Remittances, Consumption Insurance and Family Labour Supply

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Abstract

This thesis presents three substantive chapters on the economics of households. The objectives are to quantitatively examine if remittances are a source of insurance for recipient households, and to explore how remittance income alters family time allocation between market and home production activities. The first substantive chapter presents stylized facts on the properties and distribution of remittance flows to developing economies. Here, I document the nature and increasing share of remittances relative to other forms of international capital flows to developing countries. This chapter also studies the dynamics of household earnings, consumption and income from home production using monthly household-level panel data from the Townsend Thai survey.

The second substantive chapter examines remittances as a source of insurance for recipient households. I specify a fairly standard model that incorporates households' labour supply and consumption decisions, and derived analytical expressions for consumption and earnings as a function of wage and remittance income shocks. These expressions are empirically estimated to explore whether the presence of remittances alters the degree of household consumption smoothing. Our model predicts that households have higher access to smooth consumption against transitory wage shocks than against permanent shocks. In particular, I find that 72% of family consumption smoothing is explain by households' self-insurance behaviour through asset accumulation. On the other hand, remittances only explain 11% of consumption smoothing against wage shocks. Interestingly, households with low educational attainment rely more on remittances as a source of insurance while those with higher education levels have higher access to smooth consumption via asset accumulation.

The final chapter builds on the model developed in the previous chapter to examine the effect of remittances on households' time allocation between market and home production activities. This model was modified by giving households the opportunity to involve in home production, either for home consumption or for the market. The derived expressions are also estimated using data from the Townsend Thai survey to examine whether the presence of remittances affects family time allocation. By decomposing the response of labour hours to wage and remittance shocks, I find no support that increased remittance income leads to lower labour effort among Thai households. On the contrary, increased remittance income induces Thai households to reallocate labour hours from market to home production activities.

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Chapter 1

Introduction

Over the past two decades, there has been growing interest to understand the nature, size and importance of remittances in developing countries. This interest has been coming from different fronts, including in terms of research papers, newspaper articles, conferences, and institutions trying to understand the role remittances can play towards alleviating poverty, boosting shared prosperity and building the resilient of those living in extreme poverty. This growing interest is partly motivated by the need for development practitioners, policy-makers and other stakeholders to understand how remittances can be leveraged on to achieve the United Nations' Sustainable Development Goals (SDGs).[1]

Many households in developing economies rely on informal insurance arrangements between individuals and communities rather than on publicly managed programs or market-provided insurance schemes [Morduch, 1999]. In an incomplete-markets world where people have little protection against income and employment shocks, remittance income serves as a potential source of insurance for households in these economies. However, remittances are non-labour income. Thus, an increase in remittance income is likely to relax recipient households' budget constraints, increase their reservation wages and, through an "income effect" lower their employment likelihood. If these potential disincentives are not taken into consideration, remittances can distort work decisions which may negatively affect households' welfare at the margin. Nonetheless, remittances generally increase households' welfare when their flows and timing are carefully coordinated to minimize work disincentives, .

[1] Among the remittance-related SDG indicators include: *reducing remittance costs* (SDG indicator 10.c.1), and *increasing the volume of remittances as a percentage of Gross Domestic Product* (SDG indicator 17.3.2).

Against this backdrop, this dissertation presents three substantive chapters on the economics of households by quantitatively examining remittances as a source of insurance, and also investigates the effect of remittances on households' time allocation between market and home production activities. The first substantive chapter examines the flow of remittances to developing economies as well as the properties and distribution of these capital flows across developing regions. Here, I document the increasing share of remittances relative to other forms of international capital flows to developing countries. Despite increasing regulations to counter terrorist financing after the September 9/11 Terrorist Attacks in 2001 and recent anti-immigration rhetoric, global remittance flow has continued to grow steadily making it more stable and less pro-cyclical than private capital flows such as foreign direct investments (FDIs). The steady increase in remittance flows over the past two decades has made remittances, sent through formal channels, the second most important source of international capital flow to low- and middle-income countries. Total remittances to these economies is more than three times the size of official development assistance (ODA) and more than half of FDIs to these countries. By excluding China from this group, remittances become significantly larger than FDI to low- and middle-income countries. World Bank [2016] noted that remittances sent through informal channels could add at least 50% to the official estimate, making it the largest source of external capital in many developing countries. Although increased regulations after the September 9/11 Terrorist Attacks did not greatly affect the volume of global remittance flows, its volatility was at its peak between 2000 and 2004, seconded by higher volatility between 2005 and 2009. In the latter case, the high volatility can be explained by the 2008 Global Financial Crisis which directly affected economic conditions of migrants in Europe, North America and some parts of Asia. Interestingly, the 2008 financial crisis adversely affected both the volatility and volume of remittance flows to developing countries.

Given that remittance flows have been increasing to developing economies and households in these economies rely more on informal insurance arrangement between individuals and households [Morduch, 1999], remittances serve as a potential source of insurance for households in the face of adverse income and employment shocks. In the second substantive chapter, I examine if remittances are a source of insurance for recipient households using household-level panel data from the Townsend Thai survey. This is done by specifying a fairly standard life-cycle model that incorporates households' labour supply and consumption decisions. I derived analytical expressions for consumption and earnings as a function of wage and remittance income shocks,

and empirically estimated these expressions to examine whether the presence of remittance income alters the degree of household consumption smoothing. Three important findings are worth noting. First, full consumption insurance is soundly rejected for both transitory and permanent wage shocks. Whereas 83% of transitory wage shocks are insured, only 47% of permanent wage changes do not translate into consumption growth. Second, I find that 72% of household consumption smoothing is explain by households' self-insurance behaviour through asset accumulation whiles remittances explains only 11%. Finally, I find that households with lower educational attainment rely more on remittances as a source of consumption insurance while those with higher educational levels have higher access to smooth consumption via asset accumulation.

The final chapter builds on the model developed in the previous chapter to examine the effect of remittances on households' time allocation between market and home production activities. This model was modified by giving households the opportunity to involve in home production, either for home consumption or for the market. After deriving the dynamics of household consumption, home and market hours as a function of wage and remittance income shocks, I empirically estimate these expressions to examine if the presence of remittances affects households' time allocation. By decomposing the response of labour hours to wage and remittance income shocks, I find no support that increased remittance income leads to lower labour effort among Thai households. On the contrary, increased remittance income induces Thai households to reallocate labour hours from market to home production activities. This time reallocation effect is stronger among households with low educational attainment suggesting a positive wealth effect associated with permanent remittance income shocks on home production time. Moreover, I find that the negative effect of remittances on household market hours increases with age of household heads while its positive effect on home hours declines with age. Interestingly, the positive effect of remittances on home hours dies down when household heads are more than 40 years old signalling that it is households with young heads that actually increase home production time in response to higher remittance incomes. This has very important policy implications as it suggests that remittances provide young adults, who are usually the most innovative and entrepreneurial group, the opportunity to enhance home production activities. Given that young people are less likely to find formal sector employment, remittances strengthen their participation in development processes by helping them to increasingly participate in entrepreneurial home production activities.

Chapter 2

Remittance and Income Dynamics: what have we learnt?

2.1 Introduction

Remittances and migration flows have increased substantially over the past two decades. According to data from the World Bank, between 2000 and 2017, the number of people living outside their country of birth grew from 2.9% (175 million) to 3.5% (266 million people) of the world population. In 2015, global remittances was estimated at $601 billion out of which developing countries received $441 billion. This amount is more than three times the size of official development aid ($131.62 billion) and more than half of total foreign direct investment ($741 billion) to these developing countries in the same period [World Bank, 2016].[1] In smaller countries such as Tajikistan and the Gambia, where in 2015 remittances equivalent to 42% and 22% of GDP respectively, migrants' remittances provide a lifeline to the poor [World Bank, 2016].

Despite the nature, size and importance of remittances in developing countries, remittances remain to be one of the most, if not the most, poorly understood type of international financial flow. In the absence of a unified framework to evaluate the consumption and time-allocation impact of remittances, most studies focus on the effects of international transfers on household

[1]The authors argue that remittances sent through informal channels could add at least 50% to the official estimate making it the largest source of external capital in many developing countries. However, stricter immigration policies in many remittance-source countries presents long-term risks to the growth of remittances.

consumption and labour supply behaviors within the framework of standard static international trade and finance models. Nonetheless, remittance needs to be separated from other forms of international transfers for their uniqueness. As Rapoport and Docquier [2006] explained, access to credit and insurance are very crucial in developing countries that are often characterized by high levels of poverty, inequality and income volatility. Consequently, the marginal effects of a dollar of remittances on households' consumption and labour supply behaviour are likely to be greater than other forms of international transfers. This is because remittances go directly to households and they are sent by household members who know the direct needs of recipient household members. As a result, such "external" sources of income may contribute in (1) easing credit constraints, (2) insuring household consumption against adverse shocks, and (3) reducing poverty in developing countries.

This chapter is an introductory chapter for the subsequent two chapters on remittances as a source of consumption insurance and the effect of remittances on household time allocation. The objective is to document key stylised facts on (a) the flow of remittances to developing economies, (b) Thailand's macroeconomic environment and (c) the dynamics of Thai households' consumption, time use, earnings and income from home production conditional on their remittance income status. To achieve these, I divide the chapter into three parts. The first part documents the flow of remittances to developing countries and Thailand's macroeconomic conditions. I present stylised facts on Thailand's macroeconomic environment because this is the country I will be focusing on in the subsequent sections and chapters of this dissertation. Relative to other forms of international capital flows, I explore the macroeconomic trends, properties and distribution of remittance flows across developing regions. In the second part, I explore the dynamics of earnings, consumption, remittances and income from home production for Thai households using data from the Townsend Thai monthly survey. Finally, I examine the dynamics of household time allocation between market and home production activities, and its relation with remittances. Here, I examine the nexus between remittance and time allocation before presenting empirical evidences on the effect of business cycle variations on households' time allocation.

I document that the flow and share of remittances relative to other forms of international capital flows have been increasing making remittances the second most important source of international capital flow to developing countries. I also find that remittances are less volatile

and less pro-cyclical than other forms of international capital flows to developing countries. On the macroeconomic conditions of Thailand, I find that the 1997-98 Asian Financial Crisis led to a decline in employment rates, and increased remittance inflows reflecting the insurance motive of remittance flows. Average monthly earnings have also been increasing since 2002 for both male and female Thai workers while gender differential in monthly pay has been consistently declining since 2003. Using the "Gini index" as a measure of inequalities in the distribution of economic prosperity, I find that income is more concentrated in urban than in rural Thailand. Across regions, income inequality has sharply increased in Bangkok while consistently declining in the Central region. In the North, South and North-east regions, income inequalities sit relatively high.

Furthermore, I find that Thai households have significant access to consumption smoothing although the degree of consumption smoothing is relatively lower than the findings of Karaivanov and Townsend [2014] who used annual data from the Townsend Thai survey. On family time allocation, I find that Townsend Thai households spend more hours on home production activities than on market production regardless of their remittance income status or gender of household heads. Interestingly, home hours have been steadily increasing since 2004 for remittance-receiving households while their market hours decline. However, for non-remittance receiving households, home hours have remained relatively unchanged while market hours pick up steadily. In addition, I find that although the share of family (market) employment has declined (increased), market and home production hours have increased for all sex-skill groups during the last decade except for unskilled women who experienced decreasing market work. Over the business cycle, I notice that family business and livestock rearing hours decline while crop cultivation and fish & shrimp farming time increase when market work hours decline at business cycle frequencies. Thus, crop cultivation and fish & shrimp farming activities can be considered "substitutes" to market work in Thailand.

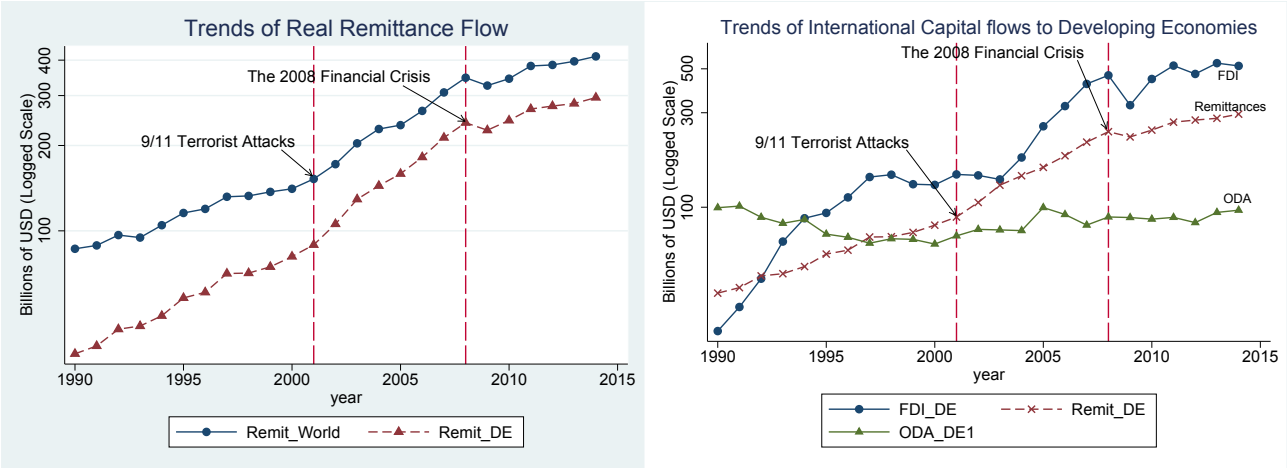
2.2 Remittance flows to Developing economies

This section examines the flow of remittances to developing countries. Here, I document the properties, distribution and increasing share of remittances relative to other forms of external capital flows to developing countries.

2.2.1 Trends of International Capital flows

Figure 2.1 shows the trends of remittances, official development assistance (ODA) and foreign direct investments (FDI) to developing economies. The panel on the left shows the increasing flow of global remittances which is closely accompanied by an increasing flow of remittances to developing economies. In the panel on the right, remittances become the second most important source of international capital flow to developing countries in 1997 when it overtook ODA to these economies. This increased remittance flows could reflect growth in diasporas as well as better measurement. Freund and Spatafora [2008] find empirical evidence that rising numbers of migrant stock is one of the main drivers of increasing remittance flows. Likewise, improvement in recording cross-country financial transactions is another important driver for the recorded increase in remittance flows. This is made possible through the creation of international standards on anti-money laundering and combating the financing of terrorism (AML/CFT) in the aftermath of the September 9/11 2001 terrorist attacks in the United States. Among the AML/CFT recommendations include licensing and registration of money transfer providers and improving record-keeping of international financial transactions. This is endorsed by almost all countries in the world. As a result, remittance transactions are increasingly reported for balance of payments purposes.

Figure 2.1: Trends of International Capital flows, 1990-2014



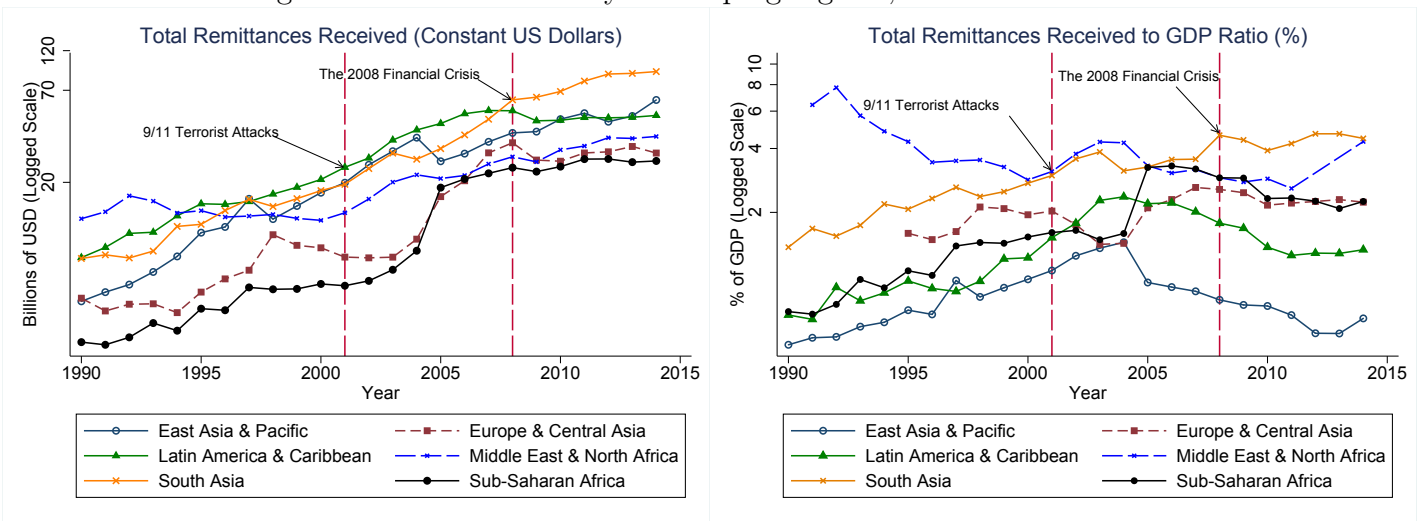
Source: Author's calculation based on private remittance (received), net official development assistance and official aid (received) and foreign direct investment (net inflows) data from the World Bank's World Development Indicator database. Data are converted from nominal US dollars to constant 2002 US dollars (in billions) using the US GDP deflator.

In addition, recorded remittance flows increases in the past decades due to shifts in sending methods, from informal to formal payment methods. There are two main explanations for this

shift. First, official remittance providers become more attractive to migrants because of lower cost of sending remittances due to higher competition especially with the emergence of Fintech operators in many developing countries. Second, crackdowns on informal remittance providers due to enforcement of AML/CFT regulations have led to reduction in informal remittance flows that do not show up in the Balance of Payments.

It is however important to stress out that the remittance estimates in figure 2.1 capture only those sent through formal channels.[2] In the face of increasing regulations to counter terrorism financing, growth of global remittance flows remained resilient in 2001. Nonetheless, the 2008 Global Financial Crisis negatively hits global remittance flows including those remitted to developing countries since this directly affected the economic conditions of migrants in Europe, North America and some parts of Asia. Across regions, this growth in remittance flows to developing countries is mainly driven by higher remittance flows to countries in South Asia, East Asia & Pacific, and Latin America & Caribbean. Figure 2.2 illustrates the increasing trends and distribution of remittance flows across developing regions.

Figure 2.2: Remittances by Developing regions, 1990-2014



Source: Author's calculation based on data from the World Development Indicator (WDI) database. Data are converted from nominal US dollars to constant 2002 US dollars (in billions) using the US GDP deflator.

Furthermore, Table 2.1 shows that South Asia (SA), East Asia & Pacific (EAP), and Latin America & Caribbean (LAC) are the top destinations of remittance flows in developing countries while Sub-Saharan Africa (SSA) and Middle East & North Africa (MENA) receive more official development aid than other developing regions. East Asia & Pacific and Latin America &

[2]World Bank [2016] noted that remittances sent through informal channels could add at least 50% to the official estimates, making it the largest source of international capital in many developing countries.

Caribbean are not only top remittance destinations, they also attract the highest foreign direct investments among developing regions.

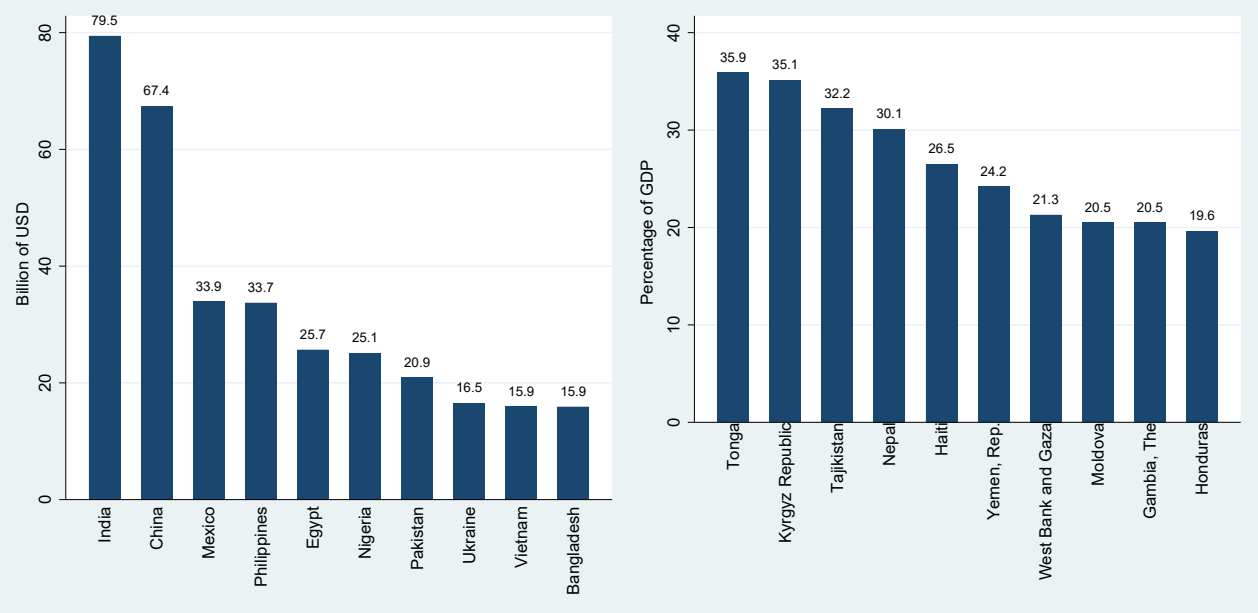
Table 2.1: Distribution of International Capital (in billion USD) by Developing Region (2014)

	EAP	ECA	LAC	MENA	SA	SSA	All Developing Countries
ODA	9.48	10.37	9.62	32.58	15.39	46.18	123.62
Remittance	78.52	38.13	63.60	47.79	115.53	34.23	377.81
FDI	350	44.53	161.65	22.07	39.52	44.03	661.79

Note: East Asia & Pacific (EAP), Europe & Central Asia (ECA), Latin America & Caribbean (LAC), Middle East & North Africa (MENA), South Asia (SA), Sub-Saharan Africa (SSA). Data obtained from the WDI.

At country level, India, Philippines and Mexico are the top three remittance-receiving countries in 2018. However, as a percentage of GDP, Tonga, Kyrgyzstan and Tajikistan top the league in the same year.

Figure 2.3: Top Remittance Receivers, 2018



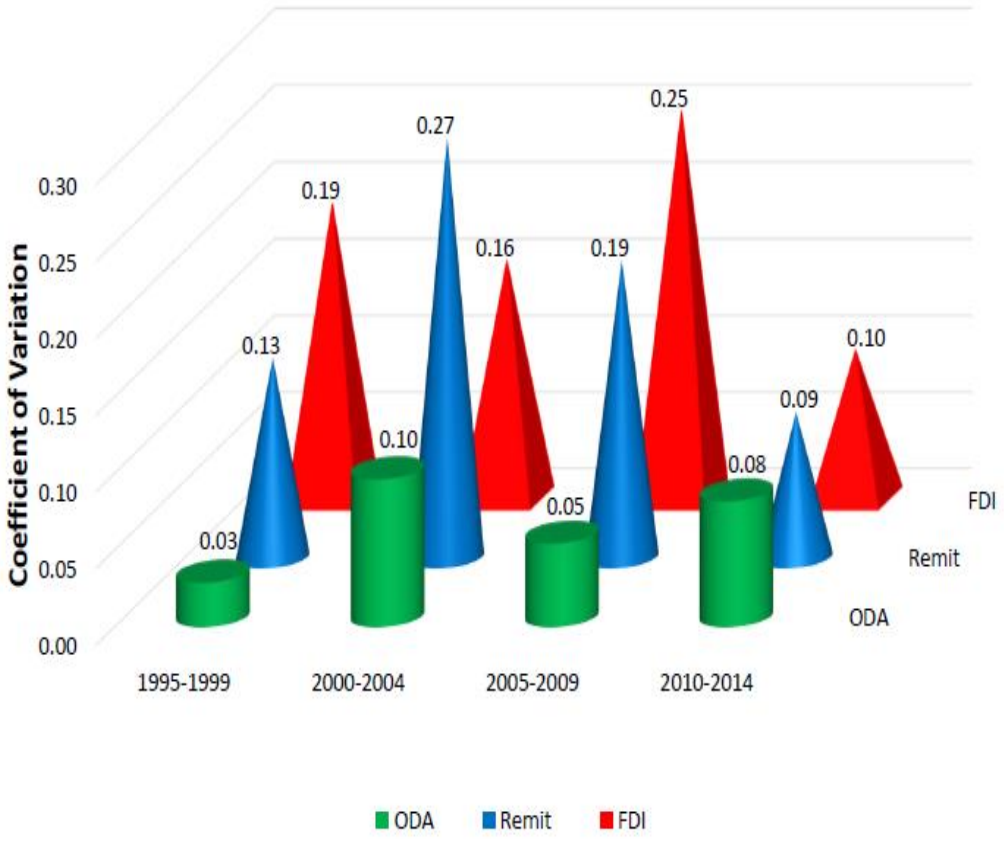
Source: Data obtained from the World Bank's Migration and Remittance Team. The panel on the left is in billions of USD while the panel on the right is the share of remittances as a percentage of GDP.

2.2.2 Properties of Remittances

Overall, remittances are characterised by two main properties that make them unique forms of private international capital flows to developing countries: remittances are less volatile and are less pro-cyclical compared to other forms of international private capital flows. Generally,

official development aids are the most stable form of international capital flows to developing countries. This should not be very surprising given ODAs are mostly government to government transfers. Nonetheless, when compared with only private capital flows such as foreign direct investments, remittances become the most stable among all other forms of private international capital flows. The steadiness of remittances makes it a potential source of insurance for households in developing countries.

Figure 2.4: Volatility of External Capital Flows to Developing countries

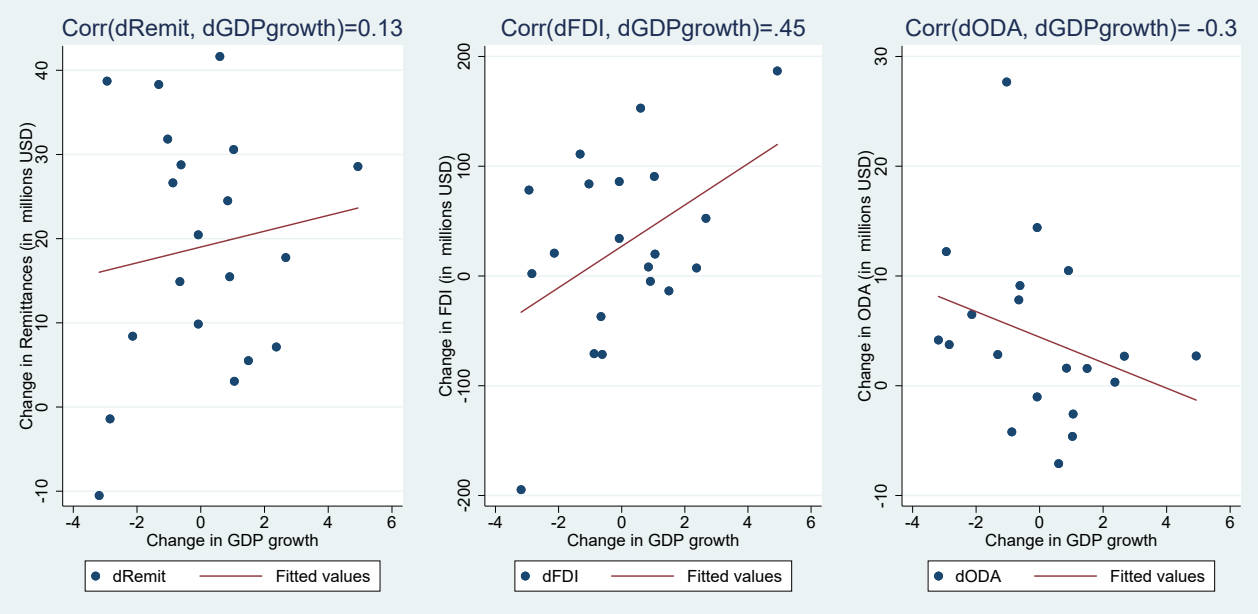


Source: Data obtained from the World Bank's WDI database. Volatility is measured by computing the coefficient of variation (CV) for average change in each form of international capital flows to developing countries. CV is a measure of relative variability, it is measured by taking the ratio of the standard deviation to the mean for each form of capital flow.

As can be seen in Figure 2.4, the volatility of remittances was at its peak between 2000 and 2004, followed by its volatility between 2005 and 2009. The volatility exhibited between 2000 and 2004 can be explained by changes in regulations governing international capital flows after the September 9/11 Terrorist Attacks in 2001. As a result, remittances became more volatile than even FDIs during these periods. For the 2005-2009 episode, this can be explained by

volatility stimulated by the 2008 Financial Crisis. Although, remittances pass-through shocks from developed-sending economies to receiving-developing countries, they are less pro-cyclical than foreign direct investment. This is clearly illustrated in Figure 2.5 where the correlation coefficient of FDI with respect to economic growth in receiving countries is more than 3 times the correlation between remittances and GDP growth.

Figure 2.5: Cyclicality of Capital Flows to Developing Economies, 1995 - 2015



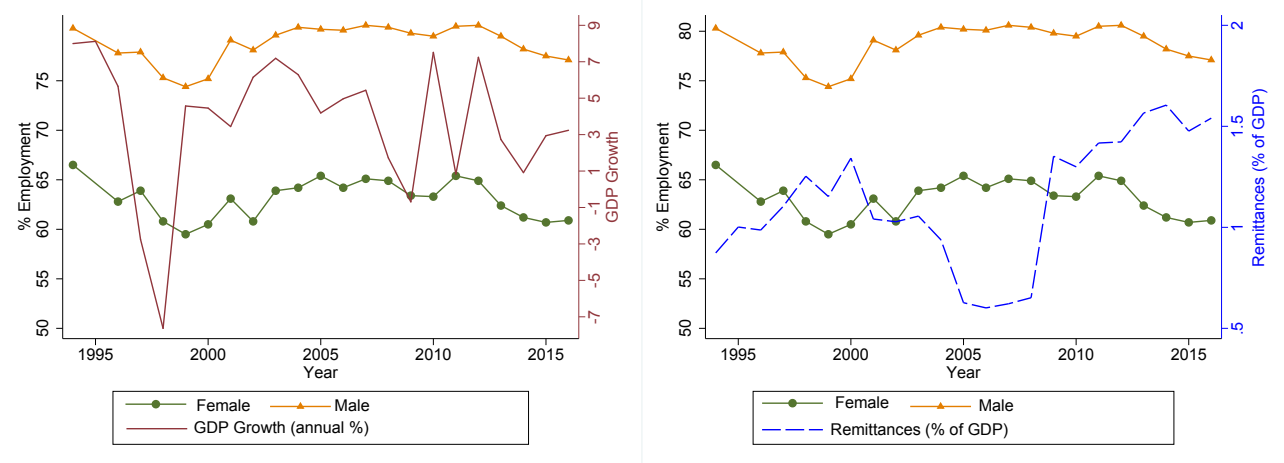
The figures above show the correlations between changes in remittances and GDP growth, FDI and ODA respectively. Data was obtained from the World Bank's WDI database.

2.3 The Macroeconomic Background

After discussing the flow of remittances with its properties and distribution across developing regions, I now proceed by discussing Thailand's macroeconomic conditions since this is the country I will be focusing on in the subsequent sections and chapters. I examine the country's macroeconomic environment focusing on economic growth, employment, remittances, private consumption, and time allocation between market and non-market production activities. Figure 2.6 shows the trends and relationships between growth, remittances and employment. As illustrated in the panel on the left, the 1997-98 Asian Financial crisis that started in Thailand led to a strong decline in real GDP growth causing a reduction in employment rates for both male and female workers. This was followed by substantial remittance inflows reflecting the insurance motive of remittances as shown in the panel on the right. Employment started to

increase in 2000 when growth rebounded. By 2005, male employment rates returned back to their pre-1997 levels while female employment rates still fall below their pre-1997 levels. However, growth became very volatile between 2007 and 2015 mainly due to downturn in business confidence in the wake of the September 2006 military coup in Thailand in addition to the spillover effects of the 2008 Global Financial Crisis. Nonetheless, employment did not change much during these periods of uncertainty apart from the decline in employment rates in the late 2012. In contrast, remittance flows to Thailand increased sharply since the beginning of the 2008 global financial crisis and it is now at an all time high.

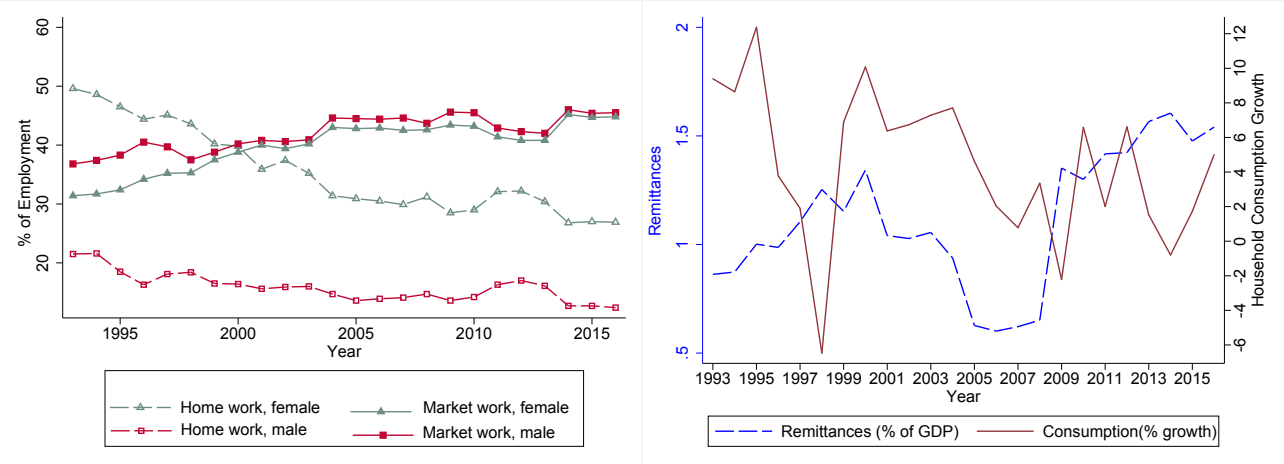
Figure 2.6: Remittance, Growth and Employment



The panel on the left shows the trends of male and female employment rates as well as GDP growth rates. In addition to male and female employment rates, the panel on the right illustrates the trends of remittances as a share of GDP. Thailand's country-level data was obtained from the World Bank's WDI database.

Apart from fluctuations in GDP growth, remittance flows and employment, the share of wage and salaried workers, as a percentage of total employment, has been increasing while the share of family workers consistently decline for both men and women since 1994. In 1994, the overall share of market and non-market workers were equal only for the share of market workers to surpass non-market workers after 1994. This gap has been widening over the years. Furthermore, male labour market participation are higher than their female counterparts as well as male participation in home production activities. Figure 2.7 clearly illustrates that a greater share of female workers is traditionally allocated to home production in Thailand. This trend started to change in 2000 when female labour market participation overtakes their family work. On the relationship between remittances and consumption, the right panel of Figure 2.7 shows that remittances and household consumption move closely together especially after the 1997-98 Asian Financial Crisis.

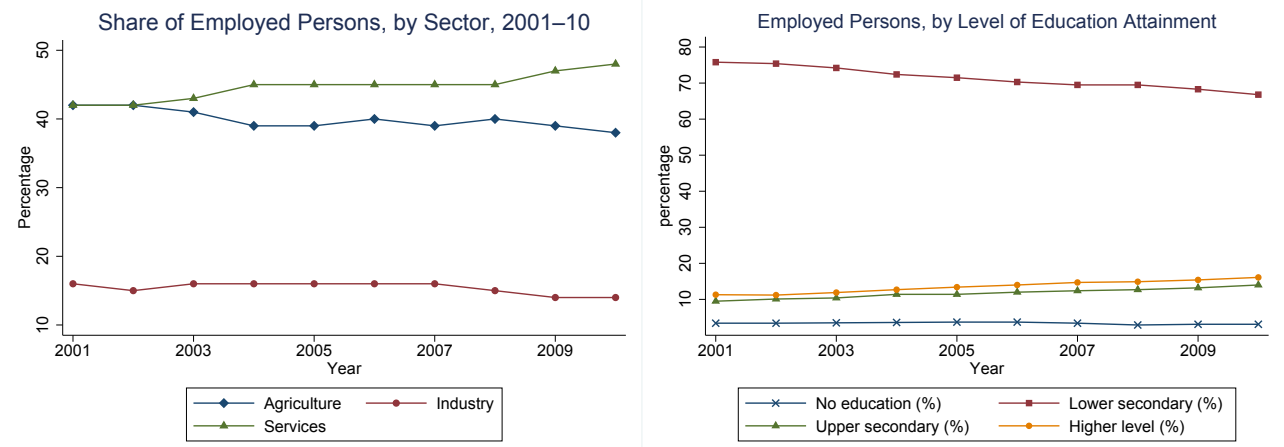
Figure 2.7: Home & Market Employment, Remittances and Consumption



Data was obtained from the World Bank's WDI database. The panel on the left shows the trends of home and market employment as a share of total employment for both male and female workers. On the right, the figure presents time series trends of consumption growth and remittances as a share of GDP.

Across sectors, the panel on the left of figure 2.8 displays the trends on the declining share of employed workers in the agricultural sector, the domination of the service sector and the stagnation of industry employment. Between 2001 and 2010, employment in the industry sector did not changed significantly, employing at most 16 percent of total employed individuals. On the other hand, the panel on the right decomposes total employment by education attainment. As of 2010, approximately 67 percent of employed people in Thailand receive only lower secondary education. This used to be as high as 75 percent a decade earlier. Similarly, the shares of employed persons with upper secondary and higher level education have been increasing consistently between 2001 and 2010 while the percentage of workers with no education remains below 4 percent.

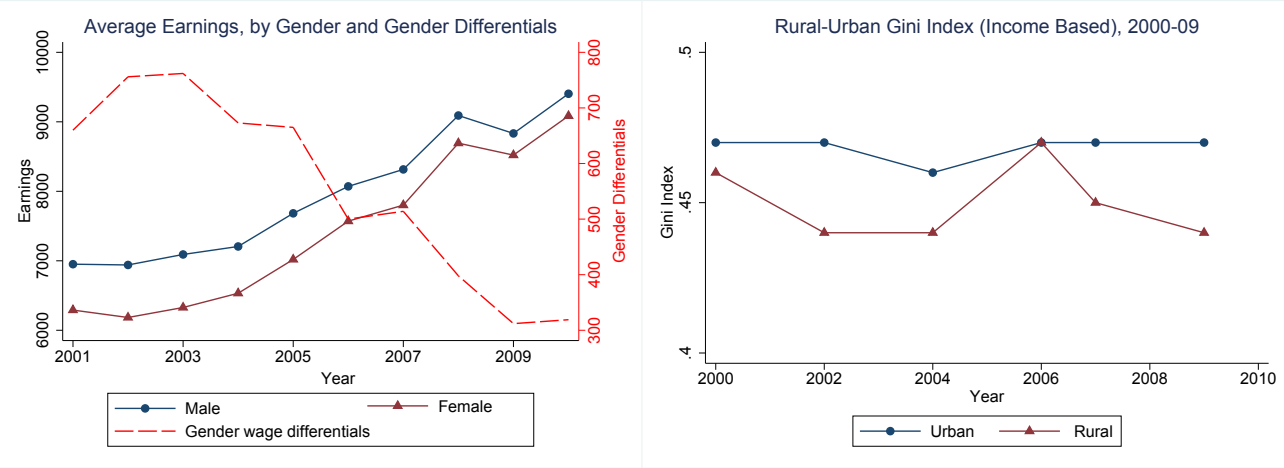
Figure 2.8: Share of Employed Persons by Sector and Education



Data was obtained from Thailand's Labour Force Surveys, 2001–10. These figures show trends of employment shares by sector and educational attainment.

Beyond economic and consumption growth, the distribution of growth is equally important in measuring the extent to which economic prosperity is being distributed in a society. To start with gender-based inequality, Figure 2.9 illustrates that gender difference in monthly pay has been consistently declining since 2003. Although average monthly pay for male workers has been increasing since 2002, the corresponding pay increment for their female counterparts has been much faster leading to a decline in the gender-based earning divide. This declining trend in gender-based pay differentials has been well documented in developing economies even though gender-based wage discrimination still persists in many developing countries [Weichselbaumer and Winter-Ebmer, 2005].

Figure 2.9: Gender-Based Earning Differentials (in Thai Baht) and Income inequality

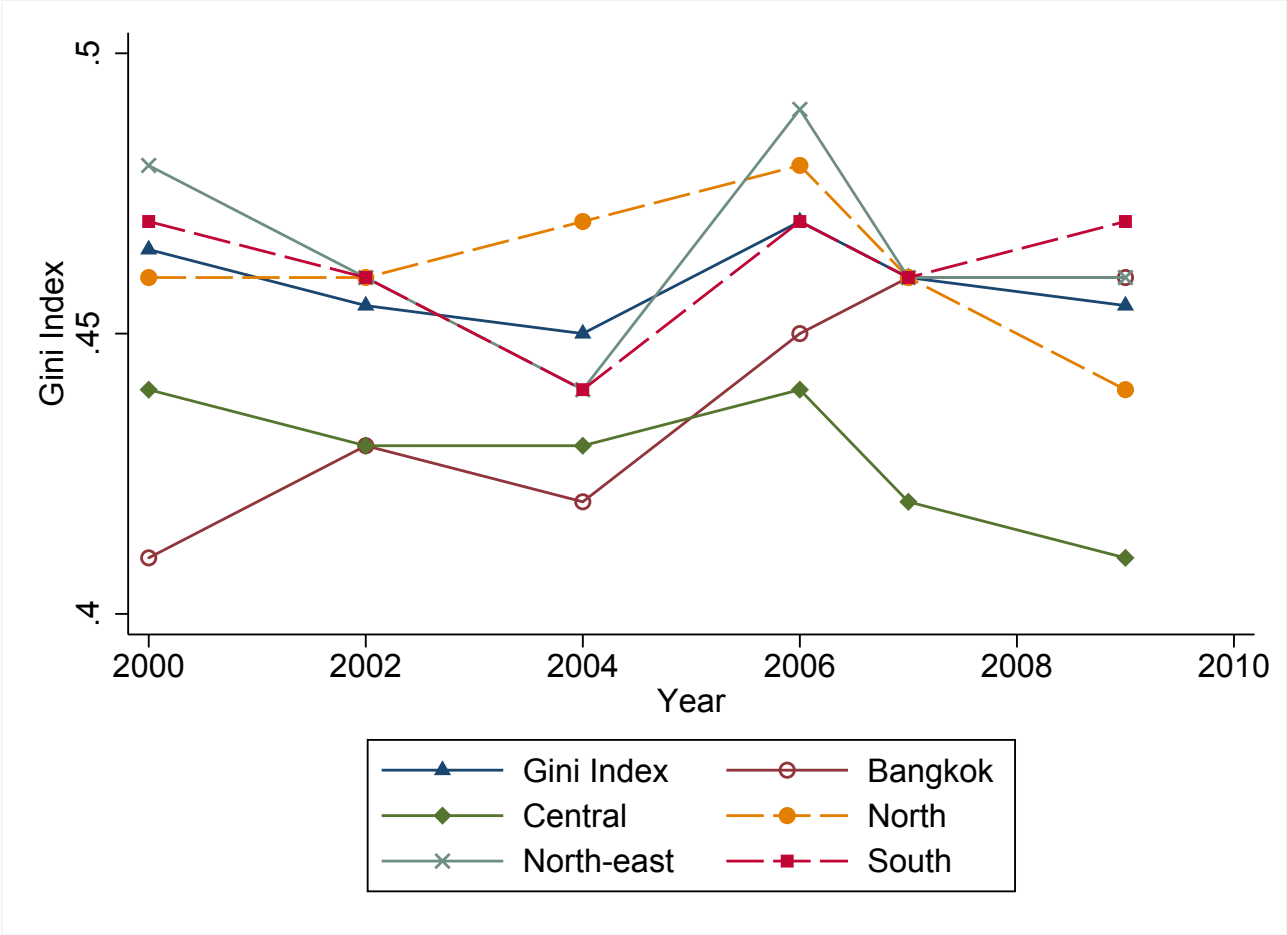


The panel on the left shows average monthly earnings (in Thai Baht) by gender and the associated gender difference in average monthly earnings. On the right panel, the figure illustrates Gini Indexes for rural and urban Thailand. Data obtained from Thailand's Labour Force Surveys, 2001–10, and National Economic and Social Development Board of Thailand (NESDB), 2011.

Interestingly, income inequality also exists across geographical regions, and between rural and urban Thailand. To measure these inequalities, I use the "Gini index" as an indicator to gauge the distribution of economic prosperity across geographical regions. The lower the Gini index, the lower income concentration which implies better income distribution in the measured area. The panel on the right of figure 2.9 shows that income is more concentrated in urban Thailand than in rural areas where income is relatively better distributed. In 2000, the Gini coefficient in urban Thailand stood at 0.47 slightly above the index for rural areas (0.46). However, income inequality subsequently narrows down in rural Thailand while the distribution of income in urban areas remains unchanged. This led to a wider divide in income distribution between rural and urban Thailand. Figure 2.10 illustrates the distribution of income across geographical regions in Thailand. In Bangkok, income inequality started relatively low at 0.41 in 2000 but

increases to 0.46 in 2009. In the Central region, income inequality has consistently decline, with few exception in 2006, from 0.44 in 2000 to 0.41 in 2009. In the North, South and North-east regions, income inequalities sit relatively high moving between 0.44 and 0.49.

