1.2e-01	1.3e-01	1.7e-02	8.1e-02	-2.8e-01
	(6.0e-02)	(1.0e-01)	(1.4e-01)	(1.4e-01)	(1.3e-01)	(1.6e-01)	(1.8e-01)
Flood	1.6e-01	-8.9e-02	2.1e-01	7.3e-02	-2.7e-01	2.8e-01	
	(1.4e-01)	(2.9e-01)	(2.3e-01)	(5.9e-01)	(6.1e-01)	(2.3e-01)	
Drought	-1.1e-01	-2.5e-01*	-1.9e-01	1.3e-01	-7.1e-02	8.7e-02	-5.6e-01
	(7.3e-02)	(1.2e-01)	(1.4e-01)	(4.4e-01)	(2.0e-01)	(1.4e-01)	(6.4e-01)
Low Yield	3.0e-03	-9.2e-02	-1.2e-01	-1.8e-03	-2.6e-01	3.9e-01	2.6e-01
	(8.5e-02)	(1.6e-01)	(2.2e-01)	(2.8e-01)	(1.5e-01)	(2.3e-01)	(1.7e-01)
Health/Death	2.4e-02	-1.7e-01	2.6e-01	3.6e-01	-1.8e-01	8.0e-01	-3.0e-01
	(1.4e-01)	(2.3e-01)	(3.3e-01)	(3.2e-01)	(2.8e-01)	(5.1e-01)	(3.3e-01)
Constant	2.2e+00***	2.1e+00***	2.4e+00***	3.6e+00**	2.3e+00***	2.4e+00***	2.4e+00**
	(2.6e-01)	(5.2e-01)	(5.3e-01)	(1.2e+00)	(6.1e-01)	(5.5e-01)	(8.7e-01)
N	12053	2583	2614	693	2596	2622	830
R^2	0.0011	0.0019	0.0026	0.0142	0.0027	0.0065	0.0164
r2_a	3.9e-04	-1.2e-03	-4.9e-04	2.6e-03	-4.1e-04	3.4e-03	8.0e-03

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 8: Fixed Effects on Female Migrants in t+1

	(1) All	(2) Lopburi	(3) Buriram	(4) Phrae	(5) Chachoengsao	(6) Sisaket	(7) Satun
Number of Members	1.2e-02	2.9e-02	-6.2e-03	-4.9e-03	4.5e-02	-2.9e-02	5.7e-02*
	(1.0e-02)	(2.3e-02)	(2.0e-02)	(4.0e-02)	(2.4e-02)	(2.2e-02)	(2.6e-02)
Hhd Head Age	8.8e-04	-3.1e-03	7.3e-04	-2.1e-02	-6.9e-03	-1.1e-03	-1.1e-02
	(2.1e-03)	(5.1e-03)	(4.2e-03)	(1.1e-02)	(5.7e-03)	(4.1e-03)	(6.3e-03)
Hhd Head School	-1.3e-02	1.5e-02	6.2e-03	-7.3e-02**	5.8e-03	-4.1e-02*	-1.5e-02
	(8.3e-03)	(2.1e-02)	(2.1e-02)	(2.4e-02)	(1.9e-02)	(1.8e-02)	(2.2e-02)
Farmer	-3.9e-02	6.6e-02	-5.5e-02	4.6e-02	-8.9e-03	1.1e-01	-2.2e-01
	(3.5e-02)	(6.9e-02)	(8.2e-02)	(1.0e-01)	(7.4e-02)	(9.8e-02)	(1.2e-01)
Flood	9.3e-02	5.7e-02	3.6e-02	2.0e-01	1.3e-01	4.0e-02	
	(9.1e-02)	(2.0e-01)	(1.2e-01)	(6.5e-01)	(4.4e-01)	(1.5e-01)	
Drought	7.7e-03	-2.0e-01*	-7.9e-02	-6.4e-02	-8.3e-02	-5.3e-03	-2.8e-01
	(4.2e-02)	(8.6e-02)	(7.8e-02)	(2.1e-01)	(1.2e-01)	(8.2e-02)	(3.8e-01)
Low Yield	-3.4e-02	-8.9e-03	-7.6e-02	1.0e-01	-8.4e-02	2.9e-01*	2.7e-01*
	(4.7e-02)	(1.2e-01)	(1.3e-01)	(9.4e-02)	(1.0e-01)	(1.4e-01)	(1.2e-01)
Health/Death	7.3e-02	-1.5e-01	1.3e-01	-1.1e-01	-9.3e-02	2.2e-01	-1.7e-01
	(8.1e-02)	(1.3e-01)	(1.9e-01)	(2.7e-01)	(1.5e-01)	(2.7e-01)	(2.1e-01)
Constant	9.4e-01***	8.6e-01*	1.2e+00***	2.2e+00**	1.2e+00***	1.6e+00***	9.9e-01
	(1.5e-01)	(4.0e-01)	(3.2e-01)	(8.0e-01)	(3.6e-01)	(3.1e-01)	(5.1e-01)
N	12053	2583	2614	693	2596	2622	830
R^2	0.0012	0.0038	0.0012	0.0113	0.0023	0.0054	0.0236
r2_a	5.0e-04	7.2e-04	-1.8e-03	-3.1e-04	-7.5e-04	2.4e-03	1.5e-02

