Rural Pathways out of Poverty –

Cash Crop Farming as a Driver of Pro-Poor Growth

An Assessment of Long-Term Income Dynamics and Poverty Reduction at Rainforest Margins in Central Sulawesi, Indonesia

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Abstract

While agriculture is frequently identified as the principal pathway out of poverty and driver of pro-poor growth in rural economies, evidence on the long-term impact of cash crop farming on poverty reduction and rural income growth remains scarce. This paper sets out to investigate the pathways out of rural poverty in Central Sulawesi, Indonesia, drawing on a unique household panel survey collected in the vicinity of the Lore Lindu National Park in the years 2001, 2006, and 2013.

Building on a unified conceptual framework of the determinants and drivers of poverty reduction in the rural farm and non-farm economy, we find that the wide-spread adoption of cocoa as the principal crop was succeeded by substantial reductions in rural poverty between 2006 and 2013.

Although the shift in cropping patterns towards the adoption and intensification of cocoa comprises the majority of farm households in our sample, the pursued livelihood strategies thereto reveal a markedly different reliance on cash crop income. Cash crop farmers with a high degree of specialization in cocoa were particularly more successful than commercial farmers relying on other crops. Their contribution to poverty reduction however is equaled by farmers that follow a diversified income strategy of cash cropping and employment in either the farm and non-farm sector.

Considering the wide-spread and inclusive adoption and intensification of cocoa farming among poor households on the one hand, and the significant entry barriers to participation of poor smallholders in non-farm activities on the other, we argue that cash cropping entails a high potential for pro-poor growth in rural settings, eventually opening a pathway out of rural poverty.

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Abbreviations

BPS	Indonesian National Statistical Office
COPAL	Alliance of Cocoa Producing Countries
EFFORTS	Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems, Indonesia
FE	Fixed Effects
FGT	Foster-Greer-Thorbecke Index
GMM	Generalized Method of Moments
ICCO	International Cocoa Organization
IDR	Indonesian Rupiah
LLNP	Lore Lindu National Park
MDG	Millennium Development Goals
MNL	Multinomial Logit
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PPP	Purchasing Power Parity
RE	Random Effects
STORMA	Stability of Rainforest Margins in Indonesia
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
US	United States

Many paths lead from the foot of the mountain,

but at the peak we all gaze at the single bright moon.

-Ikkyū

I Introduction

While the structural transformation that takes place at different stages of economic development has long been at the core of development economics, its interdependencies with poverty reduction is an area of research that has witnessed increasing attention over the last decade. With poverty reduction standing out as the central aim of development efforts in light of the Millennium Development Goals (MDGs), policy research has increasingly focused on finding those structural pathways associated with significant reductions of poverty. The concept of pro-poor growth has received especial acclaim in this respect and is singled out as an essential factor in sustainable, broad-based poverty reduction (e.g. UN, 2000; Ravallion, 2004; World Bank, 2004). While there is little doubt that economic growth contributes to poverty alleviation, the debate on pro-poor growth acknowledges the fact that a growing number of studies point to the observed sectoral heterogeneity in the poverty-growth relationship and emphasize the importance of understanding the composition of growth for the design of appropriate poverty reduction policies (Bourguignon, 2003; Kakwani et al., 2004; McCulloch et al., 2007; Loayza and Raddatz, 2010). Thus, the debate about pro-poor growth is inherently linked to the structural transformation process of developing economies and attempts to disentangle the poverty-reducing effect of growth induced in an environment of changing sectoral patterns. The sectoral composition of growth and poverty reduction inevitably deals with transformation of the rural economy, where most of the world's poor are located (World Bank, 2007). Thus the main pathways out of poverty will be connected to increases in the productivity of the rural poor. Since the rural economy of developing countries is primarily characterized by low productivity agricultural activities, the most comprehensive literature assesses the impact of agricultural growth on poverty reduction (e.g. Thorbecke and Jung, 1996; Tiffin and Irz, 2006; Ravallion and Chen, 2007; Christiansen and Demery, 2007). These studies find broad-based agricultural growth driven by smallholder commercialization and agricultural productivity to be most effective in poverty reduction (for reviews see Thirtle, et al., 2003; Majid, 2004; Kirsten et al., 2013). Especially the inclusive agricultural development observed during the Green Revolution in Asia inspired new empirical insights into the potential of agricultural commercialization as a tool for poverty reduction. Agriculture not only presented itself as being highly responsive to

technological change and thereby capable of substantial productivity growth, but it has also proven to be a powerful force in reducing poverty and stimulating broad economic development (Rosegrant and Hazell, 2000). Based on this finding, the potential economic returns, low labor requirements and absence of seasonality associated with higher value cash crops could entail significant welfare benefits for the rural poor (Feintrenie et al., 2010).

Contrary to the prototypical image of smallholders as pure farmers, landed rural households rely on many activities and income sources. Besides farming, they participate in agricultural wage employment, wage and self-employment in the rural non-farm economy, or receive remittances from migrating household members (World Bank, 2007). Consequently, a second strand of literature highlights the importance of the rural non-farm economy as an engine of rural development, income growth, and poverty reduction (e.g. Lanjouw, 2001; Lanjouw and Lanjouw, 2001; Foster and Rosenzweig, 2004; Mwabu and Thorbecke, 2004; Haggblade et al., 2010; Hoang et al., 2014). Engagement in the rural non-farm economy may not only serve as a supplementary activity for poor households to diversify their income sources and insure against shocks to their agricultural income, but shows to be a critical source of long-term growth and poverty alleviation in rural areas.

McCulloch et al. (2007) argue that there many narrative theories describing either one of these pathways out of poverty, but that there are few quantitative models that have been tested over long time periods due to the lack of panel data for many developing countries. Our paper aims to fill this empirical gap in the literature on pathways out of poverty and builds on a unique data set based on a household panel survey collected at three different points in time (2001; 2006; 2013) in 13 villages at the rainforest margins of the Lore Lindu region in Central Sulawesi. The household survey comprises 326 households in 2001, 380 households in 2006 and 388 households in 2013. From the whole survey, 271 households could be interviewed in all three years.

The economic development and rural transformation observed in the Lore Lindu Region in Central Sulawesi, Indonesia, provides an interesting case study for rural income dynamics and resembles much of the development observed in Indonesia as a whole.

Since the late 1960s, Indonesia experienced high and sustained economic growth, which was driven by significant developments in the agricultural sector specifically promoting export oriented agricultural production (Mundlak et al., 2002; Timmer, 2007; Feintrenie et

al, 2010). The vast expansion of agricultural area, the adoption of subsidized new technologies such as irrigation, fertilizer, pesticides and improved seeds and shifts in cropping patterns towards the cultivation of various cash crops including coffee, cocoa and oil palms were prominent drivers in the development of the Indonesian economy (Maertens et al., 2002; Mundlak et al., 2002). This rapid economic growth translated into significant progress in reducing poverty, with poverty rates at the national level declining from 24.2 percent to 11.47 percent between 1998 and 2013 (Indonesian National Statistical Office [BPS], 2014). However, despite sustained economic progress, around 28 million Indonesians remain below the national poverty line (BPS, 2014). Moreover, estimates show that half of all Indonesian households are clustered around the poverty line, underlining the risk of falling into poverty and high vulnerability to shocks (World Bank, 2012).

Our sample region of Central Sulawesi was particularly attractive for cash crop adoption based on its availability of land with high initial soil fertility, low levels of pests and abundance of pollinators (Clough et al., 2010). Cocoa production witnessed a sharp increase by 111 percent from 2001 to 2013 with the total acreage size used for cocoa plantation more than doubling from 185 ha to 391 ha. With a large share of the population in Lore Lindu living on less than US 2 $ a day, cocoa cultivation has become an attractive option for income diversification and the main source of income for many smallholder families (van Edig, 2010). Klasen et al. (2013) find that local innovations related to the adoption and intensification of cocoa explained a substantial part of the observed income growth between 2001 and 2006. At the same time, farmers have also benefitted from the engagement in non-farm activities as an additional source of household income.

Our panel data set provides an ideal opportunity to assess the role of cash crop cultivation as well as the increasing diversification into non-farm activities as potential pathways out of rural poverty. Our analysis of poverty outcomes, the determinants of poverty dynamics and rural growth as well as the sectoral composition of growth and poverty reduction will give us an overview of the long-term transformative processes observed in the rural economy of Central Sulawesi.

The successive analytical steps are summarized in the following research questions,

(1) How has the poverty situation in the vicinity of the Lore Lindu National Park changed between 2001 and 2013? [descriptive analysis]
(2) What are the determinants of rural growth? [dynamic regression analysis]
(3) What are the sectoral pathways (drivers) most effective in poverty reduction? [decomposition analysis]

In order to conceptualize the determinants and drivers of rural poverty reduction in a unified framework of pathways out of poverty, we need to gain an understanding of the theoretical underpinnings and empirical evidence accompanying each of these two lines of thought. Hence, Chapter II will provide an overview of these two analytical strands of poverty and outline some of the current state of research.
Chapter III builds on the findings from our literature review and presents the conceptual framework of pathways out of poverty used in the subsequent analysis.
Chapter IV presents the methods used for data analysis. We first provide some short remarks on the definition of our poverty measures and the use of poverty lines. Thereafter, we outline the growth-equity decomposition method (Datt and Ravallion, 1992) as well as the sectoral decomposition method provided by Ravallion and Huppi (1991). Our analysis of the determinants of rural income dynamics will based on the system generalized method of moments (GMM) estimator developed by Arrellano and Bond (1991).
Chapter V provides an overview of our sample region's characteristics and furthermore outlines the construction and particularities of our panel data set and the variables used in our analysis.
Chapter VI presents our analytical findings in the order of our research questions outlined above. We will first provide a general overview of the changes in poverty and income in our sample before we apply a growth-equity decomposition to disentangle the interdependence of growth, inequality and poverty reduction. Subsequently, we will assess the determinants of poverty dynamics and rural income growth to identify those household characteristics associated with a reduction in poverty and higher income growth. Finally, the sectoral decomposition will detect those income sectors which were most effective at

poverty reduction and especially concentrate on the performance of cocoa households. We will also take a more detailed look at the factors associated with changes in cocoa income and the livelihood strategies of cocoa households.

Chapter VII will close our analysis with a reconsideration of our conceptual framework developed in Chapter III and combine findings from our various strands of analysis in a unified framework of rural growth and pathways out of poverty in the Lore Lindu region.

Finally, Chapter VIII will summarize our main findings and present some concluding remarks on their implications for future research and policies.

We include a summary of the main findings at the end of each major section so as to ensure the congruence and interconnection between the different parts of our study.

II Literature Review: Determinants and Drivers of Poverty Reduction and Rural Growth

According to Loayza and Raddatz (2010), the literature essentially provides two different, albeit complementary, approaches to cover the sources of rural growth and poverty reduction. One line of literature focuses on the socioeconomic preconditions surrounding each unit of observation, in our case the household. This approach tries to identify the determinants of the relationship between growth and poverty reduction and estimates how demographics, social and economic household characteristics influence the degree to which output growth helps reduce poverty. This concept is more commonly referred to as poverty dynamics. The notion of poverty dynamics will give us an insight into the household characteristics that are associated with movements in and out of poverty as well as income growth.

Another approach to assess the sources of rural growth is to identify those sectoral pathways most effective at reducing poverty. This approach focuses on the characteristics of output growth itself to assess whether growth in certain sectors is more poverty reducing than growth in others. The decomposition of economic growth and poverty reduction is a frequently applied method in the pro-poor growth literature. We believe that both approaches are essential to the concept of pathways out of poverty and cover crucial aspects of the process of rural transformation. Henceforth, we will provide a short overview of the two approaches and their empirical findings, before we conceptualize their implications in a unified framework of pathways out of poverty

II.1 Determinants of Poverty Dynamics and Economic Mobility

Pathways out of poverty crucially depend on the poor's capabilities to nourish expanding economic opportunities and actively participate in economic activities. Hence changes in the rural economy are interlinked with determinants of poverty dynamics and economic mobility, i.e. the factors associated with movements in and out of poverty and with income growth. Based on the concept of Baulch and Hoddinott (2000), the analysis of poverty dynamics addresses the short-term and refers to changes in the household welfare measure that cause households to move in or out of poverty by crossing a fixed poverty line.

Economic mobility, on the other hand, deals with the longer-term processes via which households change their relative rankings in the entire welfare distribution.

II.1.1 The Dynamics of Poverty

Poverty dynamics describe the evolution of poverty, identifying its duration and persistence over time (Hulme and Shepherd, 2003; McKay and Lawson, 2003). Whereas some households might experience a chronic state of poverty over a long time period, others might be subject to movements in and out of poverty from year to year. Essentially, studies on poverty dynamics attempt to identify and distinguish between those factors that prevent people from escaping poverty, those that lead people to fall back into poverty and those that enable households to escape poverty.

According to Baulch (2011), factors associated with preventing people from escaping poverty are, broadly defined, poor endowments, low returns to those endowments and vulnerability to shocks. He defindes endowments as all the assets a households may possess, which includes labor, physical capital (e.g. productive assets and housing), natural capital (e.g. land), human capital (e.g. knowledge, skills and health), financial capital (e.g. bank deposits and other stores of wealth) and social capital (e.g. organizational membership in networks and informal institutions). A low level of asset endowment is considered to be a crucial maintainer of chronic poverty.

In contrast to chronic poverty, transient poverty is associated with an inability of households to maintain their levels of consumption as a consequence of price fluctuations in agricultural commodities or negative shocks such as crop failure, illness or unemployment (McKay and Lawson, 2003). Thus, a frequent fall into poverty is often associated with a combination of shocks and other negative events. Households that are highly vulnerable to shocks most often dispose over a low level of endowments, which impedes their resilience to negative income shocks and increase the likelihood of falling into poverty.

Finally, improvements in the return to endowments, asset accumulation, and good fortune enable households to break the cycle of low incomes (Baulch, 2011). Here the acquisition of higher levels of education, employment or productive assets such as fertile land can act as the triggers which allow households to initiate a pathway out of poverty.