Figure 2.10: Gini Index (Income-Based) by Region, 2000-09



This figure illustrates Gini Indexes across regions in Thailand. Data was obtained from Thailand's National Economic and Social Development Board of Thailand (NESDB), 2011.

2.4 Data

The dataset used in the rest of this dissertation is a household-level panel data obtained from the Townsend Thai survey. This is an ongoing monthly survey which provides relatively long series on households' remittances, consumption, work hours and income fluctuations. I briefly provide background descriptions of this survey, and discuss the approaches I used to construct the key variables (remittances, consumption, income and work hours) used in this dissertation. Samphantharak and Townsend [2010, 2013] provide more detailed descriptions of the Townsend Thai survey.

2.4.1 The Townsend Thai monthly survey and Sample selection

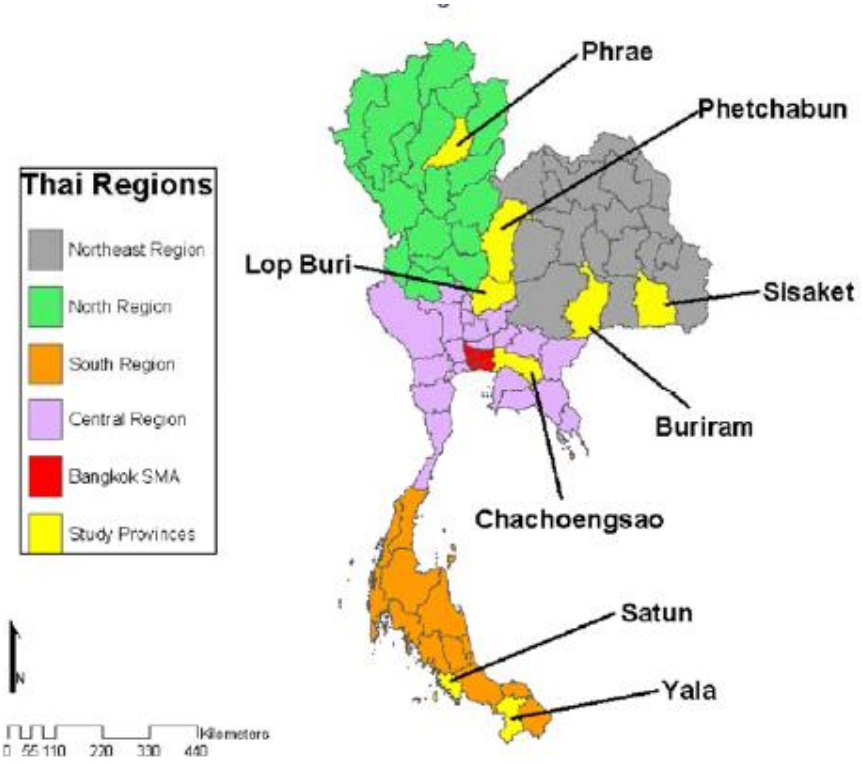
The Townsend Thai Project started in May 1997, just before the beginning of the 1997-98 Asian Financial Crisis, to examine the role of formal and informal networks in protecting and enhancing the welfare of households in rural and semi-urban Thailand. Informal institutions play very important roles in mobilizing and allocating scarce resources towards insuring the welfare of individuals, families and communities against adverse shocks. The Townsend Thai survey includes separate instruments for households, village headmen (considered key informants), local financial institutions and environmental factors [Samphantharak and Townsend, 2010].

To take into account regional differences, two distinct regions were chosen: the more developed, industrialized and fertile central region near the capital city, Bangkok, and the relatively poorer semi-arid northeast region. Two provinces were selected from each region – Lop Buri and Chachoengsao in the central region and, Sisaket and Buriram in the northeast region – giving us a total of four provinces. These four provinces were chosen as benchmark because each of them has a county that had been sampled on an annual basis in the Thai Household Socio-Economic Survey. Furthermore, 12 counties were randomly selected by stratification in each of these four provinces using satellite imagery. Subsequently, four villages were randomly selected in each county, giving a total of 192 villages in 48 counties of the four provinces.

The subsequent devaluation of the Thai baht in July l997, which gave birth to the Asian Crisis, led to the understanding that the Townsend Thai project is well position to assess the effect of business cycle variations and economic crises on households and firms based on sound micro-founded understanding of formal and informal financial institutions. This led to the annual resurveying of one-third of the original sampled villages (64 villages). In 2003 and 2004, the annual survey was expanded to include two provinces in the North (Phrae & Phetchabun) and two provinces in the South (Satun & Yala). However, the monthly survey focuses on only the initial four provinces (Chachoengsao, Lop Buri, Buriram, and Sisaket). In these provinces, four villages were randomly selected from each province to give a total of 16 villages. 45 households were surveyed from each village giving a total of 720 households in the Townsend Thai monthly survey. These households were identified based on eating and sleeping patterns. The baseline interview on initial conditions started in August 1998 with subsequent monthly interviews

starting in September 1998 to track changing conditions of the sampled households. This provides detailed information on households' composition, consumption, income, remittances, assets, savings, borrowing, lending, and agricultural and entrepreneurial activities over time.

Figure 2.11: The Townsend Thai Project Surveyed Areas



Source: Townsend Thai Monthly Household Survey Data Summaries

The data I use covers 172 months starting from September 1998 to December 2012, a period of 14 years 4 months. I use an unbalanced panel in the analysis since the attrition rate during the periods under study averaged to less than three percent per month. This attrition is largely due to migration which is the source of remittances. I did not drop households that moved out of the village before month 172 neither did I remove those that were included in the survey to replace the drop-out households. However, I dropped households whose consumption and (or) remittance data are (is) missing. Consequently, the data has 138,227 monthly observations for 800 households (199 households from Chachoengsao, 207 from Lop Buri, 216 from Buriram and 178 from Sisaket). Table 2.2 presents the distribution of these observations by province and by gender of household heads while Table 2.3 highlights some basic characteristics of Townsend Thai households. The latter table shows that average family size for Thai households

is approximately 4, average years of education is 5.26 years, and the average lowest and highest years of schooling are roughly 3 and 8 years respectively. As expected, 69 percent of the sampled households are male-headed while the remaining 33 percent have female household heads.

Table 2.2: Data Characteristics by Provinces and Gender of Household Heads

Provinces	Observations	Percent
Observations by Province		
Chachoengsao(chan=07)	34,427	24.91
Buriram (chan=27)	37,368	27.03
Lop Buri(chan=49)	35,638	25.78
Sisaket(chan=53)	30,794	22.28
Total	138,227	100
Gender of Household Heads		
Male	71,446	68.61
Female	32,689	31.39
Total	104,135	

Table 2.3: Descriptive Statistics of Household Characteristics

	Mean	Std. Dev.	Min	Max
Number of Adult Female	1.90	1.23	0	10
Number of Adult Male	1.69	1.15	0	8
Number of Children	0.66	0.88	0	7
Family Size	3.83	1.78	1	15
Household Head's Age	56.62	13.61	17	95
Average Age in Household	41.53	14.66	0	100
Household Head's Education (years)	4.53	2.67	0	16
Minimum Education in Household (years)	2.92	2.38	0	16
Maximum Education in Household (years)	7.93	3.61	0	16
Average Education level in Household (years)	5.26	2.3	0	16
Households	800			
Monthly Observation	138,227			

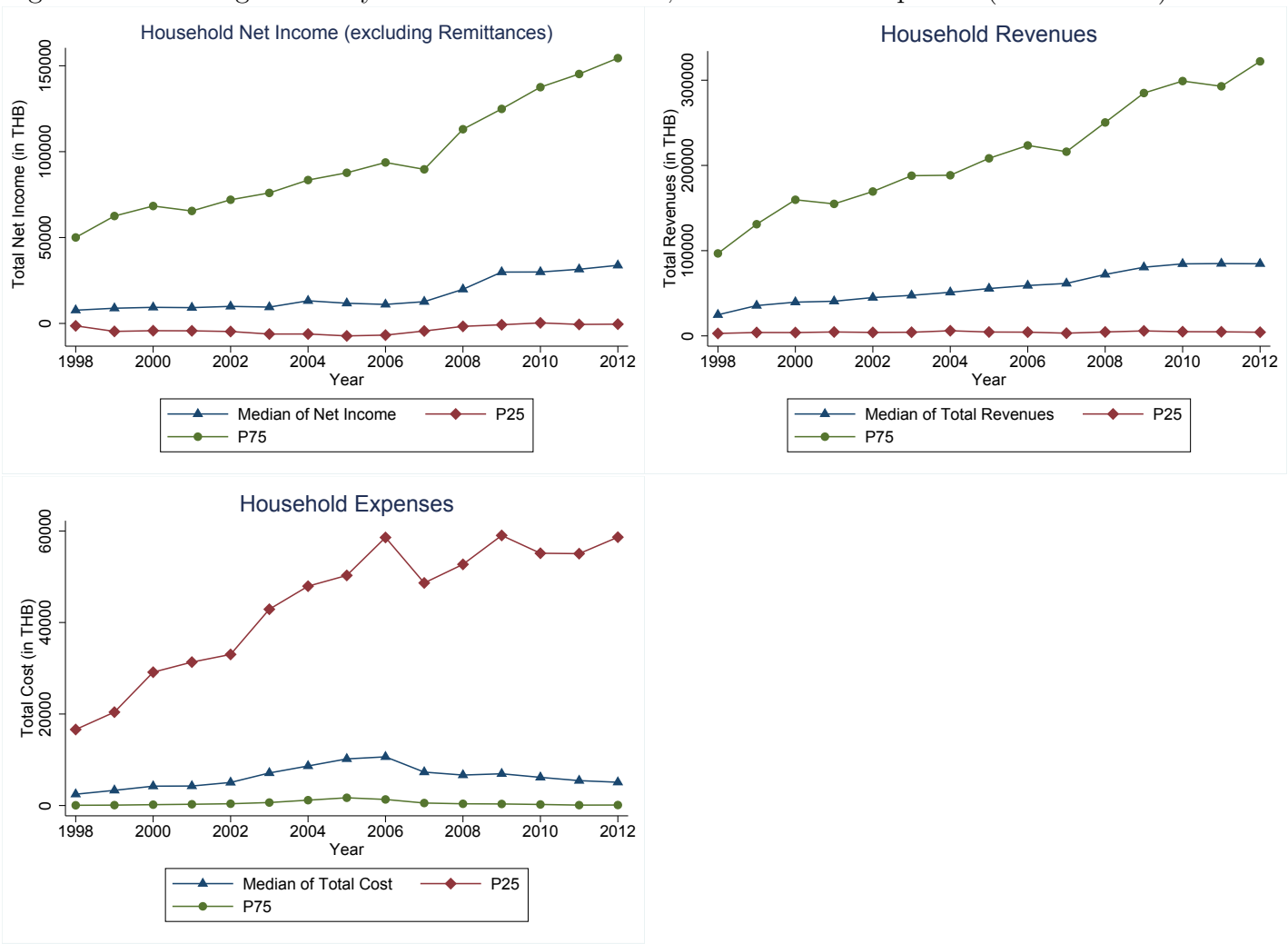
Source: Townsend Thai Monthly Household Survey

2.4.2 Construction of Net Income

The Townsend Thai survey captures a very important characteristic of households in developing countries where households often involve in series of production activities, both agricultural and non-agricultural. In this survey, households have five potential sources of domestic income: crop

cultivation, livestock rearing, fish & shrimp, labour market earnings, and other non-agricultural business activities. As a result, to obtain household net income, I follow Samphantharak and Townsend [2010] who treated households as if they were firms by creating standard financial accounts for each household. These financial accounts include a balance sheet, statement of income, and a cash-flow statement. For each production activity, I computed household revenues and expenses to find their net profit (or loss). The summation of these net profits (or losses) gives household net income in each month. As previously used by Chiappori et al. [2014], I also relied on the accrual approach to income in which expenses are booked at the time of sale of product rather than when cash is actually paid. Figure 2.12 shows that Thai households on average make net profit from these productivity activities.

Figure 2.12: Average Monthly Household Net Income, Revenues and Expenses (in Thai Baht)



Source: Townsend Thai Monthly Data

Tables 2.4 presents descriptive statistics of households' monthly net income by provinces. As expected, provinces in the central and more developed region of Thailand (Chachoengsao and

Lopburi) have higher average net incomes than those in rural Thailand (Buriram and Sisaket). Between 1998 and 2012, Chachoengsao has the highest average net income ($478 per month) while Buriram has the lowest with an average monthly income of $121. The overall average net income for all the sampled Thai households sits at $279 per month.[3]

Table 2.4: Summary Statistics of Monthly Income by Provinces (in THB)

Provinces	Obs.	Mean	Std. Dev.
Chachoengsao (chan=07)	30,319	14,633.31	58,820.45
Buriram (chan=27)	31,994	3,730.42	33,274.94
Lopburi(chan=49)	31,338	12,021.13	62,492.9
Sisaket(chan=53)	28,923	3,633.61	18,963.26
All sampled household	122,574	8,524.09	47,456.03

Source: Townsend Thai Monthly Household Survey

It is important to note that I calculated real net income by deflating nominal net income using monthly regional Consumer Price Index (CPI) obtained from Thailand's Ministry of Commerce. Although I am aware that regional inflation could be different from inflation at a village-level, I rely on regional CPI because I do not have any reliable price index at village levels. Thus, I use regional CPI as a proxy for village-level price index.

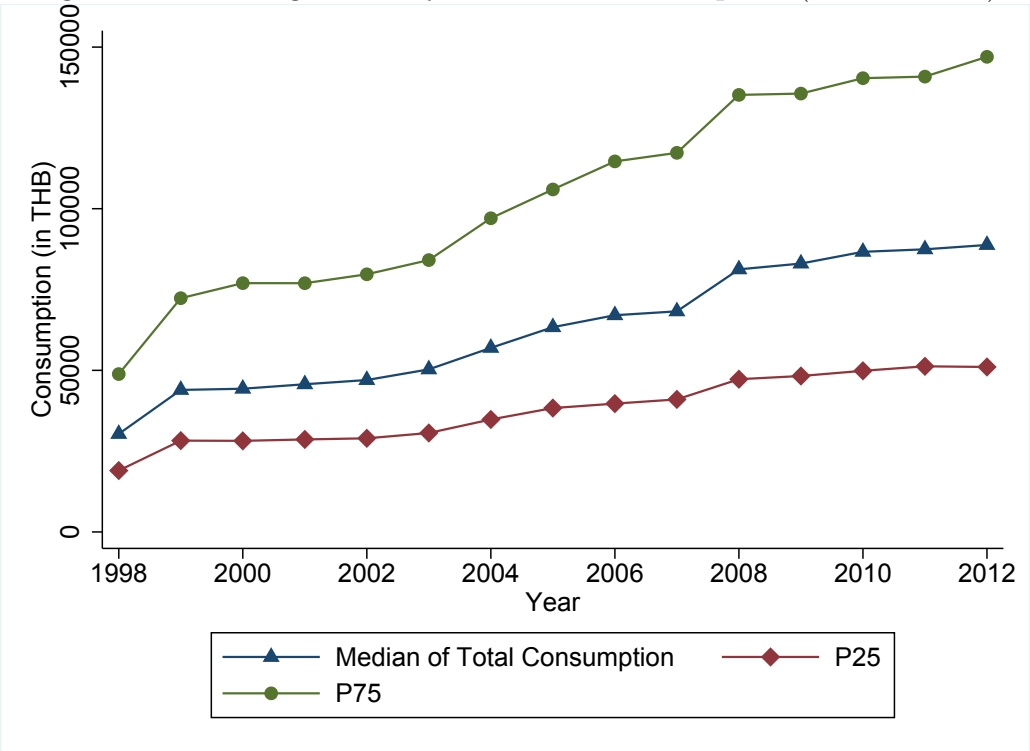
2.4.3 Construction of Consumption Variable

To construct our consumption variable, I sum up households consumption of food and non-food items including expenditures on utilities, housing and other durable goods. Since many households in developing countries are also producers, our food consumption variable includes the consumption of home produced goods as well as those purchased from the market. Consumption of food and non-food items are the only modules in the Townsend Thai monthly survey that were collected weekly from month 1 to month 25. However, from month 26 onward, household expenditure on food and non-food items were collected biweekly in order to minimize error. Figure 2.13 displays the evolution of household consumption over the period under consideration. This figure illustrates that consumption has been increasing since the

[3]Using Thai Baht (THB) to US Dollars (USD) exchange rate for December 31, 2012 from https://www.exchange-rates.org/Rate/THB/USD/12-31-2012

beginning of the Townsend Thai survey although it fluctuates month-by-month mainly due to the seasonality of household income.

Figure 2.13: Average Monthly Household Consumption (in Thai Baht)



Source: Townsend Thai Monthly Data

The disintegrated trends of household consumption of market and home produced goods as well as food and non-food consumption are presented in the Appendix. The key message from these figures is that the consumption of non-food items (and market goods) has been increasing more than food consumption (and the consumption of home produced goods). Despite these consumption variations over time, households in Chachoengsao and Lopburi (the more developed provinces) consistently have higher average consumption than those in rural Thailand (Buriram and Sisaket). In particular, Chachoengsao households register the highest consumption (with average monthly consumption of $361), followed by those in Lopburi who on average consume $295 monthly. Interestingly, these two provinces also have the lowest consumption rate as a share of net income. Households in Sisaket have the least monthly consumption of US$146 but the second highest proportion of net income consumed. The fact that households in Buriram and Sisaket consume significantly higher than their net income implies that these households have significant access to credit from formal and/or informal credit sectors. Nonetheless, it is important to point that a large proportion of Thai households report having problems accessing credit from financial institutions according to surveys and opinion polls conducted by the Bank

of Thailand.[4] These households, the report continues, resort to informal credit arrangements. This signals the potential role remittances can play in explaining why household consumption in Buriram and Sisaket are significantly higher than their net income. Nonetheless, before exploring the impact of remittances on household welfare, lets start by discussing how I measured households' remittance income.

Table 2.5: Summary Statistics of Monthly Consumption by Provinces (in THB)

Provinces	Obs	Mean	% of Average Income	Std. Dev.
Chachoengsao (chan=07)	30,319	11,035.39	75%	16,993.27
Buriram (chan=27)	31,994	6,675.47	179%	9,686.42
Lopburi(chan=49)	31,338	9,018.71	75%	16,230.18
Sisaket(chan=53)	28,923	4,458.51	123%	8,727.69
All sampled household	122,574	7,829.87	92%	13,680.95

Source: Townsend Thai Monthly Household Survey

2.4.4 Construction of Remittance Variable

How do I measure households' remittance income? Our remittance variable is constructed by summing the total value of monthly gifts and money that Thai households receive from family members and friends living abroad. At any point in time, households in the Townsend Thai survey have one out of four possible remittance statuses. They either (I) send but do not receive remittances, (II) receive but do not send remittances, (III) send and receive remittances, or (IV) they neither receive nor send remittances. Since I am interested in examining how remittances affect households' consumption and time allocation decisions, I focus on remittance receiving households. In the Townsend Thai data, 36.79 percent of the interviewed households receive remittances. As can be seen in Table 2.6, households in relatively poorer provinces (Buriram and Sisaket) receive the highest amount of remittances as a percentage of net domestic income than those in richer provinces (Chachoengsao and Lopburi). In terms of the actual amount of remittances received, Chachoengsao households receive the lowest while Lopburi receives a little more than Sisaket but lower than Buriram, the highest remittance receiving province in

[4]Among the most common reasons cited are (1) tedious and bureaucratically difficult process, (2) the number and types of documents required are burdensome, and (3) the approval/rejection decisions take a very long time. Available at: https://www.bis.org/ifc/publ/ifcb31f.pdf

the Townsend Thai data. Overall, the average remittance income of Thai households (1,973 Thai baht) is equivalent to 23% of their average monthly domestic income (8,524 Thai baht).

Table 2.6: Summary Statistics of Monthly Remittances by Provinces (in THB)

Provinces	Obs	Mean	Remit-Income Ratio	Std. Dev.
Chachoengsao (chan=07)	32,743	1,868.291	12.8%	12,477.77
Buriram (chan=27)	34,235	2,221.548	59.6%	11,442.85
Lopburi(chan=49)	34,804	1,898.307	15.8%	32,563.85
Sisaket(chan=53)	31,211	1,892.481	52.1%	7,630.80
Total remittance received	132,993	1,972.758	23%	19,058.42

Source: Townsend Thai Monthly Household Survey

2.4.5 Construction of Labour Hours

To measure work hours, I decompose household labour hours into market and home time since households in developing countries involve both in market and home production activities. Total home hour is obtained by summing the number of hours households spend in cultivating family plots, rearing family livestock, caring for family fish & shrimps, and working in family businesses. On the other hand, market hour is the sum of the number of hours households spent working outside the household for pay and the time spent looking for paid work. I excluded the number of hours households spend working outside their homes for free, labour exchange, fulfilling social obligations, doing work related to village positions, attending school or training programs. Table 2.7 shows that Townsend Thai households on average spend more hours on home production than on labour market activities. Interestingly, households in the more developed Chachoengsao and Lopburi provinces spend more hours in both market and home production activities than those in Buriram and Sisaket.

Table 2.7: Summary Statistics of Monthly Market and Home Hours

	Market Hours		Home Hours	
Provinces	Mean	Std. Dev.	Mean	Std. Dev.
Chachoengsao (chan=07)	152	120	397	90
Buriram (chan=27)	130	88	255	115
Lopburi(chan=49)	155	164	393	187
Sisaket(chan=53)	150	221	307	125
All sampled household	145	178	314	136

2.5 Remittances, Income and Consumption Dynamics

After providing a background description of the Townsend Thai data and the approach I used to construct the key variables of this dissertation, I now discuss the life-cycle dynamics of household consumption, earnings and income from home production activities. I also discuss the dynamics of these variables conditional on the remittance status of Thai households. Moreover, the nexus between household income and consumption is examined to discuss the extent to which consumption is insured against income shocks.

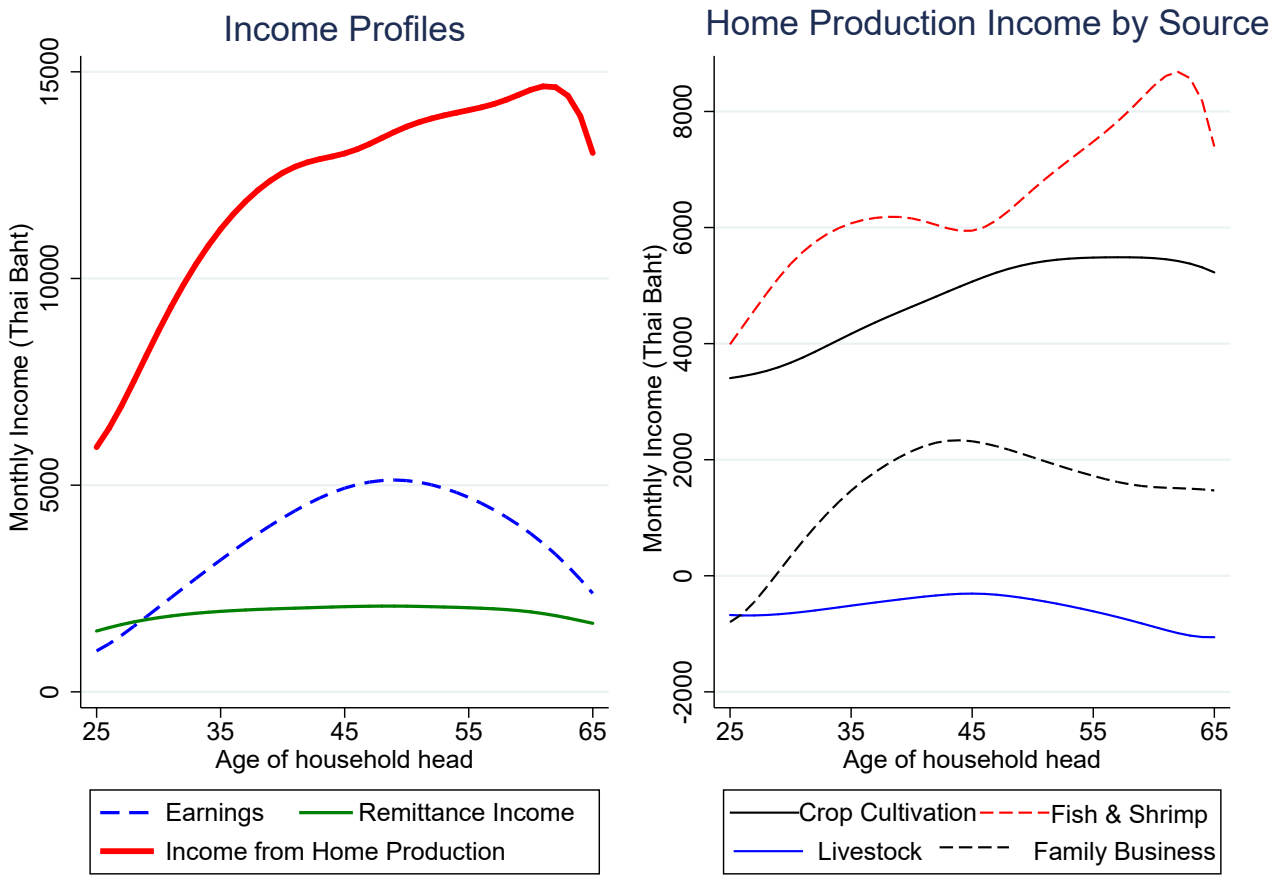
2.5.1 Life Cycle Profiles of Household Incomes

The panel on the left of Figure 2.14 illustrates the life cycle dynamics of household earnings, remittances and income from home production activities. In the panel on the right, I decompose income from home production into the different home production activities Thai households are engaged in. This is very important as it helps to pinpoint the life-cycle dynamics of household income from different sources. Moreover, it provides the platform to comparatively analyse the importance of remittances relative to other forms of income.

Overall, Townsend Thai households receive more income from home production activities than from labour market participation or remittances. On average, income from home production increases with age of household heads. During the early years of the life-cycle, income from home production activities increases smoothly with age before declining around the retirement age of household heads. This can be explained by the fact that at this age, experienced retiring household heads are replaced by their children who are less experienced on these home production activities. The fact that children are consider as means to increase family labour is well documented especially in low-technology communities where labour is considered the most expensive cost of production [Mamdani, 1972; Brant, 1975]. On the other hand, labour earnings follow the popular inverted-U shape in which earnings are low at the beginning and end of the life-cycle, and at their highest during prime working age. For remittances, households' average income (in Thai Baht) is relatively constant over the life cycle. This is partly because remitters take into account the real amount they send to their families after controlling for exchange rate volatility and the cost of sending remittances. This is to say, exchange rate volatilities are mainly absorbed by remitters instead of pushing them down the chain to receivers. This is somewhat

consistent with the insurance motive of remittances which postulates that remittances are use as income smoothing device [Gubert, 2002].

Figure 2.14: Life Cycle Profiles of Household Income



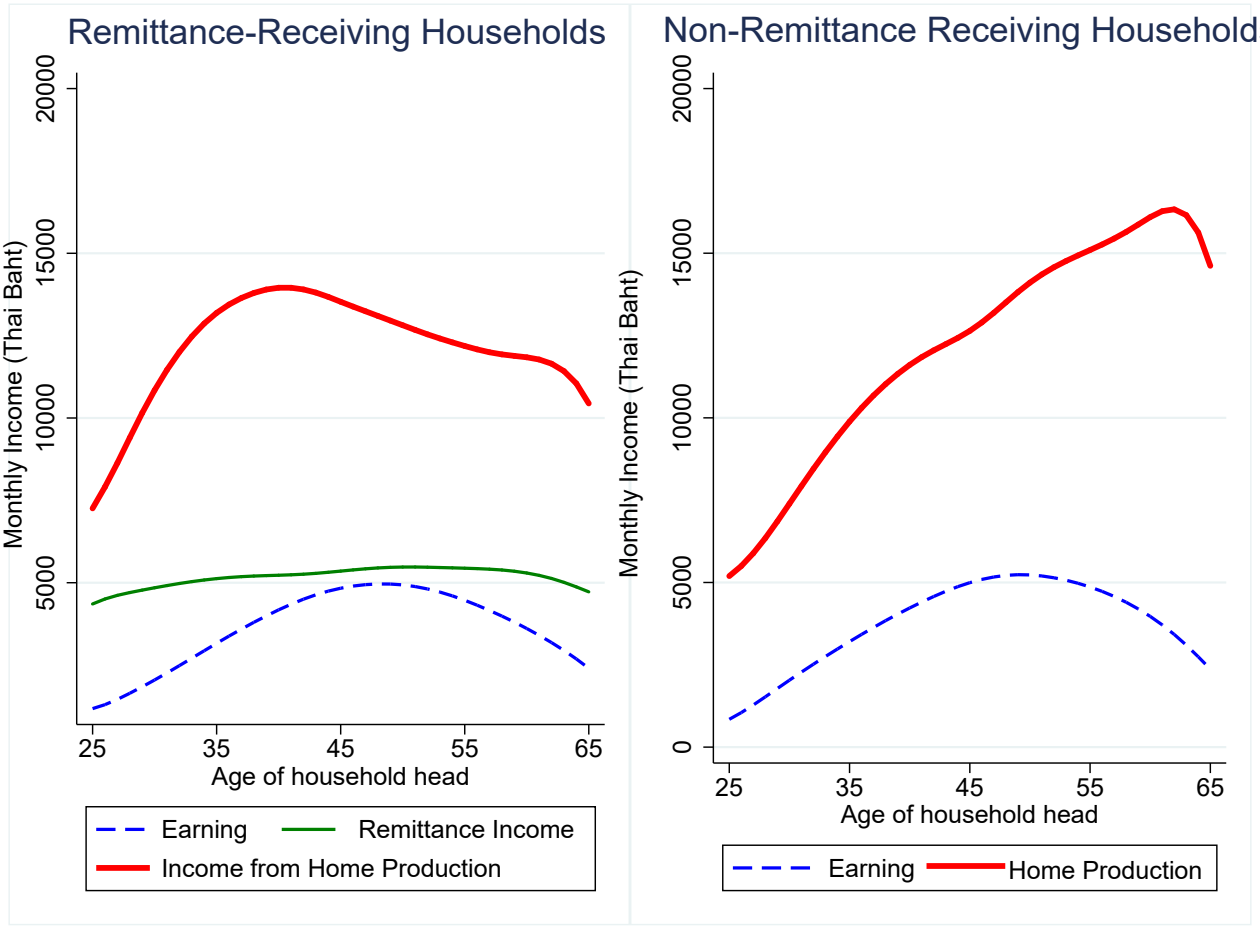
Source: Townsend Thai Monthly Household Survey

Furthermore, the panel on the right makes it visible that Townsend Thai households receive most of their income from home production through fish & shrimp farming. Apart from fish & shrimp production, the surveyed Thai households receive more income from crop cultivation than from family business or livestock rearing. In fact, in most periods of the life-cycle, these households earn profit from all home production activities except livestock production.

But how does households' remittance income status affect their earnings from market and home production activities? Figure 2.15 presents the life-cycle dynamics of household incomes conditional on their remittance income status. Two important things are worth noting from this figure. First, Townsend Thai households receive the highest income from home production activities regardless of their remittance income status. This makes home production the most

important source of income for these households. Second, non-remittance receiving households on average receive higher incomes from home and labour market activities than remittance-receiving households. That is to say, since non-remittance receiving households rely solely on domestic income, they put great efforts in home and labour market activities yielding higher incomes from these production activities than their counterparts who receive external support in the form of remittances. Notwithstanding, the amount of remittances remittance-receiving households receive is more than their labour market earnings making remittances the second most important source of income for this group of Thai households.

Figure 2.15: Income Profiles by Remittance Income Status

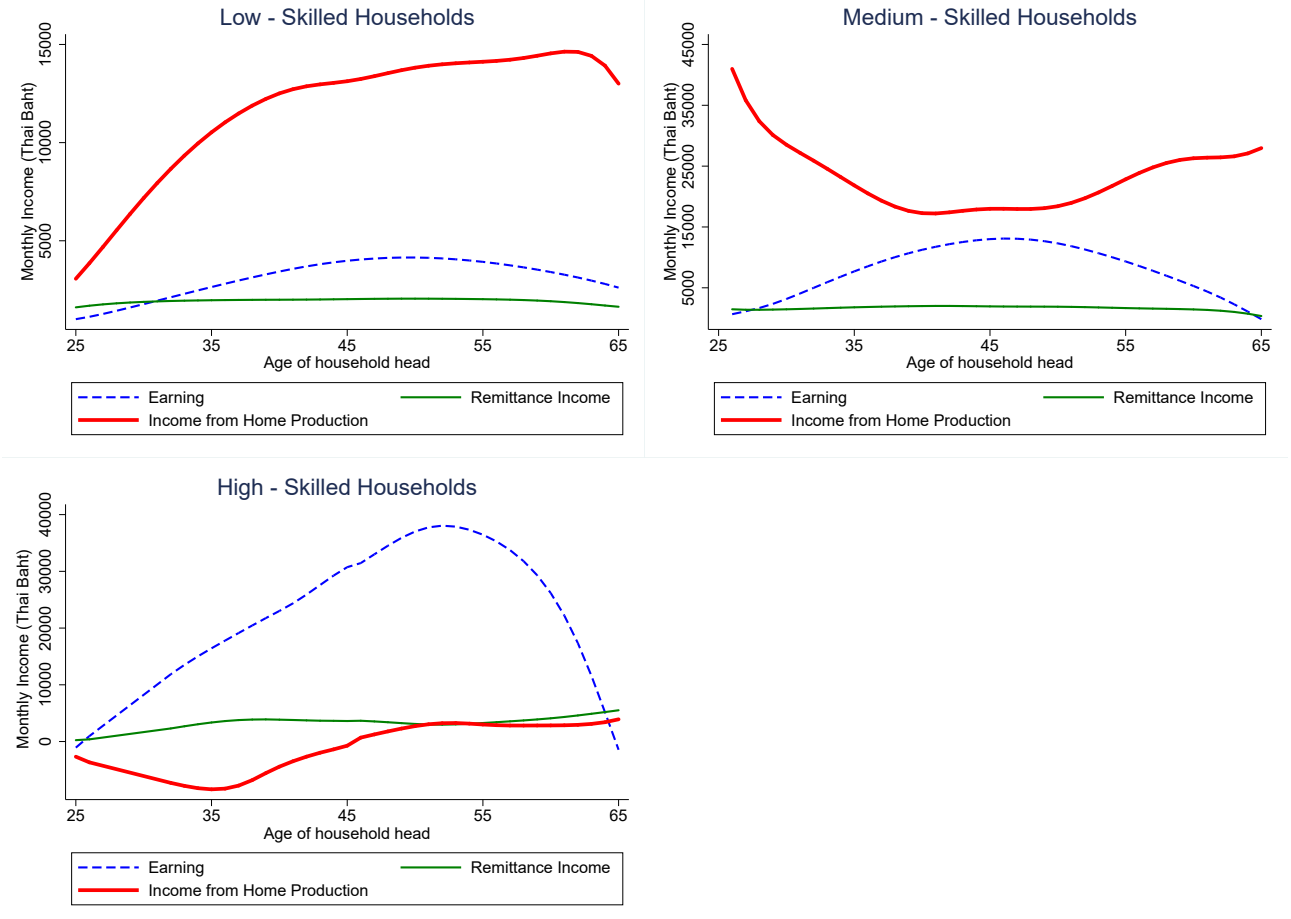


Source: Townsend Thai Monthly Household Survey

Moreover, to examine how education affects the income of Thai households, I divide these households into three groups — low-skilled, medium-skilled and high-skilled — based on the educational attainment of household heads. I categorise medium-skilled households to be those households whose heads have between 12 and 15 years of education. For low- and high-skilled households, these are households whose heads have less than 12 years and more than 15 years

of education, respectively. Using these definitions, Figure 2.16 presents the life-cycle dynamics of household incomes conditional on the educational attainment of household heads. These figures provide suggestive evidence that low-skilled households rely more on income from home production, with labour earnings playing minimal role compared to medium and high-skilled households. Average income from home production activities is driven mainly by low-skilled households while medium-skilled households depend on both market and home production activities. Even though the contribution of home production to the income base of medium-skilled households starts very high at the beginning of the life-cycle, its importance declines before stabilising as these household heads get older. For market earnings, these follow the popular hump or inverted-U shape for both medium-skilled and high-skilled households who rely more on labour earnings.

Figure 2.16: Income Profiles by Education Attainment



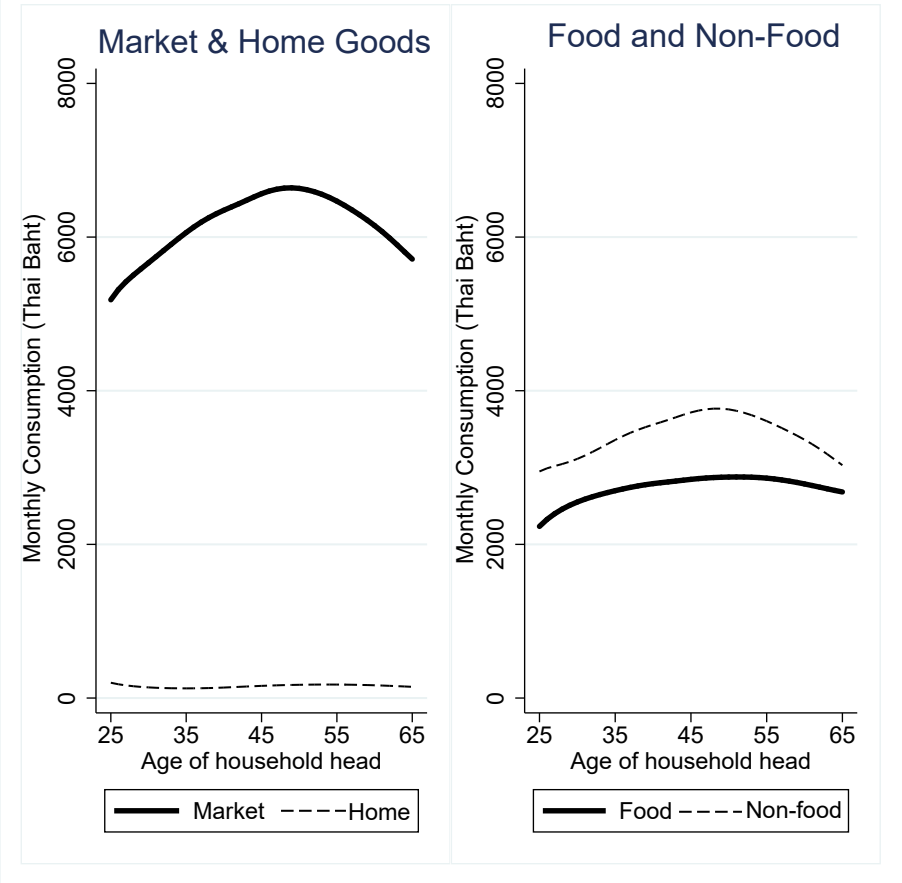
Finally, it is worth noting that remittances become the least significant income contributor when all households are lump together regardless of their remittance income status. Thus, it is important to focus on remittance-receiving households in the subsequent chapters when

examining the effect of remittances on households' consumption and time allocation decisions. This is because remittances are indeed significant income contributors to remittance-receiving households as shown in Figure 2.15.

2.5.2 Income - Consumption Nexus

Given the income dynamics discussed above, I now examine the relationship between households' consumption and changes in their income. In the Townsend Thai survey, household consumption is divided into market and non-market (consumption of home produced goods) consumption as well as consumption of food and non-food products. Figure 2.17 illustrates the life-cycle dynamics of market and non-market consumption in the panel on the left while the panel on the right divides household consumption between food and non-food consumption.

Figure 2.17: Monthly Consumption of Food, Non-food, Market and Home Goods



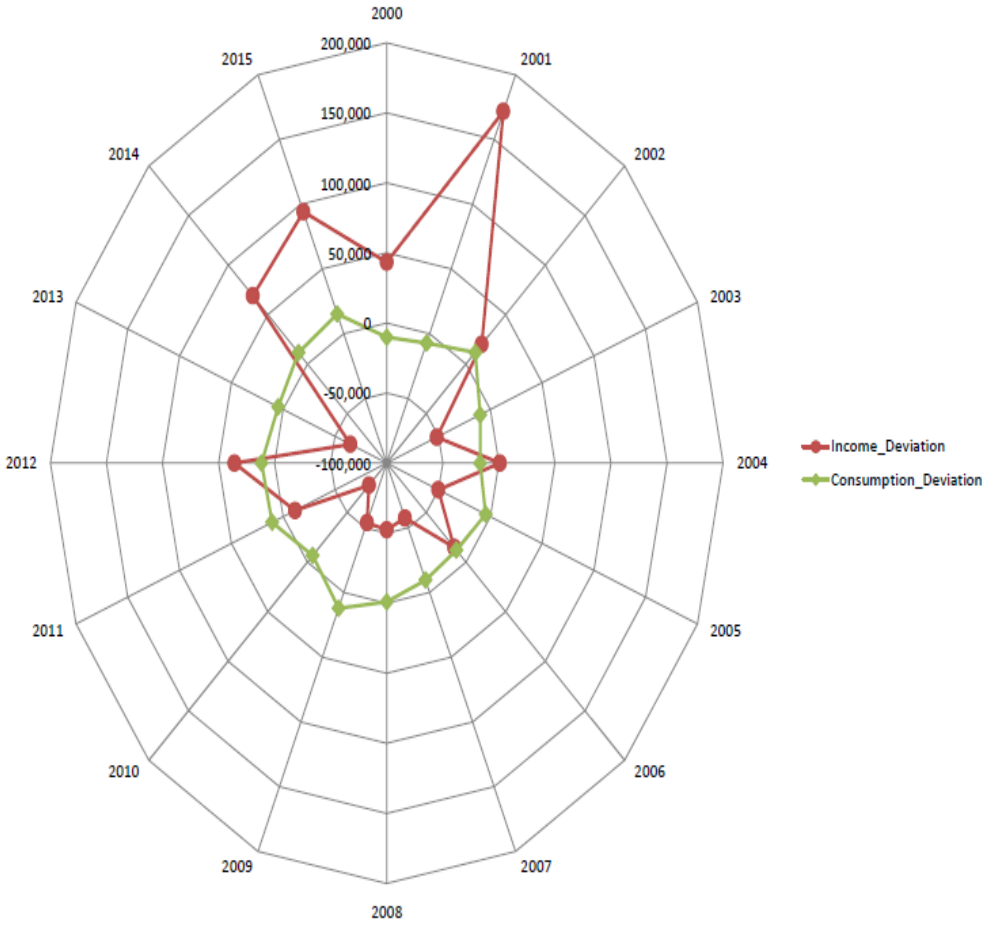
Data Source: Townsend Thai Data

As expected, Thai households consume more market goods than home produced goods and the gap between market and non-market consumption has been relatively stable for most parts of

the life cycle. While the consumption of home produced goods is relatively stable throughout the life cycle, market consumption declines around the end of the life cycle following a hump-shape pattern similar to the earning profile. Likewise, food and non-food consumption follow a hump-shape pattern over the life cycle although the gap between the two narrows down due to sharp decline in non-food consumption when household heads become older than 45 years. This is to say, whereas households stabilise food consumption when household heads get older, they reduce their consumption of non-food items during these periods.

But how do changes in income affect households' consumption patterns? Figure 2.18 presents the deviations of yearly income and consumption from their sample year averages (1999-2015). Similar to Karaivanov and Townsend [2014], this figure visualizes the degree of consumption smoothing against income fluctuations for Thai households.

Figure 2.18: Income and Consumption Co-movement

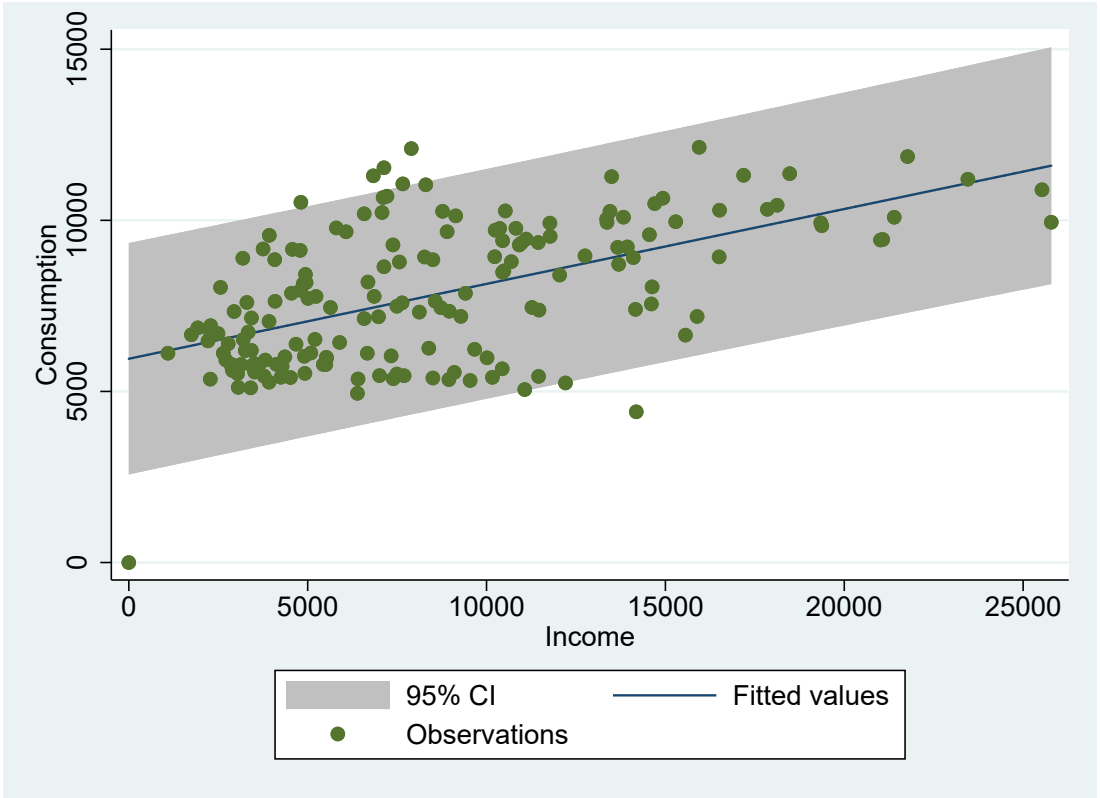


This figure displays the deviations of yearly income and consumption from their sample year averages (2000-2015). The data came from the Townsend Thai Household Survey.