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 9: Fixed Effects on Male Migrants in t+1

	(1) All	(2) Lopburi	(3) Buriram	(4) Phrae	(5) Chachoengsao	(6) Sisaket	(7) Satun
Number of Members	1.5e-02	-2.3e-02	4.7e-03	9.8e-03	3.0e-02	2.5e-02	-2.4e-03
	(9.9e-03)	(2.3e-02)	(2.1e-02)	(4.2e-02)	(2.4e-02)	(2.0e-02)	(3.0e-02)
Hhd Head Age	-3.5e-03	-1.8e-03	2.4e-03	-2.4e-02*	-3.6e-03	5.7e-03	-1.0e-02
	(2.1e-03)	(3.7e-03)	(4.1e-03)	(1.1e-02)	(5.2e-03)	(4.2e-03)	(6.1e-03)
Hhd Head School	-4.8e-03	-9.9e-03	-1.7e-02	-3.7e-02*	-1.1e-02	-8.4e-03	-3.8e-02
	(8.8e-03)	(1.4e-02)	(2.1e-02)	(1.7e-02)	(1.5e-02)	(2.2e-02)	(2.0e-02)
Farmer	2.8e-03	-7.6e-02	-9.3e-02	6.4e-02	2.4e-02	-1.7e-02	-1.1e-01
	(3.7e-02)	(6.2e-02)	(8.4e-02)	(8.7e-02)	(7.1e-02)	(9.6e-02)	(9.5e-02)
Flood	4.4e-02	-1.4e-01	2.1e-01	-4.0e-01**	-4.7e-01	1.4e-01	
	(8.2e-02)	(1.7e-01)	(1.5e-01)	(1.4e-01)	(2.6e-01)	(1.4e-01)	
Drought	-8.6e-02*	-2.7e-02	-4.2e-02	2.3e-01	4.1e-03	1.0e-01	-2.2e-01
	(4.3e-02)	(6.3e-02)	(8.2e-02)	(2.8e-01)	(1.1e-01)	(8.5e-02)	(2.8e-01)
Low Yield	5.5e-02	-8.9e-02	1.5e-02	4.0e-02	-1.8e-01*	7.9e-02	6.6e-02
	(5.4e-02)	(9.9e-02)	(1.2e-01)	(2.3e-01)	(8.0e-02)	(1.3e-01)	(8.6e-02)
Health/Death	-4.1e-02	2.2e-03	1.8e-01	4.4e-01	-8.9e-02	4.1e-01	3.7e-04
	(7.8e-02)	(1.3e-01)	(2.0e-01)	(2.3e-01)	(1.5e-01)	(3.5e-01)	(1.5e-01)
Constant	1.2e+00***	1.2e+00***	1.2e+00***	2.0e+00**	1.1e+00***	6.9e-01*	1.3e+00**
	(1.6e-01)	(3.0e-01)	(3.1e-01)	(7.5e-01)	(3.1e-01)	(3.3e-01)	(4.5e-01)
N	12053	2583	2614	693	2596	2622	830
R^2	0.0009	0.0022	0.0031	0.0206	0.0036	0.0062	0.0109
r2_a	2.4e-04	-9.4e-04	6.1e-05	9.1e-03	4.7e-04	3.2e-03	2.5e-03

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6.2 Fixed Effects with Savings Interaction

As in the previous section, I consider the simplest case with the interaction and then break the results down further. All of the results given in Tables 10, 11, and 12 show marginal effects of shocks on migration for households with and without savings rather than the raw coefficients. In these tables, the top four rows give the marginal effects of environmental shocks on migration for households that do not have savings. Then rows six through nine give the marginal effects of shocks on migration in the case of households that do have savings.