Haughton and Khandker (2009) emphasize the importance of differentiation between different states of poverty for poverty reduction policies to be successful. Transitory poor households may especially be in need of short-term relief that addresses household vulnerability, such as insurance or income stabilization schemes. On the other hand, chronic poor households may rely on income generating programs that build on the improvement of education, skills and assets.

The analysis of poverty dynamics is usually based on a discrete indicator of welfare, which involves the construction of a poverty line that classifies those whose income falls below the respective amount as poor. Whereas we will apply a descriptive assessment based on Nargis and Hossain (2006), the common approach to an analysis of a discrete indicator such as poverty is to apply multinomial (or binomial) logistic regressions, with the multinomial logit (MNL) model being the most commonly used discrete choice model in studies of poverty dynamics (Baulch, 2011).

Van Edig and Schwarze (2011) estimate a multinomial logit model to study the determinants of both chronic and transitory poverty using data from 264 randomly selected households interviewed in 2005 and 2007 in our sample region Central Sulawesi. The results of the estimated multinomial logit model applied in this study indicate that demographics are an essential determinant of movements in and out of poverty. They find that a larger household increases the probability of being chronically poor. Furthermore, the presence of dependents in a household, meaning higher numbers of small children and elderly people, increase the likelihood of poverty, especially chronic poverty. Their results also show that social capital fosters chronic poverty. Social capital, which they define as civic participation measured in households' group memberships, can provide households with social protection and assistance especially after unexpected negative shocks. The study concludes that poorer households have fewer opportunities to participate and derive income from non-farm activities because of their lower resource endowment. Thus, they argue for an improved access to credit to improve people's livelihoods and allow investments in non-farm businesses as well as education schemes that provide poor households with the capabilities to participate in expanding economic opportunities.

II.1.2 Economic Mobility: Modelling the Long-Term Welfare Trajectory

The main criticism of discrete choice models is the loss of a substantial amount of information about the household's welfare dynamics when one deals with large number of rounds of panel data (Ravallion, 1996). Accordingly, several studies turned to fixed or random effects as well as GMM estimation techniques to make use of the complete panel information (Dercon, 2004; Dercon and Porter, 2011; May et al., 2011; Klasen et al., 2013)). The use of a continuous variable as a dependent variable avoids an essentially arbitrary poverty line and also controls for time-invariant heterogeneity. In view of the fact that the analysis of changes in a continuous welfare variable disregards the frequency of movements into and out of poverty, it is more precisely defined as economic mobility. Studies on economic mobility use transition matrices, regressions on levels and on changes in levels to assess the role of asset accumulation and initial conditions as well as the impact of shocks on a household's welfare trajectory (Baulch and Hoddinott, 2000). Regressing the change in a welfare measure on its initial level and other socioeconomic determinants can essentially be referred to as a micro-level growth equation (Deininger and Okidi, 2003; Fields et al., 2003a, 2003b; Dercon, 2004; Woolard and Klasen, 2005; Lawson et al., 2006).

The paucity of reliable panel data sets inspired only few studies that specifically focus on economic mobility in developing countries (Woolard and Klasen, 2005). Besides some of the statistical advantages of modelling long-term welfare trajectories, it can provide us with valuable insights into the forces influencing income growth. Fields et al. (2003b) describe two such exemplary forces identified in the literature on economic mobility. One deals with the theory of cumulative advantage, which shows that initial ownership of endowments could contribute to a situation where the wealthiest households benefit most from income growth. This is based on the fact that credit market imperfections might only allow households with a minimum level of assets to make investments that yield higher returns to land or labor (Birdsall et al., 1998). Likewise, changes in macroeconomic policies, such as the liberalization of trade, or technological change could increase the returns to existing asset endowments and potentially favor the better-off households (Aghion et al., 1999).

Deininger and Okidi (2003), using micro-level survey and panel-data evidence from Uganda spanning 1992-2000, for example find that households' initial asset endowment in the form of physical assets and education is a significant determinant of subsequent growth performance as well as for poverty reduction.

On the other hand, so-called poverty traps, which are characterized by a lack of a minimum level of physical, human, natural, financial and social assets, might prevent households from escaping poverty.

Woolard and Klasen (2005), assessing household income mobility among South Africans between 1993 and 1998, identify three poverty traps that hamper the poor in moving out of poverty, namely large initial household size, poor initial education, and poor initial participation in the labor market. However, they discover that out of the three, the most important variable is the initial employment situation. Both an initial and increasing proportion of unemployed persons in the household has a sizeable negative impact on subsequent income mobility of the household.

This short introduction into the factors influencing economic mobility in developing countries shows that a household's economic position and its subsequent income changes can provide crucial insights into the upward mobility of poor households in a setting of rural transformation.

II.2 Drivers of Poverty Reduction: Sectoral Patterns of Rural Growth

II.2.1 Agricultural Commercialization and Cash Crop Farming

Growth originating in the agricultural sector has long been identified as an essential pathway out of poverty and a crucial feature in the structural transformation process of a semi-subsistence agrarian society to a more diversified economy with higher levels of welfare. Johnston and Kilby (1975) and Mellor (1976) showed that broad-based agricultural growth was a key driver of growth and significant reductions in poverty during the structural transformation process in Asia. This assessment was supported empirically by several studies such as Datt and Ravallion (1998), who analyze panel state-level data from 1957 to 1991 in India and find that growth in agriculture, proxied by farm yield per acre, and differing initial conditions with respect to infrastructure and human resources to

be the main determinants of long-term poverty reduction. Further work from Thorbecke and Jung (1996), Sumarto and Suryahadi (2007) and Suryahadi et al. (2009) for the country of Indonesia, Christiansen and Demery (2007) for the region of Africa, Ravallion and Chen (2007) and Montalvo and Ravallion (2010), who investigate the relationship in China, and Bresciani and Valdés (2007) and Ligon and Sadoulet (2011), who provide multi-country assessments, illustrate the large consensus among researchers that agriculture is a crucial component of income growth and poverty reduction in developing economies.

The process of agricultural growth that potentially leads to reductions in poverty is part of a transition from low productivity, semi-subsistence agriculture to high productivity, commercialized agriculture, which is commonly referred to as the "agricultural transformation" (Timmer, 1988). The commercialization of agriculture is usually associated with farmers intensifying the use of technology on their farms, producing greater output per unit of land and labor, achieving greater farm surpluses which can be sold in the market, thereby expanding their participation in markets, and ultimately increases in incomes and living standards (Jayne et al., 2011).

Pingali and Rosegrant (1995) describe this transformation of agriculture as the gradual replacement of integrated, mixed farming systems by specialized enterprises producing one or few crops. As economies grow, households shift away from traditional subsistence production, which imply little specialization and imperfect markets for local products, towards profit and income-oriented decision making. Efficient markets for inputs and outputs develop, including markets for rural labor, and allow households to separate production from consumption decisions.

Higher value crops or non-food cash crops such as coffee, cocoa and palm oil represent one potential avenue of agricultural commercialization. Accordingly, cash crops, which are defined as crops that households grow for direct sale (von Braun and Kennedy, 1994), can serve as a potential route for agricultural growth and poverty reduction. Achterbosch et al. (2014) point out that cash crops can bring substantial wage and employment opportunities to the rural economy and provide a stimulus to agricultural innovation, by raising capital for agricultural investment and accelerating the build-up of institutions that enable further commercialization.

For cash crops to be successful drivers of poverty reduction, the transition from subsistence to commercial agriculture significantly depends on the market participation of smallholder

farmers, based on the fact that the vast majority of farmers in developing countries are smallholders, of which an estimated 85 percent farm less than two hectares (World Bank, 2007). Feintrenie et al. (2010) find that the potential economic returns, low labor requirements and absence of seasonality makes cash cropping particularly lucrative for traditional smallholder farmers. Often, cash crops are integrated into the already prevailing farming systems through the planting of agroforests and intercropping of the new cash crop with upland rice and food crops, which are later converted into more intensified, productive land-use systems. Many farm households balance the benefits and risks of cash crop and food crop production in their cropping decisions to mitigate risks and vulnerability to price variability (Govereh and Jayne, 2003).

Only few studies currently exist that assess the long-term impact of cash cropping on rural incomes and allow possible inferences on its potential as a pathway out of poverty. Deininger and Okidi (2003) use two national household surveys and estimate a micro-level growth equation to measure changes in the poverty level of coffee growers in Uganda from 1992 to 2000. They show that an increase in coffee prices, the country's main tradable product, as a result of the liberalization of agricultural markets made a strong impact on growth and also benefited the poor. They estimate that a 10 percent increase in coffee prices would result in a reduction of the poverty headcount index by about 6 percentage points. The farmers' high price elasticity of supply however highlights the dangers of a sudden drop in prices, especially for an agrarian economy with a very limited degree of diversification. Hence, the sufficient diversification of farm income, either with respect to other crops or other sources of income, might be an important ingredient for sustained poverty reduction based on cash crop cultivation.

Klasen et al. (2013) use panel data from 2001, 2004 and 2006 in our sample region Central Sulawesi, Indonesia, and apply a system generalized methods of moments (GMM) estimator, furthermore instrumenting the sectors of employment and cocoa with lagged coffee and cocoa prices and distance to Central Sulawesi's capital. They find that households cultivating the cash crop cocoa were on average able to achieve about 14% higher income levels compared to the planting of other crops. Moreover, ceteris paribus, an average household having planted all its two hectares with cocoa in 2006 would have had an income level about 40% higher. They find that households tend to cultivate cocoa if the household head is relatively young and male, if fewer dependents live in the

household, and if the household is well-endowed with land. Their results indicate that the demographic composition of a household as well as its natural capital determine the participation in cash cropping. Besides cash crop cultivation, their results also demonstrate the importance of engagement in non-farm activities, which contributed substantially to household income growth.

II.2.2 The Rural Non-Farm Economy

The process of agricultural and rural transformation does not only imply increased levels of productivity and commercialization in agriculture, but also an increasing economic diversification driven by the rural non-farm economy. Research on the role of non-farm enterprises as engines of rural development, income growth, and poverty reduction has received considerable attention in the past decade (Haggblade et al., 2010).

The rural non-farm economy can play a crucial role for poverty reduction in poor agrarian countries, where rural households often face small amounts of land per capita and constrained credit opportunities, and labor is the most abundant asset (Baulch, 2011). In addition, the risk and uncertainty associated with agricultural income and the prices of agricultural products often make smallholders particularly vulnerable. Given the frequently low capital requirements in the non-farm economy, many farming households, either pushed out of agriculture by increasingly commercialized farming systems or choosing to diversify their incomes, turn towards the non-farm economy for employment (Haggblade et al., 2010).

Lanjouw (2007) argues that the contribution of the non-farm sector to poverty reduction largely depends on the question whether households were pushed into such activities due to a lack of alternative options in agriculture or whether they have been pulled away from their original occupations into the non-farm sector as a result of the potentially higher incomes offered. The participation of the poor in those subsectors of the non-farm economy that can be expected to function as pull mechanisms could serve as a source of upward mobility for the poor. In situations where households were pushed out of their traditional occupations or turn towards the non-farm sector as a safety net and diversification of income source to cope with risk and uncertainty, non-farm employment opportunities can be very important in preventing households from falling into poverty or

seeing their poverty status deteriorating. Such non-farm opportunities however function as a safety net in preventing household incomes from falling rather than as a driver of long-term upward mobility.

Theses distinct transmission channels are reflected in the empirical literature. In Brazil, Ferreira and Lanjouw (2001) find that diversifying into non-farm activities provides additional income for the poor and acts as a self-insurance tool against negative shocks. They argue that the key to an understanding of the link between the rural non-farm economy and poverty reduction is the heterogeneity of the sector. Higher-return activities seem to provide sufficient income to allow rural households with limited access to land to escape poverty altogether. Households with low levels of education and a high vulnerability to shocks tend to be concentrated in the less productive rural non-farm activities. The distinction is even more vivid in Lanjouw (2001), who finds that the poor segments of the population in El Salvador are engaged in non-farm activities that are associated with low levels of labor productivity but act as a safety net and diversification strategy. The non-poor however are engaged in productive non-farm activities which offer a higher upward mobility. Determinants of the participation in these non-farm activities are education, infrastructure, location and gender. Other evidence on this twofold dynamic in non-farm activities is provided by Kijima et al. (2006) and Lanjouw and Murgai (2009).

Another transmission channel between the rural non-farm economy and poverty reduction is through more indirect channels. Based on the interlinkages between the rural non-farm and farm sector, rising non-farm incomes could lead to rising demand for agricultural products produced by poor farmers or lead to new investments in agriculture, thereby stimulating agricultural productivity (Lanjouw, 2007).

In the case of Nigeria, Oseni and Winters (2009) examine the effect of participation in non-farm activities on crop expenses of farm households and find that participating in non-farm activities can relax the credit constraints facing farm households and reduce risk, thereby helping households improve farm production and smooth consumption over time. The results show that participation in non-farm activities by Nigerian farmers has a positive and significant effect on crop expenses and in particular on payments for hired labor and inorganic fertilizers. Their findings underline the significant interlinkages between the rural farm and non-farm economy. This is furthermore supported by research undertaken by Ruben and van den Berg (2001) and Foster and Rosenzweig (2004).

Nevertheless, poor households may also face significant entry barriers to participation in non-farm activities. It has been argued for several developing countries that non-farm activities require skilled labor or relatively high levels of education to be a permanent and reliable source of income and poverty reduction (Ruben and van den Berg, 2001; Cherdchuchai and Otsuka, 2006; Lanjouw and Murgai, 2009).

Summary

Our review of the literature on poverty dynamics and pathways out of poverty shows that household endowments, the return to those endowments and the vulnerability to shocks are crucial determinants of movements in and out of poverty. Furthermore, the potential economic returns, low labor requirements and absence of seasonality in cash cropping provides a lucrative pathway out of poverty for poor smallholders with a limited asset endowment and constrained credit opportunities. On other hand, the rural non-farm economy has shown to be a potential force in the rural transformation of developing economies. Higher-return activities with sufficient income foster upward mobility and potentially allow rural households with limited access to land escape poverty. Households with low levels of education and a high vulnerability to shocks tend to use less productive rural non-farm activities as a safety net to prevent a deterioration of household incomes in the face of shocks.