Figure 2.18 contains two lines: one for yearly income deviations from sample average (the

red-circle line) and the other for yearly consumption deviations from sample average (the light-green diamond line). If there were no changes in household income, the red-circle line should be flat at zero for all years between 2000 and 2015. However, there has been both positive and negative income fluctuations although household income has on average increased during the period under consideration. On the other hand, the light-green diamond line illustrates the response of household consumption to income deviations. If Thai households had access to full consumption insurance, this light-green diamond line should also be flat at zero. That is to say, household consumption does not respond to changes in household income. Thus, this diamond line measures the degree of consumption insurance against income fluctuations. The results in Figure 2.18 show that although Thai households have access to consumption smoothing, the Townsend Thai data does not support the full consumption insurance hypothesis since the diamond line is not entirely flat at zero. This is consistent with the findings of Townsend [1994, 1995], Karaivanov and Townsend [2014], and Morten [2016] who also rejected the full insurance hypothesis because consumption does respond positively to changes in income. The positive relationship between household consumption and income is also shown in Figure 2.19.

Figure 2.19: Co-movements Between Household Income and Consumption (in Thai Baht)



Source: Townsend Thai Data.

Just like Figure 2.18, Figure 2.19 can also be viewed as a measure of consumption insurance

as it examines co-movements between households' consumption and income. The stronger this co-movement, the lower the degree of consumption smoothing.[5] Figure 2.19 shows that there is a strong positive relationship between consumption and income changes in Thailand, with a correlation coefficient of 0.56. This also rejects the full consumption insurance hypothesis since $corr(dy, dc) \neq 0$. The correlation coefficient of 0.56 signals that Thai households have relatively low access to consumption smoothing devices. This finding is consistent with the conclusions of Gertler and Gruber [2002] and De Weerdt and Dercon [2006] who found that adverse income shocks such as severe illness leads to a reduction in household consumption.

In the face of widespread risk on household income, several studies have investigated the mechanisms through which households in developing countries cope with such risk in an environment where credit and insurance markets are missing/under-developed. For instance, Rosenzweig and Stark [1989] provide evidence on how households mitigate risk by developing partnerships via marriage. Using household-level panel data from South India, they find that marriage-cum-migration significantly contributes in reducing the volatility of household food consumption for a given income volatility. In addition, households may also smooth consumption through risk sharing [Fafchamps and Lund, 2003], adjust labour supply in response to income shocks [Kochar, 1999], build up savings in good times and draw them down in hard times [Udry, 1994], accumulate assets and storing goods for future consumption, or take steps (such as self-insurance via strategic migration of family members, crop and field diversification, and learning a portfolio of occupations) to reduce income volatility [Dercon, 2002].

Many households in developing countries rely on these self- and inter-household insurance arrangements rather than on publicly managed programs or market-provided insurance schemes [Gubert, 2002; Collins et al., 2009]. However, problems of information asymmetry and moral hazard restrict households' ability to fully insure themselves against income risks using these informal insurance arrangements. One of such moral hazard problems is limited commitment which describes situations in which households with high income realizations decide to leave informal insurance networks instead of making transfers to those with low income. Moreover, households have incentive to under-report their actual income (hidden income) since income realization are un-observable by others. Kinnan et al. [2011] examine the barriers to insurance in Thai villages using models of limited commitment, moral hazard, and hidden income to

[5] Kaplan and Violante [2010] define the consumption insurance coefficient ϕ^x as $\phi^x = 1 - \frac{cov(\Delta c, \Delta y)}{var(\Delta y)}$

explain incomplete informal insurance. Using the Townsend Thai monthly data, they find that hidden income is supported while the predictions of limited commitment and moral hazard are not supported by the data.

Besides, migration has been widely used as a strategy to mitigate and manage risk exposure. Taylor et al. [2003] explain that migrants help households bypass credit and insurance markets imperfections, and they also facilitate productive investments to be financed using remittances. As a result, a number of models have been put forward to explain migration. Traditionally, Todaro [1969] viewed migration as an individual optimizing choice in which potential migrants estimate the associated costs and benefits of migration, and move out when expected benefits are more than the associated cost. In this framework however, the remittance motives are ignored in the migration process. To overcome this problem, the New Economics of Labour Migration (NELM) views the family as the relevant decision-making unit rather than the individual [Gubert, 2002]. In this case, migration choices have benefits to both migrants and non-migrant family members since migrants and households enter into a "contract" such that migrants send remittances to insure households against income shocks. Taylor and Martin [2001] argue that the NELM considers migration as a strategy to mitigate and manage risk exposure by not only maximizing expected family income but to also diversify their sources of income. This helps them reduce income variability and loosen credit constraints that curtails their ability to smooth consumption in the face of adverse income shocks. Similarly, Chen et al. [2003] note that in the context of market imperfections, households in developing countries have strong incentive to self-insure themselves through geographical dispersion of household members especially if expected income from migration is non-positively related with household income. This is because spatial diversification of income sources enhances the gains from risk sharing if and only if the probability that both the migrant and household experience negative income shock is non-positive.

The growing importance of remittance flows also led to increasing interest to understand the motives to remit. Two main explanations have been put forward to explain motivations to remit: altruism and self-interest. Remittances are motivated by altruism when migrants send remittances to their families because they care about the welfare of their relatives [Becker, 1974]. This altruistic approach is modelled by including the consumption level of those left behind in the migrant's utility function. However, remittances are also motivated by self-interest. Lucas

and Stark [1985] explain that remittances might be purely self-interest motivated if the migrant intents to return home or aspire to inherit when inheritance is conditioned on the migrant's behaviour. In this case, migrants have strong incentives to remit in order to maintain a healthy relationships with their families. Those that intent to return home also send remittances to invest in fixed capital (land, housing etc.), in public assets (enhance political influence or prestige) and in social-capital (maintaining healthy relationships with family and friends).

On the insurance effect of remittances, two channels are put forward through which remittances might improve households' welfare. The first channel is where remittances act as an ex-ante risk management mechanism. For example, Mohapatra et al. [2009] find that remittance-dependent households in Ethiopia rely more on cash reserves rather than selling household assets or livestock during food crisis episodes. They also find that remittance-receiving households in Ghana and Burkina Faso are better prepared against natural disasters because they have greater access to communication equipment and have housing built of concrete rather than mud. The second channel is where remittances act as an ex-post risk coping mechanism. Yang and Choi [2007] use household data in Philippine to study if remittances serve as insurance for recipient households. They found that changes in household income lead to changes in remittances in the opposite direction - roughly 60 percent of declines in income are replaced by remittance inflows. Similarly, Gubert [2002] uses recent household survey data from the Kayes area (western Mali) to assess the impact of income shocks on remittance flows. He provides empirical evidence to support that insurance is an important motivation for remittance inflows. Mohapatra et al. [2009] support this view when they find that remittance-receiving households in Bangladesh have higher per-capita consumption than their non-remittance receiving counterparts after the 1998 flood.

At the macro level, Yang [2008] provides cross-country evidence that remittances increase in the aftermath of natural disasters in countries that have a larger number of migrants abroad. Specifically, increased hurricane exposure is associated with greater remittance flows when private capital flows (FDI, commercial lending, and portfolio investment) actually decline to poorer countries in response to hurricane exposure. Combes and Ebeke [2011] also analyze the impact of remittances on consumption instability using a large cross-country panel of developing countries. Using system-GMM-IV estimation, they find that remittances significantly reduce consumption instability as it dampens the effect of various sources of consumption instability

such as natural disasters, agricultural shocks and discretionary fiscal policy. Interestingly, they find that the insurance role played by remittances is more important in less financially developed countries. Giuliano and Ruiz-Arranz [2009] arrive at a similar conclusion when they explore the hypothesis that remittance inflows substitute imperfect/missing credit and insurance markets in developing economies. They find that the marginal benefit of remittances received by households increases in less financially developed countries.

From these empirical evidence, it is noticeable that remittance flows have a potential positive effect on household welfare. Distinctively, the impact of remittances on households may vary in different countries depending on the economic structures and realities of these economies. Country-specific features such as economic size, financial deepening, government policies and degree of openness may affect the extent to which households' consumption and time allocation decisions response to remittance income shocks. The next two chapters build on these studies but with noticeable difference in many facets. First, I use a very rich monthly household panel data-set to examine: (a) remittances as a source of consumption insurance, and (b) how remittances alter family time allocation between market and home production activities. Most studies on the impact of remittances use either cross-country panel data [Combes and Ebeke, 2011] or cross-sectional household data [Gubert, 2002]. Studies that use cross-sectional data may suffer from severe biases in directions that are not obvious a priori. As Yang and Choi [2007] explain, these biases maybe either due to the problems of simultaneity between household consumption, time use and remittances or the difficulty in separating the cross-sectional relationship between these variables from the influence of unobserved factors that also affect households' consumption and time allocation choices. Second, our data makes it possible to capture in-kind remittances in addition to payments made by migrants to their households in developing countries. This enriches our analysis because our remittance variable is not confine to monetary transfers.

2.6 Remittances and Time Allocation

Although remittances serve as a potential source of insurance, these non-labour incomes can also distort households' work decisions in ways that can negatively affect their welfare at the margin. This phenomenon is substantially examine in chapter 4 where I investigate the effect

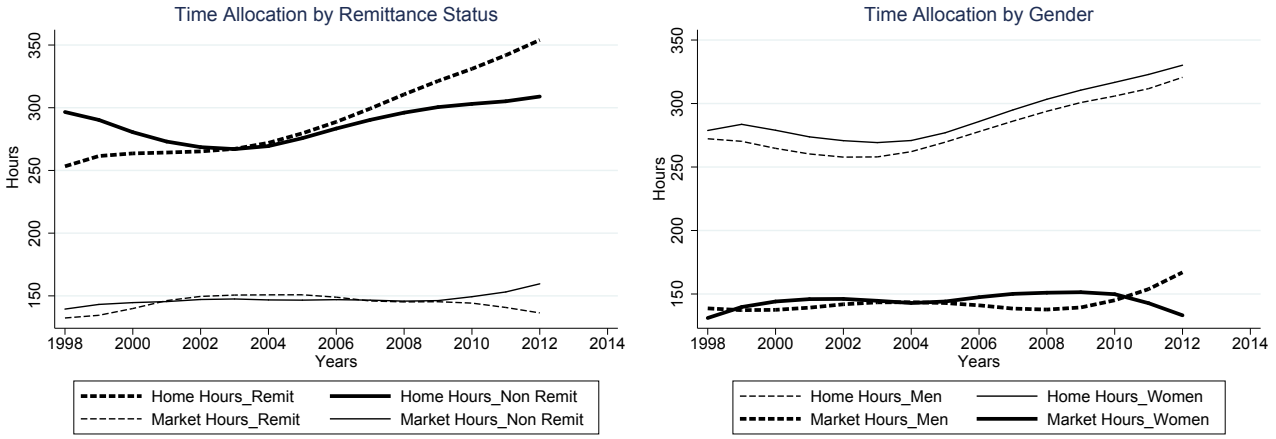
of remittances on family time allocation between market and home production activities. It is however very important to first present stylized facts on (a) time-series trends in time use, (b) the dynamics of family time allocation, and (c) how business cycle variations affect family time allocation decisions before delving deep into the analysis of how remittances alter these time allocation choices between market and home production activities, in chapter 4. This is the objective of this section. I start by presenting trends of family market and home work hours conditional on their remittance status, and the gender and education attainment of household heads. Then, I examine life-cycle dynamics of household time use focusing on two uses of time: market work and non-market production activities. These non-market activities include crop cultivation, fish & shrimp farming, livestock rearing and family businesses. Finally, I look into how business cycle variations impact family time allocations using cross-village data. I weed out these business-cycle effects to properly capture the effect of remittance on family time allocation.

2.6.1 Trends in Time Use

This subsection presents stylized facts on the trends of family market and home work hours conditional on their remittance income status, and the gender and education attainment of household heads. The main objective is to show how remittance-receiving households allocate their time compared to non-remittance receiving households overtime. Figure 2.20 and 2.21 illustrate that Townsend Thai households spend more hours on home production activities than on market production regardless of their remittance income status or gender of household heads. For remittance receiving households, home hours have been steadily increasing since 2004 while market hours have been relatively unchanged. However, market hours for remittance-receiving households dropped slightly in the aftermath of the 2008 Global Financial Crisis. In contrast, home hours have been relatively stable for non-remittance receiving households while their market hours pick up after the 2008 Global Financial Crisis. On the other hand, female-headed households spend more hours on home production activities than their male counterparts. Interestingly, market hours for both male and female-headed households have not been very different until 2011 when male-headed households started spending more hours in labour market activities than their female counterparts. Furthermore, Figure 2.21 shows the trends of home and market hours for low-skilled, medium-skilled and high-skilled households

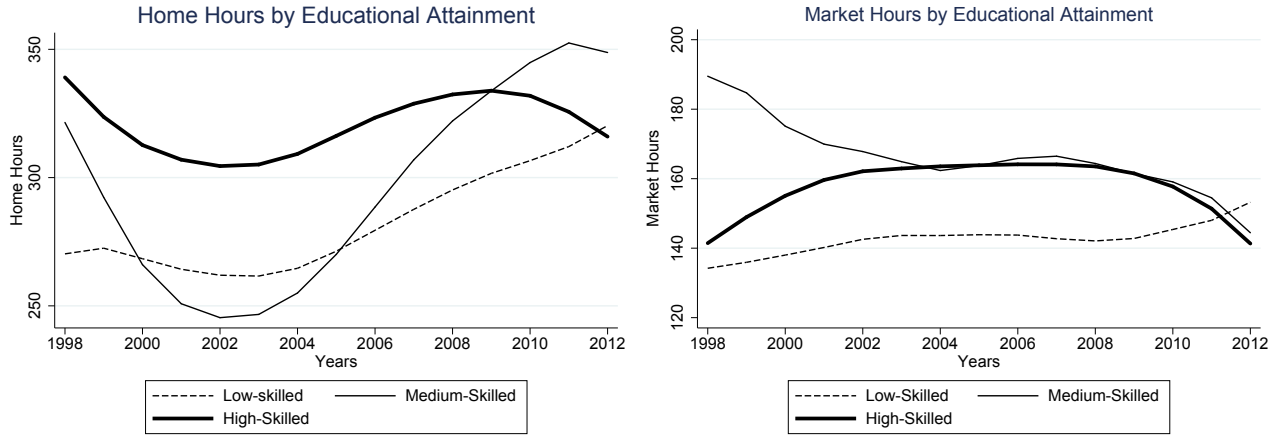
between 1998 and 2012. Households are categorized low-skilled if the household head has less than 12 years of education. Medium-skilled households are those whose heads have between 12 and 15 years of schooling while high-skilled households are those with more than 15 years of education.

Figure 2.20: Time Allocation by Remittance Status and Gender of Household Head



Trends of average monthly home and market hours for male and female headed households as well as for remittance and non-remittance receiving households. Whereas market hour is the sum of time spend on paid jobs and the time spent looking for paid jobs, home hour is the sum of time spent on home production activities such as crop cultivation, fish & shrimps farming, livestock rearing and family businesses. Data Source: Townsend Thai Data.

Figure 2.21: Home and Market Hours by Educational Attainment



These figures show the trends of monthly home and market hours for low-skilled, medium-skilled and high-skilled households. Households are categorized low-skilled if household heads have less than 12 years of education. Medium-skilled households are those whose heads have between 12 and 15 years of schooling while high-skilled households are households with more than 15 years of education. Source: Townsend Thai Data.

The panel on the right of Figure 2.21 shows that medium-skilled and high-skilled households spend more hours on market activities than low-skilled households. Surprisingly, these medium and high-skilled households also spend more hours on home production activities. It is only after 2011 that low-skilled households started spending more hours on home production than

their high-skilled counterparts. This can be partly explained by the uncertainties surrounding the Thai economy in the aftermath of the 1997-98 Asian financial crisis, the September 2006 Military coup and the subsequent spillover effects of the 2008 Global Financial Crisis on the Thai economy. To better disentangle households' time allocation conditional on educational attainment, I categories households into different sex-skill groups and study their time allocation during the time under consideration. As shown in the panel on the left of Figure 2.22, unskilled male-headed households on average spend more hours on home production than those with skilled male heads. However, the reverse is true for female headed households since families with skilled-female heads spend more time on home production than all the other skill-sex groups. This provides more insights in explaining why high-skilled households spend a lot of hours in home production as illustrated in Figure 2.21. Whereas skilled men spend more hours in the market and less time in home production activities, skilled-women allocate higher hours in home production activities. For unskilled male and female-headed households, home hours have been consistently increasing for both skill-sex groups while market hours increase (decrease) for the former (latter).

Figure 2.22: Home and Market Hours by Skill-Sex Groups

Source: Townsend Thai Data. These figures show the trends of average monthly home and market hours for skilled and unskilled men as well as for skilled and unskilled women. Households are categorized skilled if household heads receive more than 12 years of schooling. Unskilled households are defined as those without high school education.

2.6.2 Life Cycle Profiles of Time Use

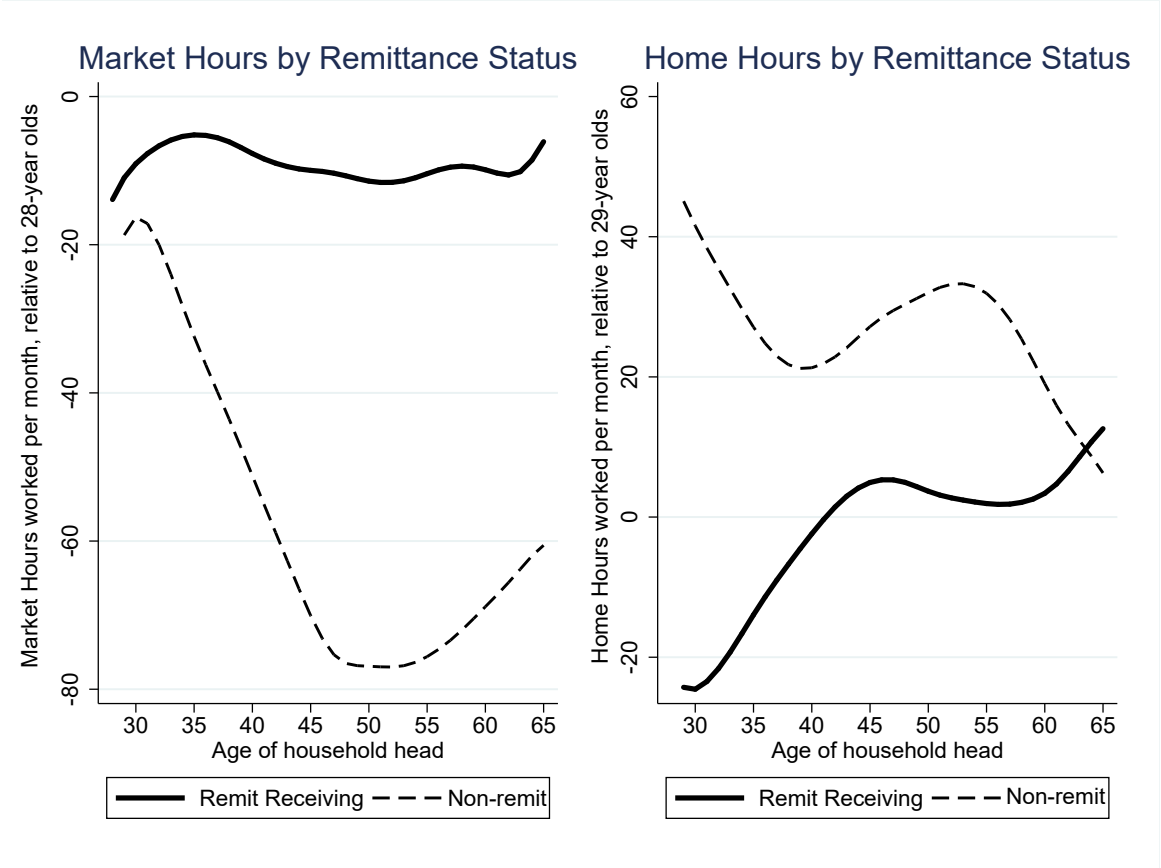
The objective of this subsection is to present stylized facts on time use over family life-cycle conditional on their remittance income status. This provides the foundation on which I will

build on to substantially examine the effect of remittances on family time allocation between market and home production activities in chapter 4. I illustrate life-cycle time allocation patterns conditional on households' remittance status using data from the Townsend Thai survey. Specifically, these life-cycle figures show age coefficients β^g_{age} (relative to age 28) from the regression below

$$Hours^g_{it} = \beta^g_0 + \beta^g_{age} Age_{it} + \beta^g_c Cohort_{it} + \varepsilon^g_{it} \tag{2.1}$$

Here g denotes household groups as it indicates whether household i is a remittance receiving household or a non-remittance receiving household in period t. $Hours^g_{it}$ denotes the number of hours household i in group g spend in home or market production activities at time t. Age_{it} is a vector of 38 1-year age dummies (for ages 28-65), $Cohort_{it}$ is a vector of 1-year birth cohort dummies (1933-1970) and ε^g_{it} is the error term for household i in group g at time t. The two panels in Figure 2.23 report age coefficients β^g_{age} using family market and home hours in the specification above for remittance and non-remittance receiving households. Each of the two

Figure 2.23: Life Cycle Profiles of Time Use



Source: Townsend Thai Data.

panels contains two lines. The thick lines, in both panels, estimate equation (2.1) for remittance

receiving households and the dashed line estimates the same equation for non-remittance receiving households. In both cases, I use age 28 as the benchmark group and compare this group with households whose heads are between 29 and 65 years old. Figure 2.23 clearly illustrates that the life cycle profiles of market and home hours differ substantially between remittance and non-remittance receiving Thai households. Remittance-receiving households spend more hours on home production and less hours on market work the older the household head gets. As we will explore further in subsequent chapters of this dissertation, this can be explained by relaxing budget constraints when household heads get older. This can be explained by the fact that there is higher probability for such households to receive more remittances to finance productive investments within and outside the household. For non-remittance receiving households, market work increases with age before declining after prime working age. Interestingly, home hours of non-remittance receiving households decline with the age of household heads.

2.6.3 Business Cycle Variation in Time Use

In this subsection, I estimate how foregone market work hours are reallocated to different home production activities at business cycle frequencies. This is done because the interpretation of changes in time allocation during a recession depends on how one controls for low frequency trends. Aguiar et al. [2013] use cross-state data to estimate business-cycle effects on time use in the United States. Following their approach, I use cross-village variations in employment changes during the recessions caused by the 1998 Asian Financial Crisis and the 2008 Global Financial Crisis to tease out potential business-cycle effects on time allocation in Thailand.

For different time use categories j, I define village level aggregates $Time^{j}_{vt}$ as

$$Time^{j}_{vt} = \sum_{i=1}^{N_{vt}} \left(\frac{w_{ivt}}{\sum_{i=1}^{N_{vt}} w_{ivt}} \right) Time^{j}_{ivt} \tag{2.2}$$

Here, $Time^{j}_{ivt}$ is hours per month household i from village v spent in time use category j at time t. Similarly, N_{vt} denotes the number of households in our sample from village v in time t. I calculated village level averages in time use using sampling weights w_{ivt} constructed from the Townsend Thai data. The Townsend Thai survey covering 172 months, from September 1998 to December 2012. I collapsed these data into multi-year samples before creating village-level averages for each time-use category in 1998-1999, 2000-2002, 2003-2006, 2007-2008, 2009-2010

and 2011-2012. For each village, I compute $\Delta Time^{j}_{vt}$ by taking the difference in hours spent in category j in village v between two adjacent time periods (i.e. 1998-1999 vs 2000-2002, 2000-2002 vs 2003-2006, 2003-2006 vs 2007-2008, 2007-2008 vs 2009-2010, and 2009-2010 vs 2011-2012). Therefore, I have a total of 80 observations, five observations for each of the 16 villages in the Townsend Thai monthly survey.

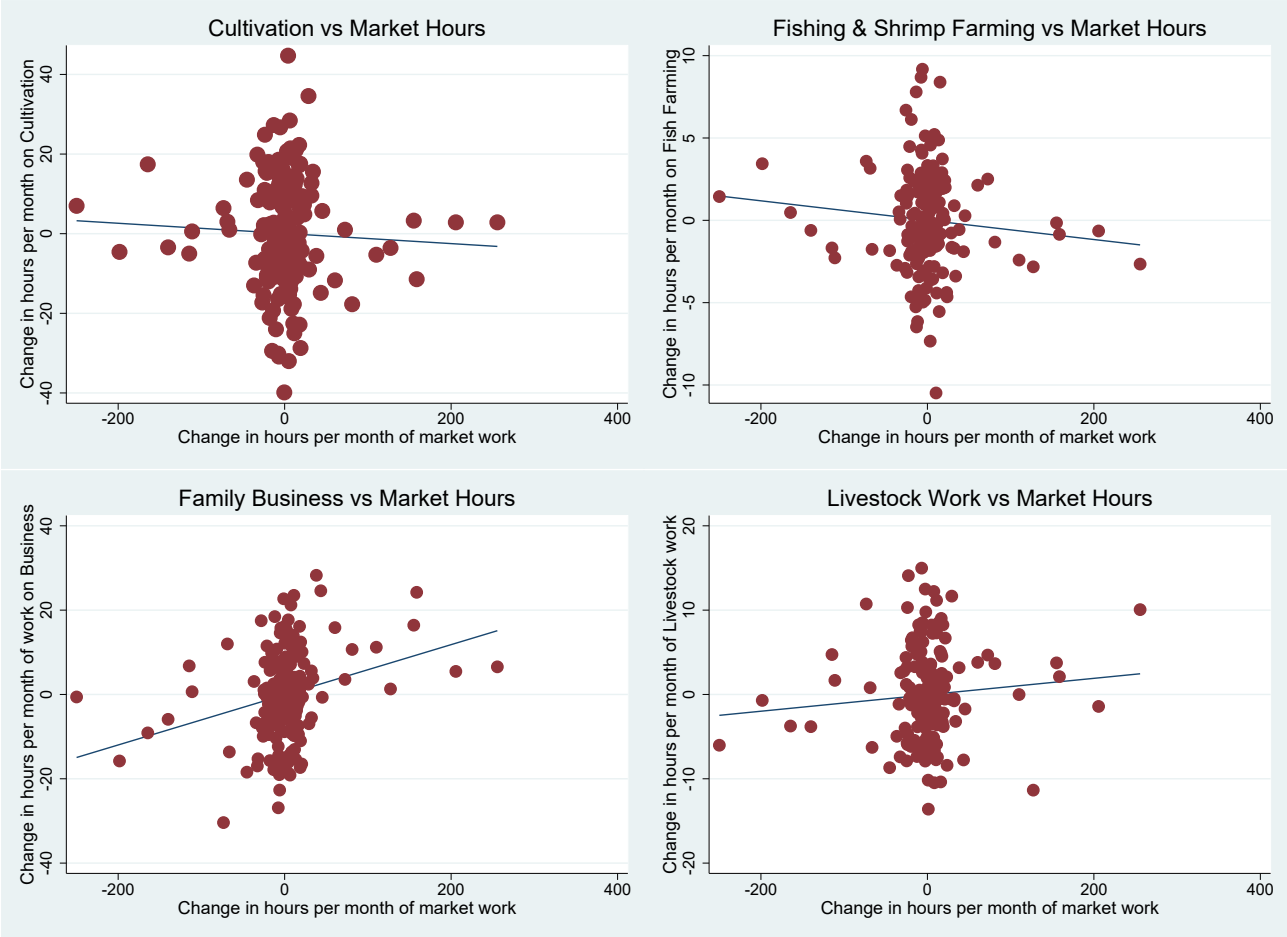
To estimate how foregone market work hours are reallocated across different home production activities, I estimate the following regression:

$$\Delta Time^{j}_{vt} = a^{j} + \alpha^{j} \Delta Time^{market}_{vt} + b^{j} D_{t} + c^{j} \Delta X_{vt} + \epsilon^{j}_{vt} \tag{2.3}$$

where $\Delta Time^{market}_{vt}$ is the change in market hours per month for the average household in village v between period t and $t+s$. $\Delta Time^{j}_{vt}$ is the change in hours per month an average household in village v spent in home production activity j between periods t and $t+s$. These home production activities are crop cultivation, fish & shrimp farming, livestock rearing and family businesses. That is, $j \in \{crop\,cultivation,\ fish\ \&\ shrimp\ farming,\ livestock\ rearing,\ family\ businesses\}$. Furthermore, D_t is a vector of five dummies for the periods 2000-2002, 2003-2006, 2007-2008, 2009-2010 and 2011-2012. These time dummies are included to make sure that the estimated substitutions of market hours across different home production activities is purely due to cross village differences, not common trend, after controlling for village specific characteristics X_{vt}.

Figure 2.24 shows the relationship between changes in market hours and changes in home production activities such as cultivation, fish & shrimps farming, family business and livestock rearing works across villages. The x-axis of each panel measures the per month change in average market hours within each village during the adjacent time periods. On the other hand, the y-axis of each panel measures the per month change in average time allocation to crop cultivation, to fish & shrimps farming, to family business, and to livestock rearing works, respectively. According to Figure 2.24, as market work hours fall at business cycle frequencies, family time allocated on family businesses and livestock rearing also decline but more family hours are allocated on cultivation and fish & shrimp farming. Thus, household cultivation and fish & shrimp farming activities can be considered "substitutes" to market work while family businesses and livestock rearing compliment market work. This implies that households use crop cultivation and fish & shrimp farming activities as insurance mechanisms against shocks in market hour.

Figure 2.24: Time Use During Business Cycle Variations



Source: Townsend Thai Data.

The lines in Figure 2.24 are OLS regression lines through the scatter plots to estimate the α^j coefficients in equation 2.3. $\alpha^{cultivation}$ is estimated to be -0.12 with a standard error equals to 0.0211. This means that an hour decline in market time at business-cycle frequencies leads to a 12-minute increase in time allocated to crop cultivation. Moreover, the time allocated to fish & shrimp farming increases by 6 minutes following an hour decline in market time at business cycle frequencies ($\alpha^{fish\&shrimp} = -.06$ with a standard error 0.0046). This suggests that a total of 18 minutes out of a foregone market hour is allocated to crop cultivation and fish & shrimp production. On the other hand, family business and livestock hours decline with households' market time. To be specific, family business hours decline by 6 minutes ($\alpha^{business} = .06$ with a standard error 0.0159) and livestock hours fall by 1 minute ($\alpha^{livestock} = .01$ with a standard error 0.0083) for every hour decline in market work. Since the total increment in crop cultivation and fish & shrimps time is higher than the decline in business and livestock hours, net home time increases with a decline in market work at business cycle frequencies. This result is consistent with the increasing home time for all skill-sex groups between 2004 and 2012 as illustrated

by the time series trends in the previous section. The fact that home hours increase for all skill-sex groups during the 2008 Global Financial Crisis signifies that business cycle factors are important drivers to time allocation patterns in Thailand. Similarly, the fact that home work increases during the recession suggest that there was no significant decline in home production time above and beyond the business cycle. This is not surprising given the importance of home production in rural Thailand.

2.7 Conclusion

This chapter is an introductory chapter for the subsequent two chapters on remittances as a source of insurance and the effect of remittances on household time allocation. The objective is to document key stylized facts on the flow of remittances to developing economies, Thailand's macroeconomic environment and the dynamics of household consumption, incomes, and time use. To achieve these, I divide this chapter into three parts. The first part documents the flow of remittances and Thailand's macroeconomic conditions. The second part examines the dynamics of households' earnings, consumption and income from home production activities conditional on their remittance income status. Finally, I examine how remittances affect the dynamics of time allocation between market and home production activities.

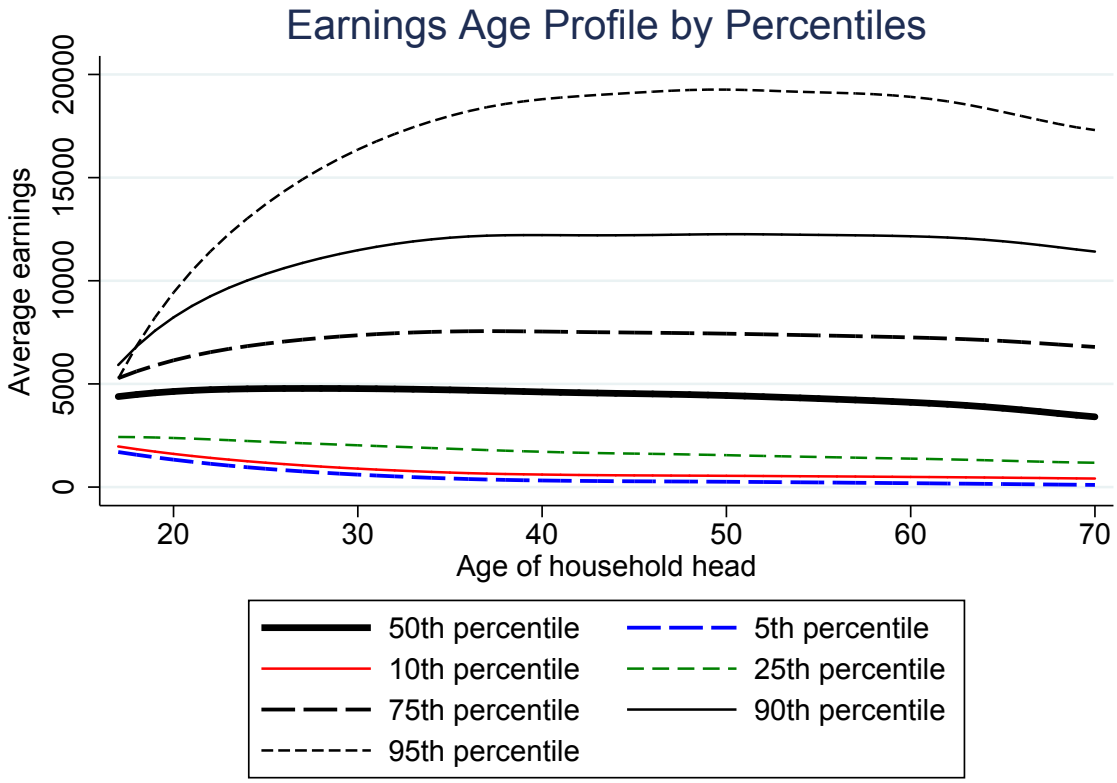
I document the increasing flow and share of remittances relative to other forms of international capital flows, making it the second most important source of international capital flow to developing countries. Interestingly, I also document that remittances are less volatile and less pro-cyclical than other forms of international capital flows to developing countries. On Thailand's macroeconomic conditions, I find that the 1997-98 Asian Financial crisis led to a decline in employment rates and a substantial increase in remittances reflecting the insurance motive of remittance flows. Moreover, I find that gender differential in monthly pay has been consistently declining since 2003 while income is more concentrated in urban Thailand using the Gini index as a measure of inequalities in the distribution of economic prosperity.

Using the Townsend Thai data, I find that households' labour earnings follow the popular inverted-U shape in which earnings are low at the beginning and end of the life-cycle, and at its highest during prime working age. In addition, Thai households receive the highest income from home production regardless of their remittance income status. Apart from income from home

production, I find remittances to be the second most important source of income for remittance-receiving Thai households. Importantly, data from the Townsend Thai survey do not support the full consumption insurance hypothesis although Thai households do have significant access to consumption smoothing devices. This result is consistent with the findings of Karaivanov and Townsend [2014] who provide evidence that income shocks do translate to adjustments in household consumption, using annual rural and urban data from the Townsend Thai survey. With regards to households' time allocation, I find that on average Townsend Thai households spend more hours on home production activities than on market production regardless of their remittance income status. For remittance receiving households, home hours have been steadily increasing while market hours decline. However, for non-remittance receiving household, home hours have remained relatively unchanged while market hours pick up steadily.

2.8 Appendix

Figure 2.25: Earning Profiles by percentiles



This figure illustrates the age profiles of households' average monthly earnings. Data Source: Townsend Thai Data.

Figure 2.26: Age Profile of Income from Home Production, by Percentiles

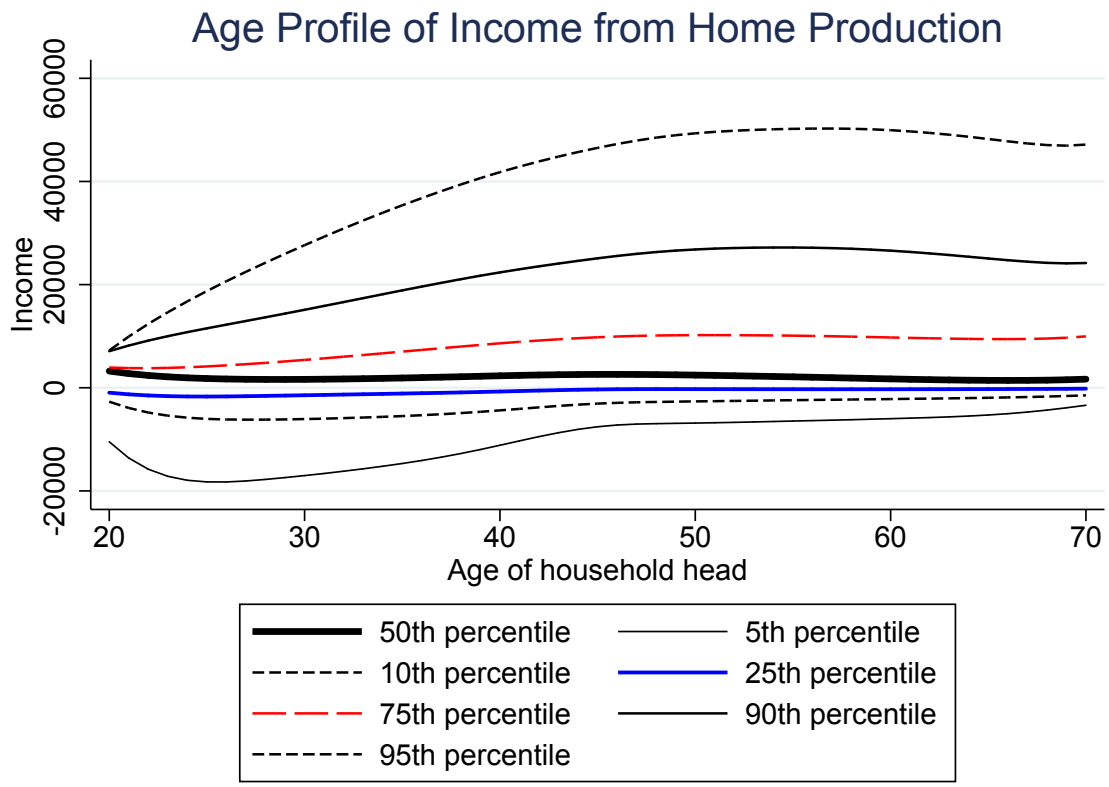


Figure 2.27: Remittance Profiles by Percentiles

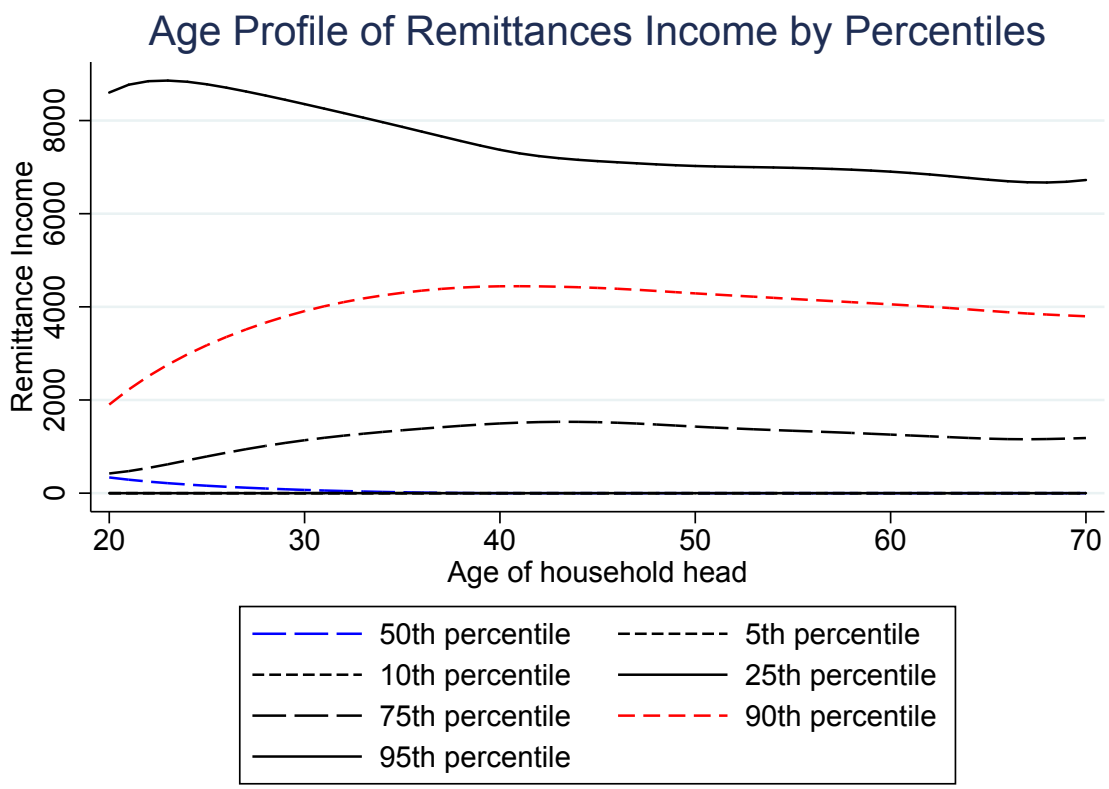
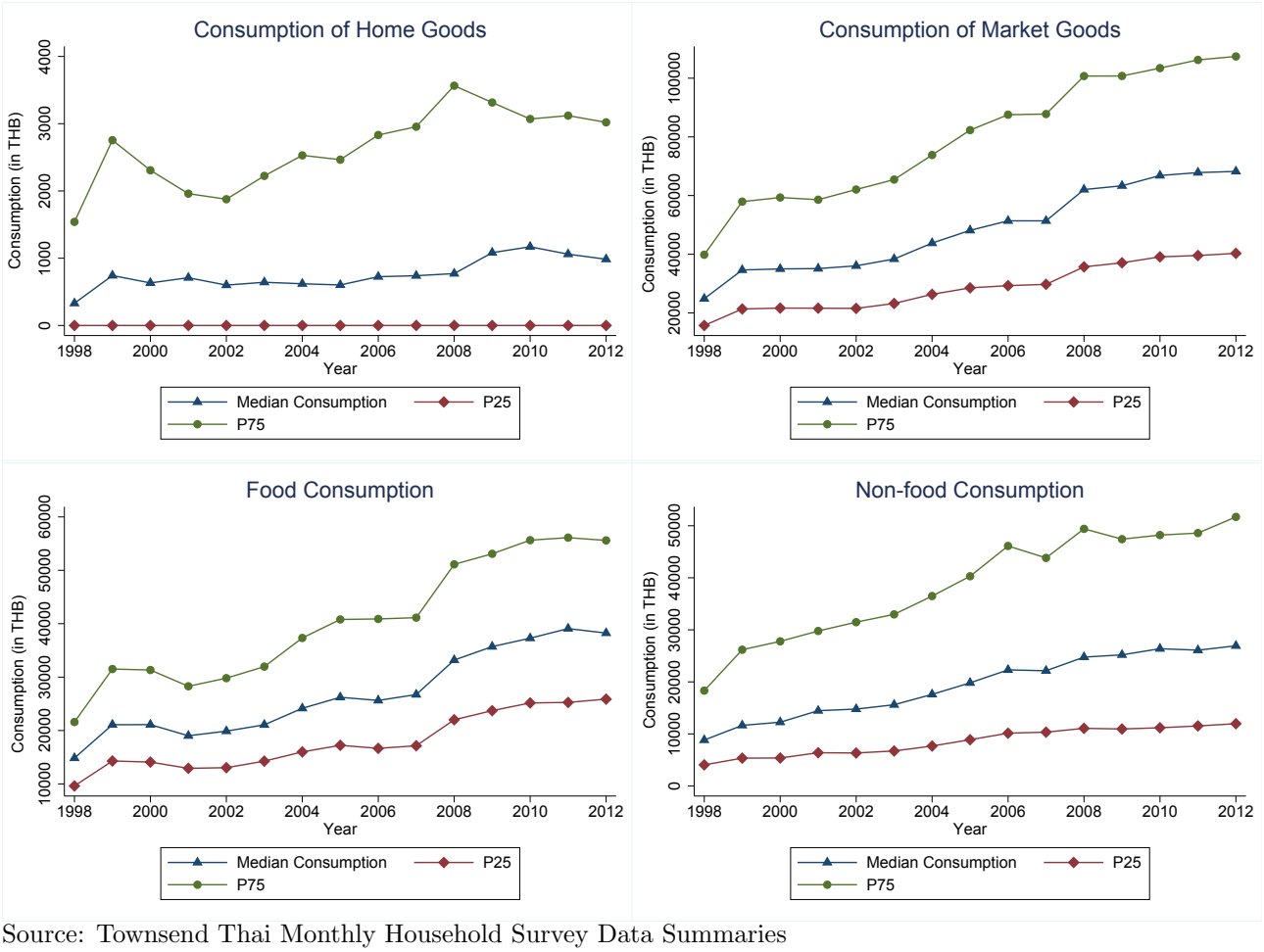