In Table 10, the first column gives the results when all of the provinces are pooled together for all migrants. As before, there is no significant relationship between environmental shocks and migration in this regression. The next six columns give the results of the same regression, but all of the provinces are separated. Again, there is little to no significant relationship between environmental shocks and household decisions to migrate. However, when male and female migrants are separated, I observe differing impacts of environmental shocks on migration.

Table 11 reports the impacts of environmental shocks in year t on male migrants in year $t+1$ for households with and without savings. When all provinces are pooled together, the results indicate that where there is significance, namely in the cases of drought and ill health or death in the household, households that have savings and experience a shock to their income will reduce the number of migrants. This regression also shows that households that do not have savings and experience a shock will send migrants away. Breaking down the regression by province shows where households are making these migration decisions as well as under what circumstances they are making these decisions. When the regression is broken down by province the results are similar in that, where there is a significant relationship, the household that experiences a shock and has a savings will have migrants come home while households that experience a shock but do not have a savings will send migrants away. The

only exceptions in this set of results are when the household experiences a flood in Lopburi and Phrae with no savings. In this case, the households will have migrants come home.

Table 12 gives the results for female migrants when the household experiences a shock interacted with the savings dummy. When all of the provinces are pooled together as one in the first column the results indicate that there is no migration response to flood or low yield, but in the case of drought, households that experience a shock to their income and do not have a savings account will send migrants away. Households that experience a shock to their income and have a savings account will have the migrants come home. This is similar in the case of ill health/death. When the regression is run by province, the results are similar to those of the pooled provinces in Sisaket and Buriram. Similar to the case of male migrants, when a household does not experience a shock and has a savings account then they will send migrants away.

When comparing Tables 11 and 12, a pattern emerges. When the household experiences drought, it will both have a migrant come home or send migrants away depending on if it has savings or not. Generally there is no relationship between either flood, low crop yield, or drought and migration. There is a somewhat similar relationship to drought in the case of health/death. Based on the gender of the migrant, this pattern appears in different provinces. In other words, this pattern occurs in Chachoengsao and Sisaket for male migrants while, for female migrants the pattern occurs in Buriram. The pattern also appears in Sisaket for female migrants, but only in the case of drought.

Table 10: Savings Household FE with Both lags and All Migrants

	(1) All	(2) Chachoengsao	(3) Lopburi	(4) Buriram	(5) Sisaket	(6) Satun	(7) Phrae
Flood	0.526	-0.0270	-0.658	0.584	1.409		0.314
	(0.488)	(1.582)	(0.453)	(0.687)	(1.150)		(0.669)
Drought	0.0581	0.601	-0.246	0.0225	0.249	-0.381	0.167
	(0.129)	(0.454)	(0.198)	(0.278)	(0.237)	(0.526)	(0.417)
Low Crop Yield	-0.175	-0.687	0.0183	-0.487	0.0417	-0.620	1.257
	(0.244)	(0.483)	(0.436)	(0.556)	(0.434)	(0.811)	(1.063)
Health/ Death	0.297	0.302	-0.0324	0.470	0.795	-0.441	0.00554
	(0.171)	(0.327)	(0.482)	(0.364)	(0.409)	(0.430)	(0.405)
Savings	-0.0512	0.146	-0.0922	0.00384	-0.0885	-0.355	-0.292*
	(0.0671)	(0.146)	(0.127)	(0.165)	(0.159)	(0.275)	(0.139)
Save*Flood	-0.348	-0.235	0.566	-0.331	-1.238		
	(0.501)	(1.701)	(0.538)	(0.706)	(1.163)		
Save*Drought	-0.155	-0.614	-0.0208	-0.229	-0.190		
	(0.140)	(0.486)	(0.212)	(0.289)	(0.276)		
Save*Low Yield	0.196	0.362	-0.0814	0.685	1.005	0.283	-0.721
	(0.282)	(0.582)	(0.482)	(0.675)	(0.824)	(0.853)	(1.103)
Save*Health/ Death	-0.303	-0.570	-0.0564	-0.644	-0.482	0.734	0.247
	(0.187)	(0.365)	(0.494)	(0.416)	(0.429)	(0.477)	(0.413)
N	17695	3865	4018	3923	3898	978	887

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 11: Savings Household FE with Both lags and Male Migrants