Our review of the literature furthermore identified two existing gaps in the current state of research. First of all, there is only scarce evidence on the long-term effect of cash cropping on poverty changes and observed income growth in rural areas. Secondly, studies on the dynamics of poverty have increasingly concentrated on empirical strategies based on discrete choice models and by this neglected the longer-term processes via which households change their relative rankings in the entire welfare distribution. Understanding how initial income conditions determine changes in income, as well as determining possible poverty traps that hamper poor in improving their ranking in the entire welfare distribution in the long run, is crucial in order to pinpoint the factors driving income growth and poverty reduction. Our unique household panel data set covering a time span of 12 years will address these two paucities and provide new empirical findings on the potential of cash crops for rural growth.

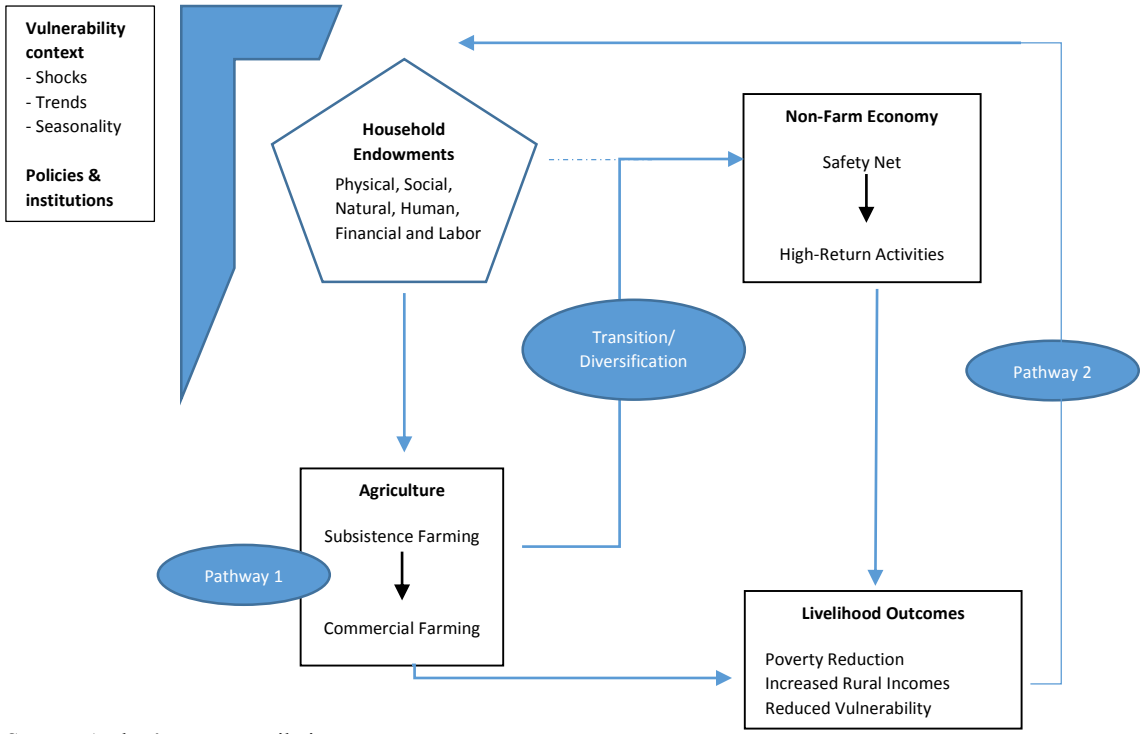
III Conceptual Framework for Pathways Out of Poverty

Having outlined the empirical evidence for the pathways out of rural poverty that accompany a country's structural transformation, we will now present a unified conceptual framework to guide us through the empirical analysis, illustrated in *Figure III.1*.

The first part of our paper will deal with the determinants of poverty and income growth. Based on the conceptual framework of poverty dynamics and economic mobility developed by Baulch and Hoddinott (2000), the household is endowed with capital and labor, where capital endowments can be categorized into physical capital (e.g. housing, agricultural tools), natural capital (e.g. land), human capital (e.g. education, skills), financial capital (e.g. savings, credits) and social capital (e.g. membership in networks or organizations). The labor endowments reflect the household's employment status in general or its ability to work in either of the agricultural or non-agricultural sectors in self-employment or wage employment.

These household endowments are allocated across income generating activities that are characterized by markedly different returns (Lanjouw, 2007; Klasen et al., 2013), and determine the pursuance of either or both of the two pathways out of poverty. One pathway takes place in the agricultural sector and describes the movement from low productivity, subsistence farming to high productivity, commercial cash crop farming. In this case, natural capital in the form of land or financial means to secure land might be important determinants of income growth. Based on our emphasis on the adoption of cash cropping, we classify farm households that derive most of their income from actively engaging in agricultural markets as commercial smallholders. Households that use the majority of their production for home consumption are classified as subsistence smallholders. This will give us an idea of the degree of agricultural commercialization in our household sample.

Figure III.1 **A Conceptual Framework of Pathways out of Poverty in the Rural Economy**



Source: Author's own compilation

The second pathway refers to increases in income based on engagement in the rural non-farm economy. There is a transition phase which describes the shift out of agriculture towards low-productivity, non-farm activities that serve a safety net function for vulnerable households. This transition phase could also be considered as a process towards the diversification of incomes and corresponds to the sectoral shift from agricultural to non-farm income generation activities as countries develop (McCulloch et al., 2007). As outlined, human capital will play a more important role in entering most higher-return activities (e.g., wage employment).

Since we only concentrate on the rural context of the rainforest margins, we will not consider rural-urban migration, which indicates a shift in the location of economic activity during structural transformation.

These transformative processes take place in a highly contextual setting and it is therefore crucial to consider the external environment. Adato and Meinzen-Dick (2002) describe this as the vulnerability context within which people operate. They argue that trends in population, resources and economic indicators; shocks such as natural disasters and economic changes; as well as seasonality in prices, agricultural production and

employment opportunities are influential in how people design their livelihood strategies. Positive and negative shocks affect both a household's endowments and the returns it receives from those endowments in the following period. The negative shocks can be seen as the drivers of chronic poverty, pulling households into poverty, while the positive shocks can be seen as the drivers that help households escape poverty (Baulch, 2011).

The initial conditions and household endowments together with the return to endowments in the respective activities generate livelihood outcomes, such as increased income, reduced vulnerability and a reduction in poverty.

Our analysis will begin with an investigation of livelihood outcomes and subsequently turn towards the determinants of poverty dynamics and income growth. This will provide the basis for our analysis of the drivers of poverty reduction via a sectoral decomposition of rural pathways out of poverty. Latter will give us an idea of the relative role of the farm and non-farm employment sectors and the respective livelihood strategies chosen.

IV Methods for Data Analysis

IV.1 Definition of Poverty and the Setting of Poverty Lines

The choice of poverty measures and poverty lines is for the most part arbitrary (Haughton and Khandker, 2009). Therefore, we will present a variety of poverty measures and poverty lines in order to control for the influence of choice on the observed poverty outcomes. We choose the two international poverty lines of 1 US$ and 2 US$ per day, using the World Bank PPP conversion factor, as well as the Indonesian national poverty line for rural areas provided by BPS (2014). Applying these poverty lines to our household income p.c., we observe an unrealistically high rate of poverty. After assessing the data of other studies in our sample region that are concerned with consumption expenditure (van Edig and Schwarze, 2011) as well as income (Klasen et al., 2013), we attribute this finding to a serious underreporting of income in our sample. This is not unusual as there are several measurement issues with respect to the reporting of income (see Chapter V.4). Henceforth we us the rural headcount index reported by the BPS (2014) to downscale the poverty lines with respect to our sample mean household per capita income. We use the poverty line calculated for year 2001 as our reference.

The poverty line serves as a cut-off value to address the extent, depth and severity of poverty and its observed changes over time. Because of its additive form, the poverty measures proposed by Foster et al. (1984) are routinely applied to relate the overall level of poverty to population subgroups. Each of the three poverty measures used our analysis is a member of the Foster-Greer-Thorbecke (FGT) class of measures Pα defined by

$$P_\alpha = \sum_{y_i<z} [(z - y_i)/z]^\alpha / n \qquad \text{(IV. 1)}$$

where y_i is the income or consumption of the i'th household or individual, z is the poverty line, n is the population size, and α is a non-negative parameter.

The **headcount index** (FGT_0) is obtained when α=0. It depicts the incidence of poverty by calculating the proportion of the population whose income is below a predefined poverty line. The **poverty gap** (FGT_1) is obtained when α=1 and calculates the mean aggregate

income shortfall relative to the poverty line across the whole population, by adding up all the shortfalls of the poor (the non-poor having a shortfall of zero) and dividing the total by the population. The **squared poverty gap (**FGT_2) is obtained when $\alpha=2$ and thereby includes the degree of inequality among poor households**.** It takes into account not only the gap separating the poor from the poverty line, but also the inequality among the poor by placing a higher weight on those households that are further away from the poverty line.

Whereas the headcount index is easy to construct and comprehensible, it has some major shortcomings. It violates the monotonicity and transfer axiom and thereby disregards the intensity and severity of poverty. Hence a transfer from a somewhat poor to a very poor household will not improve the measure of welfare, although one would suppose that overall poverty decreased (Haughton and Khandker, 2009). Furthermore, if all households below the poverty line became poorer, the headcount index would remain the same. It also ignores the distribution of poverty among the poor. This is crucial to assess whether the poorest households have benefitted from income transfers and caught up with poor households closer to the poverty line. While the poverty gap addresses the first weakness and satisfies the monotonicity axiom, it violates the transfer principle. This shortcoming is addressed by the squared poverty gap, which meets all of the mentioned axioms. The intuitive appeal of the headcount poverty measure still makes it a highly valuable measure and therefore serves as our primary reference measure. Based on our knowledge that this index does not satisfy certain axioms, we will also include the other measures to see whether the observed poverty changes are equally reflected by different poverty measures.

IV.2 Decomposition of Rural Growth and Poverty Reduction

IV.2.1 Growth, Inequality and Poverty Reduction

Our first decomposition technique will concentrate on the link between growth, inequality and poverty by decomposing changes in poverty into growth and redistribution components. Based on the work by Datt and Ravallion (1992), we decompose the poverty measure P_t at date t into a change in mean income relative to the poverty line and a change in relative inequalities L_t.

Formally, the poverty measure is described as:

$$P_t = P\left(z/\mu_{t,}L_t\right) \quad \text{(IV. 2)}$$

where z is the poverty line, μ is the mean income and L is a vector of parameters describing the Lorenz curve at date t. The change in the poverty measure is decomposed into

$$P_{t_n} - P_{t_0} = \underbrace{G\ \left(t_{0,}t_n;r\right)}_{\text{Growth effect}} + \underbrace{D\left(t_{0,}t_n;r\right)}_{\text{Redistribution effect}} + \underbrace{\varepsilon}_{\text{Residual}} \quad \text{(IV. 3)}$$

with $G\left(t_{0,}t_n;r\right) = P\left(\frac{z}{\mu_{t_n}}, L_r\right) - P\left(\frac{z}{\mu_{t_0}}, L_r\right)$

with $D\left(t_{0,}t_n;r\right) = P\left(\frac{z}{\mu_r}, L_{t_n}\right) - P\left(\frac{z}{\mu_r}, L_{t_0}\right)$

where t_0 is the initial year of the period, t_n is the final year of the period, and r is the reference year at which the welfare distribution and mean welfare are held fixed for the growth and redistribution components respectively.

The **growth component** represents the change in poverty attributable to changes in mean household income per capita when holding the relative distribution of the reference year constant. In other words, this is the change in poverty that would have occurred if everyone had experienced the same rate of growth and the distribution of income remained constant. This component will be negative if growth was positive, implying that equally distributed growth will always reduce poverty.

The **redistribution component** represents the change in poverty attributable to changes in the distribution curve, holding mean household income per capita constant. In other words, this is the change in poverty that would have occurred if the observed change in the shape of the household income per capita distribution curve had occurred without any shift in the mean of the curve. The redistribution component can either be positive or negative, depending on whether the distributional shifts have been against or in favor of the poor.

The **residual component** is also referred to as the interaction term, because it measures the effect of simultaneous changes in mean income and the Lorenz curve on poverty that cannot be solely accounted for by the other two components. The residual vanishes if mean income or the Lorenz curve remain unchanged over the selected time period.

IV.2.2 The Sectoral Decomposition of Poverty Reduction

We now turn to the sectoral decomposition introduced by Ravallion and Huppi (1991), which poses a suitable analytical tool to assess the structural factors underlying the observed changes in poverty. By quantifying the relative contributions of changes in poverty within sectors and changes in the distribution of households across the different sectors, we can make first predictions of the relative importance of the different sectors for welfare changes in our sample.

Ravallion and Huppi (1991) use the decomposable property of the Foster-Green-Thorbecke classes of poverty measures to assess how changes within socioeconomic subgroups and their weights in the population affect changes in poverty. They split the population into m subgroups with populations n_i (i=1,…..,m). This results in a subgroup poverty index, containing n persons for each subgroup i,

$$P_{\alpha i} = \frac{1}{n_i} \sum_{j=1}^{q_i} \left(\frac{g_{ij}}{z} \right)^{\alpha} \tag{IV. 4}$$

where $g_{ij} = z - y_{ij}$ is the poverty gap for the jth household in subgroup i. Depending on the choice of alpha, we obtain the subgroup measure of either the headcount, poverty gap or squared poverty gap index. Our poverty index is now a population-weighted mean of the subgroup poverty index $P_{\alpha i}$,

$$P_{\alpha} = \sum_{i=1}^{m} \frac{P_{\alpha i} n_i}{n} \tag{IV. 5}$$

where P_{α} is the poverty measure for the whole population and $P_{\alpha i}$ measures poverty in subgroup i, considering subgroup's i share or weight in the population.