Table 2.8: Descriptive Statistics by Remittances Status

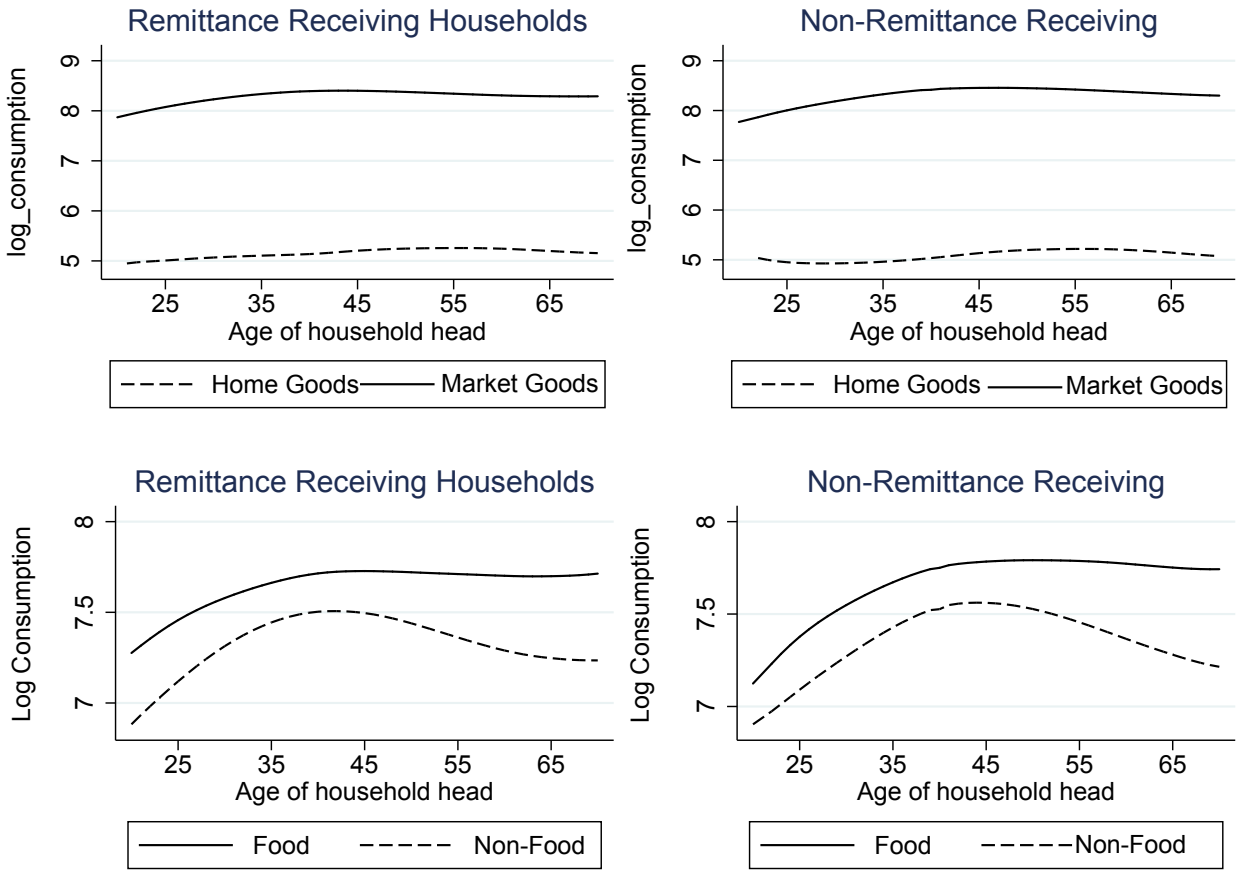
	Remit Receiving		**Non-Remit**	
	Mean	Std. Dev.	Mean	Std. Dev.
Total Assets	**1,920,823**	**5,593,071**	**2,203,496**	**7,174,556**
Cash in Hand	450,211	1,129,518	496,270	1,229,647
Account Receivables	9,877	196,979	10,485	199,255
Deposits	79,030	328,846	89,653	343,831
ROSCA	856	5,378	994	6,517
Other Lending	7,601	32,530	7,606	33,296
Inventories	126,849	327,701	133,958	362,544
Livestock	27,509	152,163	23,279	149,433
Fixed Assets	96,883	248,328	**99,595**	**266,884**
Household Assets	58,244.68	118,119	61,362	123,448
Agriculture Assets	27,781	157,413	27,586	198,861
Business Assets	10,857	103,868	10,646	83,367
Land	30,380	1,062,280	1,282,325	6,494,690
Land Improvement	59,728	216,644	59,331	217,275
Total Liabilities	**128,837**	**270,612**	**129,383**	**308,461**
Account Payable	18,891	88,351	19,545	73,030
Other Borrowings	109,138	248,123	108,865	291,088
ROSCA	808	4,903	973	5,764
Net Income	**8,170**	**40,086**	**9,126**	**52,582**
Cultivation Revenue	6,419	37,845	6,203	42,847
Livestock Revenue	332	3,770	304	3,903
Fish & Shrimps Revenue	6,214	95,742	7,223	122,137
Business Revenue	7,609	49,466	8,098	48,254
Labour Revenue	4,289	12,650	4,765	14,317
Total Consumption	**7,839**	**15,047**	**8,068**	**13,156**
Consumption of Home Goods	163	324	145	288
Consumption Expenditure	5,918	13,991	6,132	11,690
Food Expenditure	2,630	2,256	2,789	2,356
Non-Food Expenditure	3,287	13,350	3,343	10,837
Number of Adult Male	1.67	1.13	1.68	1.15
Number of Adult Female	1.88	1.21	1.91	1.24
Number of Children	0.66	0.88	0.64	0.87
Household Head's Age	55.79	13.5	56.79	13.72
Family Size	3.80	1.73	3.84	1.79
Head's Education (years)	4.58	2.60	4.55	2.75
Net wealth	**1,791,986**	**5,544,124**	**2,074,113**	**7,120,167**
Households	799			
Monthly Observation	138,227			

Figure 2.28: Average Monthly Consumption (in Thai Baht)



Source: Townsend Thai Monthly Household Survey Data Summaries

Figure 2.29: Average Monthly Consumption by Remittance Status



Source: Townsend Thai Data. The consumption patterns of remittance and non-remittance receiving households are not very different from each other. However, overall, non-remittance receiving households consume slightly more than remittance receiving households despite the fact that remittance-receiving households consume more home produced goods than non-remittance receiving households.

Chapter 3

Remittances and Consumption Insurance

3.1 Introduction

Are remittances a source of insurance for recipient households? Interest in this question is primarily motivated by two main facts that are observed in developing countries. First, studies document that risk to household income is widespread in developing countries; households in these economies are often exposed to many forms of risks such as income or crop loss due to droughts, floods, earthquakes and other natural disasters [Dercon, 2002; Yang and Choi, 2007].[1] Second, as documented in Chapter 2, remittance flows to developing countries have increased substantially over the past two decades. In the face of widespread risk, households in these economies rely on informal insurance arrangement between individuals and households rather than on publicly managed or market provided insurance schemes [Morduch, 1999]. As a results, remittances serve as a potential source of insurance for households in these environments.

The extent to which household consumption can be insured against income shocks attracts a large body of literature [Kaplan and Violante, 2010]. Researchers have generally rejected the

[1] If full insurance were available, household consumption should not respond to such idiosyncratic shocks. The proposition that under perfect insurance, consumption should be independent of idiosyncratic income shocks can be tested by regressing consumption growth on a variety of variables that are exogenous to households. Cochrane [1991] used this approach by testing β equals to zero in regressions of the form: $\log\left(\frac{C^j_{t+1}}{C^j_t}\right) = \alpha + \beta X^j_{t+1} + \epsilon^j_{t+1}$ where $\frac{C^j_{t+1}}{C^j_t}$ is household $j's$ consumption growth and X^j_{t+1} is a vector of idiosyncratic shock variables.

full insurance hypothesis. For instance, Townsend [1995], Gertler and Gruber [2002], De Weerdt and Dercon [2006] and Morten [2016] find that adverse income shocks do translate to reduction in household consumption. Kinnan et al. [2011] explain that households are neither fully insured, with consumption completely buffered against idiosyncratic income shocks, nor do they live from hand-to-mouth, with income shocks translating one-for-one to fluctuations in consumption. The extent to which consumption response to changes in income depends on the nature of income shocks and households' ability to insure themselves against such income fluctuations. Blundell et al. [2008] find that households have more ability to insure themselves against transitory earning shocks than permanent shocks.

But how does the presence of remittances alter the degree of consumption smoothing? This chapter examines remittances as a source of insurance for recipient households using a life-cycle model that allows for three potential sources of consumption insurance. The first is self-insurance via household labour supply such that households adjust their labour hours in response to income realizations. The second is self-insurance through assets (de)accumulation. Here, households build up savings in good times and draw them down in hard times. Finally, the third source of insurance, which is the focus of this chapter, is "external" insurance through remittances. That is, households receive remittance inflows from relatives or family members abroad during adverse income shocks to smooth consumption. On the modelling part, the framework used in this chapter has four distinctive features. First, household labour supply is endogenous. This makes market wages the primary source of uncertainty faced by households. Second, I decompose the wage process into three components; a deterministic component and stochastic permanent and transitory components. Third, I model remittances as an exogenous process to receiving households. This is because the amount and timing of remittance flows are determine by remitters rather than beneficiary households. Similar to the wage process, I decompose the stochastic component of remittance flows into a persistent and transitory component. Finally, I allow remittance shocks to be freely correlated with their corresponding wage shocks such that households experience permanent (transitory) changes in remittance income when they experience permanent (transitory) wage shocks. This reflects the "insurance arrangement" nature of remittances.

Since I am interested in examining the transmission mechanisms of remittance shocks on household earnings and consumption, I derive analytical expressions for consumption and earnings as

a function of wage and remittance income shocks. These expressions are empirically estimated to examine how the presence of remittances alter the degree of consumption smoothing. Three important findings are worth noting. First, full consumption insurance is soundly rejected for both transitory and permanent wage shocks. Whereas 83% of transitory wage shocks are insured (i.e. do not translate into consumption growth), only 47% of permanent wage changes are insured. Second, I find that 72% of the consumption smoothing is explain by households' self-insurance behaviour through asset accumulation while remittance explains only 11%. Finally, I find that households with low education attainment depend more on remittances as a source of insurance while those with higher educational levels have higher access to smooth consumption via asset accumulation.

3.2 Theoretical Framework

In this section, I specify a fairly standard incomplete-markets model to develop a link between household consumption and earnings as a function of wage and remittance income shocks. Households in this life-cycle model are born at time $t = 0$, work until $t = T_w$ and die at time $t = T$. At each time t, household i receives remittances, and chooses consumption and work hours in order to maximise expected lifetime utility. The objective is to derive households' optimal consumption and work hour choices as a function of wage and remittance shocks; expose them to adverse wage shocks and observe how they respond over the life-cycle using remittances and assets as insurance devices. My working assumption is that remittances are always expected, and they cover both permanent and transitory shortfalls in income, however remittance shocks are unexpected. My focus is to examine how consumption changes Δc_{it} due to unexpected changes in remittance income Δr^R_{it}. It is however important to note that some of these effects may be due to changes in remittance, not remittance shocks at all. That is to say, households may have some advance information about remittance shocks, and may therefore adjust their consumption in advance of these shocks. To test the presence of advanced information, I test whether current consumption growth can be predicted by future growth in remittance income.[2] If households do not have advance information, consumption growth at time t should be orthogonal to growth in remittance income at time $t + 2$, $t + 3$, $t + 4$, $t + 5$ etc. I estimate the covariances $\mathbb{E}_t(\Delta c_{i,t} \Delta r^R_{i,t+\tau})$ for $\tau = \{2, 3, 4, 5\}$ using GMM and test the null

[2]This follows from the intuition of Cunha et al. [2005].

hypothesis of no advanced information (i.e. they are jointly not significant) at the standard confidence level.[3] The result of our joint hypothesis test does not reject the null of no advanced information with a p-value of 0.35. Hence, one can conclude that some of our findings may be impacted by advance information.

In what follows, I specify the theoretical foundations of our household welfare maximization problem over the life cycle subject to family resource constraints, and their wage and remittance income processes.

3.2.1 Wage & Remittance Income Processes

Before deriving households' optimal consumption and labour supply decisions, I start by discussing how I modelled wage and remittance processes, and how the relationship between remittance and wage shocks reflects the "insurance motive" of remittance flows. Market wage W_{it} is compose of three components; a deterministic component $\mathbf{X}_{it}$, a transitory component u_{it} and a permanent component P_{it}. Thus, our wage process is mathematically written as

$$\ln W_{it} = \mathbf{X}'_{it}\varphi_t + \ln P_{it} + u_{it} \tag{3.1}$$

where $\mathbf{X}_{it}$ denotes a vector of observed wage characteristics at time t. The permanent (non-mean reverting) P_{it} component follows a random walk process

$$\ln P_{it} = \ln P_{i,t-1} + v_{it} \tag{3.2}$$

Both permanent v_{it} and transitory u_{it} wage shocks are i.i.d. with variances σ_v^2 and σ_u^2 respectively. As a result, household wage growth from labour market participation can be written as

$$\Delta w_{it} = v_{it} + \Delta u_{it} \quad \text{where} \quad w_{it} = \log W_{it} - \mathbf{X}'_{it}\varphi_t$$

Similar to the wage process, I modelled the remittance income process (net of its deterministic component that depends on observed households characteristics $\mathbf{X}_{it}$) as the sum of permanent remittance income shock $\zeta_{i,t}^R$ and a transitory shock τ_{it}^R. Thus, the remittance income process

[3]The estimated GMM results are presented in Table 3.5 in the Appendix.

can also be written as:

$$\Delta r_{i,t}^{R} = \zeta_{i,t}^{R} + \Delta\tau_{it}^{R}$$

where both the permanent $\zeta_{i,t}^{R}$ and the transitory τ_{it}^{R} remittance shock components are i.i.d. with variances σ_{ζ}^{2} and σ_{τ}^{2} respectively. Importantly, I allow remittance income shocks to be freely correlated with their corresponding wage shocks such that households experience permanent (transitory) changes in remittance income when they experience permanent (transitory) wage shocks. This is summarize below:

$$\mathbb{E}_t(\zeta_{j,t}^{R} v_{k,t-s}) = \begin{cases} \sigma_{\zeta v}^{2} & \text{if j = k and s = 0} \\ \sigma_{\zeta_j v_k}^{2} & \text{if j} \neq \text{k and s = 0} \\ 0 & \text{Otherwise} \end{cases} \tag{3.3}$$

$$\mathbb{E}_t(\tau_{j,t}^{R} u_{k,t-s}) = \begin{cases} \sigma_{\tau u}^{2} & \text{if j=k and s = 0} \\ \sigma_{\tau_j u_k}^{2} & \text{if j} \neq \text{k and s = 0} \\ 0 & \text{Otherwise} \end{cases} \tag{3.4}$$

Assumptions (3.3) and (3.4) capture the insurance motive of remittance flows as they specify that remittance shocks can be contemporaneously correlated with wage shocks within and across households, such that permanent wage shocks can lead to persistent changes in remittance income and transitory wage shocks can also lead to temporal changes in households' remittance income. This is an important assumption given existing empirical evidence that remittances response negatively to income shocks experienced by remittance-receiving households. For example, Yang and Choi [2007] find that roughly 60 percent of exogenous declines in household income are replaced by remittance inflows in Philippine. Similarly, I assume that households' permanent and transitory remittance shocks are uncorrelated, i.e. $\mathbb{E}_t(\zeta_{j,t}^{R}\tau_{j,t}^{R}) = 0$, and the same is true for wage shocks $\mathbb{E}_t(v_{j,t}u_{j,t}) = 0$. This is a reasonable assumption as it signifies that households do not jointly experience transitory and permanent wage or remittance shocks at the same time.

3.2.2 Household Maximization Problem

Given these wage and remittance income processes, and the relationship that exists between remittance and earning shocks, I now proceed to derive households' optimal consumption and

labour supply choices. Our households derive utility from consumption C_{it}, dis-utility from work H_{it}, and discount the future at rate β in order to maximise expected lifetime utility.

$$\max_{C_{ik},H_{ik}} \mathbb{E}_t \left(\sum_{k=t}^{T} \beta^{k-t} u(C_{i,k}, H_{ik}) \right) \tag{3.5}$$

However, households also face per-period budget constraints which restrict their feasible optimal choices. This is because whenever households decide how much to consume and how many hours to work, their consumption expenditures cannot go beyond their incomes from remittances R_{it}, labour market participation $W_{it}H_{it}$ and asset holdings A_{it}.

$$C_{i,t} + A_{i,t+1} = (1+r)A_{i,t} + W_{i,t}H_{i,t} + R_{i,t} \tag{3.6}$$

Here, W_{it} denotes market wage and r is market interest rate. Consequently, our household maximization problem becomes

$$\max_{C_{ik},H_{ik}} \mathbb{E}_t \left(\sum_{k=t}^{T} \beta^{k-t} u(C_{i,k}, H_{ik}) \right)$$

subject to a lifetime resource constraint

$$\mathbb{E}_t \sum_{k=0}^{T-t} \frac{C_{i,t+k}}{(1+r)^k} + \frac{A_{i,T+1}}{(1+r)^{T-t}} = \mathbb{E}_t \sum_{k=0}^{T_w-t} \frac{W_{i,t}H_{i,t}}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{i,t+k}}{(1+r)^k} + (1+r)A_{i,t}$$

our remittance and wage processes, as well as some non-negativity constraints

$$\Delta w_{it} = v_{it} + \Delta u_{it} \quad \text{and} \quad \Delta r^R_{i,t} = \zeta^R_{i,t} + \Delta \tau^R_{it}$$

$$C_{i,t} \geq 0, \qquad H_{i,t} \geq 0$$

The lifetime budget constrain is obtained by taking the life-time sum of the per-period budget constraints given by equation (3.6). The objective is to derive households' optimal consumption and time work choices, expose these choices to adverse wage shocks and observe how households respond using remittances and assets as insurance devices. Unfortunately, the dynamic nature of this maximisation problem makes it impossible to obtain closed-form solutions for these household decisions. Thus, I proceed by using a two-step procedure that is fairly standard in

the literature to approximate the dynamics of household consumption and work hours. These dynamic expressions will be empirically estimated in order to examine whether the presence of remittances alters the degree of households' consumption smoothing.

3.2.3 Consumption and Income Dynamics

The objective of this section is to derive dynamic consumption and labour supply (consequently earning) models that express the growth rates of household consumption and domestic earnings as a function of wage and remittance income shocks. This is achieve in two steps that are standard in the consumption literature. For simplification of notations, I use lower case letters c_t, w_t and y_t to denote the log of household consumption, wage and income net of the effects of observed household characteristics.

The first step of the approximation procedure is to apply a Taylor expansion on the first order optimality conditions of our household maximization problem. This gives us expressions for the evolution of household consumption Δc_{it} and income Δy_{it} as a function of wages w_{it} and the marginal utility of wealth, λ_{it}.[4]

$$\Delta c_{it} \simeq (\eta_{C,W} - \eta_{C,P}) \underbrace{(\Gamma_t + \varepsilon_{it})}_{\Delta \ln \lambda_{it}} + \eta_{C,W} \underbrace{(v_{it} + \Delta u_{it})}_{\Delta w_{it}}$$

$$\Delta y_{it} \simeq (\eta_{H,P} - \eta_{H,W}) \underbrace{(\Gamma_t + \varepsilon_{it})}_{\Delta \ln \lambda_{it}} + (1 - \eta_{H,W}) \underbrace{(v_{it} + \Delta u_{it})}_{\Delta w_{it}}$$

Here, $\eta_{x,y}$ denotes Frisch (constant marginal-utility) elasticities of household consumption and work hours with respect to wage and the price of consumption. The signs of $\eta_{C,W}$ and $\eta_{H,P}$ determine whether household consumption and hours worked are Frisch substitutes ($\eta_{C,W} < 0, \eta_{H,P} > 0$) or Frisch complements ($\eta_{C,W} > 0, \eta_{H,P} < 0$). These signs also depend on the sign of the cross derivative u_{CH} as can be seen in the Appendix. The growth of the marginal utility of wealth $\Delta\lambda_{it}$ is decompose into a predictable component Γ_{it} and a stochastic component ε_t. The predictable component $\Gamma_t = \rho - \frac{1}{2}E_t(\Delta \ln \lambda_{it} - \rho)^2$ is a function of interest rate r and the discount factor β since ρ is define such that $e^{\rho} = \frac{1}{\beta(1+r)}$. The variance of this predictable component captures the precautionary and intertemporal substitution motives of savings. Assuming that

[4]The derivation of the FOCs with the accompanied Taylor approximation are presented in the Appendix.

Γ_t is fixed across households, it is more useful to consider the pure innovations to consumption and earnings, net of the predictable components, since these are the portions of household consumption and earnings that cannot be explained using observed household characteristics.

$$\Delta\hat{c}_{it} \simeq (\eta_{C,W} - \eta_{C,P})\varepsilon_{it} + \eta_{C,W}(v_{it} + \Delta u_{it}) \tag{3.7}$$

$$\Delta\hat{y}_{it} \simeq (\eta_{H,P} - \eta_{H,W})\varepsilon_{it} + (1 - \eta_{H,W})(v_{it} + \Delta u_{it}) \tag{3.8}$$

However, the marginal utility of wealth and hence its innovations ε_t are not observable, thus making equations 3.7 and 3.8 not empirically useful. I therefore proceed to the second step of the approximation procedure to express the innovations of the marginal utility of wealth as a function of wage and remittance income shocks. This step is implemented by log-linearising the expenditure and income accounts of lifetime resources, apply the difference in expectation between period t and $t-1$ on both accounts and then equate the differenced income and expenditure accounts of the lifetime budget constraint. This yields an expression for the innovation of the marginal utility of wealth as a linear function of wage and remittance income shocks. Substituting this expression in equations 3.7 and 3.8 gives the following equations for the growths of consumption and earnings

$$\begin{pmatrix} \Delta\hat{c}_{i,t} \\ \Delta\hat{y}_{i,t} \end{pmatrix} \begin{pmatrix} \kappa_{c,v} & \kappa_{c,u} & \phi_t^R \\ \kappa_{y,v} & \kappa_{y,u} & \kappa_{y,\zeta^R} \end{pmatrix} \begin{pmatrix} v_{i,t} \\ \Delta u_{i,t} \\ \zeta_{i,t}^R \end{pmatrix} \tag{3.9}$$

where

$$\kappa_{c,v} = 1 - \pi_{i,t} - \phi_{i,t}^R \tag{3.10}$$

$$\kappa_{c,u} = \alpha_t(1 - \pi_{i,t} - \phi_{i,t}^R) \tag{3.11}$$

$$\kappa_{y,v} = \frac{(\eta_{H,P} - \eta_{H,W})(1 - \pi_t - \phi_t^R - \eta_{C,W})}{\eta_{C,W} - \eta_{C,P}} + 1 - \eta_{H,W} \tag{3.12}$$

$$\kappa_{y,u} = \frac{(\eta_{H,P} - \eta_{H,W})[\alpha_t(1 - \pi_t - \phi_t^R) - \eta_{C,W}]}{\eta_{C,W} - \eta_{C,P}} + (1 - \eta_{H,W}) \tag{3.13}$$

$$\kappa_{y,\zeta^R} = \frac{(\eta_{H,P} - \eta_{H,W})\phi_{i,t}^R}{\eta_{C,W} - \eta_{C,P}} \tag{3.14}$$

It is important to point out that equations 3.10 to 3.14 are derived under the assumption that households have access to consumption insurance above and beyond self-insurance. This additional source of insurance comes from remittances. The loading factors $\kappa_{x,y}$ measure the response of variable $x \in \{\Delta\hat{c}_{i,t}, \Delta\hat{y}_{i,t}\}$ to shock $y \in \{v_{i,t}, \Delta u_{i,t}, \zeta^R_{i,t}\}$. For example, $\kappa_{c,v}$ and $\kappa_{c,u}$ measure the responsiveness of household consumption to permanent and transitory wage shocks, respectively. These parameters are functions of "self-insurance" coefficients $\pi_{i,t} \approx \frac{\text{Asset}_{i,t}}{\text{Asset}_{i,t}+\text{Human Wealth}_{i,t}+\text{Remittance Wealth}_{i,t}}$ through asset accumulation, "external-insurance" coefficients $\phi^R_{i,t} \approx \frac{\text{Remittance income}_{i,t}}{\text{Asset}_{i,t}+\text{Human Wealth}_{i,t}+\text{Remittance Wealth}_{i,t}}$ through remittance income and Frisch elasticities. $\pi_{i,t}$ is the partial insurance coefficient of wage shocks through asset accumulation. As can be seen in equations 3.10 and 3.11, the higher $\pi_{i,t}$ the lower the sensitivity of household consumption to transitory and permanent wage shocks. That is, higher $\pi_{i,t}$ increases households' ability to insure themselves against permanent and transitory wage shocks through asset accumulation. On the other hand, $\phi^R_{i,t}$ is the partial insurance coefficient of wage shocks through remittances. This is the coefficient of interest in this study since I seek to examine remittances as a source of insurance for recipient households. As can be seen in equations (3.10) to (3.14), the higher $\phi^R_{i,t}$ the lower the sensitivity of both household consumption and income to wage shocks. This implies that higher $\phi^R_{i,t}$ improves households' consumption and income smoothing ability against wage shocks (i.e., a lower proportion of wage shocks translate into consumption and income growth). Thus, the insurance effect of remittance on household consumption is examine by testing whether $\phi^R_{i,t}$ equals zero. $\phi^R_{i,t} = 0$ implies that remittances have no insurance effect on household consumption. That is, there is no external source of insurance over and beyond self-insurance through asset accumulation and labour supply. If $\phi^R_{i,t} > 0$, this confirms remittances as a source of insurance for household consumption. It is also possible that $\phi^R_{i,t} < 0$ which means that household consumption over-respond to earning shocks. This can be due to for example household holding illiquid assets and transaction costs are higher than the benefits of consumption smoothing.

Equations (3.10) and (3.11) nest the two extreme cases of consumption insurance. The first is full insurance against wage shocks ($\kappa_{c,v} = \kappa_{c,u} = 0 \rightarrow \phi^R_{i,t} = 1 - \pi_{i,t}$) as contemplated by the complete markets hypothesis. The second is no consumption insurance ($\kappa_{c,v} = \kappa_{c,u} = 1 \rightarrow \phi^R_{i,t} = -\pi_{i,t} \quad and \quad \alpha_t = 1$) as in autarky where households live hand-to-mouth with wage shocks translating one-for-one to consumption fluctuations. These equations also capture imperfect consumption insurance in which $0 \leq \kappa_{c,v} \leq 1 \quad and \quad 0 \leq \kappa_{c,u} \leq 1$. The closer

the coefficients to zero, the higher is the degree of consumption insurance. Finally, to obtain Human Wealth$_{i,t}$ and Remittance Wealth$_{i,t}$, we respectively take the expected discounted flow of lifetime domestic labour and remittance incomes of the household at the beginning of period t using household panel data from the Townsend Thai Monthly Household Survey.

3.3 Empirical Framework

3.3.1 Identification

In order to estimate our loading factors ($\kappa_{c,v}, \kappa_{c,u}, \kappa_{y,v}, \kappa_{y,u}$ and κ_{y,ζ^R}), I will need to first estimate four sets of parameters: 4 preference parameters ($\eta_{C,W}, \eta_{C,P}, \eta_{H,W}$ and $\eta_{H,P}$), 6 wage and remittance income parameters ($\sigma_u^2, \sigma_v^2, \sigma_\tau^2, \sigma_\zeta^2, \sigma_{\tau u}^2$ and $\sigma_{\zeta v}^2$), 2 partial insurance parameters ($\pi_{i,t}$ and $\phi_{i,t}^R$) and the annuitization factor of income at time t, α_t. This gives us a total of 13 economically relevant parameters to estimate in the full model. I have also discussed identification of this model with measurement errors in the wage, consumption, earnings and remittance income variables in subsequent sections.

The preference or Frisch parameters ($\eta_{C,W}, \eta_{C,P}, \eta_{H,W}$ and $\eta_{H,P}$) can be identified by estimating

$$\Delta c_{it} \simeq \eta_{C,W} \Delta w_{it} + (\eta_{C,W} - \eta_{C,P}) \Delta \ln \lambda_{it} \tag{3.15}$$

$$\Delta y_{it} \simeq (1 - \eta_{H,W}) \Delta w_{it} + (\eta_{H,P} - \eta_{H,W}) \Delta \ln \lambda_{it} \tag{3.16}$$

using instrumental variable (IV) estimation if there is a valid instrument for the unobservable $\Delta\lambda_{it}$. In fact, OLS can be used to estimate (3.15) and (3.16) if: (1) there is a valid proxy for the unobservable $\Delta\lambda_{it}$ or (2) it is possible to argue that wage growth Δw_{it} is not correlated with the unobservable $\Delta\lambda_{it}$ (i.e. a residual in the OLS equation). Unfortunately, OLS estimates are generally bias and inconsistent since the cov$(\Delta w_{it}, \Delta\lambda_{it}) \neq 0$. For instance, when $\Delta w_{it} \uparrow \Rightarrow \Delta h_{it} \uparrow \Rightarrow \Delta\lambda_{it} \uparrow$, hence cov$(\Delta w_{it}, \Delta\lambda_{it}) > 0$ which leads to a downward bias in $\eta_{C,W}$ and an upward bias in $\eta_{H,W}$. Researchers such as Chetty et al. [2011] suggest several techniques that can be used to provide unbiased and consistent estimate of these parameters. These suggestions include: (1) using IV method, (2) focusing on expected wage changes, (3) focusing on transitory wage changes, and (4) using consumption data to proxy for $\Delta\lambda_{it}$. In cases (2) and (3), the

anticipated or transitory change in wage at date t has no effect on hours worked, and hence on $\Delta\lambda_{it}$. Blundell et al. [2016] use the moments of anticipated wage changes (2) and transitory wage changes (3) at date t to identify their Frisch parameters.[5] I however use consumption data as a proxy for the marginal utility of wealth and estimate equations (3.15) and (3.16) using a General Method of Moment (GMM) estimation procedure. Although, this can be implemented using 2SLS estimation, I chose to employ a GMM procedure because 2SLS estimators are generally inefficient as they do not make use of all the instruments that are available in each period. Therefore, efficiency can be improved by using more identifying information in a GMM framework, where all the available internal instruments in each period are used, to estimate the elements of our Frisch matrix.

Moreover, to identify the wage and remittance income parameters ($\sigma_u^2, \sigma_v^2, \sigma_\tau^2, \sigma_\zeta^2, \sigma_{\tau u}^2$ and $\sigma_{\zeta v}^2$), I use a similar approach as in Meghir and Pistaferri [2004]. Using our residual wage and remittance income growth equations:

$$\Delta w_{it} = v_{it} + \Delta u_{it}$$

$$\Delta r_{it}^R = \zeta_{it}^R + \Delta \tau_{it}^R$$

It can be shown that:

$$E_t[\Delta w_{it} \Delta w_{it+1}] = -\sigma_u^2$$

$$E_t[\Delta w_{it}(\Delta w_{it+1} + \Delta w_{it} + \Delta w_{it-1})] = \sigma_v^2$$

$$E_t[\Delta r_{it}^R \Delta r_{it+1}^R] = \text{var}(\Delta r_{it}^R) = -\sigma_\tau^2$$

[5] In my case, using the sample moments approach gives:

$$E_t[\Delta w_t \Delta w_{t+1}] = -\sigma_u^2$$

$$E_t[\Delta w_t(\Delta w_{t+1} + \Delta w_t + \Delta w_{t-1})] = \sigma_v^2$$

$$E_t[\Delta w_t \Delta y_{t+1}] = -(1 - \eta_{H,W})\sigma_u^2$$

$$E_t[\Delta w_t \Delta c_{t+1}] = -\eta_{C,W}\sigma_u^2$$

And the Frisch parameters are identified by:

$$\eta_{C,W} = \frac{E_t[\Delta w_t \Delta c_{t+1}]}{E_t[\Delta w_t \Delta w_{t+1}]}, \quad \eta_{H,W} = 1 - \frac{E_t[\Delta w_t \Delta y_{t+1}]}{E_t[\Delta w_t \Delta w_{t+1}]}.$$

Given that $\eta_{C,W}$ and $\eta_{H,W}$ are identified, $\eta_{C,P}$ and $\eta_{H,P}$ can be identified by applying the symmetry of the Frisch substitution matrix.

$$E_t[\Delta r^R_{it}(\Delta r^R_{it+1} + \Delta r^R_{it} + \Delta r^R_{it-1})] = \sigma^2_\zeta$$

$$E_t[\Delta w_{it}\Delta r^R_{it}] = -\sigma^2_{\tau u}$$

$$E_t[\Delta r^R_{it}(\Delta w_{it+1} + \Delta w_{it} + \Delta w_{it-1})] = \sigma^2_{\zeta v}$$

Thus, the wage and remittance income parameters $\sigma^2_u, \sigma^2_v, \sigma^2_\tau,$ and σ^2_ζ are identified using the first three moments whiles $\sigma^2_{\tau u}$ and $\sigma^2_{\zeta v}$ are identify using the last two moments. Finally, the identifications of the partial insurance parameters π_{it} and $\phi^R_{i,t}$ and the annuitization factor of income at time t, α_t, are done by backing them out from the data. I discuss in more detail how I back out these parameters from the data in the next section.

3.3.2 Estimation Issues

In order to credibly quantify the insurance effect of remittances on household consumption, there are a number of identification problems that need to be addressed before estimating (3.9). The most relevant of these problems are sample-selection bias and measurement errors. I control for these two estimation problems because they can potentially make our estimation results biased and inconsistent due to the well-known problem of endogeneity in microeconometrics. Whereas the problem of self-selection arises because the remittance status of households is potentially dependent on some household characteristics, the problem of measurement error arises because consumption, remittances, wages and earnings are invariably measured with error.

Sample-Selection Bias

When deriving analytical expressions for household consumption and earnings growth, I implicitly assumed an interior solution for households' remittance income. That is, I assumed all households receive remittances. However, some households in developing economies do not receive remittances. In the Townsend Thai data, roughly 30% of households receive remittances on average whiles the remaining 70% do not. The fact that some households have migrants (and receive remittances), and others do not, suggests that there are important distinctions between migrant and non-migrant households. For instance, some households may be more motivated

and/or have higher abilities than others to send a family member abroad. To illustrate this, I present kernel density estimates of household domestic income (i.e. household income excluding remittances) and total income (i.e. including remittances) for households with migrants and those without migrants. The results show that households with migrants do relatively better than those without migrants, and the difference between the two groups becomes more apparent once remittance income is accounted for. In the appendix of the previous chapter, we also noticed the existence of systematic differences between migrant and non-migrant households in key indicators such as education and family size: households without migrants have stock of education below national average while those with migrants are well above national average.

Since not all households in the sample are remittance-receiving households and our sample of remittance-receiving households are potentially non-random, the problems of self-selection and endogeneity become central in this study. Endogeneity is a concern because the amount of remittances Thai households receive is potential dependent on their consumption level. That is to say, although remittances may help in smoothing household consumption, households' consumption level may also influence the timing and amount of remittance emigrants send to their families. On the other hand, sample selection is a concern because both remittances and wages are observed only if a selection condition is met: remittances are observed conditional on having a migrant family member and wages are observed conditional on having an employed family member. In either case, problems arise if conventional regression techniques are used to estimate remittance and wage parameters. Such techniques result in biased and inconsistent estimates of the variances to wage and remittance income shocks. This problem exacerbates if unobserved factors affecting remittances (wages) are correlated with unobserved factors affecting self-selection into migration (employment) processes. Moreover, if we ignore selection bias, we risk estimating remittance shocks for non-remittance receiving households and wage shocks for households that do not participate in the labour market. Given that non-migrant households have no remittance information, estimating remittance equations is based on samples of households who actually have family members or friends abroad. Consequently, estimates based on remittance-receiving households do not provide reliable estimates for non-remittance-receiving households had they received remittances. This is because remittance-receiving households do not represent a random sample of Thai households since they are selected in a systematic way from the relevant distributions.

To overcome the problems of sample selection and endogenous treatment effects, I utilize an instrumental variable variant of the two-step sample-selection correction approach developed by Low et al. [2010]. This is estimated using a non-linear specification as it seems likely that migrants are drawn from the two ends of the skills or income distribution. Self-selection is addressed by first modelling selection processes into migration (equivalent to selection into being a remittance-receiving household) and employment/having an employed family member. Then, I construct sample selection terms and estimate remittance and wage growth equations conditioning on these terms. Finally, I derive estimates of the variances and covariances of wage and remittance income shocks using the first and second moments of unexplained remittance and wage growth for different age groups.

Lets briefly illustrate how the problem of self-selection is solved. Suppose households migration decision $M_{i,t}$ depends on some latent variable $M^*_{i,t} = X^{m\prime}_{i,t}\phi + a_i + \epsilon_{i,t}$ such that $M_{i,t} = 1\{M^*_{i,t} \geq 0\}$ for households with migrants and $M_{i,t} = 0\{M^*_{i,t} < 0\}$ for those with no migrants.[6] Similarly, let $E^*_{i,t} = X^{e}_{i,t}{}'\phi + a_i + \varsigma_{i,t}$ denotes the latent utility from employment such that $E_{i,t} = 1\{E^*_{i,t} \geq 0\}$ for households with employed family members and $E_{i,t} = 0\{E^*_{i,t} < 0\}$ for those that do not participate in the labour market. Selection into migration and into employment are accounted for by the correlations between $\zeta^R_{i,t}$ and $\epsilon_{i,t}$ ($\rho_{\zeta\epsilon}$), $\tau^R_{i,t}$ and $\epsilon_{i,t}$ ($\rho_{\tau\epsilon}$), $v_{i,t}$ and $\varsigma_{i,t}$ ($\rho_{v\varsigma}$), and $u_{i,t}$ and $\varsigma_{i,t}$ ($\rho_{u\varsigma}$). It is important to point out that the role of observed household characteristics in explaining self-selection into migration is sensitive to the fact that if migrant households have higher socioeconomic status before out-migration occurs and if the migrant is one of the most skilled people in the household, then such sending households may no longer have higher socioeconomic status post-migration. That is to say, migration could change the rank of households.

Assuming the error terms $\epsilon_{i,t}$ and $\varsigma_{i,t}$ are normally distributed, $Pr(M_{i,t} = 1) = \Phi(X^{m\prime}_{i,t}\varrho)$ and $Pr(E_{i,t} = 1) = \Phi(X^{e}_{i,t}{}'\varrho)$, and

$$\mathbb{E}(u_{i,t}\varsigma_{i,t-s}) = \begin{cases} \sigma_{\varsigma u} & \text{if s} = 0 \\ 0 & \text{otherwise} \end{cases}$$

[6]Note that our selection process depends on a vector of observed household characteristics $X^m_{i,t}$, such as wealth and education, and unobserved characteristics a_i such as ambition and ability.

$$\mathbb{E}(v_{i,t}\varsigma_{i,t-s}) = \begin{cases} \sigma_{\varsigma v} & \text{if s} = 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbb{E}(\zeta^R_{j,t}\epsilon_{i,t-s}) = \begin{cases} \sigma_{\zeta\epsilon} & \text{if s} = 0 \\ 0 & \text{otherwise} \end{cases}$$

$$\mathbb{E}(\tau^R_{i,t}\epsilon_{i,t-s}) = \begin{cases} \sigma_{\tau\epsilon} & \text{if s} = 0 \\ 0 & \text{otherwise} \end{cases}$$

the identification strategy already discussed in the previous section remains valid but the moment conditions are corrected to account for selection bias. The use of "conditional covariance restrictions" rather than unconditional ones is a statistical approach to derive empirical corrections for sample selection [Blundell et al., 2016].

For the endogeneity of remittances, this is addressed using an IV approach by instrumenting the remittance variable with two variables. The first instrument is the interaction between the weighted cost of sending remittances to Thailand and the percentage of Thai household members with secondary or tertiary education. The second instrument is the weighted per capita income of Thai migrants' destination countries, $\sum_j^J \frac{m_{jt}}{M_t} GDPp_{jt}$. Both the cost of sending remittances to Thailand and destination countries' income per capita are weighted using the share of Thai migrants m_{jt} in destination country j out of Thailand's total migrant stocks M_t at time t, represented as $\frac{m_{jt}}{M_t}$. These two instruments are used because the amount of remittances that Thai households receives is negatively related with the cost of remittance transfer and positively related with weighted per capita income of destination countries. Both instruments are exogenous to household decisions and do not directly affect household consumption, after controlling for its effect on remittances. The cost of sending remittances to Thailand is obtained from World Bank's Remittance Prices Worldwide database while Thailand's bilateral migration stocks to all countries in the world are obtained from World Bank's Bilateral Migration Matrices.

Measurement error

Another potential identification problem to address in this study is measurement error. The problem of measurement error is very important in this study since our data on household consumption, earnings, remittances and wages are likely to be measured with (considerable)

error. For example, suppose "reported" earnings $Y^*_{i,t}$ is given by $Y^*_{i,t} = Y_{i,t} + \xi^Y_{i,t}$, where $\xi^Y_{i,t}$ is the earnings measurement error and $Y_{i,t}$ is the true earning of a household. Even if we assume that the measurement error $\xi^Y_{i,t}$ are serially uncorrelated and uncorrelated with the true earning of households, i.e. $E(Y_{i,t}\xi^Y_{i,t}) = 0$ and $E(\xi^Y_{i,t}\xi^Y_{i,s}) = 0 \; \forall \; t \neq s$, our estimation may be biased and inconsistent. Specifically, a pooled OLS estimation will lead to the well known attenuation bias. The attenuation bias also called regression dilution is the downward bias towards zero caused by measurement errors in our explanatory variable. This bias will be greatly exacerbated if I estimate the model in differences or using fixed effects.[7] To overcome this problem, I rewrite the equations for consumption growth, earning growth, and remittance and wage growth as

$$\begin{pmatrix} \Delta\hat{c}_{i,t} \\ \Delta\hat{y}_{i,t} \\ \Delta\hat{r}^R_{i,t} \\ \Delta\hat{w}_{i,t} \end{pmatrix} \begin{pmatrix} \kappa_{c,v} & \kappa_{c,u} & \kappa_{c,\zeta^R} \\ \kappa_{y,v} & \kappa_{y,u} & \kappa_{y,\zeta^R} \\ 0 & 0 & 1 \\ 1 & 1 & 0 \end{pmatrix} \begin{pmatrix} v_{i,t} \\ \Delta u_{i,t} \\ \zeta^R_{i,t} \end{pmatrix} + \begin{pmatrix} \Delta\xi^c_{i,t} \\ \Delta\xi^y_{i,t} \\ \Delta\xi^R_{i,t} \\ \Delta\xi^w_{i,t} \end{pmatrix} \tag{3.17}$$

to take into account measurement errors in these variables. Here, $\xi^c_{i,t}, \xi^y_{i,t}, \xi^R_{i,t}$ and $\xi^w_{i,t}$ are the measurement errors in log consumption, log earnings, log remittance income and log wage of household i at time t. However, accounting for these measurement errors introduces three other problems that need to be addressed. First, Blundell et al. [2008] noted that accounting for measurement errors in models with permanent and transitory shock components such as our wage and remittance income processes creates identification problems because one cannot decompose the distribution of the measurement errors, $\xi^R_{i,t}$ and $\xi^w_{i,t}$, from the distribution of the economically relevant shocks $v_{i,t}$, $\Delta u_{i,t}$, and $\zeta^R_{i,t}$. Second, Blundell et al. [2016] explained that the effect of measurement errors on consumption choices are hard to distinguish from the consumption effect of stochastic changes in preferences or shocks to higher moments of the wage or remittance distributions. The third problem is the so-called "division bias" which arises because I derived wage by dividing monthly household earnings with monthly hours worked. This is a problem because the measurement errors of wages and earnings are not independent. Thus, ignoring measurement errors especially measurement errors in earnings, remittance income and wages is problematic since it directly affects the estimates of our structural parameters.

[7] See for example Hsiao, C. (1986) "Analysis of Panel Data, Cambridge University Press" for a detailed discussion.