	(1) All	(2) Chachoengsao	(3) Lopburi	(4) Buriram	(5) Sisaket	(6) Satun	(7) Phrae
Flood	0.541	0.637	-0.550**	0.775	0.691		-0.248*
	(0.291)	(0.887)	(0.195)	(0.446)	(0.580)		(0.120)
Drought	0.344***	0.726*	0.184	0.299	0.514***	-0.170	0.302
	(0.0808)	(0.301)	(0.112)	(0.174)	(0.150)	(0.210)	(0.257)
Low Crop Yield	0.335*	-0.165	0.588	0.188	0.629**	-0.558	0.538
	(0.155)	(0.211)	(0.310)	(0.287)	(0.239)	(0.356)	(0.982)
Health/ Death	0.424***	0.507**	0.328	0.301	0.959***	-0.212	-0.187
	(0.0952)	(0.184)	(0.278)	(0.194)	(0.250)	(0.215)	(0.321)
Savings	0.0716	0.194*	0.0495	0.0639	0.113	-0.197	-0.123
	(0.0376)	(0.0772)	(0.0633)	(0.102)	(0.0945)	(0.147)	(0.0910)
Save*Flood	-0.429	-1.092	0.456	-0.558	-0.604		
	(0.294)	(0.922)	(0.256)	(0.445)	(0.595)		
Save*Drought	-0.321***	-0.713*	-0.229	-0.365*	-0.390*		
	(0.0890)	(0.329)	(0.122)	(0.185)	(0.174)		
Save*Low Yield	-0.287	0.0475	-0.553	-0.133	-0.179	0.469	0.0583
	(0.170)	(0.261)	(0.313)	(0.364)	(0.493)	(0.372)	(1.024)
Save*Health Death	-0.468***	-0.710***	-0.431	-0.282	-0.899**	0.275	0.345
	(0.105)	(0.202)	(0.287)	(0.226)	(0.279)	(0.245)	(0.403)
N	17931	3918	4080	3980	3962	978	887

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 12: Savings Household FE with Both lags and Female Migrants

	(1) All	(2) Chachoengsao	(3) Lopburi	(4) Buriram	(5) Sisaket	(6) Satun	(7) Phrae
Flood	0.505	0.631	0.0667	0.372	1.370*		0.336
	(0.291)	(0.540)	(0.444)	(0.374)	(0.683)		(0.683)
Drought	0.307***	0.436	0.109	0.323*	0.466***	-0.151	-0.0835
	(0.0786)	(0.257)	(0.137)	(0.163)	(0.140)	(0.329)	(0.216)
Low Crop Yield	0.0482	0.162	-0.157	-0.162	0.294	-0.0730	0.211
	(0.128)	(0.298)	(0.194)	(0.302)	(0.307)	(0.480)	(0.291)
Health/ Death	0.445***	0.338	0.259	0.821***	0.459	-0.251	0.234
	(0.109)	(0.203)	(0.271)	(0.224)	(0.282)	(0.283)	(0.333)
Savings	0.131**	0.197*	0.0820	0.257**	0.126	-0.171	-0.127
	(0.0406)	(0.0907)	(0.0798)	(0.0923)	(0.0941)	(0.154)	(0.0968)
Save*Flood	-0.445	-0.483	-0.0512	-0.285	-1.417*		
	(0.302)	(0.694)	(0.490)	(0.394)	(0.691)		
Save*Drought	-0.381***	-0.498	-0.281	-0.426*	-0.484**		
	(0.0850)	(0.278)	(0.151)	(0.170)	(0.159)		
Save* Low Yield	-0.0504	-0.302	0.119	0.327	0.0676	-0.0510	-0.270
	(0.157)	(0.345)	(0.249)	(0.391)	(0.487)	(0.513)	(0.385)
Save*Health/ Death	-0.374**	-0.403	-0.239	-0.952***	-0.163	0.557	-0.0359
	(0.119)	(0.232)	(0.284)	(0.249)	(0.292)	(0.315)	(0.325)
N	17931	3918	4080	3980	3962	978	887

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6.3 Fixed Effects with Loan Interaction

The loan dummy variable was then interacted with the shock categorical variable in order to get a better idea of the differences in decisions made by households that have loans and households that do not have loans. Again, all of the results listed in the following tables are of the marginal effects of shocks on migration for households with and without loans. According to Table 15, when all of the migrants are pooled together and the provinces are pooled, there is no relationship. When the provinces are separated, there is mainly no relationship between environmental shocks and migration. But where there is a relationship, the results indicate that households that experience a shock to their income and do not have a loan will choose to have migrants come home, while households that experience a shock to their income and have a loan will send migrants away. Notice that for particular shocks, low crop yield in Lopburi and Buriram and drought in Sisaket, the results will switch signs depending on whether or not the household has a loan. Again, the results are more revealing of household decisions when the regressions are separated by gender.