Subsequently, Ravallion and Huppi (1991) derive the following formula to assess how intra-sectoral gains and population shifts contributed to changes in the aggregated poverty measures, i.e. the relative gains poor attained within specific sectors and the changes in the distribution of the population across these sectors,

$$(\text{IV}.6)\quad P_\alpha^{t'} - P_\alpha^t = \underbrace{\sum \left(P_{\alpha i}^{t'} - P_{\alpha i}^t\right) s_i^t}_{\text{Intra-sectoral effect}} + \underbrace{\sum \left(s_i^{t'} - s_i^t\right) P_{\alpha i}^t}_{\text{Population-shift effect}} + \underbrace{\sum \left(s_i^{t'} - s_i^t\right)\left(P_{\alpha i}^{t'} - P_{\alpha i}^t\right)}_{\text{Interaction effect}}$$

where $P_{\alpha i}^t$ again denotes measured poverty in sector or population subgroup *i* at time *t* with a corresponding population share s_i^t.

The first component, the **intra-sectoral effect**, measures the change in poverty attributable to changes in poverty rates within specific sectors or population subgroups, holding the population share in each sector or subgroup constant at the initial level. Hence, this component would measure the effect of a change in poverty rates in the crop agriculture sector on aggregate poverty, keeping the population share in the crop agriculture sector constant.

The second component, the **population-shift effect**, illustrates how changes in the distribution of the population across sectors contributed to changes in aggregate poverty. Changes in aggregate poverty could result from people shifting away from the crop agriculture sector towards non-farm employment sectors, e.g. presumably from a sector with high poverty incidence into a sector with lower poverty incidence.

The third component**, the interaction effect**, measures the change in aggregate poverty that is attributable to the correlation between population shifts and intra-sectoral changes in poverty. It thus reflects simultaneous poverty changes that are due to people shifting between sectors where poverty is falling or rising.

IV.3 A Dynamic Model of Long-Term Economic Mobility

Our focus now shifts to identifying the structural relationship between changes in income, poverty and its determinants. The techniques used so far do not enable us to establish a link between changes in income and fundamental economic variables such as education, location or demographics. The main feature of our panel data is that we can observe the same households over time, which entails several econometric advantages over cross-sectional data or pooled cross-sectional data. First of all, a major benefit of panel data is that it captures more variability and less collinearity among the variables than typical cross-

section or time-series data (Baltagi, 1998). Having repeated observations on the same households also allows us to control for certain unobserved heterogeneity such as ability, intelligence or motivation. It also allows us to determine the dynamics of household income. As our short review of the theories of cumulative advantage or poverty traps in Chapter II.1.2 suggested, household income is characterized by a certain dependence on its own past values and can thus be considered highly persistent. Thus, a high household income can result from a household-specific characteristic that generates high income, but it can also be a consequence of having a high past income (Cameron and Trivedi, 2005). The time dimension of our unique panel data set enables us to define an empirical growth model that allows for the dynamics of adjustment and relate the past levels of income and other household characteristics to current income growth. Essentially, we estimate a dynamic panel model that reflects in parts a micro-level growth equation (Deininger and Okidi, 2003; Fields et al., 2003a, 2003b; Dercon, 2004; Woolard and Klasen, 2005; Lawson et al., 2006).

In order to understand the determinants of incomes across households *i* (*i* = 1, . . . , N) and time *t* (*t* = 1, . . . , T), we adopt an econometric framework that links household per capita income (y_{it}) to a constant (δ) and a vector of different household endowments of physical, social, natural, human, financial and labor capital (X_{it}) observed in time period *t* (see *Appendix A.2* for selection of variables).

The econometric specification of our general log-linear static model is specified as follows:

$$\log(y_{it}) = \delta + X'_{it}\beta + u_{it} \qquad \text{(IV. 7)}$$

The sum of $u_{it} = \lambda_t + \mu_i + v_{it}$ is referred to as the composite error term, where λ_t is an unobserved time specific effect and μ_i denotes the unobservable, time-invariant individual-specific effect. This effect captures additional factors that influence incomes which are specific to each household such as ability or motivation. The remainder disturbance ν_{it} varies with individuals and time and can be thought of as the usual disturbance in the regression. A regression model that includes both individual and time fixed effects is also known as a two-way fixed effects (FE) model (Baltagi, 2008).

As outlined in the literature review of this paper, the analysis of poverty dynamics has struggled with several statistical challenges such as the loss in information using a binary

poverty measure. Furthermore, discrete choice models fail to control for the endogeneity of initial conditions of income. Endogeneity can seriously bias the estimation results and stems from three different sources: simultaneity, omitted variables and measurement bias (Woolridge, 2002). Whereas we have dealt with the possibility of measurement error during our data preparatory work and accounted for any outliers that might affect our results, the other two sources of endogeneity are addressed by the specification of our dynamic model and estimation method.

Our dynamic model is represented in the following equation:

$$\log(y_{it}) - \log(y_{it-1}) = \delta + \alpha \log(y_{it-1}) + X'_{it}\beta + u_{it} \qquad \text{(IV. 8)}$$

The dynamic panel model is characterized by the presence of the lagged income $\log(y_{it-1})$. Whereas the model thereby addresses the possible endogeneity arising through the omission of initial income, the inclusion of a lagged variable violates the assumption of strict exogeneity of the regressors, which poses that the regressors be uncorrelated with the error term in each time period (Woolridge, 2006). Since y_{it} is a function of v_i, y_{it-1} will also be a function of v_i and therefore be correlated with the error term. This renders the OLS estimator biased and inconsistent (Nickel, 1984). Baltagi (2005) shows that a dynamic panel data regression is characterized by two sources of persistence over time. Serial correlation due to the presence of a lagged dependent variable among the regressors and the presence of individual-specific effects characterizing the heterogeneity among the individuals. The consequence of a lagged dependent variable is that we can no longer apply panel estimation techniques most frequently used for static panel models such as equation IV.7, the fixed effects (FE) and the random effects (RE) estimators (Baltagi, 1998). We shortly outline the source of bias in both of these models and then turn towards our dynamic estimation method.

In a static model such as equation IV.7, the fixed effects specification (FE) helps to eliminate the effect of u_i on the other coefficients, thereby eliminates the endogeneity caused by unobserved hetereogeneity so as to achieve a higher consistency in estimation (Baltagi, 2005). This is done by time-demeaning the data, i.e. differencing the observations for the same individual. In a dynamic specification (equation IV.8), FE is no longer consistent. Consider the following FE estimation in our dynamic setting:

$$\log(y_{it}) - \log(\overline{y_{i.}}) = \alpha log(y_{i,t-1} - \overline{y_{i.-1}}) + \beta(X'_{it} - \overline{X'_{i.}}) + (v_{it} - \overline{v_{i.}}) \quad \text{(IV. 9)}$$

with $\overline{y_{i.-1}} = \sum_{t=2}^{T} y_{i,t-1}/(T-1)$. Using the FE estimator, $\log(y_{i,t-1} - \overline{y_{i.-1}})$ will still be correlated with $(v_{it} - \overline{v_{i.}})$ even if v_{it} is not serially correlated. This is because $y_{i,t-1}$ is correlated with $\overline{v_{i.}}$ based on the fact that the latter average contains v_{it-1}, which is correlated with $y_{i,t-1}$.

The RE estimator, on the other hand, is obtained by using the time-averages for both the dependent variable and regressors and then running a cross-sectional regression. In order to apply RE, quasi-demeaning is performed,

$$\log(y_{it}) - \lambda\overline{y_i} = \alpha\log(y_{i,t-1} - \lambda\overline{y_{i.,-1}}) + \delta(1-\lambda) + \beta(X'_{it} - \lambda\overline{X'_{i.}}) + (v_{it} - \lambda\overline{v_{i.}}) \quad \text{(IV. 10)}$$

where the overbar again denotes the time averages. Whereas the fixed effects estimator subtracts the time averages from the corresponding variable, the random effects transformation subtracts a fraction of that time average, where the fraction depends on the standard deviation of u_i and v_{it}, and the number of time periods, *t* (Woolridge, 2002). One advantage of RE transformation is that it allows for regressors that are constant over time. This is possible because RE assumes that the unobserved effect is uncorrelated with all regressors, whether the regressors are fixed over time or not. The RE estimator however is also biased in a dynamic panel data model (Baltagi, 2005). Similar to FE model, the bias results from the fact that $(y_{i,t-1} - \lambda\overline{y_{i.,-1}})$ will be correlated with the quasi-demeaned residuals $(v_{it} - \lambda\overline{v_{i.}})$.

A normal technique for dealing with variables that are correlated with the error term is to instrument them. Taking the first difference eliminates u_i, which is a possible source of bias in the OLS and RE estimator,

$$\log(y_{it}) - \log(y_{it-1}) = \alpha(\log(y_{i,t-1}) - \log(y_{i,t-2})) + \beta(X'_{it} - X'_{it-1}) + (v_{it} - v_{it-1}) \quad \text{(IV. 11)}$$

The difference $(y_{it-1} - y_{it-2})$ however is still correlated with the error term. Anderson and Hsiao (1982) overcome the problem of endogeneity and apply the instrumental variable method using the second lag of the dependent variable in levels y_{it-2}, which is correlated with $(y_{it-1} - y_{it-2})$ but uncorrelated with $(v_{it} - v_{it-1})$, whenever there is no serial correlation among the residuals. Whereas the Anderson-Hsiao estimates might be consistent, they do not take into account all moment restrictions. Moment restrictions define the covariance between the regressors and the error term and state that a proposed instrumental variable is correlated with the variable that is measured with error but uncorrelated with the dependent variable (Cameron and Trivedi, 2005). Moment restrictions are associated with a higher asymptotic efficiency. In the Anderson-Hsiao estimation however, the instruments are constant over time and do not vary between the different time periods.

Based on a generalized method of moments (GMM) procedure, the Arellano and Bond estimator (1991) proposes to include additional instruments subject to orthogonality conditions, which further specify the relation between the lagged values of y_{it} and the error term v_{it} for each time period. They try to solve the potential endogeneity of the first-differencing equation by using the lagged levels of the endogenous variables as instruments, based on the assumption that the error terms are not serially correlated and the lagged level of the endogenous variable is uncorrelated with future error terms. For t=3, the equation to be estimated is

$$(IV.12) \quad \log(y_{i3}) - \log(y_{i2}) = \alpha(\log(y_{i2}) - \log(y_{i1})) + \beta(X'_{i3} - X'_{i2}) + (v_{i3} - v_{i2})$$

In our case, log (y_{i1}) is a valid instrument, since it is highly correlated with (log(y_{i2})-log(y_{i1})) and not with (v_{i3}-v_{i2}) as long as the errors are not serially correlated (Baltagi, 2005). Furthermore, we have X'_{i2} and X'_{i1} available as instruments for $(X'_{i3} - X'_{i2})$. This is particularly important if we believe that one of our regressors in our set of household characteristics is believed to be endogenous and correlated with u_i. The potential for obtaining consistent parameter estimates even in the presence of endogenous regressors is a considerable strength of the GMM approach (Bond et al., 2001). The potentially endogenous regressors in our dynamic model are considered in Chapter VI.3.

The moment conditions of the differenced GMM estimator can be summarized as

$$E(Z_i' \Delta v_i) = 0 \quad \text{(IV. 13)}$$

Where Δv_i is the vector of errors for household *i* in the first differenced equation:

$$\Delta v_i = \begin{bmatrix} v_{i3} - v_{i2} \\ v_{i4} - v_{i3} \\ \\ v_{iT} - v_{iT-1} \end{bmatrix} = \begin{bmatrix} \Delta y_{i3} - \alpha \Delta y_{i2} \\ \Delta y_{i4} - \alpha \Delta y_{i3} \\ \\ \Delta y_{iT} - \alpha \Delta y_{iT-1} \end{bmatrix} \quad \text{(IV. 14)}$$

And Z_i is the optimal matrix of instruments for the dependent variable and regressors for household *i*,

$$Z_i = \begin{bmatrix} [y_{i1} X_{i1}' X_{i2}'] & 0 & 0 & 0 \\ 0 & [y_{i1} y_{i2} X_{i1}' X_{i2}' X_{i3}'] & 0 & 0 \\ 0 & \dots & 0 & [y_{i1} y_{i2}, \dots y_{iT-2}, X_{i1}' X_{i2}', \dots X_{iT-1}'] \end{bmatrix} \quad \text{(IV. 15)}$$

Bond et al. (2001) found that this differenced GMM estimator is subject to a downward finite sample bias, particularly when the number of time series observations is small, since the lagged levels of variables tend to serve as weak instruments for subsequent first-differences. Arellano and Bover (1995) and Blundell and Bond (1998) show that an extended system GMM estimator that uses lagged first-differences of y_{it} as instruments for the equations in levels, in addition to lagged levels of y_{it} as instruments for equations in first differences, is less biased and more precise compared to the differenced GMM estimator. This is particularly the case, when the number of time series observations is small and the series is persistent, as in our case. The additional moment conditions in levels in a system GMM framework are

$$E(u_{it} \Delta y_{it-1}) = E((\mu_i + v_{it}) \Delta y_{it-1} = 0 \quad \text{(IV. 16)}$$

$$E(u_{it} \Delta x_{it-1}) = E((\mu_i + v_{it}) \Delta x_{it-1} = 0 \quad \text{(IV. 17)}$$

Based on the fact that we only have three time periods, which meets the minimum required for the estimation of a system GMM estimator (Bond et al., 2001), and believe our household per capita income to be highly persistent, we consider the system GMM estimator to be the most suitable estimator for our dynamic model (IV.8).