To overcome these problems, I follow Meghir and Pistaferri [2004] by setting *a priori* the amount of earnings, hours, wages and remittance income variabilities that can be attributed to measurement errors. To do this, I use the measurement error estimates of Karaivanov and Townsend [2014] who also used the Townsend Thai monthly data to estimate the measurement error parameters of these variables of interest. Assuming that measurement error is additive and distributed according to $N(0, (\gamma_{me}\chi(x))^2)$,[8] they find that the measurement error parameters are relatively small ranging from 0.09 to 0.13.

Table 3.1: Calibrated Measurement error (m.e.) parameters

M.E.	Description	Parameters
$var(\xi^y)$	Share of m.e. in earnings out of the total variance of log(earnings)	0.09
$var(\xi^h)$	Share of m.e. in hours out of the total variance of log(hours)	0.13
$var(\xi^w)$	Share of m.e. in wages out of the total variance of log(wages)	0.12
$var(\xi^R)$	Share of m.e. in remittances out of the total variance of log(R)	0.10

I therefore adopt these measurement error estimates since Meghir and Pistaferri [2004] use the same data set and sample period I am using.Given these measurement errors with the assumptions that they are uncorrelated over time and across households, I proceed to calculate the covariance between these measurement errors in order to estimate their cross-equation moments. By definition, the covariance between the measurement errors of wages, earnings and hours is non-zero since wage is define as earnings/hours. Thus, the relationship between the measurement errors in log wages, earnings and hours can be written as:

$$var(\xi^y) = var(\xi^w) + var(\xi^h) - 2cov(\xi^w, \xi^h)$$

$$cov(\xi^w, \xi^h) = \frac{1}{2}\left[var(\xi^w) + var(\xi^h) - var(\xi^y)\right]$$

$$cov(\xi^y, \xi^h) = cov\left((\xi^w + \xi^h), \xi^h\right) = \frac{1}{2}\left[var(\xi^w) + var(\xi^h) - var(\xi^y)\right] + var(\xi^h)$$

$$cov(\xi^y, \xi^w) = cov\left((\xi^w + \xi^h), \xi^w\right) = var(\xi^w) + \frac{1}{2}\left[var(\xi^w) + var(\xi^h) - var(\xi^y)\right]$$

To derive the covariance between the measurement error of remittances and the measurement errors of wages, earning and hours, I assume that $cov(\xi^y, \xi^R) = cov(\xi^w, \xi^R)$. Hence,

$$cov(\xi^y, \xi^R) = cov\left((\xi^w + \xi^h), \xi^R\right) = cov(\xi^w, \xi^R) + cov(\xi^h, \xi^R) = \sigma_{\zeta v} + \sigma_{\tau u}$$

[8] where $\chi(x)$ denotes the range of the X grid for variable x (x is any of the variables used in the estimation e.g., earnings). That is, $\chi(x) \equiv x_{\max} - x_{\min}$.

which implies that $cov(\xi^h, \xi^R) = 0$. This is re-examined in the next chapter where I study the effect of remittances on household time allocation.

3.3.3 Empirical Strategy

After correcting for endogeneity, sample-selection and measurement errors problems, I utilize the following estimation steps to estimate our parameters of interest:

1. First, I start by constructing the first-differenced residuals of consumption $\Delta c_{i,t}$, earnings $\Delta y_{i,t}$, wage $\Delta w_{i,t}$ and remittance income $\Delta r_{i,t}$. This is done by regressing the log differences of household consumption $C_{i,t}$, earnings $Y_{i,t}$, wage $W_{i,t}$ and remittance income $R_{i,t}$ on observed household characteristics such as age, gender, marital status, education, regional dummy (a dummy for whether a household lives in an urban or rural area), number of family members as well as education-age, gender-age and region-age interactions. For the consumption and earning regressions, I added a dummy for whether the household is a migrant-household or a non-migrant household i.e. if a member of the household is residing abroad or not;

2. I estimate the variance parameters of wage and remittance income shocks as well as the covariances between these shocks using the second moments of $\Delta w_{i,t}$ and $\Delta r_{i,t}$;

3. I back out the "partial insurance coefficients" $\pi_{i,t}$ and $\phi^R_{i,t}$ using data on current household assets, earnings and remittance income as well as projected earnings and remittance wealth. In order to compute projected earnings and remittance incomes, I follow Etheridge [2015] and Blundell et al. [2016] by

   (a) pooling earnings and remittance incomes of all years and age, and

   (b) run two regressions, one for earnings and one for remittance income, on either a matrix of household characteristics that are fixed over time (X^f) or on a matrix of household characteristics that change over time (X^c) but in a forecastable fashion.

   The estimated coefficient parameters are then use to predict earnings $\hat{Y}_{i,t+s}$ and remittance income $\hat{R}_{i,t+s}$ given the available information set at t;

4. Finally, I use consumption data to proxy the marginal utility of wealth, $\Delta\lambda_{it}$, in order to estimate the preference parameters [Chetty et al., 2011].

Although differencing eliminates the fixed effects, it does not solve our measurement error problem and the fact that past household consumption may affect households' current remittance incomes. Hence, estimating by pooled OLS produces biased and inconsistent results. These problems are dealt with using instrumental variable estimation procedures, by first estimating a remittance income model in the first stage and then using predicted remittances as an instrument in the consumption equation. However, 2SLS estimators are inefficient as they do not make use of all the available information in each period. Hence, efficiency can be improved by using more identifying information in a GMM procedure, where all the available instruments in each period will be used.

3.4 Results & Discussion

This section is divided into four subsections to present and analyse the findings of this chapter. Section 3.4.1 discusses the results of the estimated partial insurance coefficients against wage shocks through asset accumulation $\pi_{i,t}$ and remittances $\phi^R_{i,t}$. Whereas, Section 3.4.2 presents the results of the estimated wage and remittance income parameters, Section 3.4.3 discusses the results of the preference parameters. Finally, Section 3.4.4 presents the age profiles of insurance coefficients for both transitory and permanent shocks.

3.4.1 Estimating $\pi_{i,t}$ and $\phi^R_{i,t}$

To estimate the effect of remittances on household consumption insurance, I begin my estimation by backing out the partial insurance coefficients $\pi_{i,t}$ and $\phi^R_{i,t}$ from the data. To calculate these partial insurance coefficients $\pi_{i,t} \approx \frac{\text{Asset}_{i,t}}{\text{Asset}_{i,t}+\text{Human Wealth}_{i,t}+\text{Remittance Wealth}_{i,t}}$ and $\phi^R_{i,t} \approx \frac{\text{Remittance Wealth}_{i,t}}{\text{Asset}_{i,t}+\text{Human Wealth}_{i,t}+\text{Remittance Wealth}_{i,t}}$, I need information on household assets, expected human wealth and expected lifetime remittance wealth. As widely applied in the consumption literature such as Blundell et al. [2016], I took household asset before consumption to measure assets in order to avoid endogeneity problems. This data is available in the Townsend

Thai data which divides household total assets as the sum of agricultural and non-agricultural assets. Since expected human wealth and expected lifetime remittance income are given by

$$\text{Human Wealth}_{i,t} = Y_{i,t} + \frac{\mathbb{E}_t(Y_{i,t+1})}{1+r} + \frac{\mathbb{E}_t(Y_{i,t+2})}{(1+r)^2} + ...$$

$$\text{Remittance Wealth}_{i,t} = R_{i,t} + \frac{\mathbb{E}_t(R_{i,t+1})}{1+r} + \frac{\mathbb{E}_t(R_{i,t+2})}{(1+r)^2} + ...,$$

the only problem I have in computing human and remittance wealth is estimating households future earnings and future remittance incomes. I follow the approach used by Etheridge [2015] and Blundell et al. [2016] to estimate households future earnings and remittance incomes. First, I start by pooling earnings and remittance income of all years and age. Second, I run two regressions, one for earnings and one for remittance income, on either a matrix of household characteristics that are fixed over time (X^f) or on a matrix of household characteristics that change over time (X^c) but in a perfectly forecastable fashion. An example for the former is gender and an example for the later is the polynomial of age.

$$Y_{i,t} = X^f_{i,t}\psi^Y_1 + X^c_{i,t}\psi^Y_2 + e^Y_{i,t}$$

$$R_{i,t} = X^f_{i,t}\psi^R_1 + X^c_{i,t}\psi^R_2 + e^R_{i,t}$$

I estimate the four coefficient parameters $\hat{\psi}^Y_1$, $\hat{\psi}^Y_2$, $\hat{\psi}^R_1$ and $\hat{\psi}^R_2$ of the two regressions above and then use these estimated parameters to predict household earnings $\hat{Y}_{i,t}$ and remittance income $\hat{R}_{i,t}$ at time t. Given the available information set at t, I obtain an estimate for expected earnings $\mathbb{E}_t(\hat{Y}_{i,t+s})$ and remittance income $\mathbb{E}_t(\hat{R}_{i,t+s})$ at time $t+s$ using $\hat{Y}_{i,t+s} = X^f_{i,t}\hat{\psi}^Y_1 + X^c_{i,t+s}\hat{\psi}^Y_2$ and $\hat{R}_{i,t+s} = X^f_{i,t}\hat{\psi}^R_1 + X^c_{i,t+s}\hat{\psi}^R_2$, respectively. In estimating remittance wealth, I take into account the fact that households do not receive remittances in all periods and that not all households receive remittances. As such, in predicting household remittance wealth, I have to predict the probability that a household receives remittance income using a probit model with education, gender, region, polynomial in age and the interactions of these variables as controls. Moreover, non-remittance receiving households are taken into account in the remittance regressions by controlling for sample selection problems using Heckman's correction. Finally, I assume that households discount the future at the market interest rate (which I set at 2% per annum) and that they retire at the age of 65.

By implementing these identification procedures to estimate the empirical partial insurance coefficients $\pi_{i,t}$ and $\phi^R_{i,t}$ using the Townsend Thai data, I found average insurance coefficients due to asset accumulation $E(\pi_{i,t})$ and remittances $E(\phi_{i,t})$ to be approximately 0.13 and 0.02, respectively. That is, $E(\pi_{i,t}) = 0.13$ and $E(\phi_{i,t}) = 0.02$. This implies that 13% of wage shocks are insured through asset accumulation whiles roughly 2% of these shocks are insured through remittance income. Table 3.2 presents the estimated partial insurance coefficients due to asset accumulation and remittance income for households with different education level.

Table 3.2: Average $\pi_{i,t}$ & $\phi^R_{i,t}$ by Education Level

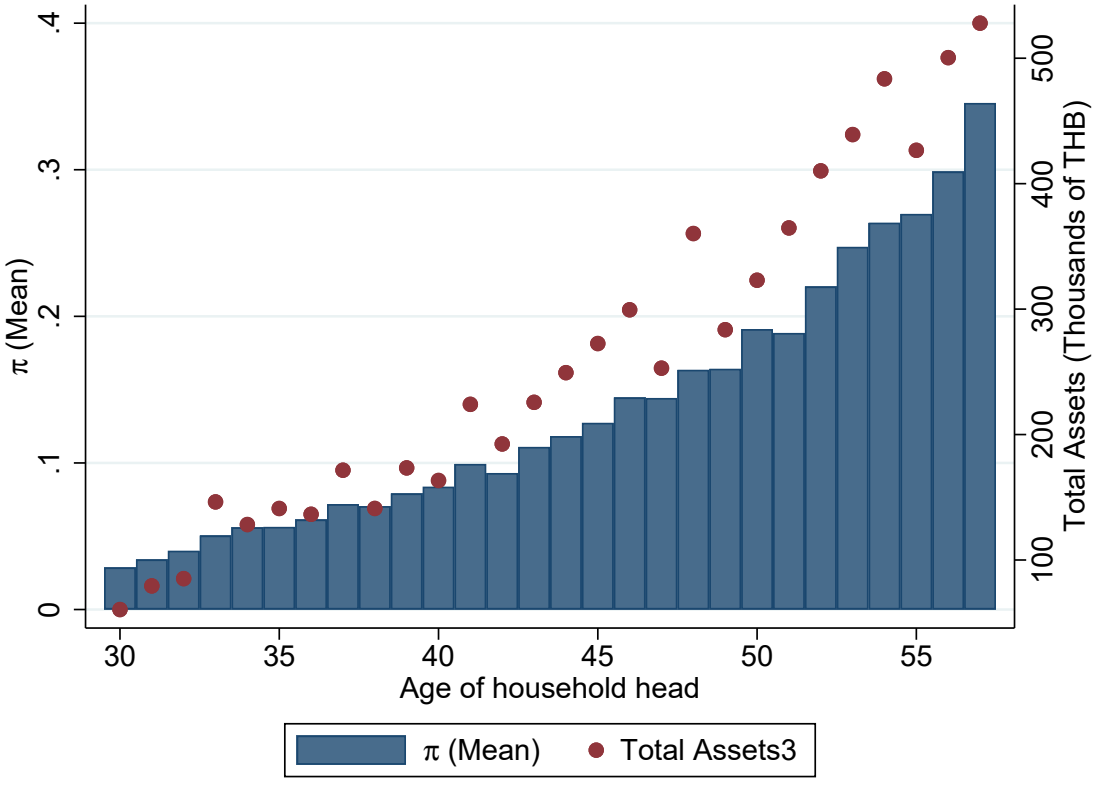
	No High School	High School	Tertiary	All sample
$\pi_{i,t}$	0.0837	0.1187	0.1455	0.1303
	(0.0247)	(0.0345)	(0.0375)	(0.0355)
$\phi^R_{i,t}$	0.0189	0.0187	0.0168	0.01761
	(0.0005)	(0.0003)	(0.0003)	(0.0003)

The estimated values of $\pi_{i,t}$ and $\phi^R_{i,t}$ conform with expectations. As can be seen in Table 3.2, households with higher educational attainment have higher access to smooth consumption against wage shocks using asset accumulation. The degree of self-insurance through asset accumulation is estimated at 8% for household heads with no high school. For household heads with high school education, their self-insurance coefficient via asset accumulation is estimated at 11.87% and increases to 14.55% for household heads with tertiary education. Interesting, the opposite is true for remittances as a source of consumption insurance. Households with lower education level rely more on remittances as a source of consumption insurance. All these empirical insurance coefficients are statistically significant at 95% confidence level. I also present the life cycle dynamics of households' self-insurance through asset accumulation choices in Figure 3.1 (on the left axis). In addition, I report the life-cycle evolution of households' total asset holdings on the right axis of Figure 3.1.

The age-specific degree of self-insurance through asset accumulation choices and the life cycle dynamics of households' total asset holdings conform to the results obtain by other researchers such as Kaplan and Violante [2010] and Blundell et al. [2016]. At the beginning of the life-cycle, households have a negligible degree of self-insurance against adverse earning shocks since they have minimal amounts of assets to smooth consumption when face with adverse earning shocks. Thus, the degree of pass-through of (both permanent and transitory) earning shocks to household consumption is at its highest at the beginning of the life-cycle. However, households

ability to insure themselves through asset accumulation increases with age for two reasons. (1) household asset accumulation increases with age due to precautionary and life-cycle motives. For example, at age 40, the average value of household asset accumulation is roughly 163,394 THB which increases to 323,021 THB at age 50. This is shown on the right axis of Figure 3.1. (2) As time goes by, expected human capital declines due to the shortening of the time horizon which increases $\pi_{i,t}$. Thus, households have access to more consumption smoothing against permanent and transitory earnings shocks as time goes by because higher $\pi_{i,t}$ increases households ability to insure themselves against adverse shocks through asset accumulation.

Figure 3.1: π by Age of Household Head



Furthermore, Figure 3.2 presents age-specific degrees of consumption smoothing through remittances (on the left axis). On the right axis of Figure 3.2, I also report the life-cycle dynamics of households' remittance wealth. The life-cycle dynamics of consumption insurance through remittances also conforms to expectations. At the early age of the life-cycle, the degree of consumption insurance against adverse earning shocks through remittance income is very negligible since household heads at this age have lower remittance income possibly because they do not have children who can send them remittances. However, as they get older especially between 40 and 55 years, they receive more remittance income. This increases $\phi^R_{i,t}$ over time

and also increases households' ability to insure themselves using remittances. The life-cycle evolution of remittance income is rather interesting. This "volatility" can be explained by the fact that remittances are secondary sources of income for receiving households and these beneficiary households do not have direct control over the amount and timing of remittance flows.

Figure 3.2: ϕ^R by Age of Household Head

3.4.2 Wage and remittance income variances

The estimates for the wage and remittance income parameters are presented in Table 3.3. These variances are estimated using General Method of Moments (GMM) estimation with an identity matrix as a weighting matrix. From these empirical results, it can be seen that the variance of permanent wage shocks exhibits a U-shaped pattern over the life-cycle which is consistent with what has been observed by Meghir and Pistaferri [2004], Blundell et al. [2015] and Blundell et al. [2016]. This implies that households have higher permanent wage shocks in the early and old age of the life-cycle while experiencing lower changes in the permanent component of wage shocks during prime working age. Moreover, I find that the variances of permanent wage shocks are

overall higher than the variances of the transitory component which is contrary to the findings of Blundell et al. [2016] in the United States. Since Thailand is an emerging economy, that has experienced a lot of structural adjustments during the period under investigation, it should not be very surprising that "wage instability" is driven more by structural wage adjustments, as measured by permanent wage shocks, rather than transitory wage shocks. Furthermore, the variances of both permanent and transitory remittance income shocks are higher than their wage counterparts which can be attributed to the fact that remittance income are "secondary source" of income for households in developing and emerging economies. Finally, although the variances of permanent remittance income shocks do not follow a U-shaped pattern over the life-cycle, the permanent components of wage and remittance income shocks are negatively correlated which supports the "insurance motive" of remittances. That is, remittances are source of insurance for recipient households because they increase during adverse earning shocks.

Table 3.3: Wage & Remittance Income Variance Estimates

		25-35	36-46	47-57	58-68	69-79	All ages
Wage shocks	Perm. σ_v^2	0.0307**	0.0302**	0.02118	0.0411**	0.0524**	0.0398**
		(0.0109)	(0.0105)	(0.0222)	(0.0198)	(0.0156)	(0.0149)
	Trans. σ_u^2	0.0482**	-0.032	0.0225**	0.0324	0.0498**	0.0288**
		(0.0212)	(0.0211)	(0.0111)	(0.0243)	(0.0222)	(0.0068)
Remittance income shocks	Perm. σ_ζ^2	0.0804**	0.0899**	0.0932**	0.0617**	0.0462**	0.0730**
		(0.0140)	(0.0126)	(0.0278)	(0.0109)	(0.0159)	(0.0071)
	Trans. σ_τ^2	0.0595**	0.0597**	0.0775**	0.0392**	0.0642**	0.0191**
		(0.0126)	(0.0115)	(0.0121)	(0.0096)	(0.0156)	(0.0067)
Covariance of remittance and wage shocks	Perm. $\sigma_{\zeta v}^2$	-0.0784**	-0.0735**	-0.0820**	-0.0497**	-0.0801**	-0.0714**
		(0.0128)	(0.0101)	(0.0101)	(0.0080)	(0.0136)	(0.0061)
	Perm. $\sigma_{\zeta_j v_k}^2$	-0.0210**	-0.0301**	-0.0312**	-0.0222**	-0.0290**	-0.0302**
		(0.0020)	(0.0023)	(0.0019)	(0.0029)	(0.0028)	(0.0027)
	Trans. $\sigma_{\tau u}^2$	0.0712**	0.0652**	0.0835**	0.0499**	0.0711**	0.0683**
		(0.0113)	(0.0094)	(0.0115)	(0.0080)	(0.0129)	(0.0059)
	Trans. $\sigma_{\tau_j u_k}^2$	-0.0471**	0.0356	0.0366	0.0389	0.0511**	-0.0393**
		(0.0233)	(0.0294)	(0.0215)	(0.0280)	(0.0229)	(0.0109)

3.4.3 Preference parameters

After estimating the insurance coefficients ($\pi_{i,t}$ *and* $\phi_{i,t}^R$), and the wage and remittance income parameters ($\sigma_u^2, \sigma_v^2, \sigma_\tau^2, \sigma_\zeta^2, \sigma_{\tau u}^2$ and $\sigma_{\zeta v}^2$), I now proceed by estimating our preference parameters

($\eta_{C,W}, \eta_{C,P}, \eta_{H,W}$ *and* $\eta_{H,P}$) in order to finally estimate the loading factors ($\kappa_{c,v}, \kappa_{c,u}, \kappa_{y,v}, \kappa_{y,u}$ *and* κ_{y,ζ^R}). To estimate these preference parameters, I employ one of the approaches suggested by Chetty et al. [2011] using consumption data to proxy the marginal utility of wealth. Table 3.4 presents the preference parameter estimates using GMM.

Table 3.4: Preference parameters

	$\eta_{c,p}$	$\eta_{c,w}$	$\eta_{h,p}$	$\eta_{h,w}$
	1.6844**	-2.4576**	0.1561	1.8819**
s.e.	(0.0588)	(0.1993)	(0.1139)	(0.3705)

As reported in Table 3.4, the Frisch elasticity of household consumption with respect to price ($\eta_{c,p}$) is estimated to be 1.68. Since $\eta_{c,p}$ measures the elasticity of intertemporal substitution (EIS) in consumption, this implies that the relative risk aversion coefficient is approximately 0.6 which is a very reasonable estimate in the consumption literature. However, my estimate of consumption responsiveness to changes in wages ($\eta_{c,w}$) is fairly high as it sits around -2.46. This means that a percentage increase in wages leads to a 2.46% decline in consumption. Although the sign or direction of effect is consistent with many researchers such as Blundell et al. [2016], the magnitude is fairly high. Blundell et al. [2016] find the responsiveness of household consumption to changes in wages to hover around -0.182 and -0.03 depending on the model specification used. The EIS of labour supply ($\eta_{h,w}$) is estimated at 1.88. This is a reasonable estimate for an emerging economy like Thailand as it signals a high willingness to substitute labor intertemporally. In developed countries like the U.S., Keane [2011] surveys 12 influential studies and found an average EIS estimate of 0.83 with a median of 0.17. Pistaferri [2003] also conducts a similar study in Italy using data from the Bank of Italy's Survey of Households' Income and Wealth. He estimates that the Frisch elasticity of labour supply is 0.704 with a standard error of 0.093. However, using a richer specification to capture human capital, Imai and Keane [2004] estimates this Frisch elasticity at 3.8. This intertemporal elasticity of substitution is much higher than conventional estimates (i.e. estimates from model without human capital) because of the downward bias due to "the omission of the human capital accumulation effect".

3.4.4 How much consumption insurance?

Finally, I compute the loading factors ($\kappa_{c,v}, \kappa_{c,u}, \kappa_{c,\zeta^R}, \kappa_{y,v}, \kappa_{y,u}$ *and* κ_{y,ζ^R}) using the estimated partial insurance coefficients, and the estimated wage, remittance and preference parameters. The equations below present the results of the estimated loading factor matrix in (3.9) with elements given by equations (3.10) to (3.14).

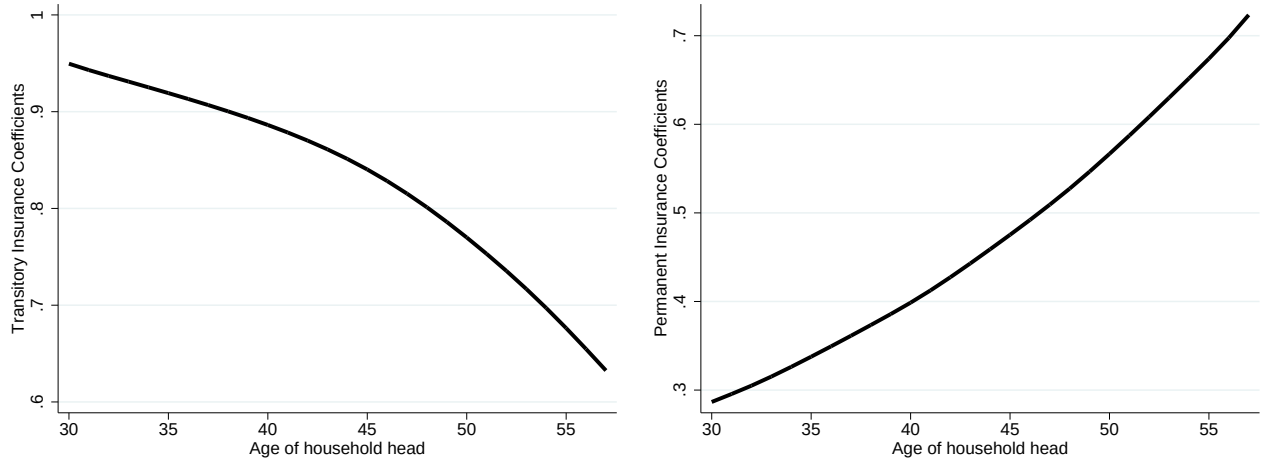
$$\hat{c}_{it} = 0.53v_{it} + 0.17\Delta u_{it} + 0.02\zeta_{it}^R$$

$$\hat{y}_{it} = 0.50v_{it} + 0.16\Delta u_{it} + 0.007\zeta_{it}^R$$

These results show how household consumption and earnings response to wage shocks as well as changes in remittance inflows. In the consumption function, $\kappa_{cv} = 0.53$, $\kappa_{cu} = 0.17$ and $\kappa_{c,\zeta^R} = 0.02$ which suggests that consumption declines by 53% and 17% respectively in response to adverse permanent and transitory wage shocks. This means that the insurance coefficients against permanent and transitory wage shocks are 0.47 and 0.83 respectively. Thus, Thai households have more access to smooth consumption against transitory than permanent wage shocks since only 47% of permanent wage shocks are insured (i.e., do not translate into consumption growth) whereas 83% of transitory wage shocks are insured. Similarly, $\kappa_{yv} = 0.50$, $\kappa_{yu} = 0.16$ and $\kappa_{y,\zeta^R} = 0.007$ in the earning function. This shows that household earnings increase by 50% and 16% respectively following a permanent and transitory wage shock. As expected, household earnings also increase slightly in response to permanent remittance inflows. A percentage increase in remittances raises household earnings by 0.7%. This is not a surprising result since households can afford to invest in human capital development following permanent remittance inflows.

Figure 3.3 plots the age-profiles of consumption insurance against transitory and permanent wage shocks. Three things are worth noting in these age-profiles. First, households' ability to insure themselves against transitory wage shocks decreases over the life cycle whiles their ability to insure against permanent wage shocks increases with age. Second, the responsiveness of household consumption to transitory wage shocks is very minimal over the life cycle. At any period in the life cycle, Thai households have the ability to insure at least 62% of transitory wage shocks. Finally, the responsiveness of consumption to permanent wage shocks is relatively high in the early years of the life cycle comparing to older years when household heads have

Figure 3.3: Age profiles of insurance coefficients for Transitory and Permanent shocks



accumulated higher assets and have higher probability of receiving remittance income.

3.5 Conclusion

This chapter seeks to examine remittances as a source of insurance for recipient households using a life-cycle model that distinguishes three main sources of consumption insurance. The first is self-insurance via household labour supply such that households adjust their labour hours in response to income realizations to smooth consumption. The second is self-insurance through assets (de)accumulation. Here, households build up savings in good times and draw them down in hard times. The third source of insurance, which is the focus of this chapter, comes through "risk-sharing" in the form of remittances. The key contribution of this chapter is in its emphasis on credible identification of the effect of remittances on consumption insurance. I derive analytical expressions for household earnings and consumption as a function of wage and remittance income shocks. These expressions are empirically estimated to examine if the presence of remittances alter the degree of household consumption smoothing.

The responsiveness of household consumption and earnings to wage and remittance income shocks depend on structural preference parameters, partial insurance parameters as well as on the annuitization factor of income. Thus, I had to estimate these parameters using the Townsend Thai data before estimating the extent to which consumption and earnings response to wage and remittance income shocks. My empirical results soundly reject the full insurance hypothesis for both transitory and permanent wage shocks. This suggests that the consumption

of Thai households is not completely buffered against idiosyncratic income shocks since adverse wage shocks do translate to reduction in household consumption. Townsend [1994] and Morten [2016] arrive at a similar conclusion in Thailand and India, respectively, when they find that households that experience adverse idiosyncratic shocks had consumption growth rates lower than those that did not. This result is also consistent with the findings of Gertler and Gruber [2002] and De Weerdt and Dercon [2006].

Furthermore, I find that Thai households have more access to smooth consumption against transitory wage shocks than permanent shocks. This is because 83% of transitory wage shocks are insured while only 47% of permanent wage changes are insured through remittances and household asset holdings decisions. Interestingly, self-insurance through asset holding plays a more important role in consumption insurance than remittances. This is because 72% of the consumption smoothing is explain by households' self-insurance behaviour through asset accumulation whiles remittances only explains 11%. Conditional on education levels, I find that households with higher educational attainment have higher access to smooth consumption against wage shocks through asset accumulation. On the other hand, households with lower educational attainment rely more on remittances as a source of consumption insurance. Finally, I find the life-cycle dynamics of the degree of self-insurance through asset holdings and remittances to be increasing over the life cycle. At the beginning of the life-cycle, households have a negligible degree of self-insurance against adverse wage shocks using either remittances or asset accumulations because of the low stock of both assets and remittance wealth at this stage of the life cycle. However, households' ability to insure themselves via asset accumulation increases with age because household asset holdings increase with age due to precautionary and life-cycle motives. These life-cycle profiles conform with the results obtain by other researchers such as Blundell et al. [2016] and Kaplan and Violante [2010].

3.6 Appendix

3.6.1 Household Problem

$$\max_{C_{ik},H_{ik}} \mathbb{E}_t \left(\sum_{k=t}^{T} \beta^{k-t} u(C_{i,k}, H_{ik}) \right)$$

subject to:

$$\mathbb{E}_t \sum_{k=0}^{T-t} \frac{C_{i,t+k}}{(1+r)^k} + \frac{A_{i,T+1}}{(1+r)^{T-t}} = \mathbb{E}_t \sum_{k=0}^{T_w-t} \frac{W_{i,t} H_{i,t}}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{i,t+k}}{(1+r)^k} + (1+r)A_{i,t}$$

$$C_{i,t} \geq 0$$

$$H_{i,t} \geq 0$$

$$\ln W_{it} = \mathbf{X}'_{it}\varphi_t + \ln P_{it} + u_{it}$$

$$\ln P_{it} = \ln P_{i,t-1} + v_{it}$$

$$\Delta \ln R_{i,t} = \zeta^R_{i,t} + \Delta\tau^R_{it}$$

Given our maximization problem, our first order conditions (FOCs) can be written as:

$$u_C(C_t, H_t) = \lambda_t$$

$$u_H(C_t, H_t) = W_t \lambda_t$$

$$\lambda_{it} = \beta(1+r)\lambda_{it+1}$$

Where u_C and u_H are partial differentials of $u()$ with respect to C and H respectively and λ_{it} denotes the marginal utility of wealth.

3.6.2 Approximating income and consumption growth equations

Lets denote the marginal utility of wealth as λ_{it}, $c_t \equiv \ln C_t$, and $h_t \equiv \ln H_t$, the standard Euler equation can be written as:

$$\mathbb{E}_t(\lambda_{it+1}) = \frac{1}{\beta(1+r)}\lambda_{it}$$

I define ρ such that $e^\rho = \frac{1}{\beta(1+r)}$ and apply a second order Tylor approximation to $e(\ln \lambda_{it+1})$ around $\lambda_{it+1} + \rho$, see Blundell et al. [2016]. This gives us:

$$\lambda_{it+1} \simeq \left[1 + (\Delta \ln \lambda_{it+1} - \rho) + \frac{1}{2} E_t(\Delta \ln \lambda_{it+1} - \rho)^2\right] \lambda_{it} e^\rho$$

Taking expectations with the information set available at time t, I find that

$$\mathbb{E}_t(\Delta \ln \lambda_{it+1}) \simeq \rho - \frac{1}{2} E_t(\Delta \ln \lambda_{it+1} - \rho)^2$$

which can be written as:

$$\Delta \ln \lambda_{t+1} \approx \Gamma_{t+1} + \varepsilon_{t+1} \tag{3.18}$$

where $\Gamma_{t+1} = \rho - \frac{1}{2} E_t(\Delta \ln \lambda_{it+1} - \rho)^2$ and ε_{t+1} are the predictable and unpredictable components of changes in the marginal utility of wealth. $E_t(\varepsilon_{t+1}) = 0$. Thus, our FOCs can be written as:

$$\Delta \ln u_C(C_{t+1}, H_{t+1}) = \Delta \ln \lambda_{t+1} \tag{3.19}$$

$$\Delta \ln u_H(C_{t+1}, H_{t+1}) = \Delta \ln W_{t+1} + \Delta \ln \lambda_{t+1} \tag{3.20}$$

Substituting (3.18) into (3.19) and (3.20), gives us:

$$\Delta \ln u_C(C_{t+1}, H_{t+1}) \approx \Gamma_{t+1} + \varepsilon_{t+1} \tag{3.21}$$

$$\Delta \ln u_H(C_{t+1}, H_{t+1}) \approx \Gamma_{t+1} + \varepsilon_{t+1} + v_{it+1} + \Delta u_{it+1} \tag{3.22}$$

where I used the wage process, $\Delta \ln W_{t+1} \equiv \Delta w_{it+1} = v_{it+1} + \Delta u_{it+1}$, to obtain (3.22).

Now I proceed by expanding $u_C(C_{t+1}, H_{t+1})$ around $u_C(C_t, H_t)$ and $u_H(C_{t+1}, H_{t+1})$ around $u_H(C_t, H_t)$. Starting with a first-order Tylor expansion of $u_C(C_{t+1}, H_{t+1})$ around $u_C(C_t,$ we have:

$$u_C(C_{t+1}, H_{t+1}) \approx u_C(C_t, H_t) + u_{CC}(C_t, H_t)C_t\Delta c_{t+1} + u_{CH}(C_t, H_t)H_t\Delta h_{t+1}$$

$$\Rightarrow \Delta \ln u_C(C_{t+1}, H_{t+1}) \approx \frac{u_{CC}(C_t, H_t)C_t}{u_C(C_t, H_t)}\Delta c_{t+1} + \frac{u_{CH}(C_t, H_t)H_t}{u_C(C_t, H_t)}\Delta h_{t+1} \tag{3.23}$$

Similarly, expanding $u_H(C_{t+1}, H_{t+1})$ around $u_H(C_t, H_t)$ gives

$$\Delta \ln u_H(C_{t+1}, H_{t+1}) \approx \frac{u_{HC}(C_t, H_t)C_t}{u_H(C_t, H_t)}\Delta c_{t+1} + \frac{u_{HH}(C_t, H_t)H_t}{u_H(C_t, H_t)}\Delta h_{t+1} \tag{3.24}$$

Substitute (3.21) into (3.23) and (3.22) into (3.24) gives:

$$\Gamma_{t+1} + \varepsilon_{t+1} \approx \frac{u_{CC}(C_t, H_t)C_t}{u_C(C_t, H_t)}\Delta c_{t+1} + \frac{u_{CH}(C_t, H_t)H_t}{u_C(C_t, H_t)}\Delta h_{t+1}$$

$$\Gamma_{t+1} + \varepsilon_{t+1} + v_{it+1} + \Delta u_{it+1} \approx \frac{u_{HC}(C_t, H_t)C_t}{u_H(C_t, H_t)}\Delta c_{t+1} + \frac{u_{HH}(C_t, H_t)H_t}{u_H(C_t, H_t)}\Delta h_{t+1}$$

Solving these two equations simultaneous for Δc_t and Δh_t[9] gives us:

$$\Delta c_t \approx (\eta_{C,W} - \eta_{C,P})(\underbrace{\Gamma_t + \varepsilon_t}_{\Delta \ln \lambda_t}) + \eta_{C,W}(\underbrace{v_{it} + \Delta u_{it}}_{\Delta w_t}) \tag{3.25}$$

$$\Delta h_t \approx (\eta_{H,P} - \eta_{H,W})(\underbrace{\Gamma_t + \varepsilon_t}_{\Delta \ln \lambda_t}) - \eta_{H,W}(\underbrace{v_{it} + \Delta u_{it}}_{\Delta w_t}) \tag{3.26}$$

which are useful to express in pure innovations forms:

$$\Delta \hat{c}_t \approx (\eta_{C,W} - \eta_{C,P})\varepsilon_t + \eta_{C,W}(v_{it} + \Delta u_{it}) \tag{3.27}$$

[9]Using $\Delta y_{it} = \Delta w_{it} + \Delta h_{it}$, I can also obtain an equation for income dynamics:

$$\Delta y_t \simeq (\eta_{H,P} - \eta_{H,W})(\Gamma_t + \varepsilon_t) + (1 - \eta_{H,W})\Delta w_t$$

$$\Delta y_t = (\eta_{H,P} - \eta_{H,W})(\Gamma_t + \varepsilon_t) + (1 - \eta_{H,W})(v_{it} + \Delta u_{it})$$

which is the income dynamics equation in the main text.

$$\Delta\hat{y}_t = (\eta_{H,P} - \eta_{H,W})\varepsilon_t + (1 - \eta_{H,W})(v_{it} + \Delta u_{it}) \tag{3.28}$$

Equations (3.25)-(3.28) give the income and consumption equations in the main text. P is the price of consumption goods which is normalize to 1 and $\eta_{x,y}$ are Frisch (marginal-utility constant) elasticities of consumption and work hours with respect to the price of consumption and wage. These elasticities are defined as:

$$\begin{aligned}
\eta_{C,W} &\equiv -\frac{u_{CH}u_H}{u_{CC}u_{HH} - u_{CH}^2}\frac{1}{C} \\
\eta_{C,P} &\equiv -\frac{u_{HH}u_C}{u_{CC}u_{HH} - u_{CH}^2}\frac{1}{C} > 0 \\
\eta_{H,P} &\equiv -\frac{u_{CH}u_C}{u_{CC}u_{HH} - u_{CH}^2}\frac{1}{H} \\
\eta_{H,W} &\equiv -\frac{u_{CC}u_H}{u_{CC}u_{HH} - u_{CH}^2}\frac{1}{H} > 0
\end{aligned}$$

3.6.3 Approximating Intertemporal Budget Constraint

Applying Taylor approximation on the intertemporal budget constraint given below.

$$\mathbb{E}_t \sum_{k=0}^{T-t} \frac{C_{t+k}}{(1+r)^k} + \frac{A_{T+1}}{(1+r)^{T-t}} = \mathbb{E}_t \sum_{k=0}^{T_w-t} \frac{W_{t+k}H_{t+k}}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{t+k}}{(1+r)^k} + (1+r)A_t$$

Suppose ξ_k is the series I want to approximate around ξ_k^0, the general approximation rule is given as:

$$\begin{aligned}
E_I\left[\ln \sum_{k=0}^{T-t} \exp \xi_k\right] &= \ln \sum_{k=0}^{T-t} \exp \xi_k^0 + \ln \sum_{k=0}^{T-t} \frac{\exp \xi_k^0}{\ln \sum_{j=0}^{T-t} \exp \xi_j^0}(\xi_k - \xi_k^0) \\
&\quad + \frac{1}{2} \ln \sum_{k=0}^{T-t} \sum_{j=0}^{T-t} E_I\left(\frac{\partial^2}{\xi_k \xi_j}\left[\ln \sum_{k=0}^{T-t} \exp \tilde{\xi}_k\right](\xi_k - \xi_k^0)(\xi_j - \xi_j^0)\right)
\end{aligned} \tag{3.29}$$

where $\tilde{\xi}_k$ is a vector chosen between ξ_k and ξ_k^0 such that the Taylor expansion is accurate. I now apply this expansion on both sides of the intertemporal budget constraint starting with the expenditure side.

Approximating the expenditure account of lifetime resources

I now approximate the expenditure side of lifetime resources by defining $\xi_k = \ln C_{t+k} - k\ln(1+r)$ and $\xi_k^0 = E_{t-1} \ln C_{t+k} - k\ln(1+r)$ for $k = 0, ..., T-t$.

$$E_I\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}\right] \approx \ln\sum_{k=0}^{T-t}\exp[E_{t-1}\ln C_{t+k} - k\ln(1+r)] + \sum_{k=0}^{T-t}\frac{\exp[E_{t-1}\ln C_{t+k} - k\ln(1+r)]}{\ln\sum_{j=0}^{T-t}\exp[E_{t-1}\ln C_{t+j} - j\ln(1+r)]}(E_I\ln C_{t+k} - E_{t-1}\ln C_{t+k})$$

where I ignore the second-order term and take expectation with respect to information set $\mathcal{I}$. Defining the non-random term $\mathcal{K}_e$, and θ_{t+k} as

$$\mathcal{K}_e = \ln\sum_{k=0}^{T-t}\exp[E_{t-1}\ln C_{t+k} - k\ln(1+r)]$$

and

$$\theta_{t+k} = \frac{\exp[E_{t-1}\ln C_{t+k} - k\ln(1+r)]}{\ln\sum_{j=0}^{T-t}\exp[E_{t-1}\ln C_{t+j} - j\ln(1+r)]}$$

I rewrite the approximated expenditure account of lifetime resource as:

$$E_I\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}\right] \approx \mathcal{K}_e + \sum_{k=0}^{T-t}\theta_{t+k}(E_I\ln C_{t+k} - E_{t-1}\ln C_{t+k})$$

At $I = t$, I apply the operator $E_t - E_{t-1}$ on the expression above to obtain:

$$(E_t - E_{t-1})\circ\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}\right] \approx (E_t - E_{t-1})\circ\mathcal{K}_e + \left(\sum_{k=0}^{T-t}\theta_{t+k}\right)[(E_t - E_{t-1})\circ\ln C_{t+k}]$$

Note that $E_t\ln C_{t+k} - E_{t-1}\ln C_{t+k} \equiv \Delta c_{t+k} \approx (\eta_{C,W} - \eta_{C,P})(\Gamma_t + \varepsilon_t) + \eta_{C,W}(v_{it} + \Delta u_{it})$, I simplify the right hand side (RHS) of the expression above as:

$$\left(\sum_{k=0}^{T-t}\theta_{t+k}\right)[(E_t - E_{t-1})\circ\ln C_{t+k}] \simeq \left(\sum_{k=0}^{T-t}\theta_{t+k}\right)[(\eta_{C,W} - \eta_{C,P})(\Gamma_t + \varepsilon_t) + \eta_{C,W}(v_{it} + \Delta u_{it})]$$

Finally, I can consider the pure innovations to household consumption, net of predictable components.

$$E_t\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}\right] - E_{t-1}\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}\right] \approx (\eta_{C,W} - \eta_{C,P})\varepsilon_t + \eta_{C,W}(v_{it} + \Delta u_{it}) \quad (3.30)$$

Here I use $\left(\sum_{k=0}^{T-t}\theta_{t+k}\right) = 1$, i.e. households use all their lifetime expenditure on consumption. Thus, θ_{t+k} can be seen as the annuitization factor for consumption.

Approximating the income account of lifetime resource

Similar to the approximation of the expenditure side of lifetime resource, I now apply the approximation rule given by (3.29) to the total discounted lifetime income of households:

$$\mathbb{E}_t \sum_{k=0}^{T_w-t} \frac{W_{t+k}H_{t+k}}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{t+k}}{(1+r)^k} + (1+r)A_t - \frac{A_{T+1}}{(1+r)^{T-t}}$$

around $\mathcal{K}_y = \ln \sum_{k=0}^{T_w-t} \exp[E_{t-1}\frac{W_{t+k}H_{t+k}}{(1+r)^k} + \sum_{k=0}^{T-t} E_{t-1}\frac{R_{t+k}}{(1+r)^k} + (1+r)A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}}]$ where $A_t^0 = (1+r)^t A_0 + \sum_{k=1}^{t}(1+r)^{t-k}[Y_k + R_k - C_k]$ is the path followed by assets if no shocks are observed. Lets define:

$$\xi_k = \ln W_{t+k}H_{t+k} - k\ln(1+r) \qquad \text{for} \qquad k = 0, ..., T_w - t$$

$$\xi_k^0 = E_{t-1} \ln W_{t+k}H_{t+k} - k\ln(1+r) \qquad \text{for} \qquad k = 0, ..., T_w - t$$

$$\xi_j = \ln R_{t+j} - j\ln(1+r) \qquad \text{for} \qquad j = 0, ..., T - t$$

$$\xi_j^0 = E_{t-1} R_{t+j} - j\ln(1+r) \qquad \text{for} \qquad j = 0, ..., T - t$$

$$\xi_A = \ln(1+r)A_t - A_{T+1}(1+r)^{-(T-t)}$$

$$\xi_A^0 = \ln(1+r)A_t^0 - A_{T+1}^0(1+r)^{-(T-t)}$$

Applying the approximation rule (3.29) to the discounted lifetime income of households while ignoring the second-order term and take expectation with respect to information set $\mathcal{I}$.

$$\begin{aligned} E_I \ln \left[\sum_{k=0}^{T_w-t} \frac{W_{t+k}H_{t+k}}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{t+k}}{(1+r)^k} + (1+r)A_t - \frac{A_{T+1}}{(1+r)^{T-t}} \right] \approx \quad & \mathcal{K}_y \\ + \quad (1-\pi_t-\phi_t^R) \sum_{k=0}^{T_w-t} \alpha_{t+k}[E_I w_{t+k}h_{t+k} - E_{t-1}w_{t+k}h_{t+k}] & \\ + \quad \phi_t^R \sum_{k=0}^{T-t} \delta_{t+j}[E_I \ln R_{t+j} - E_{t-1} \ln R_{t+j}] & \\ + \quad \pi_t \sum_{k=0}^{T-t} E_I \left[(1+r)A_t - \frac{A_{T+1}}{(1+r)^{T-t}} \right] - \left[(1+r)A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}} \right] & \end{aligned}$$

where

$$\alpha_{t+k} = \frac{\exp[E_{t-1}w_{t+k}h_{t+k} - k\ln(1+r)]}{\ln \sum_{j=0}^{T_w-t} \exp[E_{t-1}w_{t+j}h_{t+j} - j\ln(1+r)]}$$

$$\delta_{t+j} = \frac{\exp[E_{t-1} \ln R_{t+j} - j\ln(1+r)]}{\ln \sum_{s=0}^{T-t} \exp[E_{t-1} \ln R_{t+s} - s\ln(1+r)]}$$

$$\pi_t = \frac{\left[\ln(1+r)A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}}\right]}{\sum_{k=0}^{T_w-t} \exp[E_{t-1}w_{t+k}h_{t+k} - k\ln(1+r)] + \sum_{k=0}^{T-t} \exp[\ln R_{t+k} - k\ln(1+r)] + \ln(1+r)A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}}}$$

$$\phi_t^R = \frac{\sum_{j=0}^{T-t} \exp[\ln R_{t+j} - j\ln(1+r)]}{\sum_{k=0}^{T_w-t} \exp[E_{t-1}w_{t+k}h_{t+k} - k\ln(1+r)] + \sum_{k=0}^{T-t} \exp[\ln R_{t+k} - k\ln(1+r)] + \ln(1+r)A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}}}$$

α_{t+k} and δ_{t+j} are the annuitization factors of domestic and remittance incomes respectively such that $\sum_{k=0}^{T_w-t}\alpha_{t+k}=1$ and $\sum_{j=0}^{T-t}\delta_{t+j}=1$. π_t and ϕ_t^R are the shares of asset wealth and remittance wealth on total discounted lifetime wealth, respectively.