Table 14 gives the results for the impact of environmental disasters interacted with loans on male migration. The first column shows that when the provinces are pooled together, there is no relationship between environmental shocks and male migrants. When the models become more detailed by breaking them up into provinces we find that if there is any relationship, households will have a migrant come home when they experience an environmental shock and do not have a loan. Conversely, households will send migrants away when they experience a shock to their income and have a loan. This relationship is in the case of low crop yield in Lopburi and Buriram. There is also some evidence of a similar relationship between drought and migration.

Female migrants yield similar results to male migrants with the loan interaction. This means that in the cases when the household experiences a shock to their income and does not have a loan, they are going to have migrants come home while when the household does

have a loan and experiences a shock, they will send migrants away. The exception in this case is households in Lopburi that experience a flood. In this instance the households will send migrants out when they do not have a loan and have migrants come home when they do have a loan. Again, there is no relationship between households that did not experience a shock to their income and have a loan and their decisions as to whether to bring migrants home or send them out.

In the case of loans, as opposed to savings, the results switch signs for low crop yield in the case of both male and female migrants. That is to say, when households with a loan experience an environmental shock, they will increase the number of migrants, while households without loans that experience shocks will reduce the number of migrants. This relationship occurs in Lopburi when households experience low crop yield for both male and female migrants and in Buriram when households experience low crop yield for just male migrants. For female migrants only, there is a sign switch for two provinces in the case of flood. These provinces are Lopburi and Sisaket. But, in the case of Lopburi, households will increase the number of migrants when they experience a flood and do not have a loan, while households with loans that experience flooding with reduce the number of migrants.

Table 13: Loan Household FE with Both lags and All Migrants

	(1) All	(2) Chachoengsao	(3) Lopburi	(4) Buriram	(5) Sisaket	(6) Satun	(7) Phrae
Flood	0.154	-0.129	1.003	0.448	-0.513		-0.101
	(0.436)	(1.440)	(0.973)	(0.852)	(0.516)		(0.392)
Drought	-0.284	-0.0595	-0.0169	-0.184	-0.661*	-0.561***	0.139
	(0.171)	(0.392)	(0.405)	(0.338)	(0.313)	(0.132)	(0.113)
Low crop Yield	-0.278	0.335	-1.480***	-1.356***	1.132	-0.509	0.347
	(0.374)	(0.996)	(0.316)	(0.252)	(1.124)	(0.347)	(0.547)
Health/ Death	-0.0753	-0.530	-0.297	0.762	0.0462	0.320	-0.529
	(0.173)	(0.295)	(0.439)	(0.614)	(0.462)	(0.321)	(0.368)
Loan	0.0492	-0.00162	0.0930	0.223	-0.0744	0.115	-0.0110
	(0.0633)	(0.132)	(0.137)	(0.209)	(0.146)	(0.163)	(0.127)
Loan*Flood	0.0200	-0.239	-1.243	-0.230	0.838		0.519
	(0.450)	(1.617)	(1.003)	(0.859)	(0.574)		(0.891)
Loan*Drought	0.190	-0.0375	-0.305	-0.0209	0.874**	0.195	-0.0511
	(0.184)	(0.436)	(0.426)	(0.363)	(0.337)	(0.662)	(0.546)
Loan*Low Yield	0.341	-0.840	1.595***	1.700***	-0.138	-0.167	0.212
	(0.419)	(1.087)	(0.430)	(0.457)	(1.380)	(0.618)	(0.734)
Loan*Health/ Death	0.0437	0.340	0.199	-1.090	0.339	-0.189	0.657
	(0.197)	(0.323)	(0.486)	(0.691)	(0.513)	(0.419)	(0.483)
N	11167	2427	2316	2414	2445	806	650

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 14: Loan Household FE with Both lags and Male Migrants