V Data Description and Study Area

V.1 The Lore Lindu Region in Central Sulawesi, Indonesia

The Indonesian island of Sulawesi is located in the Wallacea biogeographic region, one of the world's biodiversity and endemism hotspots (Clough et al., 2010). The Lore Lindu region is part of the Indonesian province Central Sulawesi and is located south of Palu, the capital of Central Sulawesi. The area's altitude ranges between sea level to a height of 2700 meters and although average rainfall is around 2000 − 3000 mm per year, the region is periodically disturbed by ENSO (El Niño -Southern Oscillation) droughts (Kessler et al., 2005).

Figure V.1 **The Lore Lindu Sample Region**

Source: EFFORTS

The Lore Lindu region was declared a UNESCO Biosphere Reserve in 1977 and is characterized by a great diversity of ecosystems, including lowland forest, montane forest, monsoon forest and cloud forest (Maertens et al., 2006; UNESCO, 2010). The Biosphere Reserve consists of a core zone and a buffer zone, the latter being intended to serve as an area for sustainable land-uses (UNESCO, 2008). Since 1993, the core area of the Lore Lindu Biosphere Reserve constitutes the Lore Lindu National Park (LLNP), which is illustrated in *Figure V.1*. The region's centrally located Lore Lindu National Park forms one of the last and largest mountainous rainforests of Sulawesi. The National Park has a total area of 2,290 km2 and adjoins several Kecamantan (subdistricts) of Central Sulawesi, namely Sigibiromaru, Palolo, Lore Utara, Kulawi and Lore Tengah.

V.2 Land-Use Change in Sulawesi: The Role of Cocoa Cultivation

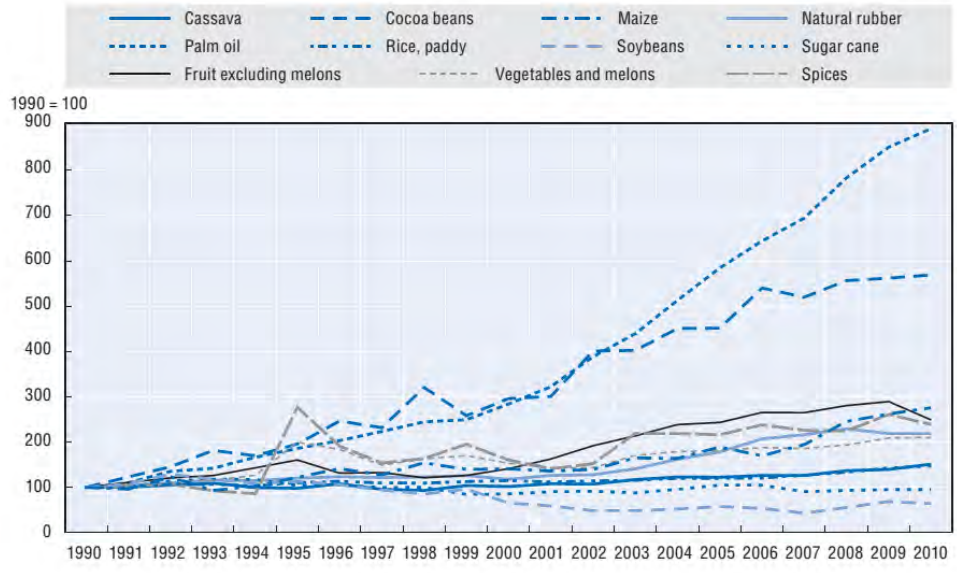
Since the mid-1980s, Indonesia experienced a surge in the production of its major cash crops, in particular cocoa. Indonesian farmers started to either cultivate cocoa on newly appropriated land or gradually shifted from coffee production into the production of cocoa as a response to the substantial decline in world coffee prices in the 1990s (Sunderlin et al., 2001). Following Côte d'Ivoire and Ghana, Indonesia has become the third largest cocoa producer with an estimated 450.000 tonnes and a world market share of around 9 percent (ICCO, 2012).

Figure V.2 shows the changes in crop production in Indonesia between 1990 and 2010. Palm oil and cocoa are the two crops that illustrate the biggest increases in production levels. Cocoa production increased by the factor of six over this time span, which underlines its importance as a causal factor of land-use change in Indonesia.

In addition to the favorable climate conditions of tropical countries, cocoa is especially attractive for subsistence farmers who want to diversify their income as part of a low risk and low cost strategy (Deheuvels et al., 2007). This is exemplified by the fact that around 90 percent of world cocoa production originates from smallholder farming (ICCO, 2012). Cocoa production on smallholder farms is usually limited to the extraction, selection, fermentation and drying of cocoa beans (Talbot, 2002). The sun-dried cocoa beans are then sold to local traders. Klasen et al. (2013) point out that the ready adoption of cocoa in Indonesia was fostered by the already prevailing knowledge on cocoa production and its

distribution channels in other parts of the country, which reduced the perceived risk of adopting a new crop variety.

Figure V.2 **Changes in Crop Production, Indonesia, 1990-2010**

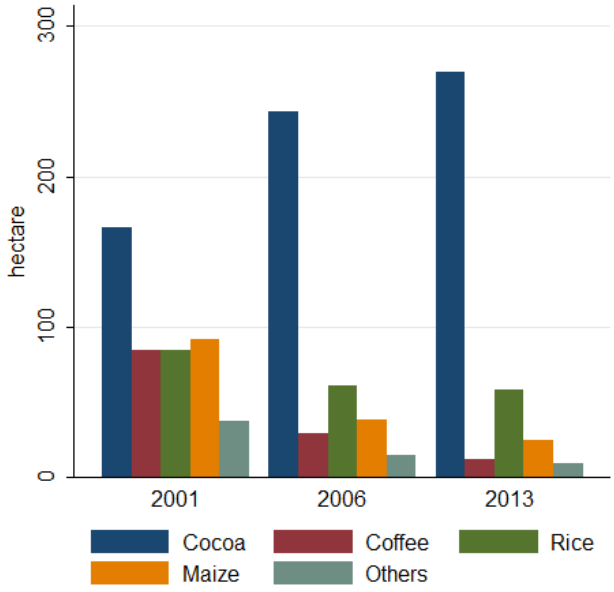


Source: OECD (2012)

Indonesia's cocoa boom soon led small-scale farmers in Central Sulawesi to adopt cocoa cultivation (Weber et al., 2007). The availability of land with high initial soil fertility, low levels of pests and abundance of pollinators provided forest rents which made it particular attractive to invest in cocoa cultivation (Clough et al., 2010). Upland farmers in Central Sulawesi began experimenting with cocoa beans starting in 1990. Farmers established cocoa agroforests on former forested land, which was often used for slash-and-burn agriculture, and by replacing coffee (Juhrbandt et al., 2010). After a second cocoa boom in 2001, Bugis people from the south of Sulawesi increasingly migrated to Central Sulawesi and concentrated their agricultural activities on cocoa production, which induced local farmers to rapidly adopt the new crop as well (Weber et al., 2007). Whereas most cocoa was grown under a diverse set of natural shade trees in the 1990s, more and more intensive land-use systems have been established with almost no shade trees (Reetz, 2008). Sulawesi is now responsible for around 75 percent of national cocoa production (COPAL, 2011). Besides its favorable climate, Sulawesi's competitive advantage is its productive capacity with 400 to 800 kg of fat cocoa beans/ha, low production costs (especially low

costs of labor) and an abundance of suitable land (Abbate, 2007). With a large share of the population in Lore Lindu living on less than 2 $ a day, cocoa cultivation has become an attractive option for income diversification and the main source of income for many smallholder families (van Edig, 2010).

Figure V.3 **Changes in Crop Areas in the Lore Lindu Region, 2001-2013**



Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

As *Figure V.3* reveals, there have been significant changes in land use in our sample region over the last 12 years, which reflects the developments in Indonesia as a whole. Cocoa production displays a sharp increase by 111 percent from 2001 to 2013, the acreage size used for cocoa plantation more than doubling from 185 ha to 390 ha. Besides cocoa plantations however, all other agricultural areas decrease in relative and absolute numbers over the complete survey period. Calculated on the basis of our sample, the total agricultural area in the Lore Lindu region is rather constant during the sample period. The agricultural area in 2001 is equal to 591 ha and more or less remains at this level in 2013 with 557 ha. Smallholder crop production increasingly shifted towards cocoa cultivation: In 2001, land used for cocoa plantations accounts for 31 percent of the total agricultural area, whereas in 2013 it already makes up 70 percent of the total agricultural area.

V.3 Sampling Method and Data Collection

The data was collected in 13 villages in the vicinity of the Lore Lindu National Park in rural Central Sulawesi, Indonesia. The Lore Lindu region has been the focus of the collaborative research centre STORMA (Stability of Rainforest Margins in Indonesia) between the years 2000 and 2009. It is subject of the ongoing collaborative research centre EFFORTS (Ecological and Socioeconomic Functions of Tropical Lowland Rainforest Transformation Systems, Indonesia) since 2012. The three household surveys conducted in 2001, 2006 and 2013 include information on agricultural and non-agricultural activities, assets, land holdings, demographics, and further socioeconomic characteristics of the household and individual household members. Each survey represents a random sample of households out of 13 villages, which in return were randomly chosen out of official village census data with 117 villages. For the selection of the villages, a stratified random sampling method was conducted based on the selection criteria, (1) proximity of village to Lore Lindu park, (2) population density of the village and (3) ethnic composition of the village population (see Zeller (2002) for a detailed description of the sampling method). The respective sample sizes per village are chosen proportionally to village size. In 2001, data from 321 households were obtained, from which 297 households could be re-interviewed in 2006 and 271 households in 2013. Additionally, several split-off households emerged in 2006 and 2013, which were tracked and added to the respective sample.

As Baulch (2011) points out there are few studies of poverty dynamics that include household splits and the empirical approaches to model such complex processes of household formation and dissolution are yet to be fully developed. Based on this finding and since our study is concerned with long-term income changes, we restrict the analysis to those households that were interviewed in all three rounds, which gives a total number of 271 households per round.

Studies dealing with panel data need to take into account potential sample attrition. It is not unlikely that some households might move away, drop out or otherwise attrite from the sample. If such attrition is not random, i.e. if those households that dropped out are systematically different from ones remaining in the sample, our data set of panel households is no longer representative of the original population. Hence sample attrition,

which is a form of sample-selection, can bias and threaten the validity of our results (Alderman et al., 2001). Based on a review of recent studies on poverty dynamics however, Baulch (2011) find that attrition does not seem to bias estimates of poverty dynamics from panel surveys too seriously.

In our case, the 50 households that dropped out represent an attrition rate of 15.5 percent, which is an acceptable magnitude taking other reviews of attrition into consideration (Alderman et al., 2001; Baulch, 2011). What matters however is whether the probability of attrition is systematically related to certain household characteristics. In our sample, we do not find significant differences between the characteristics of the households that dropped out and those that remained in the sample. We conclude that the results of our study are not subject to any serious attrition bias.

V.4 Construction of Variables for Data Analysis

A major part of this study was to clean and process the raw survey data and construct a panel data set from three separate surveys. Alongside the merging and harmonization of the three surveys, decisions were taken on the construction and selection of the relevant variables for our analysis.

First of all, we follow the welfarist approach (Sen, 1979) which approximates well-being by household utility. Our proxy for household utility is household income, which includes all agricultural and non-agricultural sources of income including private transfers/remittances, NGO or public transfers as well as forest products. One can consider these different sources of income as inputs into generating utlity. Given enough income, the household is assumed to know best how to utilize these resources (Haughton and Khandker, 2009).

The question whether to use household income or expenditure as a proxy for household utility is not without debate. The line of argumentation for using expenditure as a proxy for household welfare is that households exercise consumption smoothing and use savings or dissavings to deal with short-term fluctuations in incomes (Alderman and Paxson, 1994; Deaton, 1997). Hence expenditures are most often considered to be better measures of long-term welfare or the permanent income of a household. Furthermore, several measurement issues are connected to the reporting of household income. In the case of

poor households, typically self-employed in agriculture, income tends to be volatile (Woolard and Klasen, 2005). According to Haughton and Khandker (2009), people may forget sold items or money received. They might also be reluctant to reveal their income in its entirety or report illegal income sources. Also, the value of certain assets might be difficult to calculate over a longer period of time. For these reasons, households might be more willing and able to report what they spent in contrast to what they earned. Studies by Chaudhuri and Ravallion (1994) and Naga and Burgess (2001) however provide evidence that expenditure must not necessarily be a more superior measure of long-term welfare than income. Since our surveys do not include consistent data on household expenditure, data considerations alone and the focus of our study on sources of income changes necessitate us to use income.

A further point is how to adjust for household size. Fields et al. (2003b) argue that there is no consensus on the proper way to account for household economies of scale. We therefore report all our income data using the household per capita adjustment unless noted otherwise.

Whereas all other sources of income are mostly straightforward calculations, the construction of agricultural self-employment income entails certain assumptions. We not only want to take into account the value of crops produced and sold on the market, but also refer to total value of agricultural production including subsistence production intended for home consumption. We therefore compute an implicit income from agricultural production, multiplying the reported yields for each crop by the median village prices. Median village prices are used so as to minimize the presence of measurement errors in the price data (Klasen et al., 2013). Next, we subtract the costs of land preparation, irrigation, seeds, fertilizer, pesticide, hired labor, processing and transportation. Agricultural and non-agricultural wage incomes include payments in kind. Non-agricultural self-employed income is net of all business costs, including expenditures on raw materials and hired labor. For an overview of the selection of variables used in our analysis, see *Appendix A.2*.

VI Data Analysis and Results

VI.1 A Descriptive Assessment of Changes in Rural Poverty

VI.1.1 Overview of Changes in Poverty

We present a variety of prominent poverty measures and poverty lines that will give us a first overview of long-term income changes over the three survey periods in *Table VI.1*. The choice and construction of the poverty lines and measures is discussed in Chapter IV.1.

The US 1$/day poverty line shows that all poverty measures have roughly halved over the complete time span. The headcount index depicts a reduction in the incidence of poverty over the complete time period of 27.94 percentage points, from 63.14 percent to 35.2 percent. Its most pronounced reduction however can be observed for the period between 2006 and 2013, which generated a reduction in poverty of 18.94 percentage points. The depth and severity of poverty indicate the sharpest decrease between the years 2001 and 2006. For illustration, almost 74.89 percent of the overall decline in the severity of poverty is registered between 2001 and 2006.