Defining $I=t$ and applying the operator E_t-E_{t-1} on the expression above, I obtain:

$$(E_t-E_{t-1})\circ\ln\left[\sum_{k=0}^{T_w-t}\frac{W_{t+k}H_{t+k}}{(1+r)^k}+\mathbb{E}_t\sum_{k=0}^{T-t}\frac{R_{t+k}}{(1+r)^k}+(1+r)A_t-\frac{A_{T+1}}{(1+r)^{T-t}}\right]\approx(E_t-E_{t-1})\circ\mathcal{K}_y$$
$$+\quad(1-\pi_t-\phi_t^R)\left(\sum_{k=0}^{T_w-t}\alpha_{t+k}\right)(E_t-E_{t-1})\circ w_{t+k}h_{t+k}\;+\;\phi_t^R\left(\sum_{k=0}^{T-t}\delta_{t+j}\right)(E_t-E_{t-1})\circ\ln R_{t+j}$$
$$=(1-\pi_t-\phi_t^R)[v_t+\alpha_t\Delta u_t]+\phi_t^R(\zeta_{i,t}^R+\Delta\tau_{it}^R)\tag{3.31}$$

Equating innovations to the expenditure and income accounts

Given that I have approximated the expenditure (3.30) and the income (3.31) accounts of households' lifetime resources, I now equate the two sides of the approximated intertemporal budget constraint

$$(\eta_{C,W}-\eta_{C,P})\varepsilon_t+\eta_{C,W}(v_{it}+\Delta u_{it})=(1-\pi_t-\phi_t^R)[v_t+\alpha_t\Delta u_t]+\phi_t^R(\zeta_{i,t}^R+\Delta\tau_{it}^R)\tag{3.32}$$

in order to derive an expression for the innovation in marginal utility of wealth ε_t. Since we have two transitory shocks, a remittance income shock τ_{it}^R and a transitory earning shock u_{it}, I assume that transitory remittance shocks τ_{it}^R do not affect shocks on marginal utility of wealth ε_t but transitory earning shocks do. Equation (3.32) hence implies that

$$\varepsilon_t=\frac{1-\pi_t-\phi_t^R-\eta_{C,W}}{\eta_{C,W}-\eta_{C,P}}v_t+\frac{[\alpha_t(1-\pi_t-\phi_t^R)-\eta_{C,P}]}{\eta_{C,W}-\eta_{C,P}}\Delta u_t+\frac{\phi_t^R}{\eta_{C,W}-\eta_{C,P}}\zeta_t^R\tag{3.33}$$

Now I substitute the expression for the innovation in marginal utility of wealth (3.33) in equations (3.27) and (3.28) to obtain analytical expressions for households' consumption and income dynamics as a function of wage and remittance income shocks.

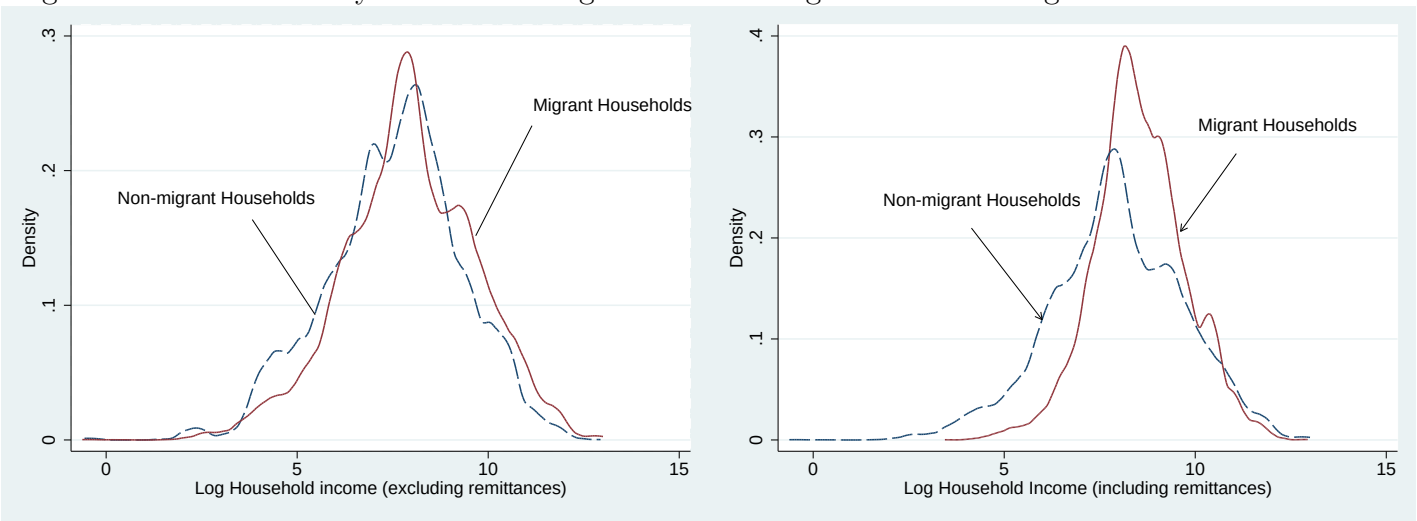
$$\Delta\hat{c}_t\approx(1-\pi_t-\phi_t^R)v_t+\alpha_t(1-\pi_t-\phi_t^R)\Delta u_t+\phi_t^R\zeta_t^R$$
$$\Delta\hat{y}_t=\kappa_{y,v}v_t+\kappa_{y,u}\Delta u_t+\kappa_{y,R}\zeta_t^R$$

where I define

$$\kappa_{y,v}=\frac{(\eta_{H,P}-\eta_{H,W})(1-\pi_t-\phi_t^R-\eta_{C,W})}{\eta_{C,W}-\eta_{C,P}}+1-\eta_{H,W}$$
$$\kappa_{y,u}=\frac{(\eta_{H,P}-\eta_{H,W})[\alpha_t(1-\pi_t-\phi_t^R)-\eta_{C,W}]}{\eta_{C,W}-\eta_{C,P}}+(1-\eta_{H,W})$$
$$\kappa_{y,R}=\frac{(\eta_{H,P}-\eta_{H,W})\phi_t^R}{\eta_{C,W}-\eta_{C,P}}$$

This is (3.9) in the main text.

Figure 3.4: Kernel density estimates of log incomes for migrant and non-migrant households



3.6.4 Advance Information

Table 3.5: Test for Superior or Advanced Information

	(1) Coef.	(2) Robust Std. Err.	(3) z	(4) $P > \|z\|$	(5) [95% Conf.	Interval]
$E(\Delta c_{i,t}\Delta r^R_{i,t+2})$	.0019529	.0030666	0.64	0.524	-.0040574	.0079633
$E(\Delta c_{i,t}\Delta r^R_{i,t+3})$	-.0028764	.0042186	-0.68	0.495	-.0111447	.0053919
$E(\Delta c_{i,t}\Delta r^R_{i,t+4})$	.0062939	.004757	1.32	0.186	-.0030296	.0156175
$E(\Delta c_{i,t}\Delta r^R_{i,t+5})$	-.009823	.0051993	-1.89	0.059	-.0200134	.0003674

Estimated using GMM

Chapter 4

Remittances and Family Time Allocation

4.1 Introduction

The structures of labour markets in many developing countries are vastly different from those in advanced countries. One of these structural differences is the presence and importance of informal labour market arrangements in developing countries. Second, the dominance of the agriculture sector as the prime employment creator mainly consisting of self-employed and unpaid family workers is another salient feature of labour markets in developing economies. These features shape the way in which households in these economies allocate family hours in response to changing domestic and international conditions. One of these changing conditions is the increasing flow of remittances to developing countries. Despite the growing importance of remittances in developing countries, little is known about the impact of this "external" source of income on family time allocation in these countries.

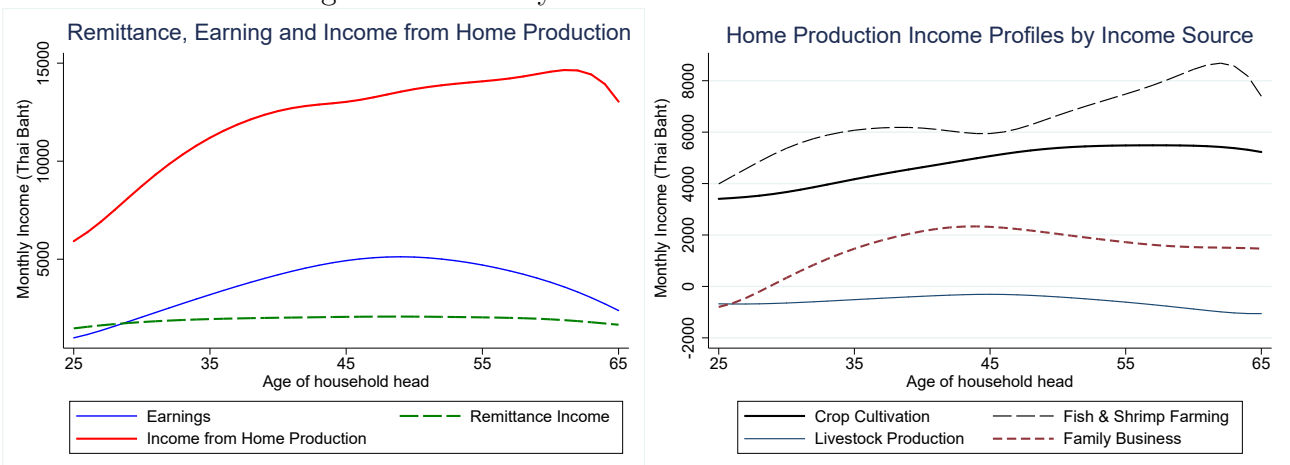
Remittance serves as an important source of insurance for households in developing economies especially among families with low educated household heads.[1] Morduch [1999] explains that in an environment where people have low protection against income and employment shocks,

[1]This has been extensively investigated in the previous chapter, chapter 3

households rely more on informal insurance arrangements between individuals and communities rather than on publicly managed programs or market-provided insurance schemes. However, since remittances are non-labour incomes, remittance inflows are likely to lift recipient households' budget constraints, increase their reservation wages and, through an "income effect" lower their employment likelihood. Thus, if not carefully coordinated to minimize potential work disincentives, remittances can distort work decisions which may negatively affect households welfare at the margin.

Most empirical studies find that remittances to developing economies have adverse effects on recipient households' market hours. However, these studies fail to take into account the fact that households in these economies also involve in home production [Deaton and Zaidi, 2002]. Figure 4.1 shows that Townsend Thai households receive more income from home production activities than from labour market participation. By decomposing income from different home production activities, it becomes clear that fish & Shrimp farming is the most important source of income from home production activities.

Figure 4.1: Life Cycle Profiles of Household Income



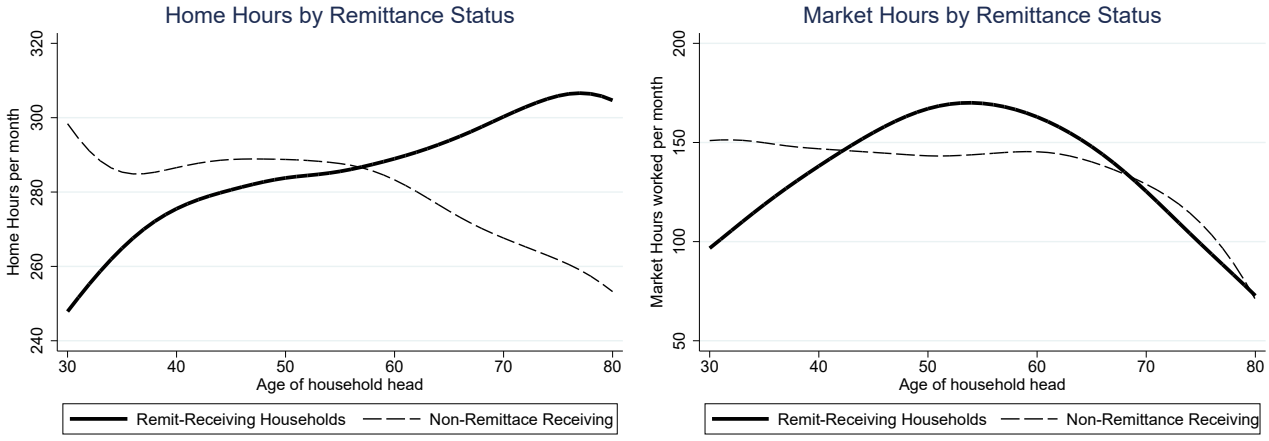
Source: Townsend Thai Monthly Household Survey. The panel on the left of Figure 4.1 shows the life cycle patterns of household earnings, remittance income and income from home production. Overall, Thai households receive more income from home production activities than from labour market participation.

Given these home production choices, remittances may not only affect households' market hours, it can also affect the optimal allocation of family hours between market and home production activities. In the face of uncertainties, the allocation of labour hours plays an important role in insuring households against adverse income shocks [Blundell et al., 2017]. Consequently,

I extend Chapter 3 of this dissertation by explicitly accounting for the interactive effect of remittances and households' time allocation decisions on their ability to insure themselves against negative wage shocks.

Figure 4.2 provides illustrative evidence that home hours of remittance-receiving households increase over the life-cycle while decreasing for non-remittance receiving households. However, market hours have been relatively flat for remittance-receiving households while exhibiting the usual inverted-U shape for non-remittance receiving households. The reallocation of household hours towards home production activities among remittance-receiving households has been documented by Amuedo-Dorantes and Pozo [2006] for Mexican men. Amuedo-Dorantes and Pozo [2006] provide evidence that remittance income induces reallocation of men hours from formal to informal sector employment in Mexico. However, labour supply drops for women in response to higher remittance inflows due to reductions in informal and non-paid works; market hours for women remain unaffected.

Figure 4.2: Life Cycle Profiles of Time Use



Source: Townsend Thai Household Survey. These figures show household time allocation between home and market production activities for two groups of households: remittance and non-remittance receiving households.

To support the view that the reallocation of household hours from market to home production activities is linked to increased remittance income, I provide some evidence by empirically estimating the impact of remittances on households' time spent on market and home production activities respectively. I focus on time allocation because even without affecting the decision to work or not (i.e. the extensive margin), remittances may induce changes in the hours worked and/or the type of work performed (the intensive margin). I find that remittance

inflows significantly increase home production time with no detectable effects on market hours. Although reduced-form models provide some insights on the impact of remittances on time allocation, they do not reveal the dynamics nor the rich underlying mechanisms through which remittances impact households' time allocation. For this reason, I develop a dynamic model of household time allocation choices in the presence of remittances, and estimate this model using household-level panel data from the Townsend Thai monthly survey.

To the best of my knowledge, there has not been any study on the effect of remittances on households' time allocation using a dynamic labour supply model. Most of the studies are done using reduced-form models. For example, Rodriguez and Tiongson [2001] examined the impact of remittances on the decision to work in Philippines. Without accounting for endogeneity of remittances with respect to labour supply, they conclude that remittances reduce employment and slightly increase self-employment. After accounting for endogeneity, for the zero-inflated nature of hours of work, and for self-selection of the migrant sample, Jadotte and Ramos [2016] arrived at the same conclusion. While informative, these studies focus on the extensive margin and do not factor that, without changing the employment status of recipient households, remittances may induce changes in hours worked and/or the type of work performed (the intensive margin). Amuedo-Dorantes and Pozo [2006] address these issues using a reduced form IV-Tobit model and data from Mexico. They find no support that men reduce labour effort in response to greater remittance incomes - remittances only alter the allocation of male labour supply from market to home production activities. In contrast, women work less in informal and non-paid work in response to greater remittance receipts.

This study draws from the remittance and the consumption insurance literature. Whereas the theoretical underpinnings draw from the remittance literature, the methodological framework borrows from the consumption insurance literature such as Blundell et al. [2017]. I build on this literature by allowing time allocation to evolve depending on changes in remittances. By decomposing the response of time allocation to remittance income shocks, I find no support that increased remittance income leads to lower labour effort among Thai households. On the contrary, I find that permanent remittance inflows induce Thai households to reallocate labour hours from market to home production activities. This time-reallocation effect is stronger

among households with low education attainment suggesting a positive wealth effect associated with permanent remittance shocks on home production time. In what follows, I highlight the reduced-form analysis of the effect of remittances on time allocation before presenting our dynamic labour supply model as well as the estimation and predictions of this dynamic model.

4.2 Longitudinal Evidence on Time Use

The basic idea behind our descriptive empirical strategy is to support the view that the reallocation of household hours from market to home production activities is linked to increased remittance income. These reduced-form estimations are implemented using data from the Townsend Thai survey which provides detailed longitudinal information on households' time use, remittance income, and labour market characteristics.

4.2.1 Empirical Framework

I respectively regress households' time spent on market and home production activities on their remittance income, labour market characteristics and a set of household level controls. This econometric model is given as:

$$Time_{it}^{j} = \alpha_0^j + \alpha_1^j R_{it} + \delta_Z^j Z_{it} + \delta_X^j X_{it} + Time_{i,t-1}^{j} + \epsilon_{it}^{j} \qquad i = 1, 2, ..., N, \tag{4.1}$$

where $j \in \{\text{home hours}, \text{market hours}\}$. $Time_{it}^{j}$ is average hours per month household i spent in production activities j at time t and $Time_{i,t-1}^{j}$ is the lagged of labour hours. α_1^{market} and α_1^{home} therefore measure the effects of remittances on household time spent on market and home production activities respectively. Home hour is defined as the sum of time spent on household crop cultivation, fish & shrimps farming, livestock rearing and family business. R_{it} measures household i's average monthly remittance income at time t, Z_{it} is a vector of labour market characteristics such as wages and earnings, and X_{it} is a vector of household level controls such as family size, number of kids in the household, average age and education level of the household.

Moreover, I included the characteristics of household heads such as gender and marital status in the regressions as controls. This is done to help improve the robustness of our time allocation estimations. Finally, ϵ_{it}^{j} is a vector of normally distributed random errors. I am interested in testing whether α_1^{market} and α_1^{home} are different from zero. If $\alpha_1^{market} = 0$ but $\alpha_1^{home} \neq 0$, this suggests that remittances only affect households' home hours with no detectable effect on market hours. If $\alpha_1^{home} = \alpha_1^{market} = 0$, remittances do not affect households' time allocations after controlling for their labour and non-labour market characteristics. However, remittances do affect households' time allocations between market and home production activities if $\alpha_1^{home} = \alpha_1^{market} \neq 0$.

4.2.2 Empirical strategy

There is a number of identification problems that arises with the estimation of equation (4.1). These are endogeneity problems that need to be overcome in order to credibly estimate the effect of remittances on time allocation. Endogeneity may arise due to self-selection, measurement error and/or reverse causality between households' work hours and their remittance income. Thus, estimating equation (4.1) by OLS may yield biased and inconsistent estimates because remittance R_{it} is potentially correlated with the error term ϵ_{it}.

The problem of self-selection exists if remittances are related to say wealth, which in turn, may be correlated with the choice of households' work hours. This causes our estimates of α_1^{market} and α_1^{home} to be (possibly upward) biased and inconsistent because $E(\epsilon_{it}, R_{it}) \neq 0$ violates the standard estimation assumptions. Additionally, measurement error is particularly important in this study because our remittance and work hour variables are likely to be measured with considerable error. For example, suppose "reported" remittance equals $R_{it}^{*} = R_{it} + \xi_{it}$, where ξ_{it} is measurement error and R_{it} is households' actual or true remittance income. Even by assuming that measurement errors ξ_{it} are serially uncorrelated and uncorrelated with true households' remittance income, pooled estimation will lead to the well known attenuation bias i.e. the downward bias towards zero caused by measurement errors in our explanatory variables. Furthermore, the possibility of reverse causality exists in equation (4.1) if hours worked influence

the decision of emigrants to send remittances home. For example, reverse causality exists if past hours worked affect current remittance flow. Suppose households that devote more time on home production receive more remittance income ($\gamma_s^j > 0$),

$$R_{it} = a_0 + a_1 X_{it} + b_1 Z_{it} + \sum_{s=0}^{t} \gamma_s^j Time_{i,t-s}^j + error_{it} \tag{4.2}$$

then our estimates of α_1^{market} and α_1^{home} will be (possibly) downward biased. To address these problems, I use an IV approach by instrumenting the remittance variable with two variables. The first instrument is the interaction between the weighted cost of sending remittances to Thailand and the percentage of household members with secondary or tertiary education. The second instrument is the weighted per capita income of Thai migrants' destination countries, $\sum_j^J \frac{m_{jt}}{M_t} GDPp_{jt}$. Both the cost of sending remittances to Thailand and destination countries' income per capita are weighted using the share of Thai migrants m_{jt} in destination country j out of Thailand's total migrant stocks M_t at time t, represented as $\frac{m_{jt}}{M_t}$.

Table 4.1: Instrumental Variable: First Stage Regression Results

	(1)	(2)
$Remittances_{it}$	Pooled OLS	Fixed Effect
$Instrument_1$	0.0792***	0.0239***
	(0.00241)	(0.00240)
$Instrument_2$	0.0048*	0.0032*
	(0.00192)	(0.0011)
Age, Education, Gender, Year Controls	YES	YES
Number of obs	6,498	6,498
Prob > F	0.0000	0.0015

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

These instruments are used because the amount of remittances Thai households receive is negatively related with the cost of remittance transfer and positively related with weighted per capita income of destination countries. Furthermore, both instruments are exogenous to household decisions and do not directly affect household consumption, after controlling for its effect on remittances. The cost of sending remittances to Thailand is obtained from World

Bank's Remittance Prices Worldwide database while Thailand's bilateral migration stocks to all countries in the world are obtained from World Bank's Bilateral Migration Matrices. The Remittance Prices database provides data on the cost of sending and receiving small amounts of money from one country to another. As of November 2019, the average cost of sending remittances globally is 6.84 percent of the amount sent. Table 4.1 summarises the first-stage results of our IV estimation. The results show that our instruments are valid instrument since they are both individually and jointly statistically very significant. The positive sign on the first instrument signals that changes in the percentage of household members with secondary or tertiary education dominate most of the variations of the first instrument.

4.2.3 Empirical Results

I also present the regression results for the second-stage of our IV estimation in Table 4.2 using different specifications. Columns (1) and (4) present the effect of remittances on time allocation without controlling for household characteristics. These results suggest that households tend to allocate more hours in home production and less time in labour market activities when they receive higher remittances. The relationship becomes more robust for home hours in columns (2) and (3) when household characteristics are taken into consideration. Thus, the re-allocation of family hours from market to home production activities due to increased remittance income is supported since $\alpha_1^{home} > 0$ and $\alpha_1^{market} < 0$. Nonetheless, the effect of remittances on market hours is statistically insignificant. Moreover, the results show that labour market earnings are strong determinants of households' market and home hours. Importantly, households tend to devote more time to market work when they receive higher earnings from such activities. And as expected, higher educational attainment reduces home hours and increases market work while average age has a positive but decreasing marginal effect on both home and market hours. In summary, Table 4.2 highlights that households' time allocation depends not only on their labour market characteristics, but also on their remittance income. In the next section I propose a model that provides a dynamic link between remittances and households time allocation.

Table 4.2: Longitudinal Regressions of Time Use on Market and Home Production

	(1) Home Hours	(2) Home Hours	(3) Home Hours	(4) Market Hours	(5) Market Hours	(6) Market Hours
Remittance income	0.00046*	0.00197***	0.00297***	-0.00006	-0.000193	-0.0002
	(0.0002)	(0.0003)	(0.0003)	(0.0004)	(0.0003)	(0.0003)
Labour earnings	0.000114	0.00048*	0.00048*	0.0169***	0.0125***	0.0125***
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)
Family size		4.858***	4.763***		-0.0471	-1.586
		(1.146)	(1.199)		(1.488)	(1.564)
Number of kids		-11.06***	-5.112		2.917	-5.408
		(2.965)	(5.307)		(3.854)	(6.934)
Education		-4.712***	-12.94***		-0.894	9.860
		(1.329)	(3.895)		(1.727)	(5.085)
Age		-0.941***	5.800***		0.124	1.163
		(0.243)	(0.866)		(0.316)	(1.127)
Gender		1.600	2.336		1.006	0.195
		(2.926)	(2.923)		(3.807)	(3.819)
Education^2			0.474			-0.763*
			(0.244)			(0.318)
Kids^2			1.052			4.501*
			(1.725)			(2.255)
Age^2			-0.0658***			-0.00948
			(0.00805)			(0.0104)
Lag of Home hours	0.165***	0.142***	0.130***			
	(0.0111)	(0.0123)	(0.0123)			
Lag of Market hours				0.193***	0.149***	0.148***
				(0.00912)	(0.0109)	(0.0109)
Constant	237.0***	297.7***	171.3***	54.02***	71.53**	21.85
	(3.382)	(18.55)	(27.72)	(2.291)	(23.52)	(36.09)
Observations	8013	6498	6498	8013	6498	6498
P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
R-squared	0.1996	0.0582	0.0129	0.3828	0.2728	0.2724

Standard errors in parentheses

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

4.3 A Life Cycle Model with Home Production Function

To explain how remittances affect households' time allocation decisions, I specify a parsimonious model in which households derive utility from the consumption of market goods, leisure and the consumption of home produced goods. I assume that home goods are produced using as inputs household labour hours and home appliances with a technology that is consistent with substitution between these two inputs. Households live for T periods and work for T_w periods. In each of these periods, they receive remittance income, income from home production and wages from labour market participation. Households' optimization problem therefore is to choose consumption (of market and home-produced goods) and the allocation of family hours between market and home production activities in order to maximize expected lifetime utility subjected to some feasibility constraints. I assume throughout that both the wage and remittance income processes are exogenous but non-stationary over the life cycle. I also allow remittance income shocks to be potentially correlated with their corresponding earning shocks such that households experience permanent (transitory) changes in remittance income when they experience permanent (transitory) earnings shocks. Following Blundell et al. [2017], I define transitory shocks as those shocks that have negligible or no effect on household wealth while permanent shocks are those shocks with significant wealth effects. As a result, Frisch (or λ-constant) elasticities will be measured by the responsiveness of labour hours to transitory remittance and wage shocks while Marshallian (or uncompensated) elasticities will be measured by the responsiveness of labour hours to permanent remittance and wage shocks.

4.3.1 Home Production

The fact that households in developing countries are involve in home production is an integral part of this study. This is because remittances do not only alter households' time allocation but it also affects home production through its effect on asset accumulation. Following Siegel [2017], I assume that home goods are produced using a Cobb–Douglas production function

$$Q_{i,t} = \left[K_{i,t}\left(R_{i,t}\right)\right]^{\gamma} H_{i,t}^{1-\gamma} \qquad 0 \leq \gamma \leq 1 \tag{4.3}$$

Here, $Q_{i,t}$ denotes total output of home produced goods which are produced using two inputs: home capital/appliances $K_{i,t}$ and family labour $H_{i,t}$. Therefore, home production is dependent on family labour and asset accumulation. The latter is however a function of remittances since remittances can be used to finance asset accumulation. In a broader sense, these assets or home appliances can include paid workers since they are all labour-saving inputs that are acquired from the market. The technology used to produce home goods is consistent with substitution between family labour and home appliances.

As Deaton and Zaidi [2002] noted, home produced goods are normally use for home consumption and sometimes for the market. I use s_0 to denote the portion of home produced goods that is use for home consumption and $(1-s_0)$ is the fraction sold at the market. Hence, s_0 $(0 \leq s_0 \leq 1)$ measures the "marketability" of home produced goods and it is likely to depend on household characteristics. For example, households facing food (or basic needs) insecurity are more likely to consume a higher percentage of their home produced goods (i.e. to be involved in subsistence production) than those who do not face such insecurities. I abstract from this by assuming that a constant share of home goods are consume within a given household.

4.3.2 Choices and Preferences

Households in our model are born at time $t = 0$, work until $t = T_w$ and die at time $t = T$. At every period t, our households derive utility from the consumption of leisure L_{it}, market goods C_{it} and home produced goods $v(H_{i,t+k}, K_{i,t+k}(R_{i,t+k}))$. Our households discount the future at rate β to optimize expected lifetime utility:

$$\max_{C_{ik},L_{ik},H_{ik},K_{ik}} \mathbb{E}_t \left[\sum_{k=0}^{T-k} \beta^k U_{t+k} \left(C_{i,t+k}, 1 - N_{i,t+k} - H_{i,t+k}, v\Big(H_{i,t+k}, K_{i,t+k}(R_{i,t+k}); s_0\Big); x_{it+k} \right) \right]$$

In this model, households are endowed with one unit of time. Consequently, leisure is the time spent not working either at home $H_{i,t}$ or in the labour market $N_{i,t}$. The sub-utility $v(.)$ from the consumption of home produced goods is a function of two inputs that are use in the home production process. These inputs are home hours $H_{i,t}$ and home appliances $K_{i,t}$. As explained

above, households holding of home appliances is a function of remittances. Remittance can be used not only to finance consumption smoothing and, in this way, as an alternative to asset accumulation, but also to fund asset accumulation. This rationalises the link between remittances and home production through asset holdings. Finally, I conditioned household utility on a set of demographic variables x_{it+k} such as family size, number of kids in the households, and average age and education level in the household.

For empirical application, I follow Blundell et al. [2017] by decomposing household preference into two utility sub-aggregates. This separability restriction on households' preferences allows us to rewrite household utility as

$$\max \mathbb{E}_t \left(\sum_{k=0}^{T-k} \beta^k \left[\Big(1-\mu(x_{it+k})\Big) \Psi\Big(C_{i,t+k}, L_{i,t+k}\Big) + \mu\Big(x_{it+k}\Big) v\Big(H_{i,t+k}, K_{i,t+k}\left(R_{i,t+k}\right)\Big) \right] \right) \quad (4.4)$$

Here $\Psi_m > 0$, $\Psi_{mm} < 0$ for $m \in \{C, L\}$ and $v_m > 0$, $v_{mm} < 0$ for $m \in \{H, K\}$. While the first utility aggregate $\Psi\left(C_{i,t+k}, L_{i,t+k}\right)$ captures the satisfaction derive from leisure and consumption of market goods, the second utility aggregate $v\Big(H_{i,t+k}, K_{i,t+k}\left(R_{i,t+k}\right)\Big)$ captures the utility derive from the consumption of home produced goods. These sub-utilities are weighted using a weight $\mu(x_{it+k})$ that depends on demographic conditioning variables x_{it+k}.

4.3.3 Budget Constraint

In trying to maximize their welfare, households face a budget constraint at each point in time which limits the feasible choices. This per-period budget constraint can be written as:

$$C_{i,t} + K_{i,t}\left(R_{i,t}\right) + A_{i,t+1} = (1+r)A_{i,t} + W_{i,t}N_{i,t} + R_{i,t} + (1-s_0)\,Q_{i,t} \quad (4.5)$$

The left hand side of equation 4.5 gives household expenditures at time t. This is the sum of purchase of consumption goods $C_{i,t}$, time-saving inputs $K_{i,t}$ for home production and asset holdings $A_{i,t+1}$. On the right hand side of equation 4.5, this shows households' total income at time t. The income side of the budget constraint is the sum of household incomes from asset

holdings $(1+r)A_{i,t}$, labour market participation $W_{i,t}N_{i,t}$, remittances $R_{i,t}$ and sales of home produced goods $(1-s_0)\,Q_{i,t}$. I normalize prices to one and denote the rate of return on asset holdings with r. By substituting equation 4.3 in equation 4.5, the effective budget constraint to the household maximization problem becomes:

$$C_{i,t} + K_{i,t}\left(R_{i,t}\right) + A_{i,t+1} = (1+r)A_{i,t} + W_{i,t}N_{i,t} + R_{i,t} + (1-s_0)\left[K_{i,t}\left(R_{i,t}\right)\right]^{\gamma} H_{i,t}^{1-\gamma} \qquad (4.6)$$

4.3.4 Household Optimization Problem

Given this budget constraint, households maximize their lifetime utility by choosing: consumption $(C)_{t=0}^{T}$, leisure hours $(L)_{t=0}^{T}$, home hours $(H)_{t=0}^{T}$ and the optimal amount of home appliance K_{it} for home production. The household utility maximization problem becomes:

$$\max_{C_{ik},L_{ik},H_{ik},K_{ik}} \mathbb{E}_t\left(\sum_{k=0}^{T-k}\beta^k\left[\Big(1-\mu(x_{it+k})\Big)\Psi\Big(C_{i,t+k},L_{i,t+k}\Big)+\mu\Big(x_{it+k}\Big)v\Big(H_{i,t+k},K_{i,t+k}\left(R_{i,t+k}\right)\Big)\right]\right)$$

subject to

$$C_{i,t} + K_{i,t}\left(R_{i,t}\right) + A_{i,t+1} = (1+r)A_{i,t} + W_{i,t}N_{i,t} + R_{i,t} + (1-s_0)\left[K_{i,t}\left(R_{i,t}\right)\right]^{\gamma} H_{i,t}^{1-\gamma}$$

$$N_{i,t+k} = 1 - L_{i,t+k} - H_{i,t+k}$$

$$\Delta w_{i,t} = v_{i,t} + \Delta u_{i,t}$$

$$\Delta r_{i,t}^{R} = \zeta_{i,t}^{R} + \Delta\tau_{i,t}^{R}$$

$$C_t \geq 0, \quad K_{i,t} > 0, \quad H_{i,t} > 0 \quad \text{and} \quad L_{i,t} \geq 0$$

Whereas the first two constraints are households' budget and time endowments respectively, the next two constraints are their wage and remittance income processes. These processes are exactly the same processes that were specified and discussed in chapter 3. As in chapter 3, $v_{i,t}$ and $u_{i,t}$ denote permanent and transitory wage shocks while $\zeta_{i,t}^{R}$ and $\tau_{i,t}^{R}$ represent persistent and transitory remittance income shocks, respectively. The shocks are household-specific with vari-

ances σ_v^2, σ_u^2, σ_ζ^2 and σ_τ^2 respectively. Furthermore, the remittance shocks are freely correlated with their corresponding wage counterparts such that households experience permanent (transitory) changes in remittance income when they experience permanent (transitory) earnings shocks. Finally, the last constraints are non-negativity conditions on household consumption, home appliances, home hours and leisure time. Optimality requires $H_{i,t}$ and $K_{i,t}$ to be positive since the home production function (4.3) features complementarity between family home hours and home appliances.

Maximizing the objective function subject to the constraints gives the following first order conditions (FOCs):

$$\lambda_{t+1} = \beta(1+r)\lambda_t \tag{4.7}$$

$$(1-\mu)\Psi_C(C_t, L_t) = \lambda_t \tag{4.8}$$

$$(1-\mu)\Psi_L(C_t, L_t) = \lambda_t W_t \tag{4.9}$$

$$v_H\Big(H_t, K_t\left(R_t\right)\Big) = \lambda_t \underbrace{\left[\frac{W_t}{\mu} + \frac{\left(\gamma-1\right)\left(1-s_0\right)}{\mu}\left(\frac{K_t\left(R_t\right)}{H_t}\right)^{\gamma}\right]}_{C_H(W_t, K_t(R_t), H_t)} \tag{4.10}$$

$$v_K\Big(H_t, K_t\left(R_t\right)\Big) = \lambda_t \underbrace{\left[\frac{1}{\mu} - \frac{\gamma\left(1-s_0\right)}{\mu}\left(\frac{K_t\left(R_t\right)}{H_t}\right)^{\gamma-1}\right]}_{C_K(K_t(R_t), H_t)} \tag{4.11}$$

Equations (4.7) to (4.11) fully characterize the household utility maximizing choices. When allocating time between market and home production activities, households outweigh the associated costs and benefits from each activity. Take equation (4.10) for instance, the marginal benefit of allocating an additional family hour on home production, the left-hand side, should be equal to its marginal cost on the right at optimum. The term $C_H(W_t, K_t\left(R_t\right), H_t) = \left[\frac{W_t}{\mu} + \frac{(\gamma-1)(1-s_0)}{\mu}\left(\frac{K_t(R_t)}{H_t}\right)^{\gamma}\right]$ is the lowest cost of producing an extra unit of home goods using family labour hours. This depends on wages, remittances and households' level of home appliances per capita $\frac{K_t}{H_t} = \tilde{k}$. $C_H(W_t, K_t\left(R_t\right), H_t)$ depends on wage rates because wages represent the opportunity cost of home hours; devoting more time to home production lowers labour income. Remittances affect optimal time allocation choices through two main channels. First, remittances affect the marginal cost of allocating an additional family hour on home production

through its effects on asset/home appliance holding. Since home production is dependent on home appliances and remittances can be used to acquire such labour-saving inputs, a change in remittances can alter the marginal cost of home production time due to substitutability between family labour and home appliances in home production. Second, remittances affect these optimal decisions through its impact on the marginal utility of wealth λ_t which directly affects all the equations that characterize the solutions to this household optimization problem.

4.4 The Dynamics of Home and Market Hours

Since a closed-form solution does not exist for this problem, I proceed by approximating the dynamics of time allocation decisions as a function of wage and remittance income shocks. This is done by using a two-step approximation procedure that is fairly standard in the consumption literature (see Blundell et al. [2016]). The first step is to apply a Taylor series expansion on the first order conditions of our household maximization problem. This yields expressions (the Frisch elasticities) for the growth rates of consumption, of market hours, and of home production time as a function of changes in wages and the marginal utility of wealth. However, the marginal utility of wealth and hence its innovations are not observable making them not empirically useful. To overcome this problem, the second step log-linearized the intertemporal budget constraint by expressing the unobserved shocks on the marginal utility of wealth as a linear function of wage and remittance income shocks. This yields expressions (the Marshallian elasticities) for the growth rates of consumption, home and market hours as functions of remittance and wage shocks.

4.4.1 The Frisch Elasticities

Frisch (constant-λ) elasticities measure the response of household consumption, market and home hours to wealth-constant changes in prices and wages.[2] The marginal utility of wealth $\lambda_{i,t}$

[2]For example, the Frisch elasticity of market labour supply with respect to wages measures the percentage change in market hours due to a percentage change in wages, holding the marginal utility of wealth constant.

is the Lagrange multiplier on household i's sequence of budget constraints. The matrix of Frisch responses is obtain by log-linearising the FOCs of our household maximization problem. For simplification of notations, I use lower case letters c_t, l_t, and h_t to denote the log of consumption, log of leisure hours, and log of home production time respectively, net of the predictive effects of observed household characteristics. As shown in the Appendix, approximation of the Euler equation gives us expressions for the evolution of household consumption Δc_{it}, leisure hours Δl_{it} and home hours Δh_{it} as functions of changes in the log marginal utility of wealth $\Delta \ln \lambda_{it}$ and wages.

$$\begin{pmatrix} \Delta c_{i,t} \\ \Delta l_{i,t} \\ \Delta h_{i,t} \\ \Delta k_{i,t} \end{pmatrix} \cong \begin{pmatrix} -\eta_{c,p} & \eta_{c,w} & 0 & 0 \\ \eta_{l,p} & \eta_{l,w} & 0 & 0 \\ 0 & 0 & \varpi_{h,w} & \varpi_{h,p_k} \\ 0 & 0 & \varpi_{k,w} & \varpi_{k,p_k} \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 2 & 1 & \gamma \\ 1 & 0 & 1-\gamma \end{pmatrix} \begin{pmatrix} \Delta \ln \lambda_{i,t} \\ \Delta \ln W_{i,t} \\ \Delta \ln \tilde{k} \end{pmatrix} \tag{4.12}$$

where the matrix of Frisch responses of household consumption and time allocation is:

$$\mathcal{F} \cong \begin{pmatrix} -\eta_{c,p} & \eta_{c,w} & 0 & 0 \\ \eta_{l,p} & \eta_{l,w} & 0 & 0 \\ 0 & 0 & \varpi_{h,w} & \varpi_{h,p_k} \\ 0 & 0 & \varpi_{k,w} & \varpi_{k,p_k} \end{pmatrix}$$

Here, the parameters $\eta_{x,y}$ denote the Frisch elasticities of variable x with respect to changes in y associated with sub-utility $\Psi(\cdot)$. These elasticities measure the responsiveness of leisure hours and consumption to changes in wages and the "price" of current consumption in terms of future consumption, holding the marginal utility of wealth constant. Similarly, the parameters $\varpi_{x,y}$ denote the Frisch elasticities of variable x with respect to changes in y associated with sub-utility $v(\cdot)$. For example, $\varpi_{h,w}$ and ϖ_{h,p_k} measure the responsiveness of home hours to changes in wages and the price of home appliances, respectively, holding λ constant. The zeros in the matrix of Frisch elasticities come directly from the assumption that $\Psi(.)$ and $v(.)$ are

separable. In the context of separability, these Frisch elasticities are define as follows:

$$\eta_{c,p} = -\frac{\Psi_c}{C}\frac{\Psi_{ll}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}; \qquad \eta_{c,w} = -\frac{\Psi_l}{C}\frac{\Psi_{lc}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}$$

$$\eta_{l,p} = -\frac{\Psi_c}{L}\frac{\Psi_{lc}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}; \qquad \eta_{l,w} = \frac{\Psi_l}{L}\frac{\Psi_{cc}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}$$

$$\varpi_{h,w} = -\frac{v_h v_{kk}}{H(v_{kk}v_{hh} - v_{kh}^2)}; \qquad \varpi_{h,p_k} = -\frac{v_k v_{hk}}{H(v_{kk}v_{hh} - v_{kh}^2)}$$

$$\varpi_{k,w} = -\frac{v_h v_{kh}}{K(v_{kk}v_{hh} - v_{kh}^2)}; \qquad \varpi_{k,p_k} = \frac{v_k v_{hh}}{K(v_{kk}v_{hh} - v_{kh}^2)}$$

However, since we do not observe leisure hours, I re-write the Frisch matrix in terms of market hours rather than leisure hours. The relation between market, home and leisure hours elasticities is defined by Blundell et al. [2017] as:

$$\eta_{h,w} = -\frac{L_{it}}{N}\eta_{l,w} - \frac{H_{it}}{N}\eta_{h,w}$$

Using this definition, I re-write the Frisch matrix in terms of market hours instead of leisure hours.

$$\mathcal{F} \cong \begin{pmatrix} -\eta_{c,p} & \eta_{c,w} & 0 & 0 \\ \eta_{n,p} & \eta_{n,w} & -\frac{H_{it}}{N}\varpi_{h,w} & -\frac{H_{it}}{N}\varpi_{h,p_k} \\ 0 & 0 & \varpi_{h,w} & \varpi_{h,p_k} \\ 0 & 0 & \varpi_{k,w} & \varpi_{k,p_k} \end{pmatrix} \tag{4.13}$$

I expect $\varpi_{h,w} < 0$ and $\varpi_{h,p_k} > 0$ since wages are the opportunity cost of home hours, and the technology use in home production is consistent with the substitution between home appliances and household labour inputs. $\varpi_{k,w} > 0$ implies that an increase in household wages increases their ability to purchase more goods including labour saving inputs on home production. On the other hand, $\varpi_{k,p_k} < 0$ follows from the basic law of demand, ceteris paribus.

Estimating the equations in (4.12) with the Frisch matrix given by (4.13) should therefore help in estimating the Frisch elasticities of consumption, home and market hours to changes in wage and remittance income. However, this characterization does not explicitly show the effect of remittances on household consumption, market and home hours. Moreover, the Frisch

elasticities only measure the responsiveness of time allocation to transitory shocks when permanent remittance inflows do also affect households' consumption and time allocation. I define transitory shocks to be those shocks with negligible or no effect on household wealth.