	(1) All	(2) Chachoengsao	(3) Lopburi	(4) Buriram	(5) Sisaket	(6) Satun	(7) Phrae
Flood	0.0675	-0.790	-0.267	0.280	0.231		-0.435*
	(0.262)	(0.646)	(0.410)	(0.530)	(0.388)		(0.206)
Drought	-0.100	-0.00810	0.119	-0.144	-0.250	-0.240**	0.581***
	(0.0920)	(0.204)	(0.220)	(0.177)	(0.173)	(0.0819)	(0.120)
Low Crop Yield	-0.0802	-0.0988	-0.607***	-0.931***	0.801	-0.0912	0.750
	(0.226)	(0.490)	(0.179)	(0.151)	(0.909)	(0.134)	(0.604)
Health/ Death	-0.107	-0.383**	-0.303	0.633	-0.162	0.152	-0.436
	(0.0871)	(0.132)	(0.172)	(0.324)	(0.298)	(0.162)	(0.314)
Loan	0.0448	0.0198	0.0528	0.142	-0.00761	0.110	-0.0133
	(0.0348)	(0.0733)	(0.0718)	(0.116)	(0.0818)	(0.0831)	(0.0688)
Loan*Flood	0.0312	0.351	0.224	-0.0917	-0.129		0.300
	(0.276)	(0.706)	(0.446)	(0.543)	(0.422)		(0.234)
Loan*Drought	0.110	-0.0100	-0.207	0.102	0.407*	0.0381	-0.482
	(0.102)	(0.232)	(0.234)	(0.193)	(0.198)	(0.296)	(0.365)
Loan*Low Yield	0.152	-0.0692	0.740**	1.090***	-0.616	-0.147	-0.309
	(0.248)	(0.523)	(0.265)	(0.276)	(1.012)	(0.258)	(0.663)
Loan*Health/ Death	0.0532	0.237	0.206	-0.703	0.222	-0.208	0.631
	(0.103)	(0.165)	(0.189)	(0.368)	(0.328)	(0.215)	(0.410)
N	11167	2427	2316	2414	2445	806	650

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 15: Loan Household FE with Both lags and Female Migrants

	(1) All	(2) Chachoengsao	(3) Lopburi	(4) Buriram	(5) Sisaket	(6) Satun	(7) Phrae
Flood	0.167	0.778	1.330*	0.290	-0.597*		-0.434
	(0.259)	(0.796)	(0.606)	(0.449)	(0.272)		(0.253)
Drought	-0.151	-0.0630	-0.159	0.112	-0.421*	-0.246**	-0.268***
	(0.108)	(0.224)	(0.240)	(0.229)	(0.203)	(0.0911)	(0.0749)
Low Crop Yield	-0.183	0.388	-0.828***	-0.179	0.133	-0.229	-0.411*
	(0.182)	(0.513)	(0.211)	(0.152)	(0.316)	(0.262)	(0.188)
Health/ Death	0.0593	-0.230	0.0622	0.244	0.293	0.280	-0.0327
	(0.113)	(0.192)	(0.335)	(0.376)	(0.285)	(0.204)	(0.0869)
Loan	0.0211	-0.0233	0.0523	0.146	-0.0641	0.0486	0.0407
	(0.0391)	(0.0821)	(0.0857)	(0.121)	(0.0926)	(0.0969)	(0.0778)
Loan*Flood	-0.143	-0.808	-1.536*	-0.245	0.667*		0.978
	(0.266)	(0.966)	(0.631)	(0.452)	(0.313)		(0.799)
Loan*Drought	0.0673	-0.0400	-0.0628	-0.226	0.481*	0.121	0.248
	(0.116)	(0.260)	(0.253)	(0.240)	(0.221)	(0.391)	(0.267)
Loan*Low Yield	0.175	-0.715	0.839**	0.395	0.456	-0.138	0.436
	(0.213)	(0.580)	(0.259)	(0.278)	(0.618)	(0.396)	(0.426)
Loan*Health/ Death	-0.0214	0.205	-0.0867	-0.456	0.00530	-0.0397	0.130
	(0.125)	(0.204)	(0.374)	(0.413)	(0.305)	(0.253)	(0.149)
N	11167	2427	2316	2414	2445	806	650

se in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

6.4 Key Findings

Overall, the relationship between environmental shocks and migration is mixed. Findings indicate that sometimes the relationship is positive, sometimes it is negative, and sometimes there is no relationship at all. When households are separated into either having or not having savings or loans, there is a bit of a clearer relationship. When there are results, we generally find that households with savings that experience a shock will reduce the number of migrants, while households without savings that experience a shock will increase the number of migrants. In the case of loans, when there is a relationship, households that have loans and experience a shock will increase the number of migrants, while households that do not have loans and experience a shock will reduce the number of migrants.