Regarding the US 2 $/day poverty line, we observe that a large number of households report a per capita income below US 2 $/day, with more than half of all individuals in the sample disposing over less than US 2 $/day in 2013. Nevertheless, the changes in poverty reflect similar trends to what we observed for the US 1$/day poverty line. It is however notable that the reduction in the depth and severity of poverty is more evenly distributed over the two time periods.

Table VI.1 **Comparison of Poverty Measures for Three Poverty Lines from 2001-2013, N= 271**

	International poverty line of US 1 $/day			International poverty line of US 2 $/day			Indonesian national poverty line for rural areas		
	2001	2006	2013	2001	2006	2013	2001	2006	2013
Poverty Headcount (FGT_0)	63.14	54.14	35.20	84.25	77.92	59.34	67.12	59.17	37.30
Poverty Gap (FGT_1)	35.07	23.14	16.08	55.86	46.35	32.09	37.57	25.98	17.74
Squared Poverty Gap (FGT_2)	23.99	13.40	9.85	41.87	31.38	21.56	25.97	15.20	10.98

Notes: Currency conversion based on World Bank PPP conversion factor for private consumption (LCU per international $)
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

In sum, *Table VI.1* shows more prominent changes below the poverty line over the first time period, which is reflected in a stark decline in the depth and severity of poverty. The following time period is characterized by a conspicuous upward mobility with a significant number of households escaping poverty. Haughton and Khandker (2009) claim that if various measures of poverty tell the same story and are close substitutes for one another, it does not matter which measure one chooses. We argue that the headcount index presents a more informative illustration of poverty changes in our sample and captures the significant upward mobility over the second time period more closely, which correlates with our framework of rural growth and long-term economic mobility. Nevertheless, we will perform most analyses with several poverty measures for robustness checks.

In order to gain a first overview of these dynamic movements in and out of poverty within our sample, we compute (unconditional) transition probabilities for the US 1 and 2 $/day poverty lines, presented in *Table VI.2*. The transition matrix illustrates the absolute numbers of households in the different poverty groups and the probabilities of a change in the categorical variables of being extremely poor (US 1$/day), moderately poor (2 $/day) and non-poor for our two sample periods between 2001 and 2013. For instance, the probability of remaining extremely poor, moving out of extreme poverty into moderate poverty and escaping the status of extreme poverty are 56.36 percent, 26.06 percent and 17.58 percent respectively for the first period between 2001 and 2006. When one contrasts the observed transition probabilities for the first period with the second period between 2006 and 2013, the pattern of changes in poverty observed in the previous *Table VI.1* is reinforced. Whereas the first period is characterized by more chronic manifestations of poverty and a high probability for non-poor households to fall back into poverty, the second period denotes a much more dynamic upward mobility. The probability of poor households escaping either extreme or moderate poverty is much higher than for non-poor households to fall back into poverty. Moreover, the probability for moderately poor households to escape poverty completely is much higher than to remain moderately poor or fall back into extreme poverty.

These observations necessitate us to differentiate between the two time periods in our following analysis in order to obtain a representative insight into the drivers and determinants of pathways out of poverty in our sample.

Table VI.2 **Transition Probability Matrix for US 1 and 2 $/day PPP poverty lines, 2001-2013**

a) Period 2001-2006

	2006			
2001	Extreme Poverty (US 1$/day)	Moderate Poverty (US 2$/day)	Non-Poor	Total
Extreme Poverty (US 1$/day)	56.36	26.06	17.58	100
Moderate Poverty (US 2$/day)	57.63	20.34	22.03	100
Non-Poor	26.67	20	53.33	100
Total	51.67	23.79	24.54	100

b) Period 2006-2013

	2013			
2006	Extreme Poverty (US 1$/day)	Moderate Poverty (US 2$/day)	Non-Poor	Total
Extreme Poverty (US 1$/day)	43.61	26.32	30.08	100
Moderate Poverty (US 2$/day)	20.31	31.25	48.44	100
Non-Poor	11.48	14.75	73.77	100
Total	30.23	24.81	44.96	100

Notes: Currency conversion based on World Bank PPP conversion factor for private consumption (LCU per international $)
Source: Author's calculation based on STORMA and EFFORTS data

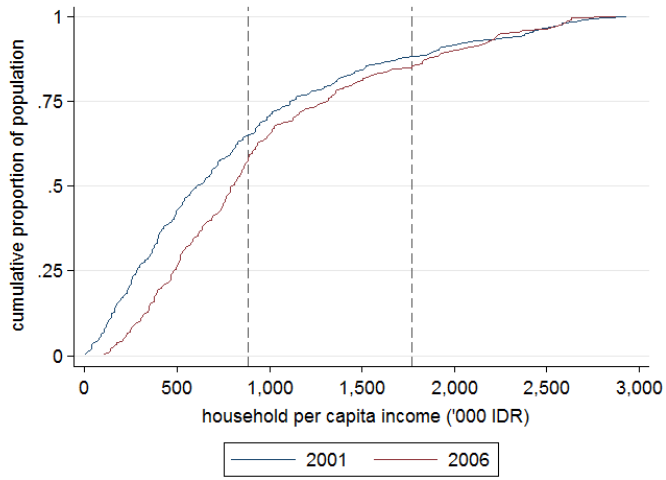
VI.1.2 The Influence of Poverty Lines

Ravallion's (1998) critical review of the setting of poverty lines points to the fact that the choice of poverty lines matters a great deal in poverty analysis and demands greater analytic scrutiny. In this respect, testing for stochastic dominance of any order has become a useful tool to study the influence of the setting of poverty lines.

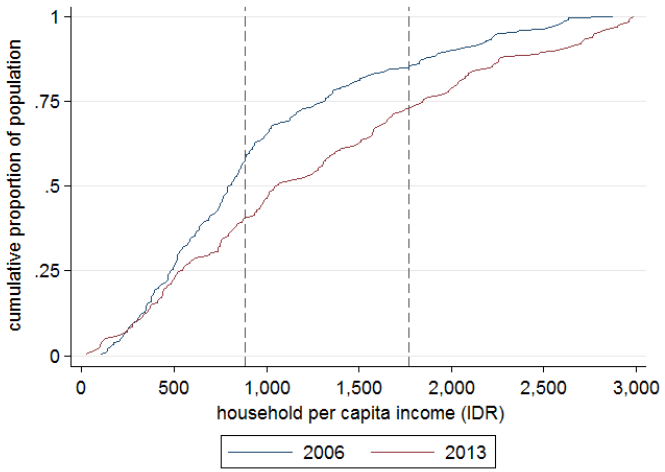
In line with Ravallion (1998), *Figure VI.1* plots the headcount index on the vertical axis and the poverty line on the horizontal axis, latter varying from zero to the highest possible poverty line. The resulting curve is a cumulative distribution function, which can be referred to as the poverty incidence curve and describes the proportion of the sample having less income than the designated poverty line on the horizontal axis. If the poverty incidence curve of the second year lies nowhere above and somewhere below the poverty incidence curve of the first, we have first-order stochastic dominance. This means that at any given poverty line on the horizontal axis, there are less poor households in the second year than in first year. Any social welfare function that is increasing in income will depict lower levels of poverty for the distribution of income in the second year than for the distribution of income in the first year (Haughton and Khandker, 2009).

Figure VI.1 **Transition Probability Matrix for US 1 and 2 $/day PPP poverty lines, 2001-2013**

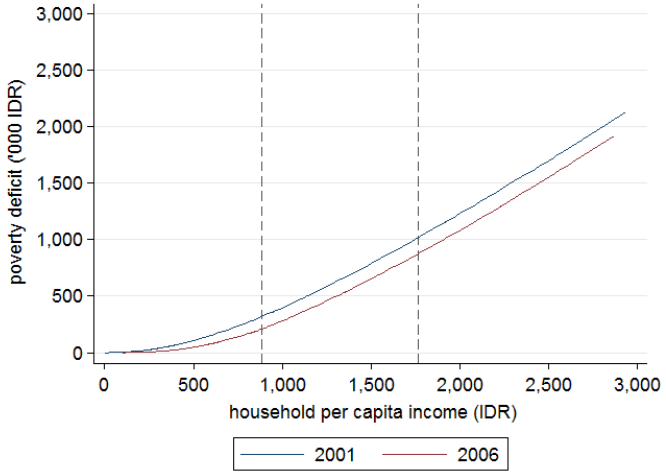
a) Poverty Incidence Curves, 2001 and 2006



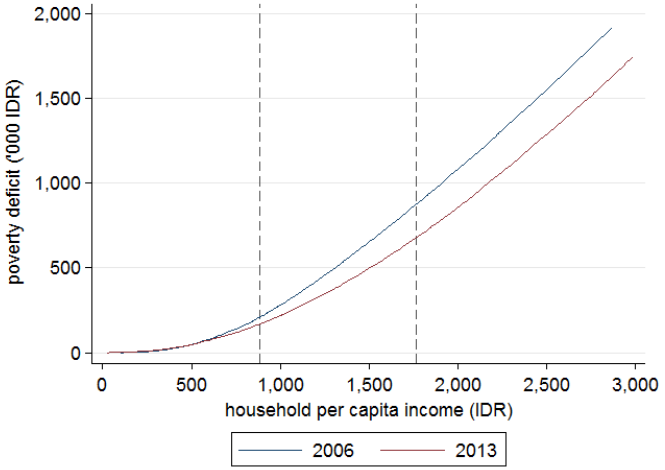
b) Poverty Incidence Curves, 2006 and 2013



c) Poverty Deficit Curves, 2001 and 2006



d) Poverty Deficit Curves, 2006 and 2013



Notes: Calculated using World Bank Poverty Analysis Toolkit (Michael M. Lokshin and Martin Ravallion, 2002-2004))
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

The top two graphs in *Figure VI.1* illustrate the poverty incidence curves for the years 2001 and 2006 and 2006 and 2013. We consider the US 2$/day poverty line to be the maximum poverty line in our sample, but plot all possible poverty lines until 3.000.000 IDR to check for robustness of our results. Nevertheless, all poverty lines above US 2$/day poverty are not considered to be relevant for the study of poverty in our sample.

The first graph shows that the poverty incidence curve for the year 2006 is below the 2001 poverty incidence curve for all possible poverty lines up to the maximum poverty line of US 2$/day. This confirms that we have first-order stochastic dominance in the relevant range of poverty lines. Nevertheless we observe that the 2006 curves exceeds the 2001 for poverty lines somewhat above 2.000.000 IDR. We undertake the same robustness check for the period between 2006 and 2013. The second graph shows more ambiguous result when testing for first-order stochastic dominance. The two poverty incidence curves cross below the US 1 $/day poverty line and hence we cannot safely assume that poverty has fallen irrespective of the poverty line applied.

We therefore test for second-order stochastic dominance by plotting the poverty deficit curves. One obtains the poverty deficit curve by calculating the area under the poverty incidence curve up to each point on the poverty incidence curve and plotting it against all possible poverty lines. The poverty deficit curve thereby traces out the total value of the poverty gap. We have second-order stochastic dominance if the sum of the poverty gaps is smaller in the second year than in the first. Hence the poverty deficit curve in the second year must be nowhere higher and at least somewhere lower than in the first year for any given poverty line to prove second-order stochastic dominance.

The two bottom graphs in *Figure VI.1* illustrate that we clearly have second-order stochastic dominance and therefore a moderately robust finding that poverty has fallen in both time periods irrespective of the poverty line used. Furthermore, separate tests for third-order stochastic dominance using the squared poverty gap confirms this finding. The following analysis will base its findings on the US 1$/day poverty line.

VI.1.3 The Rural Economy: Changes in Growth, Poverty and Inequality

Chapter VI.1.1 showed that the reduction in the depth and severity of poverty was most pronounced in the first time period, while the incidence of poverty had its greatest decline in the second time period. This raises questions about the link between growth, poverty and inequality. The evolution of inequality plays a crucial role in the assessment of pro-poor growth. Ravallion and Datt (1999) show that growth has a relatively small impact on poverty reduction in economies where the distribution of income is highly unequal. Kappel et al. (2005) furthermore point out, that changes in the distribution will make growth either more or less effective in reducing poverty. Hence, if only the upper segments of the distribution gain from growth and thereby increase the level of inequality, growth will not have any poverty reducing effect.

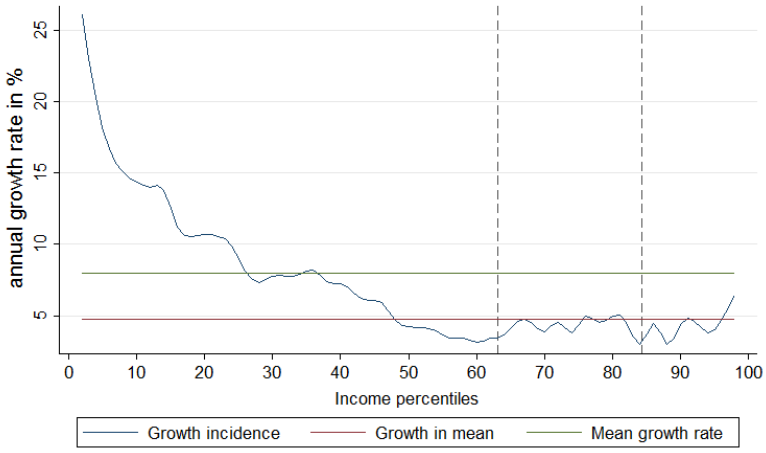
The growth incidence curve is a visual way to shed light on the distribution of household per-capita income growth rates and approximate the question whether mean income growth was especially pro-poor or not (Ravallion and Chen, 2003). We divide our sample into centiles based on household per capita income and then graph the percentage change in household per capita income for each centile.