4.4.2 The Marshallian Elasticities

The responsiveness of household market and home hours to permanent remittance inflows are measured by Marshallian elasticities. In order to estimate these elasticities, we need to express the growth of the marginal utility of wealth as a function of permanent wage and remittance income shocks. This will help us link the dynamics of household consumption and time allocation with these two shocks. To achieve this, I follow a two-step approach that is standard in the consumption literature (see Blundell et al. [2016]). In the first step, I decompose changes in the marginal utility of wealth, $\Delta \ln \lambda_{i,t}$, into a predictable component Γ_t and a stochastic component $\varepsilon_{i,t}$. The predictable component $\Gamma_t = \rho - \frac{1}{2}E_{t-1}(\Delta \ln \lambda_{it} - \rho)^2$ depends on interest rate r and the discount factor β since ρ is define such that $e^{\rho} = \frac{1}{\beta(1+r)}$. The variance of this predictable component captures intertemporal substitution and precautionary motives for savings.

However, the marginal utility of wealth and hence its innovations are not observable making them not empirically useful. The second step log-linearised the intertemporal budget constraint

$$\mathbb{E}_t \sum_{k=0}^{T-t} \frac{C_{i,t+k}}{(1+r)^k} + \frac{K_{i,T+1}}{(1+r)^{T-t}} = \mathbb{E}_t \sum_{k=0}^{T_w-t} \frac{(W_{i,t+k}N_{i,t+k})}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{i,t+k}}{(1+r)^k} + (1-s_0)\,\mathbb{E}_t \sum_{k=0}^{T-t} \frac{Q_{i,t}}{(1+r)^k} + (1+r)A_{i,t} - \frac{A_{i,T+1}}{(1+r)^{T-t}} \tag{4.14}$$

by expressing the shocks on the marginal utility of wealth $\varepsilon_{i,t}$ as a linear function of wage and remittance income shocks. This is done by approximate both the income and expenditures side of lifetime resources, apply difference in expectation between period t and $t-1$ and then equate the income and expenditure accounts of the intertemporal budget constraint. In the appendix, I show that linear approximation of the intertemporal budget constraint and solving for the

marginal utility of wealth yields an expression for the innovation of the marginal utility of wealth as a linear function of (transitory and permanent) wage and remittance income shocks.

$$\varepsilon_{i,t} = \frac{(1-\pi_t-\phi_t^R-\omega_t^Q+\theta\eta_{c,w})}{\theta(\eta_{c,p}-\eta_{c,w})}v_{i,t} + \frac{\left[\alpha_t(1-\pi_t-\phi_t^R-\omega_t^Q)+\theta\eta_{c,w}\right]}{\theta(\eta_{c,p}-\eta_{c,w})}\Delta u_{i,t} + \frac{\phi_t^R}{\theta(\eta_{c,p}-\eta_{c,w})}\left(\zeta_{i,t}^R+\Delta\tau_t^R\right) \tag{4.15}$$

Substituting equation (4.15) in the consumption, market and home hours equations yields dynamic models of household consumption, market and home hours as functions of permanent and transitory wage and remittance income shocks. By mapping (unobservable) marginal utility of wealth shocks into wage and remittance income shocks, this helps in decomposing the responsiveness of time allocation (i.e., how households change their time allocation between market and home production activities) to these shocks.

$$\begin{pmatrix} \Delta\hat{c}_{i,t} \\ \Delta\hat{n}_{i,t} \\ \Delta\hat{h}_{i,t} \\ \Delta\hat{k}_{i,t} \end{pmatrix} = \begin{pmatrix} \kappa_{c,v} & \kappa_{c,u} & \kappa_{c,\zeta} & \kappa_{c,\tau} \\ \kappa_{n,v} & \kappa_{n,u} & \kappa_{n,\zeta} & \kappa_{c,\tau} \\ \kappa_{h,v} & \kappa_{h,u} & \kappa_{h,\zeta} & \kappa_{c,\tau} \\ \kappa_{k,v} & \kappa_{k,u} & \kappa_{k,\zeta} & \kappa_{c,\tau} \end{pmatrix} \begin{pmatrix} v_{i,t} \\ \Delta u_{i,t} \\ \zeta_{i,t}^R \\ \Delta\tau_{i,t}^R \end{pmatrix} \tag{4.16}$$

Here, the loading factor $\kappa_{x,y}$ measures the response of variable $x \in \{\Delta\hat{c}_{i,t}, \Delta\hat{n}_{i,t}, \Delta\hat{h}_{i,t}, \Delta\hat{k}_{i,t}\}$ to shock $y \in \{v_{i,t}, \Delta u_{i,t}, \zeta_{i,t}^R, \Delta\tau_{i,t}^R\}$. For example, $\kappa_{h,\zeta}$ measures the responsiveness of family home hours to permanent remittance inflows while $\kappa_{n,\tau}$ measures the impact of transitory remittance shocks on family market hours. The exact derivation of these loading factors are shown in the Appendix. For discussion purpose, the response of family consumption and labour hours to wage and remittance income shocks faced by household i are written generally as:

$$\kappa_{c,v} = f(\pi_{it}, \phi_{it}^R, \omega_{it}^Q, \theta_{it}),\ \kappa_{c,u} = f(\alpha_{it}, \pi_{it}, \phi_{it}^R, \omega_{it}^Q, \theta_{it}),\ \kappa_{c,\zeta} = f(\phi_{it}^R, \theta_{it}),\ \text{and}\ \kappa_{c,\tau} = f(\phi_{it}^R, \theta_{it})$$

$$\kappa_{n,v} = f(\pi_{it}, \phi_{it}^R, \omega_{it}^Q, \theta_{it}, \eta),\ \kappa_{n,u} = f(\alpha_{it}, \pi_{it}, \phi_{it}^R, \omega_{it}^Q, \theta_{it}, \eta),\ \kappa_{n,\zeta} = f(\phi_{it}^R, \theta_{it}, \eta),\ \kappa_{n,\tau} = f(\phi_{it}^R, \theta_{it}, \eta)$$

$$\kappa_{h,v} = f(\pi_{it}, \phi_{it}^R, \omega_{it}^Q, \theta_{it}, \varpi_{h,w}, \varpi_{h,p_k}, \eta_{c,p}, \eta_{c,w}),\ \kappa_{h,\zeta} = f(\phi_{it}^R, \theta_{it}, \varpi_{h,w}, \varpi_{h,p_k}\eta_{c,p}, \eta_{c,w})$$

$$\kappa_{h,u} = f(\alpha_{it}, \pi_{it}, \phi^R_{it}, \omega^Q_{it}, \theta_{it}, \varpi_{h,w}, \varpi_{h,p_k}, \eta_{c,p}, \eta_{c,w}),\ \kappa_{h,\tau} = f(\phi^R_{it}, \theta_{it}, \varpi_{h,w}, \varpi_{h,p_k}\eta_{c,p}, \eta_{c,w})$$

These parameters are linear functions of partial self-insurance coefficients through asset holdings $\pi_{i,t}$ and home production $\omega^Q_{i,t}$, partial insurance coefficients through remittances $\phi^R_{i,t}$, the share of household income spend on home appliances θ_{it} (which determines home production) and two separate vectors of Frisch elasticities η and ϖ. The insurance coefficient through asset accumulation $\pi_{i,t} \approx \frac{\text{Asset}_{i,t}}{\text{Asset}_{i,t}+\text{Human Wealth}_{i,t}+\text{Remittance Wealth}_{i,t}+\text{Wealth from Home Production}_{i,t}}$ can be back-out from the data. Higher asset holdings (higher $\pi_{i,t}$) lowers the sensitivity of household consumption, home and market hours to adverse wage shocks. That is to say, higher $\pi_{i,t}$ increases households' ability to insure themselves against wage shocks via asset accumulation. Similarly, $\omega^Q_{i,t} \approx \frac{\text{Wealth from Home Production}_{i,t}}{\text{Asset}_{i,t}+\text{Human Wealth}_{i,t}+\text{Remittance Wealth}_{i,t}+\text{Wealth from Home Production}_{i,t}}$ is a partial insurance coefficient through home production. The higher $\omega^Q_{i,t}$, the lower the sensitivity of household consumption and work hours to adverse wage shocks. The responsiveness of consumption and work hours to adverse wage shocks also depends on the insurance coefficient via remittances $\phi^R_{i,t} \approx \frac{\text{Remittance income}_{i,t}}{\text{Asset}_{i,t}+\text{Human Wealth}_{i,t}+\text{Remittance Wealth}_{i,t}+\text{Wealth from Home Production}_{i,t}}$. The higher $\phi^R_{i,t}$, the lower the elasticities of market and home labour hours to permanent and transitory wage shocks. Remittances therefore improve households' ability in smoothing labour hours in the face of adverse wage shocks. However, higher $\phi^R_{i,t}$ also increases the sensitivity of market and home hours to shocks on remittance income. This is to say that although remittances enhance households' ability to smooth consumption and labour hours against adverse wage shocks, it also exposes them to an extra source of uncertainty in the form of changes in remittance income. I will discuss this further in the next subsection since this coefficient is of great interest. To obtain $\text{Human Wealth}_{i,t}$, $\text{Remittance income}_{i,t}$ and $\text{Wealth from Home Production}_{i,t}$, I respectively take at the beginning of period t the expected discounted flow of lifetime labour market income, remittance income and income from home production. The model is estimated using household panel data obtained from the Townsend Thai Monthly Household Survey.

4.4.3 Transmission Mechanisms

In this subsection, I discuss in theory the factors that derive the transmission of shocks to household consumption, market and home labour hours. As can be seen in equation (4.16), consumption and work hours do response to (transitory and permanent) wage and remittance income shocks. However, the transmission of these shocks depends on partial insurance coefficients via asset holdings $\pi_{i,t}$, home production $\omega^Q_{i,t}$ and remittances $\phi^R_{i,t}$. These transmissions also depend on the share of household income spend on home appliances θ_{it} (which in turn determines home production) and two separate vectors of Frisch elasticities η and ϖ. I start with how consumption responds to these shocks before discussing home and market hours responses.

Consumption Insurance

Household consumption do respond to wage and remittance income shocks. The impact of wage and remittance inflows on household consumption are respectively given by:

$$\kappa_{c,v} = \frac{1-\pi_t-\phi^R_t-\omega^Q_t}{\theta}, \quad \kappa_{c,u} = \frac{\alpha_t(1-\pi_t-\phi^R_t-\omega^Q_t)}{\theta} \text{ and } \kappa_{c,\zeta} = \kappa_{c,\tau} = \frac{\phi^R_t}{\theta}$$

π_t, $\phi^R_{i,t}$ and ω^Q_t are "partial insurance" coefficients against wage shocks using asset holdings, remittances and output from home production, respectively. The higher the partial insurance coefficients, the lower the sensitivity of household consumption to permanent and transitory wage shocks. That is, higher π_t, $\phi^R_{i,t}$ or ω^Q_t improves households' consumption smoothing ability against adverse wage shocks. The intuition is that the higher π_t, $\phi^R_{i,t}$ or ω^Q_t, the more assets, remittances or home output households have to smooth consumption against wage shocks. However, higher $\phi^R_{i,t}$ also exposes household consumption to greater sensitivity to changes in remittance income. The fact that permanent and transitory remittance income shocks have the same effect on household consumption, $\kappa_{c,\zeta} = \kappa_{c,\tau} = \frac{\phi^R_t}{\theta}$, is very interesting. This can be explained by the fact that remittance-receiving households do not have knowledge on whether such remittance income are transitory or permanent income source. $\kappa_{c,v}$ and $\kappa_{c,u}$ capture the two extreme cases of consumption insurance - full insurance ($\kappa_{c,v} = \kappa_{c,u} = 0$) and no insurance

($\kappa_{c,v} = \kappa_{c,u} = 1$) - as well as imperfect insurance $0 \leq \kappa_{c,v} \leq 1$ and $0 \leq \kappa_{c,u} \leq 1$. The closer the coefficients to zero, the higher the degree of insurance through asset accumulation, remittances and home output – hence, lower fraction of wage shocks translate into consumption growth. The insurance effect of remittances on household consumption can be tested by testing whether $\phi_{i,t}^R$ equals zero. $\phi_{i,t}^R = 0$ implies that remittance has no insurance effect on household consumption and $\phi_{i,t}^R > 0$ confirms remittances as a source of insurance for household consumption. The effect of remittances on household consumption is amplify when remittance income is use to purchase home appliances. This is because higher home appliances increases home output thereby increasing households' ability to smooth consumption against permanent and transitory wage shocks using home output, higher ω_t^Q.

Labour Supply Responses

Although remittances help in smoothing household work hours against adverse wage shocks, it also exposes labour hours to fluctuations in remittance income. As can be seen in the equations below, higher $\phi_{i,t}^R$ lowers the elasticities of market and home hours to permanent and transitory wage shocks.

$$\kappa_{h,v} = \frac{(2\varpi_{h,w} + \varpi_{h,p_k})(1 - \pi_t - \phi_t^R - \omega_t^Q + \theta\eta_{c,w})}{\theta(\eta_{c,p} - \eta_{c,w})} + \varpi_{h,w}$$

$$\kappa_{h,u} = \frac{(2\varpi_{h,w} + \varpi_{h,p_k})\left[\alpha_t(1 - \pi_t - \phi_t^R - \omega_t^Q) + \theta\eta_{c,w}\right]}{\theta(\eta_{c,p} - \eta_{c,w})} + \varpi_{h,w}$$

$$\kappa_{n,v} = \frac{(\eta_{n,w} - \eta_{n,p})(1 - \pi_t - \phi_t^R - \omega_t^Q + \theta\eta_{c,w})}{\theta(\eta_{c,p} - \eta_{c,w})} + \eta_{n,w}$$

$$\kappa_{n,u} = \frac{(\eta_{n,w} - \eta_{n,p})\left[\alpha_t(1 - \pi_t - \phi_t^R - \omega_t^Q) + \theta\eta_{c,w}\right]}{\theta(\eta_{c,p} - \eta_{c,w})} + \eta_{n,w}$$

The signs of the responsiveness of market ($\kappa_{n,v}$ and $\kappa_{n,u}$) and home ($\kappa_{h,v}$ and $\kappa_{h,u}$) hours to permanent and transitory wage shocks are unrestricted in theory. Whether home production and/or market participation are use as "shock absorbers" depend on the net effect between the income and substitution effects of wage changes. Home production is use as an income smoothing mechanism when $\kappa_{h,v} < 0$ and $\kappa_{h,u} < 0$. That is, households allocate more family

hours towards home production and work longer at home when face with adverse permanent and/or transitory wage shocks. Similarly, market work is an income-smoothing device when $\kappa_{n,v} < 0$ and $\kappa_{n,u} < 0$. This implies that households increase their supply of market hours when they experience adverse wage shocks. In this case, the substitution effect dominates the income effect of wage changes. In the presence of remittances, households are expose to an extra source of uncertainty in the form of fluctuations in remittance income. The responses of market ($\kappa_{n,\zeta}$ and $\kappa_{n,\tau}$) and home ($\kappa_{h,\zeta}$ and $\kappa_{h,\tau}$) hours to permanent and transitory remittance income shocks are given by:

$$\kappa_{h,\zeta} = \kappa_{h,\tau} = \frac{(2\varpi_{h,w} + \varpi_{h,p_k})\phi_t^R}{\theta(\eta_{c,p} - \eta_{c,w})}, \quad \kappa_{n,\zeta} = \kappa_{n,\tau} = \frac{(\eta_{n,w} - \eta_{n,p})\phi_t^R}{\theta(\eta_{c,p} - \eta_{c,w})} \tag{4.17}$$

It is very interesting to note that while the response of market and home hours to remittance shocks are different ($\kappa_{n,\zeta} \neq \kappa_{h,\zeta}$ and $\kappa_{n,\tau} \neq \kappa_{h,\tau}$), neither the response of market hours nor the response of home hours varies depending on whether the remittance shock is transitory or permanent ($\kappa_{n,\zeta} = \kappa_{n,\tau}$ and $\kappa_{h,\zeta} = \kappa_{h,\tau}$). This can be explained by the fact that when households receive remittances, they do not have advanced knowledge on when this "external income" is transitory or permanent. However, these Marshallian elasticities depend on household's partial remittance-insurance coefficients $\phi_{i,t}^R$, the share of household's income spend on home appliances θ_{it} as well as on the consumption, market and home hours Frisch elasticities. The net effect of remittance income shocks on time allocation depends on the relative magnitudes of $\eta_{c,p}$, $\eta_{c,w}$, $\varpi_{h,w}$, ϖ_{h,p_k}, $\eta_{n,p}$ and $\eta_{n,w}$ since we expect $\varpi_{h,w} < 0$, $\varpi_{h,p_k} > 0$, $\phi_t^R \geq 0$, $\theta_t > 0$, $\eta_{c,p} > 0$, $\eta_{c,w} > 0$, $\eta_{n,p} > 0$ and $\eta_{n,w} > 0$. Thus, in theory the responsiveness of home and market hours to remittance income shock is also unrestricted. $\kappa_{h,\zeta} = \kappa_{h,\tau} > 0$ implies that remittances and home hours move in the same direction - i.e. households reallocate more labour hours on home production activities when they experience positive remittance income shocks. Moreover, the sensitivity of home hours to remittance income shocks is increasing with $\varpi_{h,w}$ and ϖ_{h,p_k} but decreasing with $\eta_{c,p}$ and $\eta_{c,w}$. This is because households with high consumption elasticities with respect to wage fluctuations are less likely to allocate more hours on home production when face with positive wage shocks.

4.4.4 Nature of Markets for Assets

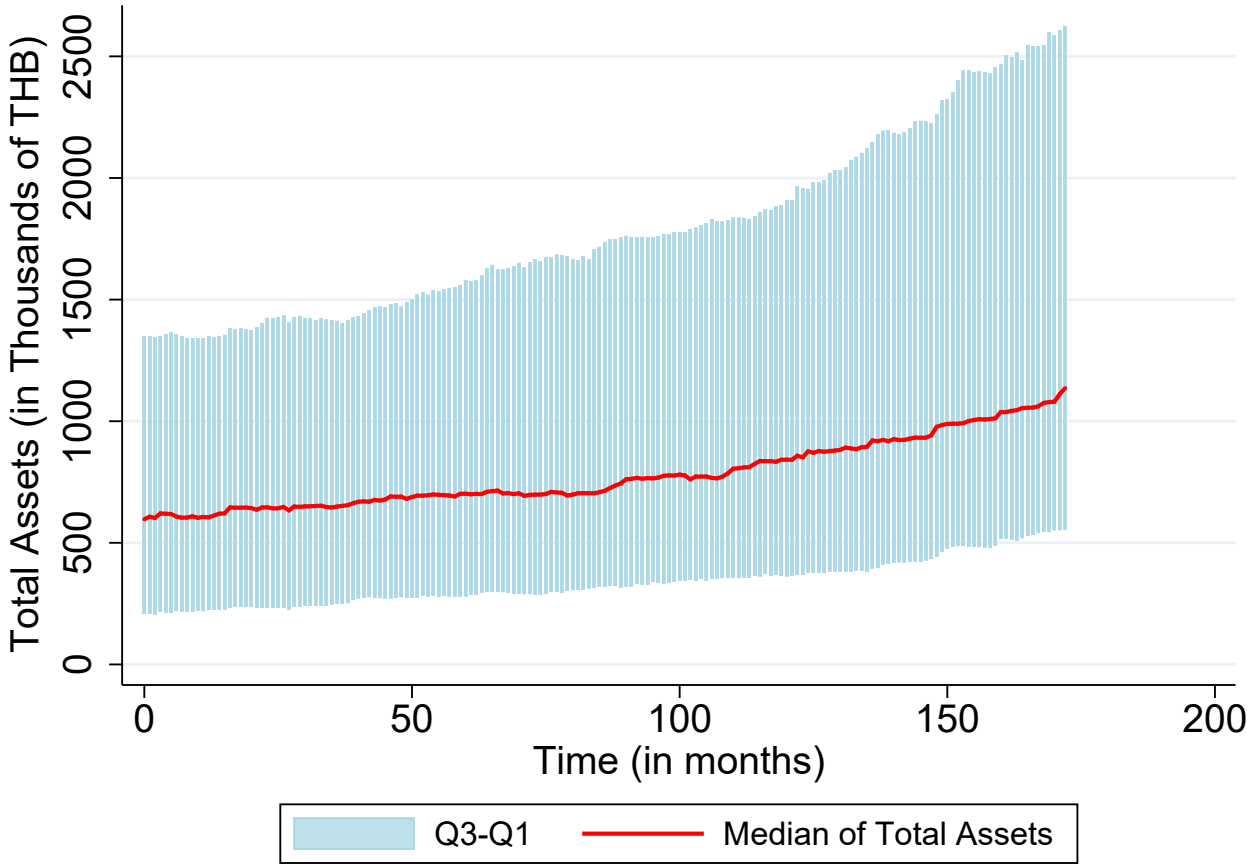
Since asset accumulation/deaccumulation is one way of achieving consumption insurance, I briefly discuss the nature of markets for assets in Thailand before discussing the identification strategies used to estimate the empirical results of this chapter. Like in many developing economies, markets for assets in Thailand are generally inefficient, incomplete and informal, especially in rural provinces. The buying and selling of assets typically occur in parallel markets characterized by huge information asymmetry. The lack of centralized market to quote an instantaneous price raise difficulty in assessing values of assets traded in these markets. As a result, trade is executed with cash-and-carry exchange at prices negotiated on the spot. In rural areas where contracts are not always respected, credit transactions depend on social networks and personal trust to a greater degree than in developed countries. Therefore, moral hazard and adverse selection may arise in such environment with huge information asymmetries. Thus, risk and information are very important consideration in executing credit transactions in markets for assets in Thailand.

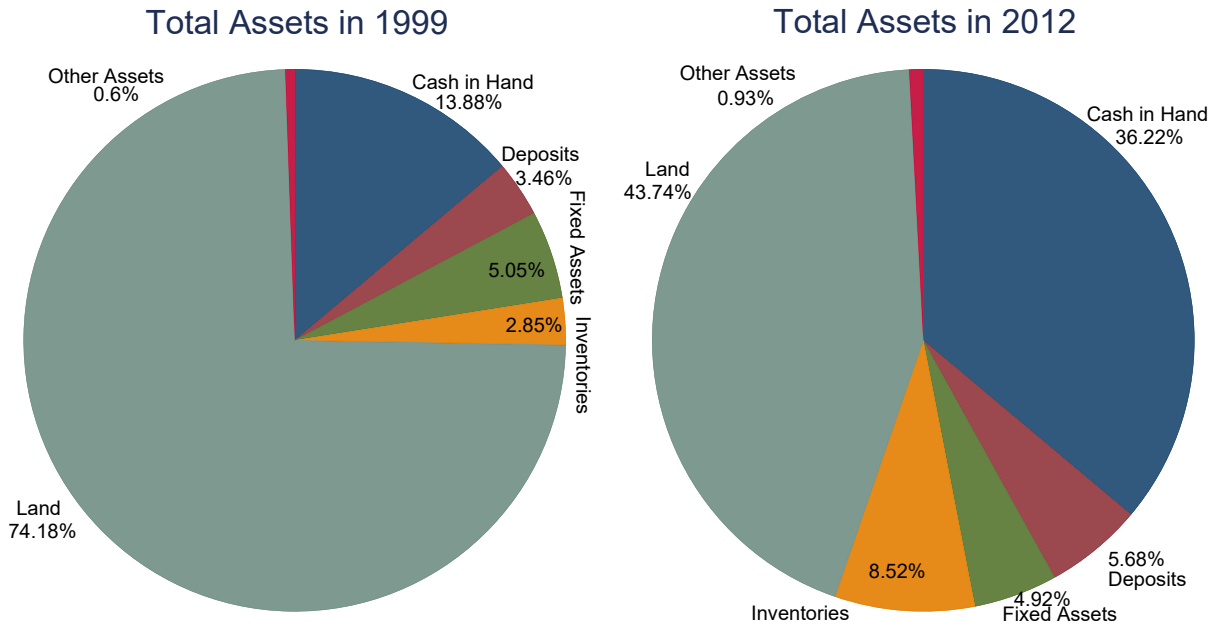
As shown in Figure (4.3), Thai households have been gradually accumulating assets between August 1998 to December 2012. In this figure, the ends of each box represent the first and third quartile of household assets in each month. This implies that the box plots do not include values higher than the third quartile and those below the first quartile. In addition, median household assets is displayed by the red line inside the boxes. From the panel that shows the evolution of total assets, household asset holding has never been zero for Thai households in the first quartile and beyond. The value of total assets for a median household increased from 597,187 THB (16,497 USD) in August 1998 to 1,135,705 THB (37,102 USD) in December 2012. This does not include households below the first quartile and those above the third quartile. Although the number of households in these two groups are few, those in the first quartile have very small amount of assets while those above the third quartile accumulate high value of assets.

Across asset types, Thai households have both current and non-current assets. Current assets are liquid assets such as cash in hand, deposits at financial institution, inventories and other

assets including account receivables, net ROSCA (Rotating Credit and Savings Association) position, other lending, prepaid insurance and livestock assets.

Figure 4.3: Evolution of Household Total Assets





Source: Townsend Thai Household Survey.

For non-current assets, these are illiquid assets such as land and fixed assets. Included in the fixed assets component are illiquid household, agricultural and business assets. Between 1999 and 2012, figure (4.3) illustrates that the share of non-current asset decreases while the holding of current assets increases proportionally. To give an example, cash holding increases from 14% in 1999 to 36% in 2012 while the contribution of land declines from 74% in 1999 to roughly 44% in 2012. Nonetheless, land is one of the most important assets to Thai households as it still accounts for the highest share of their total asset in both periods. The importance of land in developing countries like Thailand cannot be overemphasised because it is a vital input in agricultural production which is one of the main sources of income for many households in these economies, especially in rural provinces.

4.5 Identification Problem

After discussing the nature of markets for assets in Thailand, I now proceed by discussing the identification strategies used in this chapter. When deriving the analytical expressions for household consumption and earnings growth, I implicitly assume an interior solution for household remittance income. That is to say, I assumed that all households receive remittances. However, some households in developing economies do not receive remittances. In the Townsend Thai data, only approximately 30% of the households receive remittances whiles the remaining 70% do not receive remittances. Thus, the need to endogenously model the probability that a household receives remittances conditional on some observed household characteristics. The possibility of self-selection in migration decisions exists if there are systematic differences between households with migrants and non-migrant households (i.e. households without family members abroad). The existence of any systematic differences between migrant and non-migrant households makes our sample of migrants and remittance senders not random. To overcome this problem, I explicitly model households' migration decision. This is done by modifying an approach used by Low et al. [2010] to derive an empirical correction for the sample selection. To illustrate this procedure, suppose household i's migration decision $M_{i,t}$ depends

on some latent variable $M^*_{i,t} = Z'_{i,t}\vartheta + \varsigma_{i,t}$ such that:

$$M_{i,t} = \begin{cases} 1 & \text{if } M^*_{i,t} \geq 0 \\ 0 & \text{otherwise} \end{cases}$$

Here, $M_{i,t} = 1$ for households with migrants at time t and $M_{i,t} = 0$ for non-migrant households. In addition, $Z_{i,t}$ is a vector of observed household characteristics that affect migration decisions. I assume $\varsigma_{i,t}$ to be a normally distributed error term. Therefore, the migrant status of households can be written as

$$Pr(M_{i,t} = 1|Z_{i,t}) = \Phi(Z'_{i,t}\vartheta)$$

and

$$Pr(M_{i,t} = 0|Z_{i,t}) = 1 - \Phi(Z'_{i,t}\vartheta)$$

Against this backdrop, I construct the first-differenced residuals of remittances by regressing the log differences of remittance income $\Delta \ln R_{i,t}$ on observed household characteristics that affect remittance inflows X_{it} and the dummy variable $M_{i,t}$ representing household migration status, i.e. $\Delta \ln R_{i,t} = X'_{it}\psi + \delta M_{i,t} + \digamma_{it}$. Hence, the joint density of remittance income and migration decisions $f(\digamma, \varsigma)$ can be specified as

$$(R, M = 1) = \int_{-\infty}^{Z'\vartheta} f\left(\Delta \ln R - \delta - X'\psi,\ \varsigma\right) d\varsigma$$

$$(R, M = 0) = \int_{Z'\vartheta}^{\infty} f(\Delta \ln R - X'\psi,\ \varsigma) d\varsigma$$

and the log likelihood functions that maximize the probability of a household receiving remittances are given by:

$$LL = \ln \Phi \left\{ \frac{-Z'_{i,t}\vartheta + (\Delta \ln R_{i,t} - \delta - X'_{i,t}\psi)\rho/\sigma}{\sqrt{1-\rho^2}} \right\} - \frac{1}{2}\left(\frac{\Delta \ln R_{i,t} - \delta - X'_{i,t}\psi}{\sigma}\right)^2 - \ln\sqrt{2\pi\sigma} \tag{4.18}$$

for migrant households $M_{it} = 1$ and

$$LL = \ln \Phi \left\{ \frac{-Z'_{i,t}\vartheta + (\Delta \ln R_{i,t} - X'_{i,t}\psi)\rho/\sigma}{\sqrt{1-\rho^2}} \right\} - \frac{1}{2}\left(\frac{\Delta \ln R_{i,t} - X'_{i,t}\psi}{\sigma}\right)^2 - \ln\sqrt{2\pi\sigma} \tag{4.19}$$

for non-migrant households $M_{it} = 0$. Here, I assume that the error terms $\digamma$ and ς are normally distributed with mean zero and covariance matrix

$$\begin{bmatrix} \sigma_{\digamma}^2 & \rho\sigma \\ \rho\sigma & 1 \end{bmatrix}$$

4.6 Results & Discussion

This section presents the results and analysis of the empirical estimations of this study. The section is divided into three subsections. Section 6.1 highlights the results of the estimated wage, remittance and home production parameters before discussing the outcomes of our Frisch responses. The main findings of this paper are presented in Section 6.2 where I analyze the results of our estimated Marshallian elasticities as well as the results of our partial insurance coefficients through asset accumulation $\pi_{i,t}$, remittances $\phi_{i,t}^R$ and income from home production $\omega_{i,t}^Q$. Finally, Section 6.3 presents and discusses the results of household consumption insurance against transitory and permanent wage shocks.

4.6.1 Frisch Elasticities and Insurance Coefficients

Before discussing the results of the estimated Frisch elasticities and insurance coefficients, I start off by presenting the results of the estimated wage, remittance and home production parameters. The calibrated parameters are also reported in Table 4.3.

Table 4.3: Parameters of the Model

Home Production		
γ	0.183	Elasticity of home output to change in home capital.
s_0	0.3	Share of home output consume within household.
Others		
r	0.05	Annual return on risk-free assets
β	$1/(1+r)$	Discount factor
θ	0.95	The share of household income spend on consumption
α	0.05	Annuity Value

For the wage and remittance income parameters, these estimates are similar to the ones estimated in the previous chapter. Thus, I only report the results in Table 4.4 since I have extensively discussed the estimation of these parameters in the last chapter. As reported in Table 4.4, the variance of permanent wage shocks is higher than the variance of transitory wage shocks, and the covariance between permanent wage and remittance shocks is positive.

Table 4.4: Wage & Remittance Income Parameters

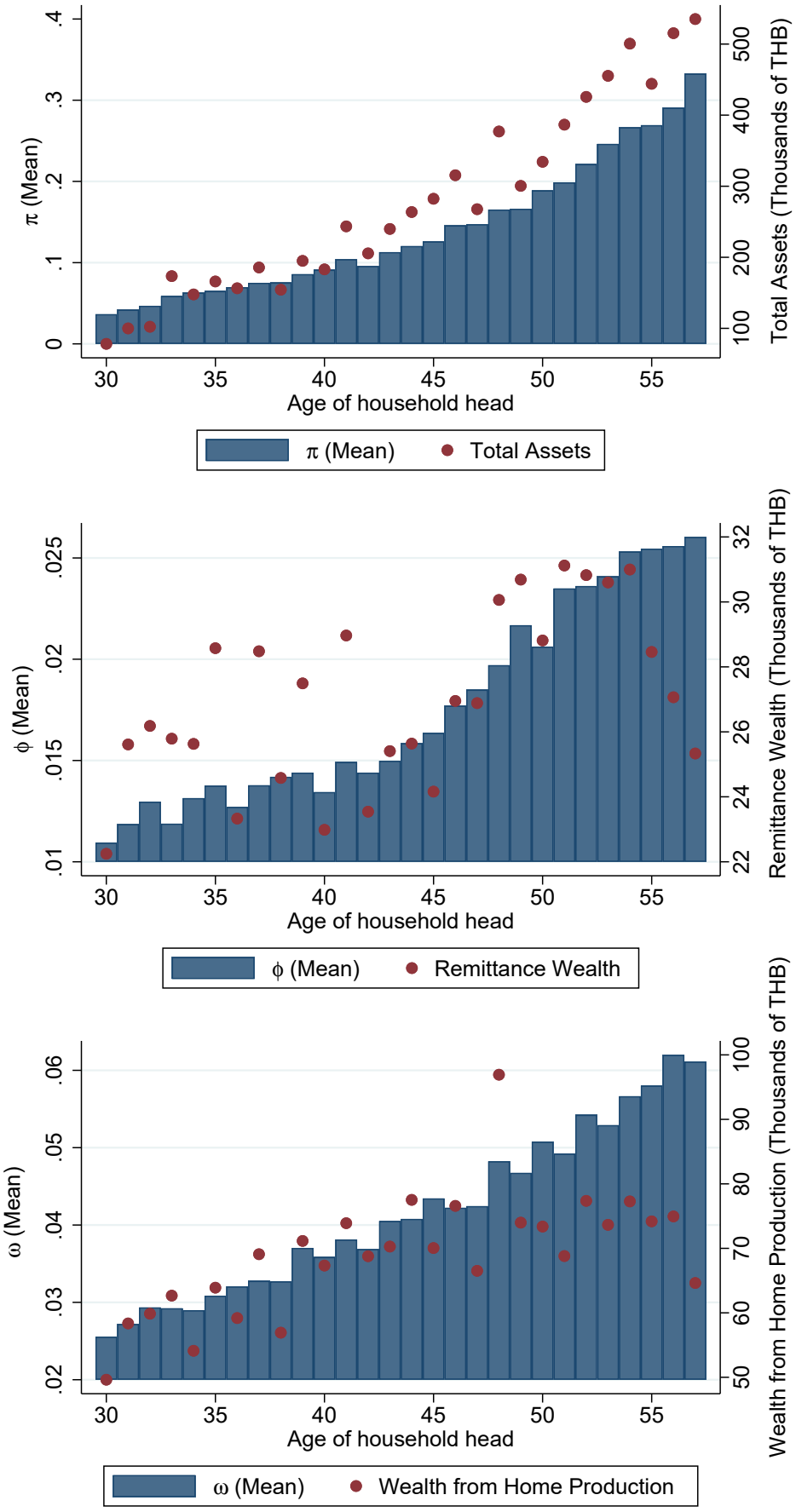
σ_v^2	0.0398	variance of permanent wage shocks.
$se(\sigma_v^2)$	(0.0149)	Standard error of the estimated Variance of permanent wage shocks.
σ_u^2	0.0288	Variance of transitory wage shocks.
$se(\sigma_u^2)$	(0.0068)	Standard error of the estimated variance of transitory wage shocks.
σ_ζ^2	0.0730	Variance of permanent remittance income shocks.
$se(\sigma_\zeta^2)$	(0.0071)	Standard error of the estimated variance of permanent remittance income shocks.
σ_τ^2	0.0191	Variance of transitory remittance income shocks.
$se(\sigma_\tau^2)$	(0.0067)	Standard error of the estimated variance of transitory remittance income shocks.
$\sigma_{\zeta v}^2$	-0.0714	Covariance of permanent wage and remit income shocks.
$se(\sigma_{\zeta v}^2)$	(0.0061)	Standard error of the estimated covariance between permanent wage and remittance income shocks.
$\sigma_{\tau u}^2$	0.0683	Covariance of transitory wage and remit income shocks.
$se(\sigma_{\tau u}^2)$	(0.0059)	Standard error of the estimated covariance between transitory wage and remittance income shocks.

Source: Townsend Thai data.

The elasticity of home output to changes in home appliances is estimated using the Townsend Thai monthly household survey (TTMHS) while the share of home produced goods that are consume within the household is calculated from the TTMHS by taking the average of the ratio of home produced goods consumed within the household over total output of home produced goods for each household.

For the smoothing parameters, the life cycle profiles of these insurance coefficients ($\pi_{i,t}$, $\phi_{i,t}^R$ and $\omega_{i,t}^Q$) are presented in Figure 4.4. These parameters $\pi_{i,t}$, $\phi_{i,t}^R$ and $\omega_{i,t}^Q$ are partial insurance coefficients through households' assets accumulation, remittances and home production activities respectively. The higher households' asset holdings (higher $\pi_{i,t}$), remittance income

Figure 4.4: Partial Insurance Coefficients



(higher $\phi^R_{i,t}$) or income from home production activities (higher $\omega^Q_{i,t}$), the lower the sensitivity of households' consumption, home and market hours to (transitory and permanent) earning shocks. That is to say, these parameters increase households' ability to self-insure themselves against adverse earning shocks through asset accumulation, remittances and output from home production, respectively. As already seen in the previous chapter, this figure clearly shows that the life cycle profiles of these insurance coefficients are increasing over households' life time. This implies that households' ability to insure themselves against adverse income shocks using remittances, asset accumulation and income from home production increases with the age of the household head.

Moreover, Table 4.5 presents the results of the estimated net Frisch elasticities as given in the $\mathcal{F}$ matrix in equation 4.13. By decomposing time responses, this table takes into account the fact that households can allocate time into multiple uses such as leisure, market and home production activities. Thus, an increase in market wage keeping wealth constant affects not only market hours but also alters households' leisure and home production time allocation.

Table 4.5: Total Frisch Elasticities

	(1)	(2)	(3)
	Market Hours	Home Hours	Consumption
Wage	0.576***	-0.193**	0.0295
	(0.152)	(0.0710)	(0.0411)
Price	0.150	-0.0780	0.118
	(0.132)	(0.0989)	(0.0644)

Notes: Parameters estimated by GMM under the assumptions of separable preferences, and age-varying remittance and wage variances. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The first row reports the net responses of households' market hours to transitory changes in wages, and prices. The estimated total market time Frisch response to changes in wages, $\eta_{n,w} = 0.576$, is within the range of estimates in the labour supply literature. Keane [2011] provides a survey of this literature. This implies that Thai households increase their market work hours by approximately 58% given a percentage increase in market wages. Interestingly, roughly 19% of this increased market time comes from fall in home production time. In particular, consider

a Thai household that experiences a positive transitory wage shock. Due to intertemporal substitution, this incentivizes the household to increase market hours while reducing home and leisure time. Similarly, Thai households increase market hours and reduce home labour supply in response to higher prices, however these responses are not statistically significant. The third column reports the Frisch responses of consumption to transitory changes in its price and hourly market wages. Our estimated consumption elasticity to transitory changes in market wage $\eta_{c,w} = 0.03$ is within reasonable range although it differs from the slightly negative estimates obtained by Blundell et al. [2016] and Blundell et al. [2017]. Furthermore, although our estimated own price elasticity for consumption $\eta_{c,p} = 0.11$ is with the expected sign, it is significantly lower than estimates in the consumption literature especially in developed economies. For example, Blundell et al. [2017] estimated this to be 0.64 while Blundell et al. [2016] estimate it to be between 0.372 and 0.578 using data from the United States' Panel Study of Income Dynamics in both studies. On a practical level, this is likely because the variance of permanent wage shocks is higher for Thai households than households in the United States. This partly explains why the responsiveness of household consumption to variations in prices is lower for Thai households than what is estimated for households in the United States.

4.6.2 Main Results: Marshallian Elasticities

Although the Frisch estimates illustrate the wealth-constant responses of Thai households' consumption and time use to changes in prices and transitory wage shocks, I am more interested in examining how households response to changes in remittance income. Moreover, it is of policy importance to examine how households adjust their consumption and labour hours in response to permanent changes in wages and remittances. Permanent wage and remittance changes induce both a substitution and a wealth effect that could trigger households to adjust their consumption and time allocation patterns. Table 4.6 reports the Marshallian elasticities of households' consumption, market and home hours with respect to wage and remittance income shocks. These estimates measure the extend to which households alter their consumption and labour hours when faced with permanent wage and remittance income shocks. The estimates in

Column 1, 2 and 3 correspond to the averages of the loading factors $\kappa_{x,y}$ in equation **??** where the response variables are $x \in \{\Delta c_{i,t}, \Delta n_{i,t}, \Delta h_{i,t}\}$ and the permanent shocks are $y \in \{v_{i,t}, \zeta^R_{i,t}\}$.

Table 4.6: Responses to Permanent Wage and Remittance Changes

	(1) **Consumption**	(2) **Market Hour**	(3) **Home Hour**
Permanent Wage shock	0.00245	0.471***	-0.104
	(0.00934)	(0.134)	(0.0568)
Permanent Remittance shock	0.0872**	-0.0682	0.0842**
	(0.0530)	(0.0500)	(0.048)

Notes: Parameters estimated by GMM under the assumptions of separable preferences, and age-varying remittance and wage variances. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The results in Table 4.6 show that permanent remittance inflows have a significant positive effect on the consumption choices of Thai households. As can be seen in Column 1, a percentage increase in remittances increases household consumption by approximately 9%. To put this in context, consider a Thai household with an average monthly consumption of 1000 Thai Baht and average monthly remittance income of 2000 Thai Baht. If this household experiences a one percent permanent increase in remittances, the new monthly remittance income increases to 2020 Thai Baht while consumption increases to 1090 Thai Baht. This clearly illustrates that the increment in household consumption far surpasses the monetary increase in remittances suggesting a significant positive wealth effect of remittance shocks on household consumption. Interestingly, the elasticity of consumption with respect to permanent wage shocks (0.002) is much smaller comparing to their remittance counterparts (0.09). This difference suggests that the wealth effect on household consumption is stronger for remittances than wage shocks.

Since our model allows us to decompose the Marshallian elasticities of market and home production time with respect to permanent wage and remittance income shocks, I now proceed to discuss how these shocks affect households' time allocation between market and home production activities. Table 4.6 shows no support that increased remittance income leads to lower labour effort among Thai households. On the contrary, permanent remittance inflows induces Thai households to reallocate labour hours from market to home production activities. Specifically, a one percent increase in remittance income on average leads to a 6.8% decline in Thai

households market hours and 8.4% increase in their home production time. For illustration purpose, assume that our Thai household with monthly remittance income of 2000 Thai Baht on average supplies 80 hours to the market and 80 hours on home production activities every month. As presented in Table 4.6, if monthly remittances permanently becomes 2020 Thai Baht, Thai households on average will reduce market work by approximately 5.5 hours and increase home hours by 6.7 hours per month. Thus instead of lowering labour effort, remittance inflows increase total labour hours which can be interpreted as a reduction in leisure hours among Thai households by 1.2 hours per month. For wage shocks, Table 4.6 reports that Thai households increase market hours (by 0.471) and reduce home production time (by 0.104) in response to permanent wage shocks in almost the same way like they do when they experience transitory wage shocks as reported in Table 4.5. The fact that there is very little difference between the Marshallian and the Frisch time elasticities of wage shocks imply that there is very little wealth effect in the way Thai households allocate time in response to these shocks.

4.6.3 Heterogeneity

To better understand the dynamics in which remittances alter households' market and home production hours, I explore how the effect of remittances on time allocation varies across age and educational attainment. For educational attainment, this decomposition is done for three levels: households with no high school, those with high school but no tertiary education and for those with tertiary education. Table 4.7 decomposes the estimates in Table 4.6 according to these education groups to examine if the responses of household time allocation to permanent wage and remittance shocks depend on educational attainment. Although I could not decompose the effect of remittances for all groups, Table 4.7 shows that the time reallocation effect of remittances presented in Table 4.6 is on average stronger among households with the lowest educational attainment. This suggests a positive wealth effect associated with permanent remittance income shocks on home production time. For wage shocks, Thai households with the lowest and highest educational attainments increase their market hours in response to persistent wage shocks more than those with medium educational levels.