Breaking the results up further, in the case of both savings and loans, when male and female migrants are separated, the relationship between environmental shocks and migration does not change considerably. Differences might arise in terms of where households that are making migration decisions are located, but, overall, the direction of this relationship stays the same between male and female migrants. The provinces that these relationships are observed in are Buriram, Sisaket, Chachoengsao, and Lopburi. Those that appear to have this relationship the most are Buriram and Sisaket as they both have a relationship between environmental shocks and migration in the case of savings and loans. When individual shocks are considered, we find that, in the case of savings, this relationship is between either drought or heath/death and migration decisions. In the case of loans, households will make migration decisions when they experience low crop yield most often.

Another key finding is the magnitude of the relationship between environmental shocks and migration. In order to better understand these results, I calculated the predicted number of migrants for households with and without savings who had and had not experienced an environmental shock. From these results, the predicted number of migrants for households with no savings that experience the shocks of either drought or health/death, relative to

those who do not experience these shocks, will generally increase by .2 to .5 in Buriram and Sisaket. That is, for every ten households that do not have savings and experience a shock, two to three households are predicted to send out a migrant than if these households had not experienced the shock in the first place. The key finding in this relationship is that households are increasing the number of migrants by about the same magnitude when they experience either drought or the poor health or death of a household member. When loans are considered, it is a similar case. Households that experience low crop yield and that do not have loans will reduce the number of migrants by .2 to .6 on average. That is, the predicted number of migrants for households without loans who experience a shock ranges from 0.2 to 0.8 while the predicted number of migrants for households without loans that do not experience a shock ranges from 0.8 to 1 in Lopburi and Buriram. In the case of both loans and savings, the number of male versus female migrants does not vary greatly.

7 Discussion

It is well understood that shocks to household income have negative outcomes for the households. Sometimes, households are able to prepare for increased risk by buying insurance or accumulating assets to sell after the shock has occurred. Oftentimes in less industrialized countries, households do not have access to insurance, causing them to cope in a multitude of different ways. All methods of dealing with shocks have some cost associated with them. This cost could come in the form of adversely affecting human capital, the loss of assets, or the movement of family members. Because of this it is important to understand the circumstances that cause households to send migrants away and those that cause migrants to come home. Having a better understanding of what causes households to make migration decisions, or use any other coping mechanisms, will allow policy makers and NGO's to take actions that reduce the costs associated with household decisions when they experience a shock.

Exploring how different households make decisions about migration has proven to be a worthwhile exercise. My results suggest that for the overall results there is no clear, general relationship between shocks and migration for this sample. But there are some relationships in different places in response to different shocks and for different types of households.

While, for the most part, my results suggest that there is no relationship between environmental shocks and migration, in the cases where there is a relationship, it implies that households will be less likely to send migrants away when they have more alternative coping mechanisms. Where there is a relationship with respect to savings and loans, in some instances, households in different provinces in Thailand will send migrants of either gender away when they do not have access to savings or if they have loans and an environmental shock occurs. Conversely, households will have migrants come home in response to a shock when they do have access to savings or they do not have loans. From this, it can be inferred

that migration is used as a coping mechanism for households that have less access to assets. The fact that households with savings accounts or that do not have loans are reducing the number of migrants in order to deal with a shock to their income suggests that households would prefer to use alternative methods from migration when faced with an environmental shock. Recall from the literature review that researchers find migration can be used as a way to diversify income. Yet, the literature is not enough to adequately explain why it is that households with savings would have migrants come home after a shock. It is possible that households with savings might have a different flow of remittances than households without savings. That is to say, households with savings may either send or receive more money to the migrant than households without savings. I investigated this possibility by conducting a set of ttests at the means of money sent to the migrant and money received from the migrant between households with and without savings. These tests were broken down by province and year. All tests showed no significant difference in the remittance flow of household with savings and households without savings. So the question of why households with savings would have migrants come home remains unanswered.

Recall from the results section that the main findings showed the major shocks associated with this relationship are drought, health problems or death and low crop yield. It is important to understand why households would make these decisions based on the type of shock that they experience. A households response to drought could possibly be explained by the fact that drought is typically a long-term shock that households have to cope with over that course of time. The nature of the shock then causes households with fewer assets to have to diversify their income with migration. The important thing to understand about the relationship between health/death and household migration decisions for households that do or do not have savings is that households that experience the idiosyncratic shock of health/death act in the same way as households that experience the covariate shock of drought.