The growth incidence curves in *Figure VI.2* for the periods 2001-2006 and 2006-2013 provide us with contrary images of which of the segments of the income distribution benefitted most from growth. In the first period, the lower percentiles of the population experienced considerably higher growth rates than the mean household. Whereas the household per capita income of the poorest 10 percent grew by an annual rate of almost 30 percent, the growth rate in the mean averaged 4.73 percent per year (see *Table VI.3)*. Furthermore, the richest 10 percent of households in our sample only grew at an annual rate of around 4.47 percent.

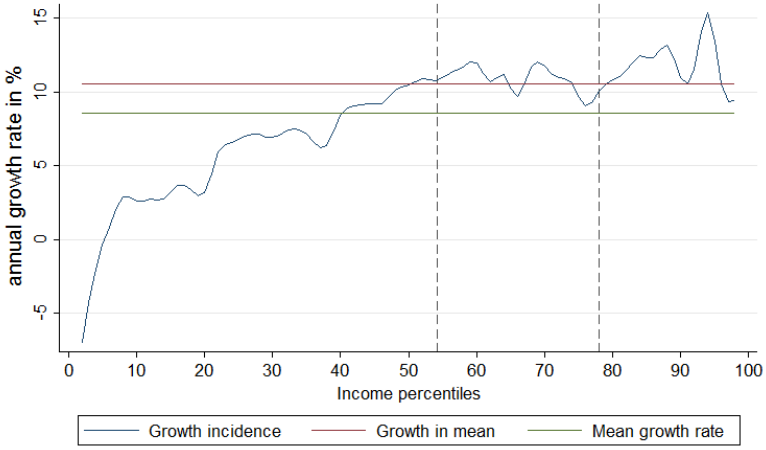
The mean growth rate in the following time period is considerably higher with 10.53 percent per year. Despite the high mean growth rate, the lowest percentile of the sample witnessed a negative mean growth rate of -0.5 percent. The highest growth rates are observed among the richest 10 percent of households with an annual rate of 14.87 percent. The poverty incidence curve for the whole period illustrates an average income growth of 7.59 percent per year. The highest growth rates can be found among households in the lowest and highest percentile of the income distribution.

Figure VI.2 Growth Incidence Curves, 2001-2013

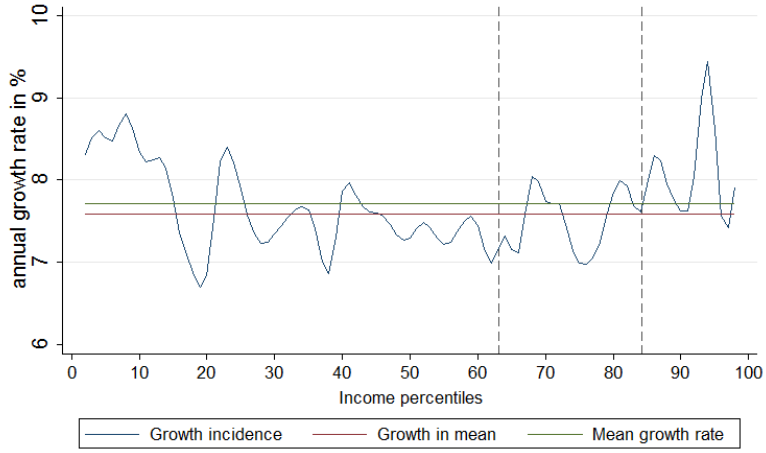
a) Growth Incidence Curve, 2001-2006



b) Growth Incidence Curve, 2006-2013



c) Growth Incidence Curve, 2001-2013



Notes: Calculated using World Bank Poverty Analysis Toolkit (Michael M. Lokshin and Martin Ravallion, 2007))
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

From the debate on whether growth is good for the poor and pro-poor growth can be considered a sufficient condition for poverty reduction, two definitions for measuring pro-poor growth emerged.

The absolute definition, popularized by Ravallion and Chen (2003), considers growth to be pro-poor if poor people benefit in absolute terms. Hence any positive change in mean growth rate of the poor, which is determined by both the rate of growth and its distributional pattern, is considered to be pro-poor. The relative definition of pro-poor growth takes into account the distributional shifts that accompany growth and argues that growth is pro-poor when growth in the incomes of the poor predominates growth in the incomes of the non-poor (McCulloch and Baulch, 1999; Kakwani and Pernia, 2000). Whereas both definitions entail certain merits and limitations, they essentially share the ultimate goal of maximizing the reduction of poverty and are not necessarily mutually exclusive but remind us that changes in the rate of growth of the poor might be reinforced or undermined by changes in inequality.

In order to assess whether growth was pro-poor or not, Ravallion and Chen (2003) proposed to measure the "rate of pro-poor growth", the mean growth rate of household per capita income experienced by the poor. It can be interpreted as the area under the growth incidence curve up to the initial headcount index on the horizontal axis. A positive rate of pro-poor growth indicates that growth has been pro-poor for those household segments whose income was below the poverty line in the initial year. In addition, if the rate of pro-poor growth exceeds the growth rate in the mean, we can conclude that distributional shifts in income were in favor of the poor, implying that they have benefited relatively more from growth than the rest of the population (Kappel et al., 2005). We observe pro-poor growth in absolute terms over all time periods *(Table VI.3)*. In our first time period, the rate of pro-poor growth equals 8.99 percent per year, which is clearly higher than the growth rate in the mean and therefore indicates that distributional shifts were also in favor of the poor. In line with our recent observations, the period between 2006 and 2013 provides the direct opposite picture. Even though we observe pro-poor growth, the distributional shifts clearly worked in favor of the non-poor households. Hence in relative terms, growth was only pro-poor between 2001 and 2006.

Table VI.3 **Annual Growth in Mean Income and Rate of Pro-Poor Growth, 2001-2013**

	2001-2006	2006-2013	2001-2013
Rate of pro-poor growth	8.99	5.63	7.52
Growth rate in mean	4.73	10.53	7.59
The lowest 10 %	29.98	-0.5	14.3
The lowest 20 %	20.26	2.08	12.43
The highest 20 %	4.26	15.65	11.96
The highest 10 %	4.47	14.87	11.67

Notes: Calculation of rate of pro-poor growth using World Bank Poverty Analysis Toolkit (Michael M. Lokshin and Martin Ravallion, 2007))
Source: Author's calculation based on STORMA and EFFORTS data

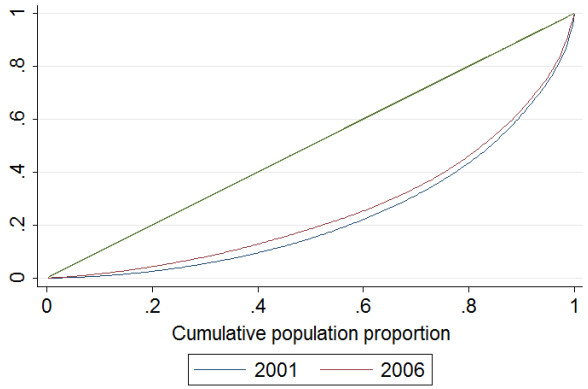
In order to assess the link between growth, inequality and poverty more closely, we decompose poverty changes into growth and inequality components (see Chapter IV.2.1 for theoretical background). *Figure VI.3* provides us with a first overview of the distributional changes in income over the two time periods and the complete time span. On the left hand side, we find the changing shapes in the Lorenz curve, whereas on the right hand side we present the kernel density estimates for the distribution of household income per capita at the beginning and end of the respective time periods.

The Lorenz curves reveal two contrasting changes in the distribution of income between 2001 and 2006 and between 2006 and 2013. In the former time period, poverty reduction is accompanied by a reduction in inequality. In fact, the Gini coefficient declined by almost 5 percentage points (see *Appendix A.1*). On the other hand, the stark reduction in the incidence of poverty over the second time period actually coincides with an increase in inequality and the Gini coefficient resumes its initial value. This poses an interesting setting for the analysis of pro-poor growth in our sample.

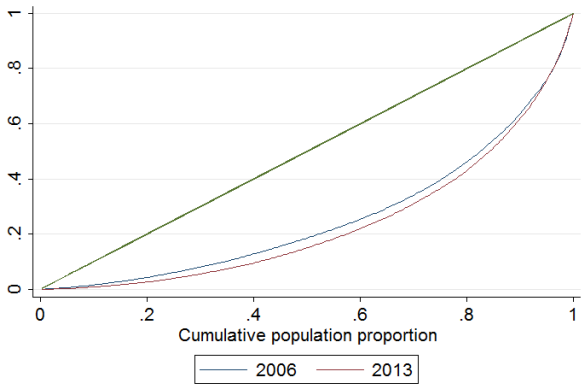
The kernel density estimates reveal a rightward shift of the entire distribution over the two time periods, which implies an increase in the median income. Whereas in 2001 and 2006 the kernel density curves locate the vast bulk of households below the US 1$/day poverty line, we observe that between 2006 and 2013 a shift has taken place with households moving into moderate poverty (US 2$/day) as well as out of poverty. The extremely right-skewed shape of the distributions points to the fact that only very few households are at a considerable distance from the poverty line. Even the majority of households that managed to escape poverty over the second time period remain at risk of falling back into poverty below the US 2 $/day line.

Figure VI.3 **Distribution of Yearly Household per Capita Income, 2001-2013**

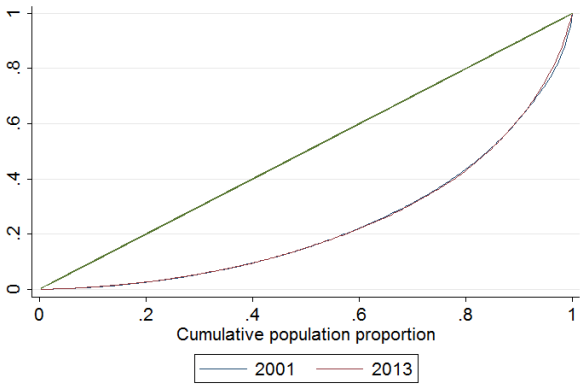
a) Lorenz Curves, 2001 and 2006



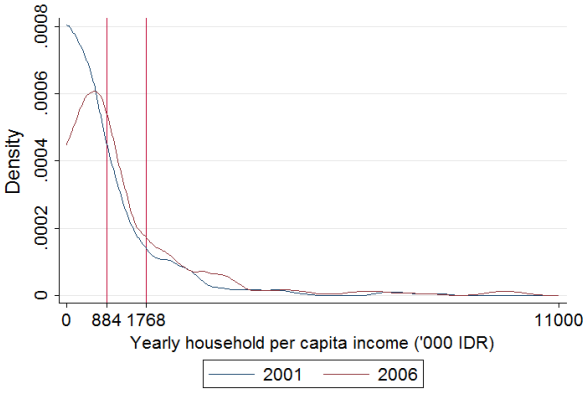
b) Lorenz Curves, 2006 and 2013



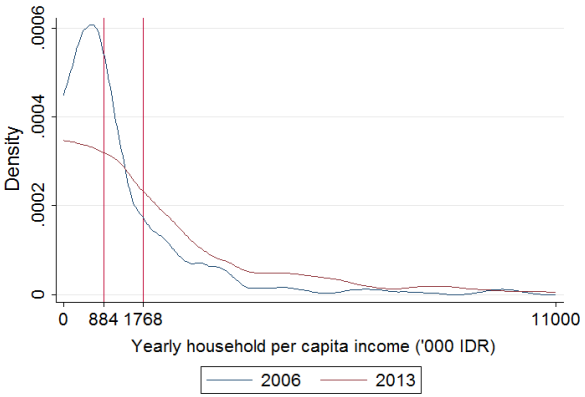
c) Lorenz Curves, 2001 and 2013



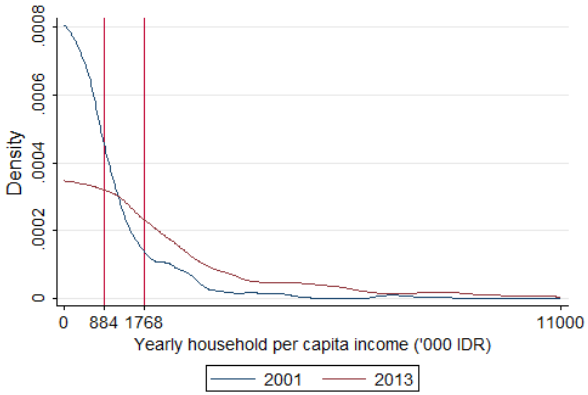
d) Income Density Functions, 2001-2006



e) Income Density Functions, 2006-2013



f) Income Density Functions, 2001-2013



Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

As in Datt and Ravallion (1992), we compute a growth-equity decomposition for the annual change in all three poverty measures to gain a broad understanding of the relationship between growth, inequality and poverty (see *Table VI.4*).

Between 2001 and 2006 the incidence of poverty decreased by an annual 1.63 percentage points. The growth component amounted to -1.97 points, implying that poverty would have decreased by more than it actually did had the distribution remained unchanged. The distributional component takes the value of 0.41, which suggests that distributional shifts in this period were against the poor. Yet, as the growth component clearly dominates the distributional component, poverty reduction achievements were only slightly hampered by increasing inequality. The picture looks different when one takes into account the measures for poverty depth and severity over the same time period, where annual poverty changes are more pronounced with -2.15 and -1.91 respectively. In both cases the growth and distributional components worked in favor of the poor, with redistribution accounting for 28.8 and 47.4 percent of the total change in the poverty depth and severity respectively.