Table 4.7: Consumption and Labour Supply Responses Across Educational Levels

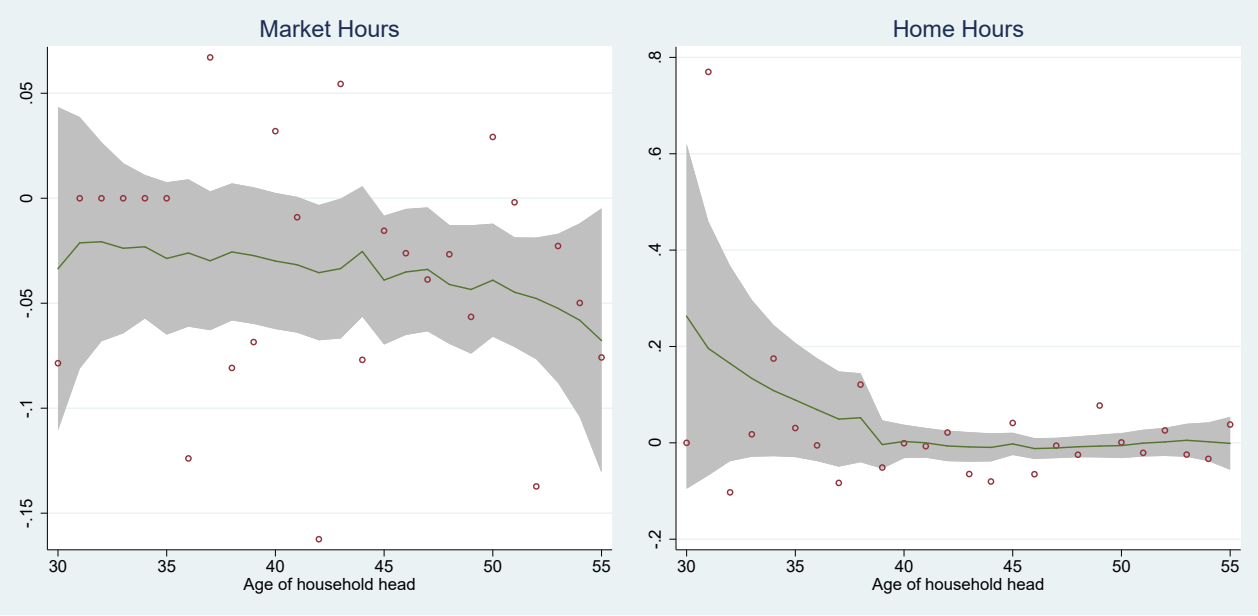
		(1) No High School	(2) High School	(3) Tertiary
Consumption				
	C to Perm. wage shock	0.0127	-0.0292	-0.0349
		(0.0104)	(0.0303)	(0.0228)
	C to Perm. remit shock	0.0124		
		(0.0481)		
Market Hour				
	N to Perm. wage shock	0.476**	0.346	0.510*
		(0.176)	(0.259)	(0.208)
	N to Perm. remit shock	-0.0802		
		(0.310)		
Home Hour				
	H to Perm. wage shock	-0.0341	-0.110	-0.478**
		(0.0562)	(0.141)	(0.169)
	H to Perm. remit shock	1.261*		
		(0.618)		

Notes: Parameters estimated by GMM under the assumptions of separable preferences, and age-varying remittance and wage variances. Standard errors in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Moreover, Figure 4.5 presents the life-cycle profiles of the effect of a 1% positive shock of remittance income on Thai households' market and home production time. The figure illustrates that a percentage point increase in remittance income decreases households' average market hours and increases their home production hours. The effect of remittances on market hours increases with age signalling that the older the head of the household gets, the more they will reduce their market hours in the face of higher remittance inflows. On the other hand, the effect of remittances on home hours decreases with age of household heads. From the right hand panel of Figure 4.5, the effect of remittances on households home hours dies down when household heads are more than 40 years old. This is very interesting as it indicates that it is households with young heads that actually increase home production time in response to higher remittance inflows. Since access to credit is a problem for young entrepreneurs, remittances relax this credit constraint and provide young Thai adults, who are usually the most innovative

and entrepreneurial group,[3] the opportunity to enhance home production activities. In addition, young people account for approximately 40% of unemployed people worldwide and are up to four times more likely to remain unemployed than their adults counterparts.[4] Similarly, a third of the world's young population are not in education, employment, or training (NEETs) and one-in-four cannot find a job paying more than $1.25 per day, the international benchmark for extreme poverty. In developing countries, 75% of young people are either unemployed, underemployed, working in irregular and insecure jobs or are employed in the informal sector. Given that young people are less likely to find formal sector employment, remittances strengthen the participation of these young adults in development processes by helping them to increasingly participate in entrepreneurial home production activities.

Figure 4.5: Heterogeneity of the Effect of Remittances on Time Allocation across age



Source: Using data from the Townsend Thai Monthly Household survey.

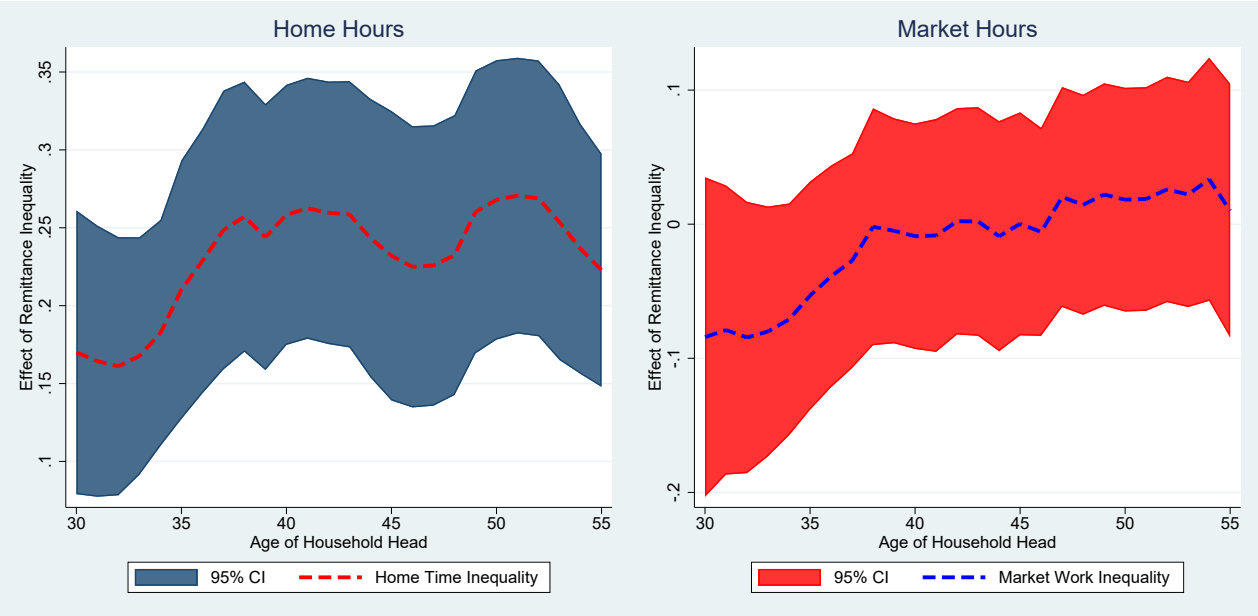
However, as can be seen in the right-hand panel of Figure 4.5, the effect of remittances on home hours is very noisy among these young household heads, especially those below 40 years old. To understand the impact of remittance inequality on household time allocation, Figure 4.6 illustrates the effect of inequalities in remittance income on inequalities in market and home hours over the life cycle. This figure shows that average effects of remittance inequality on

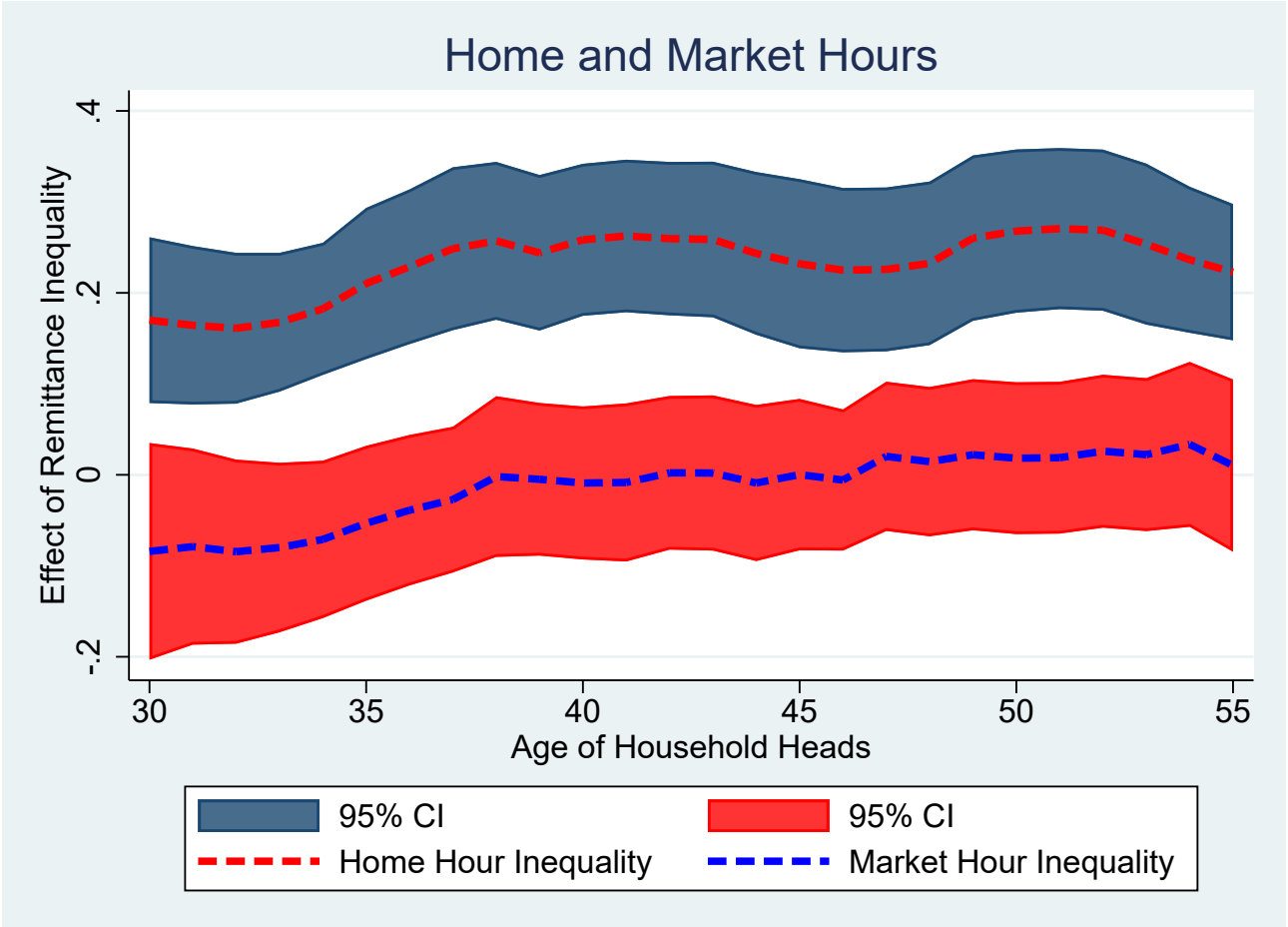
[3]According to the 2015 Global Entrepreneurship Monitor report, young adults between 25 and 34 display the highest early-stage entrepreneurial activity worldwide.

[4]International Labour Organization's 2015 Solutions for Youth Employment (S4YE) flagship report.

home time inequality is hump-shaped while it is increasing on market hour inequality over the

Figure 4.6: Impact of Remittance Inequality on Home and Market Hours Inequality





Note: I measured inequality using standard deviations and data from the Townsend Thai Monthly Household survey.

life cycle. Indeed, these time inequalities on average is greater on home hours over the life cycle

comparing to market hours.

4.7 Conclusion

The objective of this study is to examine the effect of remittances on households' time allocation between market and home production activities. To explain this link, I considered a parsimonious life cycle model in which households derive utility from leisure and from the consumption of both market and home produced goods. In this paper, home goods are produced using as inputs household labour hours and home appliances with a technology that is consistent with substitution between these two inputs. Households' optimization problem is to choose consumption (of market and home-produced goods) and the allocation of family hours between market and home production activities in order to maximize expected lifetime utility subjected to some feasibility constraints. I assume throughout that both the wage, the opportunity cost of not working in the labour market, and remittance income processes are exogenous but nonstationary over the life cycle. I also allow remittance income shocks to be potentially correlated with their corresponding earning counterparts such that households experience permanent (transitory) changes in remittance income when they experience permanent (transitory) earnings shocks. I define transitory shocks to be those shocks that have negligible or no effect on household wealth while considering permanent shocks to be those shocks with significant wealth effects.

After deriving the dynamics of households' consumption, home and market hours as a function of wage and remittance income shocks, I empirically estimate these functions using household-level panel data from the Townsend Thai monthly survey. By decomposing the response of time allocation (i.e., how households change their time allocation between market and home production activities) to wage and remittance income shocks, I find no support that increased remittance income leads to lower labour effort among Thai households. On the contrary, I find that remittance inflows induce Thai households to reallocate labour hours from market to home production activities. This time reallocation effect is stronger among households

with low educational attainment suggesting a positive wealth effect associated with permanent remittance income shocks on home production time. Moreover, I find that the negative effect of remittances on household market hours increases with age of household heads while its positive effect on home hours declines with age. Interestingly, the positive effect of remittances on home hours dies down when household heads are more than 40 years old signalling that it is households with young heads that actually increase home production time in response to higher remittance income. This has very important policy implications as it suggests that remittances provide young adults, who are usually the most innovative and entrepreneurial group, the opportunity to enhance home production activities. Given that young people are less likely to find formal sector employment, remittances strengthen their participation in development processes by helping them to increasingly participate in entrepreneurial home production activities.

4.8 Appendix

4.8.1 Household Problem

Omitting the household subscripts i and x_{it+k} for simplicity, our household maximization problem becomes

$$\max_{C_k, L_k, H_k, K_k} \mathbb{E}_t \left[\sum_{k=0}^{T-k} \beta^k \left((1-\mu)\Psi\Big(C_{t+k}, L_{t+k}\Big) + \mu \cdot v\Big(H_{t+k}, K_{t+k}\left(R_{t+k}\right)\Big) \right) \right]$$

subject to

$$C_t + K_t\left(R_t\right) + A_{t+1} = (1+r)A_t + W_t N_t + R_t + (1-s_0)\,Q_t$$
$$Q_t = \left[K_t\left(R_t\right)\right]^{\gamma} H_t^{1-\gamma}$$
$$L_t + N_t + H_t = 1$$
$$\Delta w_t = v_t + \Delta u_t$$
$$\Delta r_t^R = \zeta_t^R + \Delta \tau_t^R$$
$$K_t > 0, \quad H_t > 0, \quad C_t \geq 0 \quad \text{and} \quad L_t \geq 0$$

The effective budget constrain becomes:

$$C_t + K_t\left(R_t\right) + A_{t+1} = (1+r)A_t + W_t(1 - L_t - H_t) + R_t + (1-s_0)\left[K_t\left(R_t\right)\right]^{\gamma} H_t^{1-\gamma}$$

Given our household maximization problem, our first order conditions (FOCs) can be written

as:

$$\lambda_{t+1} = \beta(1+r)\lambda_t$$
$$(1-\mu)\Psi_C(C_t, L_t) = \lambda_t$$
$$(1-\mu)\Psi_L(C_t, L_t) = \lambda_t W_t$$
$$\mu \cdot v_H\Big(H_t, K_t\left(R_t\right)\Big) = \lambda_t W_t + \lambda_t\left(\gamma - 1\right)\left(1 - s_0\right)\left(\frac{K_t\left(R_t\right)}{H_t}\right)^{\gamma}$$
$$\mu \cdot v_K\Big(H_t, K_t\left(R_t\right)\Big) = \lambda_t\left[1 - \gamma(1-s_0)\left(\frac{K_t\left(R_t\right)}{H_t}\right)^{\gamma-1}\right]$$

Where Ψ_C and Ψ_L are the partial differentials of $\Psi(.)$ with respect to C and L respectively. λ_t denotes the marginal utility of wealth and $\tilde{k} = \frac{K_t(R_t)}{H}$ represents the per capita home appliance used in the home production process.

4.8.2 Approximating consumption, home and market hours growth equations

Denoting the marginal utility of wealth as λ_{it}, the standard Euler equation can be written as:

$$\mathbb{E}_t(\lambda_{t+1}) = \frac{1}{\beta(1+r)}\lambda_t$$

I define ρ such that $e^{\rho} = \frac{1}{\beta(1+r)}$ and apply a second order Tylor approximation to $e(\ln\lambda_{t+1})$ around $\lambda_{t+1} + \rho$, see Blundell et al. [2016]. This gives us:

$$\lambda_{t+1} \simeq \left[1 + (\Delta\ln\lambda_{t+1} - \rho) + \frac{1}{2}E_t(\Delta\ln\lambda_{t+1} - \rho)^2\right]\lambda_t e^{\rho}$$

Taking expectations with the information set available at time t, I find that

$$\mathbb{E}_t(\Delta\ln\lambda_{t+1}) \simeq \rho - \frac{1}{2}E_t(\Delta\ln\lambda_{t+1} - \rho)^2$$

which can be written as:

$$\Delta\ln\lambda_{t+1} \approx \Gamma_{t+1} + \varepsilon_{t+1} \tag{4.20}$$

where $\Gamma_{t+1} = \rho - \frac{1}{2}E_t(\Delta\ln\lambda_{it+1} - \rho)^2$ and ε_{t+1} are the predictable and unpredictable components of changes in the marginal utility of wealth. $E_t(\varepsilon_{t+1}) = 0$. Thus, our FOCs can be written as:

$$\Delta\ln\Psi_c(C_{t+1}, L_{t+1}) = \Delta\ln\lambda_{t+1} \tag{4.21}$$
$$\Delta\ln\Psi_l(C_{t+1}, L_{t+1}) = \Delta\ln W_{t+1} + \Delta\ln\lambda_{t+1} \tag{4.22}$$

$$\Delta \ln v_h\Big(H_{t+1}, K_{t+1}\left(R_{t+1}\right)\Big) = 2\Delta\lambda_{t+1} + \Delta \ln W_{t+1} + \gamma\Delta \ln \tilde{k} \tag{4.23}$$

$$\Delta \ln v_k\Big(H_{t+1}, K_{t+1}\left(R_{t+1}\right)\Big) = \Delta\lambda_{t+1} + (1-\gamma)\Delta \ln \tilde{k} \tag{4.24}$$

Now I proceed by applying a first order Taylor expansion for $\Psi_c(C_{t+1}, L_{t+1})$ and $\Psi_l(C_{t+1}, L_{t+1})$ around $c_t \equiv \ln(C_t)$ and $l_t \equiv \ln(L_t)$

$$\Delta\Psi_c(t+1) \approx \frac{C_t\Psi_{cc}(t)}{\Psi_c(t)}\Delta c_{t+1} + \frac{L_t\Psi_{cl}(t)}{\Psi_c(t)}\Delta l_{t+1} \tag{4.25}$$

$$\Delta\Psi_l(t+1) \approx \frac{C_t\Psi_{lc}(t)}{\Psi_l(t)}\Delta c_{t+1} + \frac{L_t\Psi_{ll}(t)}{u_l(t)}\Delta l_{t+1} \tag{4.26}$$

where I replace the arguments in the derivative functions with timing for brevity. Similarly, I approximate $v_h(t+1)$ and $v_k(t+1)$ around $h_t \equiv \ln(H_t)$ and $k_t \equiv \ln(K_t)$ to have

$$\Delta v_h(t+1) \approx \frac{H_t v_{hh}(t)}{v_h(t)}\Delta h_{t+1} + \frac{K_t v_{hk}(t)}{v_h(t)}\Delta k_{t+1} \tag{4.27}$$

$$\Delta v_k(t+1) \approx \frac{H_t v_{kh}(t)}{v_k(t)}\Delta h_{t+1} + \frac{K_t v_{kk}(t)}{v_k(t)}\Delta k_{t+1} \tag{4.28}$$

Equating equations (4.21) and (4.22) with equations (4.25) and (4.26) respectively gives:

$$\frac{C_t\Psi_{cc}(t)}{\Psi_c(t)}\Delta c_{t+1} + \frac{L_t\Psi_{cl}(t)}{\Psi_c(t)}\Delta l_{t+1} \approx \Delta\lambda_{t+1}$$

$$\frac{C_t\Psi_{lc}(t)}{\Psi_l(t)}\Delta c_{t+1} + \frac{L_t\Psi_{ll}(t)}{u_l(t)}\Delta l_{t+1} \approx \Delta\lambda_{t+1} + \Delta w_{t+1}$$

Similarly, equating equations (4.23) and (4.24) with equations (4.27) and (4.28) respectively gives:

$$2\Delta\lambda_{t+1} + \Delta \ln W_{t+1} + \gamma\Delta \ln \tilde{k} \approx \frac{H_t v_{hh}(t)}{v_h(t)}\Delta h_{t+1} + \frac{K_t v_{hk}(t)}{v_h(t)}\Delta k_{t+1}$$

$$\Delta\lambda_{t+1} + (1-\gamma)\Delta \ln \tilde{k} \approx \frac{H_t v_{kh}(t)}{v_k(t)}\Delta h_{t+1} + \frac{K_t v_{kk}(t)}{v_k(t)}\Delta k_{t+1}$$

Solving these two (2) pair of equations simultaneously for Δc_t and Δl_t and for Δh_t, and Δk_t receptively gives the dynamic of household consumption, leisure and home time:

$$\Delta c_{i,t} \approx (\eta_{c,p} - \eta_{c,w})\Delta \ln \lambda_{i,t} - \eta_{c,w}\Delta w_{i,t} \tag{4.29}$$

$$\Delta l_{i,t} \approx (\eta_{l,w} - \eta_{l,p})\Delta \ln \lambda_{i,t} + \eta_{l,w}\Delta w_{i,t} \tag{4.30}$$

$$\Delta h_{i,t} \approx (2\varpi_{h,w} + \varpi_{h,p_k})\Delta \ln \lambda_{i,t} + \varpi_{h,w}\Delta w_{i,t} + (\gamma\varpi_{h,w} + (1-\gamma)\varpi_{h,p_k})\Delta \ln \tilde{k} \tag{4.31}$$

$$\Delta k_{i,t} \approx (2\varpi_{k,w} + \varpi_{k,p_k})\Delta \ln \lambda_{i,t} + \varpi_{k,w}\Delta w_{i,t} + (\gamma\varpi_{k,w} + \varpi_{k,p_k})\Delta \ln \tilde{k} \tag{4.32}$$

which can be written in matrix form as:

$$\begin{pmatrix} \Delta c_{i,t} \\ \Delta l_{i,t} \\ \Delta h_{i,t} \\ \Delta k_{i,t} \end{pmatrix} \cong \begin{pmatrix} -\eta_{c,p} & \eta_{c,w} & 0 & 0 \\ \eta_{l,p} & \eta_{l,w} & 0 & 0 \\ 0 & 0 & \varpi_{h,w} & \varpi_{h,p_k} \\ 0 & 0 & \varpi_{k,w} & \varpi_{k,p_k} \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 1 & 1 & 0 \\ 2 & 1 & \gamma \\ 1 & 0 & 1-\gamma \end{pmatrix} \begin{pmatrix} \Delta \ln \lambda_{i,t} \\ \Delta \ln W_{i,t} \\ \Delta \ln \tilde{k} \end{pmatrix} \tag{4.33}$$

The zeros in the Frisch matrix come directly from the assumption that $\Psi(.)$ and $v(.)$ are separable. The p is the "price" of current consumption in terms of future consumption. The Frisch (marginal-utility constant) elasticities $\eta_{x,y}$ of household consumption and leisure with respect to changes in the price of consumption and wage are define as:

$$\eta_{c,p} = -\frac{\Psi_c}{C}\frac{\Psi_{ll}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}; \qquad \eta_{c,w} = -\frac{\Psi_l}{C}\frac{\Psi_{lc}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}$$

$$\eta_{l,p} = -\frac{\Psi_c}{L}\frac{\Psi_{lc}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}; \qquad \eta_{l,w} = \frac{\Psi_l}{L}\frac{\Psi_{cc}}{(\Psi_{cc}\Psi_{ll} - \Psi_{lc}^2)}$$

$$\varpi_{h,w} = -\frac{v_h v_{kk}}{H(v_{kk}v_{hh} - v_{kh}^2)}; \qquad \varpi_{h,p_k} = -\frac{v_k v_{hk}}{H(v_{kk}v_{hh} - v_{kh}^2)}$$

$$\varpi_{k,w} = -\frac{v_h v_{kh}}{K(v_{kk}v_{hh} - v_{kh}^2)}; \qquad \varpi_{k,p_k} = \frac{v_k v_{hh}}{K(v_{kk}v_{hh} - v_{kh}^2)}$$

4.8.3 Approximating lifetime Budget Constraint

Applying Taylor approximation on the intertemporal budget constraint given below.

$$\mathbb{E}_t \sum_{k=0}^{T-t} \frac{C_{t+k}}{(1+r)^k} + \frac{e_{T+1}}{(1+r)^{T-t}} = \mathbb{E}_t \sum_{k=0}^{T_w-t} \frac{(W_{t+k}N_{t+k})}{(1+r)^k} +$$
$$\mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{t+k}}{(1+r)^k} + (1-s_0)\,\mathbb{E}_t \sum_{k=0}^{T-t} \frac{Q_t}{(1+r)^k} + (1+r)A_t - \frac{A_{T+1}}{(1+r)^{T-t}} \tag{4.34}$$

Suppose ξ_k is the series I want to approximate around ξ_k^0, the general approximation rule is given as:

$$E_I\left[\ln\sum_{k=0}^{T-t}\exp\xi_k\right]=\ln\sum_{k=0}^{T-t}\exp\xi_k^0+\ln\sum_{k=0}^{T-t}\frac{\exp\xi_k^0}{\ln\sum_{j=0}^{T-t}\exp\xi_j^0}(\xi_k-\xi_k^0)$$
$$+\frac{1}{2}\ln\sum_{k=0}^{T-t}\sum_{j=0}^{T-t}E_I\left(\frac{\partial^2}{\xi_k\xi_j}\left[\ln\sum_{k=0}^{T-t}\exp\tilde{\xi}_k\right](\xi_k-\xi_k^0)(\xi_j-\xi_j^0)\right) \tag{4.35}$$

where $\tilde{\xi}_k$ is a vector chosen between ξ_k and ξ_k^0 such that the Taylor expansion is accurate. I now apply this expansion on both sides of the intertemporal budget constraint starting with the expenditure side.

Approximating the expenditure account of lifetime resources

I now approximate the expenditure side of lifetime resources

$$\mathbb{E}_t\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}+\frac{K_{T+1}}{(1+r)^{T-t}}$$

around $\mathcal{K}_e=\ln\sum_{k=0}^{T-t}\exp[E_{t-1}\ln C_{t+k}-k\ln(1+r)+\frac{K_{T+1}^0}{(1+r)^{T-t}}]$ where $K_t^0=(1-\delta)^tK_0+\sum_{k=1}^{t}(1+r)^{t-k}[Y_k+R_k-C_k-A_k]$ is the path (depreciation adjusted) households' holdings of home appliances follow. Lets define:

$$\begin{aligned}
\xi_c&=\ln C_{t+k}-k\ln(1+r) && \text{for} && k=0,...,T-t\\
\xi_c^0&=E_{t-1}\ln C_{t+k}-k\ln(1+r) && \text{for} && k=0,...,T-t\\
\xi_e&=K_{T+1}(1+r)^{-(T-t)} && \text{for} && k=0,...,T-t\\
\xi_e^0&=K_{T+1}^0(1+r)^{-(T-t)} && \text{for} && k=0,...,T-t
\end{aligned}$$

Then, I rewrite the approximated expenditure account of lifetime resource as:

$$E_I\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}+\frac{K_{T+1}}{(1+r)^{T-t}}\right]\approx\mathcal{K}_e+\sum_{k=0}^{T-t}(1-\theta_{t+k})E_I\left[\frac{K_{T+1}}{(1+r)^{T-t}}-\frac{K_{T+1}^0}{(1+r)^{T-t}}\right]+$$
$$\sum_{k=0}^{T-t}\theta_{t+k}(E_I\ln C_{t+k}-E_{t-1}\ln C_{t+k})$$

where I ignore the second-order term, take expectation with respect to information set $\mathcal{I}$ and defining θ_{t+k} as

$$\theta_{t+k}=\frac{\exp[E_{t-1}\ln C_{t+k}-k\ln(1+r)]}{\ln\sum_{j=0}^{T-t}\exp[E_{t-1}\ln C_{t+j}-j\ln(1+r)]}$$

θ_{t+k} can be seen as the share of household lifetime income that is spent on consumption while $(1-\theta_{t+k})$ is the share of household expenditure on home appliances. As a simplifying assumption, we assume that θ_{t+k} is constant i.e. $\theta_{t+k}=\theta$.

At $I=t$, I apply the operator $E_t - E_{t-1}$ on the expression above to obtain:

$$(E_t-E_{t-1})\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}+\frac{K_{T+1}}{(1+r)^{T-t}}\right]\approx(E_t-E_{t-1})\mathcal{K}_e+\theta(E_t-E_{t-1})\ln C_{t+k}+(1-\theta)(E_t-E_{t-1})\ln K_{t+k}$$

Note that $E_t \ln C_{t+k} - E_{t-1}\ln C_{t+k} \equiv \Delta c_{t+k} \approx (\eta_{c,p}-\eta_{c,w})\Delta \ln \lambda_{i,t} - \eta_{c,w}\Delta w_{i,t} = (\eta_{c,p}-\eta_{c,w})(\Gamma_t + \varepsilon_t) - \eta_{c,w}(v_{it}+\Delta u_{it})$ and households' home appliances do not vary hugely between two periods, $E_t \ln K_{t+k} \simeq E_{t-1}\ln K_{t+k}$. Thus, I simplify the right hand side (RHS) of the expression above as:

$$(E_t - E_{t-1})\circ\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}+\frac{K_{T+1}}{(1+r)^{T-t}}\right]\approx\theta(\eta_{c,p}-\eta_{c,w})(\Gamma_t+\varepsilon_t)-\theta\eta_{c,w}(v_{it}+\Delta u_{it})$$

Finally, I can consider the pure innovations to household expenditure, net of predictable components.

$$(E_t - E_{t-1})\circ\left[\ln\sum_{k=0}^{T-t}\frac{C_{t+k}}{(1+r)^k}+\frac{K_{T+1}}{(1+r)^{T-t}}\right]\approx\theta(\eta_{c,p}-\eta_{c,w})\varepsilon_t-\theta\eta_{c,w}(v_{it}+\Delta u_{it}) \qquad (4.36)$$

Approximating the income account of lifetime resource

Similar to the approximation of the expenditure side of lifetime resource, I now apply the approximation rule given by (4.35) to the total discounted lifetime income of households:

$$\mathbb{E}_t\sum_{k=0}^{T_w-t}\frac{W_{t+k}H_{t+k}}{(1+r)^k}+\mathbb{E}_t\sum_{k=0}^{T-t}\frac{R_{t+k}}{(1+r)^k}+(1-s_0)\,\mathbb{E}_t\sum_{k=0}^{T-t}\frac{Q_t}{(1+r)^k}+(1+r)A_t-\frac{A_{T+1}}{(1+r)^{T-t}}$$

around $\mathcal{K}_y=\ln\sum_{k=0}^{T_w-t}\exp[E_{t-1}\frac{W_{t+k}H_{t+k}}{(1+r)^k}+\sum_{k=0}^{T-t}E_{t-1}\frac{R_{t+k}}{(1+r)^k}+(1-s_0)\,\mathbb{E}_{t-1}\sum_{k=0}^{T-t}\frac{Q_t}{(1+r)^k}+(1+r)A_t^0-\frac{A^0_{T+1}}{(1+r)^{T-t}}]$ where $A_t^0=(1+r)^tA_0+\sum_{k=1}^{t}(1+r)^{t-k}[Y_k+R_k-C_k]$ is the path followed by assets. Lets define:

$$\xi_k=\ln W_{t+k}H_{t+k}-k\ln(1+r)\qquad\text{for}\qquad k=0,...,T_w-t$$

$$\xi_k^0 = E_{t-1} \ln W_{t+k} H_{t+k} - k \ln(1+r) \qquad \text{for} \qquad k = 0, ..., T_w - t$$

$$\xi_R = \ln R_{t+j} - j \ln(1+r) \qquad \text{for} \qquad j = 0, ..., T - t$$
$$\xi_R^0 = E_{t-1} R_{t+j} - j \ln(1+r) \qquad \text{for} \qquad j = 0, ..., T - t$$

$$\xi_Q = \ln Q_{t+j} - j \ln(1+r) \qquad \text{for} \qquad j = 0, ..., T - t$$
$$\xi_Q^0 = E_{t-1} \ln Q_{t+j} - j \ln(1+r) \qquad \text{for} \qquad j = 0, ..., T - t$$

$$\xi_A = \ln(1+r) A_t - A_{T+1}(1+r)^{-(T-t)}$$
$$\xi_A^0 = \ln(1+r) A_t^0 - A_{T+1}^0(1+r)^{-(T-t)}$$

Applying the approximation rule (4.35) to the discounted lifetime income of households while ignoring the second-order term and take expectation with respect to information set $\mathcal{I}$.

$$E_I \ln \left[\sum_{k=0}^{T_w - t} \frac{W_{t+k} H_{t+k}}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{t+k}}{(1+r)^k} + (1 - s_0)\, \mathbb{E}_t \sum_{k=0}^{T-t} \frac{Q_t}{(1+r)^k} + (1+r) A_t - \frac{A_{T+1}}{(1+r)^{T-t}} \right] \approx$$
$$\mathcal{K}_y + (1 - \pi_t - \phi_t^R - \omega_t^Q) \sum_{k=0}^{T_w - t} \alpha_{t+k} [E_I w_{t+k} h_{t+k} - E_{t-1} w_{t+k} h_{t+k}] + \phi_t^R \sum_{k=0}^{T-t} \delta_{t+j} [E_I \ln R_{t+j} - E_{t-1} \ln R_{t+j}] +$$
$$\omega_t^Q \sum_{k=0}^{T-t} \chi_{t+j} [E_I \ln Q_{t+j} - E_{t-1} \ln Q_{t+j}] + \pi_t \sum_{k=0}^{T-t} E_I \left[(1+r) A_t - \frac{A_{T+1}}{(1+r)^{T-t}} \right] - \left[(1+r) A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}} \right]$$

where

$$\alpha_{t+k} = \frac{\exp[E_{t-1} w_{t+k} h_{t+k} - k \ln(1+r)]}{\ln \sum_{j=0}^{T_w - t} \exp[E_{t-1} w_{t+j} h_{t+j} - j \ln(1+r)]}$$

$$\delta_{t+j} = \frac{\exp[E_{t-1} \ln R_{t+j} - j \ln(1+r)]}{\ln \sum_{s=0}^{T-t} \exp[E_{t-1} \ln R_{t+s} - s \ln(1+r)]}$$

$$\chi_{t+j} = \frac{\exp[E_{t-1} \ln Q_{t+j} - j \ln(1+r)]}{\ln \sum_{s=0}^{T-t} \exp[E_{t-1} \ln Q_{t+s} - s \ln(1+r)]}$$

$$\pi_t = \frac{\left[\ln(1+r) A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}} \right]}{Z} \qquad \phi_t^R = \frac{\sum_{j=0}^{T-t} \exp[\ln R_{t+j} - j \ln(1+r)]}{Z}$$

$$\omega_t^Q = \frac{\sum_{j=0}^{T-t} \exp[\ln Q_{t+j} - j \ln(1+r)]}{Z}$$

where $Z = \sum_{k=0}^{T_w-t} \exp[E_{t-1} w_{t+k} h_{t+k} - k\ln(1+r)] + \sum_{k=0}^{T-t} \exp[\ln R_{t+k} - k\ln(1+r)] + \sum_{k=0}^{T-t} \exp[\ln Q_{t+k} - k\ln(1+r)] + \ln(1+r)A_t^0 - \frac{A_{T+1}^0}{(1+r)^{T-t}}$ is total discounted lifetime wealth. α_{t+k}, χ_{t+k} and δ_{t+j} are the annuitization factors of labour income, income from home production and remittance income respectively such that $\sum_{k=0}^{T_w-t} \alpha_{t+k} = 1$, $\sum_{j=0}^{T-t} \chi_{t+j} = 1$ and $\sum_{j=0}^{T-t} \delta_{t+j} = 1$. π_t, ϕ_t^R and ω_t^Q are the shares of asset wealth, remittance wealth and wealth from home production on total discounted lifetime wealth, respectively.

Defining $I = t$ and applying the operator $E_t - E_{t-1}$ on the expression above, I obtain:

$$
\begin{aligned}
(E_t - E_{t-1}) \circ \ln \left[\sum_{k=0}^{T_w-t} \frac{W_{t+k} H_{t+k}}{(1+r)^k} + \mathbb{E}_t \sum_{k=0}^{T-t} \frac{R_{t+k}}{(1+r)^k} + (1-s_0)\,\mathbb{E}_t \sum_{k=0}^{T-t} \frac{Q_t}{(1+r)^k} + (1+r)A_t - \frac{A_{T+1}}{(1+r)^{T-t}} \right] \\
\approx (E_t - E_{t-1}) \circ \mathcal{K}_y + (1 - \pi_t - \phi_t^R - \omega_t^Q) \left(\sum_{k=0}^{T_w-t} \alpha_{t+k} \right) (E_t - E_{t-1}) \circ w_{t+k} h_{t+k} \\
+ \phi_t^R \left(\sum_{k=0}^{T-t} \delta_{t+j} \right) (E_t - E_{t-1}) \circ \ln R_{t+j} + \omega_t^Q \left(\sum_{k=0}^{T-t} \chi_{t+j} \right) (E_t - E_{t-1}) \circ \ln Q_{t+j} \\
= (1 - \pi_t - \phi_t^R - \omega_t^Q)[v_t + \alpha_t \Delta u_t] + \phi_t^R (\zeta_{i,t}^R + \Delta \tau_{it}^R) \qquad (4.37)
\end{aligned}
$$

Equating innovations to the expenditure and income accounts

Given that I have approximated the expenditure (4.36) and income (4.37) accounts of households' lifetime resources, I now equate the two sides of the approximated intertemporal budget constraint

$$
\theta(\eta_{c,p} - \eta_{c,w})\varepsilon_t - \theta\eta_{c,w}(v_{it} + \Delta u_{it}) = (1 - \pi_t - \phi_t^R - \omega_t^Q)[v_t + \alpha_t \Delta u_t] + \phi_t^R (\zeta_{i,t}^R + \Delta \tau_{it}^R)
$$

in order to derive an expression for the innovation in marginal utility of wealth ε_t. This equation implies that

$$
\begin{aligned}
\varepsilon_{i,t} = \frac{(1 - \pi_t - \phi_t^R - \omega_t^Q + \theta\eta_{c,w})}{\theta(\eta_{c,p} - \eta_{c,w})} v_{i,t} + \frac{\left[\alpha_t(1 - \pi_t - \phi_t^R - \omega_t^Q) + \theta\eta_{c,w}\right]}{\theta(\eta_{c,p} - \eta_{c,w})} \Delta u_{i,t} \\
+ \frac{\phi_t^R}{\theta(\eta_{c,p} - \eta_{c,w})} \zeta_{i,t}^R + \frac{\phi_t^R}{\theta(\eta_{c,p} - \eta_{c,w})} \Delta \tau_t^R \qquad (4.38)
\end{aligned}
$$

Now I substitute the expression for the innovation in marginal utility of wealth (4.38) in equations (4.29) to (4.32) to obtain analytical expressions for households' consumption, market and

home hours dynamics as a function wage and remittance income shocks.

$$\begin{pmatrix} \Delta\hat{c}_{i,t} \\ \Delta\hat{n}_{i,t} \\ \Delta\hat{h}_{i,t} \\ \Delta\hat{k}_{i,t} \end{pmatrix} = \begin{pmatrix} \kappa_{c,v} & \kappa_{c,u} & \kappa_{c,\zeta} & \kappa_{c,\tau} \\ \kappa_{n,v} & \kappa_{n,u} & \kappa_{n,\zeta} & \kappa_{c,\tau} \\ \kappa_{h,v} & \kappa_{h,u} & \kappa_{h,\zeta} & \kappa_{c,\tau} \\ \kappa_{k,v} & \kappa_{k,u} & \kappa_{k,\zeta} & \kappa_{c,\tau} \end{pmatrix} \begin{pmatrix} v_{i,t} \\ \Delta u_{i,t} \\ \zeta^R_{i,t} \\ \Delta\tau^R_{i,t} \end{pmatrix}$$

where I define

$$\kappa_{c,v} = \frac{1-\pi_t-\phi^R_t-\omega^Q_t}{\theta}, \quad \kappa_{c,u} = \frac{\alpha_t(1-\pi_t-\phi^R_t-\omega^Q_t)}{\theta}, \ \kappa_{c,\zeta} = \frac{\phi^R_t}{\theta}, \ \kappa_{c,\tau} = \frac{\phi^R_t}{\theta}$$

$$\kappa_{n,v} = \frac{(\eta_{n,w}-\eta_{n,p})(1-\pi_t-\phi^R_t-\omega^Q_t+\theta\eta_{c,w})}{\theta(\eta_{c,p}-\eta_{c,w})} + \eta_{n,w}, \quad \kappa_{n,\zeta} = \frac{(\eta_{n,w}-\eta_{n,p})\phi^R_t}{\theta(\eta_{c,p}-\eta_{c,w})}$$

$$\kappa_{n,u} = \frac{(\eta_{n,w}-\eta_{n,p})\left[\alpha_t(1-\pi_t-\phi^R_t-\omega^Q_t)+\theta\eta_{c,w}\right]}{\theta(\eta_{c,p}-\eta_{c,w})} + \eta_{n,w}, \quad \kappa_{n,\tau} = \frac{(\eta_{n,w}-\eta_{n,p})\phi^R_t}{\theta(\eta_{c,p}-\eta_{c,w})}$$

$$\kappa_{h,v} = \frac{(2\varpi_{h,w}+\varpi_{h,p_k})(1-\pi_t-\phi^R_t-\omega^Q_t+\theta\eta_{c,w})}{\theta(\eta_{c,p}-\eta_{c,w})} + \varpi_{h,w}, \ \kappa_{h,\zeta} = \frac{(2\varpi_{h,w}+\varpi_{h,p_k})\phi^R_t}{\theta(\eta_{c,p}-\eta_{c,w})}$$

$$\kappa_{h,u} = \frac{(2\varpi_{h,w}+\varpi_{h,p_k})\left[\alpha_t(1-\pi_t-\phi^R_t-\omega^Q_t)+\theta\eta_{c,w}\right]}{\theta(\eta_{c,p}-\eta_{c,w})} + \varpi_{h,w}, \ \kappa_{h,\tau} = \frac{(2\varpi_{h,w}+\varpi_{h,p_k})\phi^R_t}{\theta(\eta_{c,p}-\eta_{c,w})}.$$

Chapter 5

Conclusion and Policy Recommendations

This dissertation has presented my research on remittances as a source of insurance for Thai households and the effect of remittance windfalls on households' time allocation between market and home production activities. The first chapter documented stylized facts on the increasing flow and share of remittances relative to other forms of international capital flows to developing countries. This chapter also revealed that remittances are less volatile and less pro-cyclical compared to other forms of international capital flows to developing countries. This was amply demonstrated by the substantial increase in remittance flows to Thailand during and after the 1997-98 Asian Financial crisis.

The second chapter examined remittances as a source of insurance for recipient households using a life-cycle model that distinguishes three main sources of consumption insurance. The first is self-insurance via household labour supply such that households adjust their labour hours in response to income realizations to smooth consumption. The second is self-insurance through assets (de)accumulation. Here, households build up savings in good times and draw them down in hard times. The third source of insurance comes through "risk-sharing" in the form of remittances. Although Thai households do have significant access to consumption smoothing devices, my results do not support the full consumption insurance hypothesis because I find that

adverse wage shocks (both transitory and permanent) do translate to reduction in household consumption. This is consistent with the findings of Townsend [1994] and Karaivanov and Townsend [2014] who arrive at a similar conclusion using annual rural and urban data from the Townsend Thai survey. Morten [2016] also provides evidence that household consumption is not completely buffered against idiosyncratic income shocks in India. She finds households that experience adverse idiosyncratic shocks to have consumption growth rates lower than those that did not. Moreover, my results suggest that Thai households have more access to smooth consumption against transitory wage shocks than permanent shocks. This is because 83% of transitory wage shocks are insured while only 47% of permanent wage changes are insured using our insurance devices. Interestingly, self-insurance through asset holding plays a more important role than remittances. Whereas 72% of the consumption smoothing is explain by households' self-insurance behaviour through asset accumulation, remittances only explains 11%. Conditional on education levels, I find that households with low education attainment rely more on remittances as a source of consumption insurance while those with higher educational attainment have higher access to smooth consumption against wage shocks using assets.

After establishing that remittances are importance source of insurance for Thai households, I examine whether remittance windfalls do make remittance-receiving households "lazy". This is because there is a popular argument that: since remittances are non-labour income, remittance windfalls relax recipient households' budget constraints, increase their reservation wages and, through an "income effect" lower their employment likelihood. I find no support that increased remittance income leads to lower labour effort among Thai households. On the contrary, I find that remittance windfalls induce Thai households to reallocate labour hours from market to home production activities. This time reallocation effect is stronger among households with low educational attainment suggesting a positive wealth effect associated with permanent remittance income shocks on home production time. Moreover, I find that the negative effect of remittances on household market hours increases with age of household heads while its positive effect on home hours declines with age. Interestingly, the positive effect of remittances on home hours dies down when household heads are more than 40 years old signalling that it is households with young heads that actually increase home production time in response to remittance

windfalls. This has very important policy implications as it suggests that remittances provide young adults, who are usually the most innovative and entrepreneurial group, the opportunity to enhance home production activities. In addition, given that young people are less likely to find formal sector employment and more likely to migrate, remittance windfalls can strengthen their participation in development processes by helping them to increasingly participate in entrepreneurial home production activities.

In conclusion, remittances have become a major source of external development finance that can play an effective role towards alleviating poverty, boosting shared prosperity and building the resilient of those living in extreme poverty. Consequently, policy interventions should be directed towards facilitating remittance flows especially to countries where people have little protection against income and employment shocks. In trying to maximise the developmental impact of remittances towards achieving the United Nations' Sustainable Development Goals, efforts should not be directed towards taxing remittance flows or channelling them to specific development needs. Rather, policy interventions should focus on leveraging remittance flows to boost financial access of migrants, remittance-receiving households, and the financial intermediaries in receiving countries. This is can be done by reducing remittance cost and encouraging remittance flows through formal and banking channels. Reducing remittance transaction fees promotes the use of banking and formal remittance channels which boosts the developmental impact of remittances by stimulating saving and enhancing better matching of saving with investment opportunities [Ratha et al., 2007]. This is because remittances are more likely to be saved when they are received through a bank account than if they are received as cash.

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