Finally, recall that low crop yield was mostly related to households that did or did not have loans. It is possible that the relationship between loans and migration exists because households with loans are investing in agricultural improvements or capital. If what they are investing in suddenly stops generating income, then the households will have to find other means in order to cope with this shock because of their reduction in assets. It is not always the case, though, that households will take out loans to invest in agriculture. Households could also take out loans for a multitude of reasons such as weddings, funerals, consumer goods, to invest in a different type of business, etc. It is still the case that these households would need to pay back these loans, even in the event of an environmental shock. This would suggest that households with loans who send migrants away are very poor.

The locations of these household decisions can also be explained. Remember from the discussion of the study area that Sisaket and Buriram are both the poorest provinces out of the selection of provinces. This implies that households in these provinces might have fewer resources available to help them cope with shocks. As a result these households must then resort to migration in order to diversify their income when they do not have as many assets as other households. The fact that this is happening in Chachoengsao is a little more perplexing seeing as the province is one of the richest provinces in the sample. It also has a fairly high amount of rice production relative to the other provinces. It is still unclear to me as to why households in Chachoengsao are making migration decisions. Regardless, rural households in Chachoengsao are making similar decisions to those in Sisaket and Buriram. Lopburi, despite its fairly high GDP per capita, it is the case that it is also mostly driven by farming in the province. This may cause farming households to make migration decisions when they experience low crop yield.

Another consideration with the location of Buriram and Sisaket is that they, generally, are located in the same region, Northern Thailand, with the exception of Lopburi which is closer to central Thailand. From this, it is possible that all of these provinces are easier to

migrate out of or there is a location that is accessible to migrants when households with little assets need to cope with a shock. Recall from Table 2 and Table 3 that one of the top two locations for all of the provinces of concern is Bangkok in the case of both male and female migrants until 2005 when one of the top locations for all of the provinces is Chaiyaphum for both male and female migrants. It is possible that the social networks between these provinces are strong enough to provide many opportunities to households looking to make migration decisions causing their decision to send out migrants much easier.

8 Conclusion

This thesis has explored at the impacts of environmental shocks on migration decisions in rural Thailand. Household level data from the Townsend Thai project was used to estimate how households make decisions with respect to migration when they experience an environmental shock. Household fixed effects models with lags are used to estimate the results. The findings indicate that households do sometimes, although not always, use migration as a coping mechanism when they are confronted with environmental shocks. These decisions are apparent with the distinction between holding savings and not holding savings and having a loan versus not having a loan.

In the case of households that have savings or do not have a loan, some findings show that households with an alternate coping mechanism do not use migration to deal with the shock and, in fact, will often have migrants come home after the shock. This implies that the type of work that migrants do must be flexible enough to allow the household to easily have migrants come home when there is an emergency. When households do not have savings or do have a loan, they are more likely to use migration as a coping mechanism when faced with an environmental shock.

There are a number of other implications associated with these results. Because it is the case that households will use strategies other than migration when they have the opportunity to do so, it is important for policy makers to understand this. With respect to policy, these results imply that policy makers should take steps to set up households for the opportunity to use other coping mechanisms when they experience environmental shocks. The fact that some of these patterns are associated with poorer provinces like Buriram and Sisaket shows the possibility that households in these provinces have fewer alternatives that they might prefer over choosing to send migrants out. Another implication from my research is the fact that households with low crop yield and loans will send migrants out when they experience an

environmental shock. As stated, it is possible that this is happening because the households with loans are investing in agriculture. If this is the case then it implies that households in Lopburi and Buriram are not diversifying their income in order to decrease the risk of losing more assets. The fact that they are not adequately prepared for shocks implies that they might need to use very costly coping mechanisms such as asset smoothing or consumption smoothing when they experience shocks. Finally, the fact that pooled households showed no relationship between environmental shocks and migration, while breaking the types of households down into households in different economic circumstances implied that it is the case that the relationship between environmental shocks and migration actually does differ among different households.

With respect to research, this thesis only explored savings and loans, but its findings are similar to existing literature. The similarities between this thesis and previous studies are that households will make different migration decisions based on the type of environmental shock and the location of the household. The contribution of this thesis is that it has shown that households in different economic circumstances will also make different migration decisions when faced with an environmental shock. It is crucial that we continue to understand the differences between households and how that will affect their decision to use migration in the wake of an environmental shock. For example, it is also important to know if households would select other mechanisms like consumption smoothing, asset smoothing, or insurance, over migration if they were given the opportunity. It is imperative that we continue to answer question associated with the relationship between environmental shocks and migration in order to better understand how households cope with shocks.

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