Table VI.4 **Growth-Equity Decomposition of Annual Poverty Change, 2001-2013**

	Poverty Incidence		**Poverty Depth**		**Poverty Severity**	
	2001-2006	*2006-2013*	*2001-2006*	*2006-2013*	*2001-2006*	*2006-2013*
Poverty Change	-1.63	-3.49	-2.15	-1.10	-1.91	-0.46
Growth	-1.97	-4.88	-1.20	-2.15	-0.90	-1.28
Redistribution	0.41	-0.06	-0.62	0.95	-0.91	0.98
Residual	-0.07	1.44	-0.34	0.11	-0.11	-0.16

Notes: Figures are given as percentage points. Calculation of rate of pro-poor growth using World Bank Poverty Analysis Toolkit (Michael M. Lokshin and Martin Ravallion, 2006))
Source: Author's calculation based on STORMA and EFFORTS data

The period between 2006 and 2013 shows a strong decrease in the incidence of poverty by 3.49 percentage points. Again, the poverty incidence would have decreased by even more had the distribution remained unchanged, considering the -4.88 points of the growth component. Distributional shifts only show a negligible impact on changes in the poverty incidence. The depth and severity of poverty display only small reductions of -1.1 and -0.46. In both cases, the rate of reduction would have been at least twice as high if the distribution had remained unchanged. In both cases, the distributional component had a significant poverty increasing effect of close to one percentage point. Hence whereas the

poorest households in our sample benefitted from changes in inequality over the first time period, the second time period particularly favored the richer households.
The residual component varies considerably in size. It had a poverty-reducing effect over all poverty measures in the first time period but displays a high positive value in the second time period based on the poverty incidence, meaning it had a considerable mitigating effect on poverty reduction. However in most other cases the residual is small relative to the other two components. This is an indication that the decomposition is insensitive to a change of reference from the initial to the final year (Datt and Ravallion 1992), which is supported by our calculations using the final year as a robustness check.

Summary

In sum, our analysis of the relationship between growth, poverty and inequality shows that growth was pro-poor in absolute terms over all time periods. If we extend our notion of pro-poor growth and apply a relative definition however, the picture changes considerably. Our first period between 2001 and 2006 is characterized by a high rate of pro-poor growth which led to substantial reductions in the depth and severity of poverty. Redistributive shifts in the form of a fall in inequality particularly benefitted the poorest households in the sample, whereas income growth was clearly the dominant factor in the reduction of the incidence of poverty. Overall we can conclude that growth in this period can unambiguously be considered pro-poor both in absolute and relative terms.
The following period between 2006 and 2013 growth in mean income was twice as high as the rate of pro-poor growth. Especially the richest households in our sample experienced the largest increases in income. The distributional effects, in the form of an increase in inequality, were in favor of non-poor households and mitigated the effect of pro-poor growth on the poorest households. Nevertheless a high percentage of households below the poverty line escaped poverty, the incidence of poverty being reduced by 18.94 percentage points. We found that the second time period is characterized by a substantial upward mobility with less households falling back into poverty and more households escaping extreme and moderate poverty.

This gradual improvement in the situation of the poor households in our sample is best illustrated by our kernel density curves in *Figure VI.3*. Whereas the first period is characterized by a reduction in the depth and severity of poverty, meaning an improvement in incomes of extremely poor households, many poor households that were located just below the poverty line at the end of the first period managed to escape poverty in the following period. One must however keep in mind the vulnerability of households in poverty stricken areas such as our sample region. The majority of our household's incomes are located close to the US 1$/day and US 2$/day poverty lines.

Our analysis reveals the importance of an in-depth assessment of poverty to expose the partially offsetting forces of growth and redistribution as well as the different manifestations of poverty.

VI.2 Poverty Dynamics and Transitions

VI.2.1 Chronic and Transitory Poverty

The literature provides two main methods to measure the dynamics of poverty based on panel data, the spells and the components approach (Baulch, 2011). The spells approach identifies the chronic poor based on the number or length of poverty spells which they endure (McKay and Lawson, 2003). In this approach, all households are classified as either chronic poor, those who remained poor in all time periods, or transient poor, those who were poor in either one of the time periods.

The components approach differentiates between the permanent component of a household's income, i.e. the intertemporal average of a household's per capita poverty, and its transitory variations (Jalan and Ravallion, 2000). The chronic poor are those individuals whose permanent component is below the poverty line.

Bhatta and Sharma (2006) argue for the spells approach based on the fact that panel data often incorporates a relatively limited number of time periods and this could undermine the statistical accuracy of the intertemporal average of a poverty measure. Duclos et al. (2010) also point out that this can lead to substantial systematic differences between the sample estimates and the values of the true poverty measures. If one only has two waves of panel data, a household that is poor in at least one period could depict both transient and chronic poverty components according to the components approach. Based on our limited number of time periods, we apply the spells approach to assess the transient and chronic properties of poverty in our data set.

Table VI.5 gives us an overview of the transitory nature of poverty based on the spells approach. Almost 65 percent households experiencing either one or two spells of poverty confirms that the rural households in our sample experienced large swings in income. In comparison, only 15.32 percent remained in chronic and 19.68 percent out of poverty over the whole time period. This picture changes for the US 2$/day poverty line where chronic and transitory poverty have almost equal percentages with 44.08 per cent and 48.82 per cent respectively. Only 7.1 per cent of households had incomes consistently above the US 2$/day poverty line. The large majority remain highly vulnerable and face the risk of falling back into poverty. On the other hand, the transitory nature of poverty also entails

the opportunity to escape poverty within a short period of time. Our next chapter will deal with precisely this question and assess the determinants related to movements in and out of poverty.

Table VI.5 **Chronic and Transitory Poverty, 2001-2013**

Poverty Status	US 1$/day poverty line	US 2$/day poverty line
Chronic Poor	15.32	44.08
Transitory Poor (1 Spell)	34.25	18.68
Transitory Poor (2 Spells)	30.76	30.14
Never Poor	19.68	7.1
Total	100	100

Notes: Currency conversion based on World Bank PPP conversion factor for private consumption (LCU per international $)
Source: Author's calculation based on STORMA and EFFORTS data

VI.2.2 Determinants of Poverty Transitions

Having illustrated the transitory nature of poverty in our sample, we now want to relate these findings to our conceptual framework of pathways out of poverty and relate the dynamics of poverty to a variety of household endowments. Based on Nargis and Hossain (2006), we classify our panel households into the following four groups comparing their poverty status at the beginning and the end of the observation periods 2001-2006 and 2006-2013:

i. *movers* who were poor in 2001 (2006) and escaped poverty by 2006 (2013);
ii. *entrants* who were not poor in 2001 (2006) but fell into poverty by 2006 (2013);
iii. *chronic poor* who were poor in both 2001 (2006) and 2006 (2013);
iv. *never poor* who remained out of poverty in both 2001 (2006) and 2006 (2013).

The between group comparison of means across these four types of households will give an indication of the factors associated with chronic poverty, escaping poverty and falling back into poverty. Despite the fact that these statistics are only descriptive, they do point out some important trends within and differences between different categories of poverty. Furthermore, they provide an overview of the differences in initial conditions and changes over time for all poverty groups. The time periods are considered separately.
Table VI.6 provides us with the characteristics associated with poverty dynamics for the period 2001 to 2006.

Entrants of poverty initially had 22.3 percent less household per-capita income than never poor households but experienced a substantial drop in income of an annual 10.5 percent between 2001 and 2006. Movers and chronic poor households shared similar levels of initial household per-capita income, but movers managed to increase income by a striking 115.6 percent per year. It is to underline however that also chronic poor household experienced a significant increase of mean income (20 percent annually).

The demographic variables show that while movers and chronic poor households displayed a high similarity in the demographic composition of their households in 2001, the change in household size is conspicuous, with movers experiencing a decline in household size of almost 18 percent. Never poor households have the lowest initial household size and also experience a decline over time. Entrants and chronic poor households depict relatively high household sizes with only marginal changes over time. In contrast to chronic poor households and entrants, the demographic composition of movers and never poor households is characterized by considerably lower shares of children, with a large percentage of household members being in working age.

The human capital and labor endowment variables show that the overall level of education in our sample is considerably low with roughly a third of households in each group having a secondary or tertiary schooling degree. Never poor households is the group with the highest labor market experience and the only group with a notable share of tertiary schooling. While movers and entrants share relatively similar values for education, the number of chronic poor households with secondary schooling increased by 12 percentage points. This is another factor supporting the previously presented picture that extremely poor households became better off over this time period and managed to improve their livelihoods.

The only major difference between the initial labor endowments of the respective groups is that never poor households have a significantly lower share of unemployed household members. The change over time shows that movers and never poor households both maintain a positive ratio of employed over unemployed household members. The situation is very different for entrants and chronic poor households, where this ratio turns negative over time and the share of unemployed outweighs the share of employed household members. Hence for both groups this could likely have been an additional burden on household income.

In terms of natural capital, movers and chronic poor experienced an expansion of owned land and area cultivated with cocoa. Movers' landholdings and cocoa area increased by 11.2 and 40.9 percent respectively. Chronic poor households experienced a similar expansion of owned land as well as the cocoa area with increases of 7.8 and 44.3 percent. Hence the shift towards cocoa is highly notable in both groups. On the other hand, entrants faced a pronounced drop in the area owned and depict the lowest increase in cocoa area of all groups with only 11.9 percent. For never poor households it shows that the area allocated to cocoa cultivation has increased by 25.9 percent, contrary to the decline in the mean area owned. All households however depict an increasing share of owned land being directed towards the cultivation of cocoa.

The endowment with physical and financial capital mirrors the level of income of the respective groups. Never poor households are particularly well endowed with assets, have greater access to electricity and have the best access to credit in 2006. Chronic poor households on the other end have the lowest endowments in all of these categories. Movers were able to maintain their level of physical asset endowment in contrast to entrants, who experienced a substantial drop in the value of assets. Furthermore, movers depict a better access to credit in 2006 than entrants and chronic poor households.

Never poor households are well endowed with social capital but all poverty groups faced significant increases in social capital over time. It is particularly interesting to point out that chronic poor households were especially subject to negative income shocks with almost 50 percent reporting a crop failure in 2001. The share of chronic poor that experienced a crop failure between 2001 and 2006 however converged to levels observed for the other three categories. Hence the lower incidence of crop failure over time for chronic poor households might have played a role in their improvement of household income.

Table VI.6 Characteristics of Households by Poverty Transition Status, 2001-2006

Characteristics	Mover		Entrant		Chronic Poor		Never Poor	
	2001	2006	2001	2006	2001	2006	2001	2006
Income Sources								
HH income, p.c.	247,300	1,962,474	1,583,911	588,026	228,730	501,364	2,037,991	2,095,256
Demographics								
HH size	5.89	4.83	5.46	5.39	5.80	5.56	5.31	5.08
Share of children	0.28	0.26	0.28	0.35	0.31	0.33	0.21	0.26
Share of adults	0.68	0.69	0.68	0.60	0.64	0.63	0.76	0.71
Share of elderly	0.04	0.05	0.04	0.05	0.05	0.04	0.03	0.03
Human Capital and Labor								
Workforce Age	32.47	28.27	30.78	30.10	31.20	26.29	35.23	30.22
Max Education of HH is secondary school	0.29	0.29	0.30	0.33	0.18	0.30	0.25	0.15
Max Education of HH is tertiary schooling	0.01	0.00	0.00	0.00	0.00	0.00	0.05	0.08
Share of employed	0.38	0.33	0.38	0.28	0.37	0.24	0.38	0.31
Share of unemployed	0.33	0.26	0.31	0.34	0.35	0.34	0.28	0.26
Natural Capital								
Area owned	214.22	241.23	186.99	172.07	139.88	151.63	280.57	276.20
Cocoa area	67.35	113.89	74.84	84.98	29.53	52.96	91.74	123.81
Distance to next paved road	0.77	0.24	0.85	0.68	1.09	0.85	1.09	0.65
Physical Capital								
ln (value of assets)	3,782,424	3,094,211	5,203,598	1,979,563	1,125,952	961,940	8,655,186	7,846,522
Access to electricity	0.69	0.74	0.63	0.65	0.48	0.58	0.75	0.85
Financial Capital								
Access to formal credit	0.54	0.33	0.59	0.20	0.57	0.15	0.64	0.44
Social Capital								
Number of organisations the HH is a member of	1.89	2.32	1.76	2.37	1.84	2.51	2.05	2.76
Shocks								
Crop Failure	0.35	0.35	0.35	0.30	0.49	0.33	0.37	0.27
Illness/Accident	0.14	0.03	0.15	0.04	0.19	0.12	0.07	0.07
Number of observations	72	72	46	46	93	93	59	59

Notes: All monetary values are real Indonesian Rupiahs with base year 2001, using the provincial CPI for Palu provided by BPS. Incomes are yearly. Local land units are measured in *are*. One *are* is equal to 100 m2. See *Appendix A.2* for definition of variables.
Source: Author's calculation based on STORMA and EFFORTS data

The period between 2006 and 2013 (see *Table VI.7)* displays large increases in income among movers (147.6 percent/year) and never poor households (12.6 percent/year), but stagnating incomes for chronic poor households as well as a substantial decline in income for entrants of poverty (-13.5 percent/year). One must however note that the number of entrants and chronic poor households significantly declined compared to the period 2001-2006, whereas the number of never poor households rose considerably. Movers disposed over less than half the initial household per-capita income of chronic poor households.

The demographics again reflect the observations from the previous time period. Never poor households have the lowest household size, lowest share of children and highest share of adults. Movers portray the most substantial decline in household size. The demographic composition of movers and chronic poor households slowly converges towards the levels of never poor households, with declining shares of children, a large number of household members in working age and a growing share of elderly. Entrants do not depict any substantial changes, except a tendency towards an increasing share of children over time.

All households seem to converge towards similar levels of labor market experience. The overall level of education has not changed considerably compared to the previous period. Never poor households still have the highest share in tertiary schooling though movers and entrants both depict a small but increasing share of households with tertiary education as well. In contrast to the previous period where chronic poor households showed significant increases in education, the number of chronic poor households with secondary schooling declined by 7 percentage points. The labor market variables show similar trends over time with a substantial increase in the ratio of employed over unemployed household members. Movers and never poor households have the highest share of employed and lowest share of unemployed household members.

In terms of natural capital, all households experienced an expansion of owned land as well as an increasing area cultivated with cocoa except for entrants, who faced a reduction in cocoa area. Never poor households dispose over land that is more than 100 *are* larger than for entrants. Similarly, the area cultivated with cocoa is double the size of the cocoa area of entrants. The share of area allocated to cocoa decreased from 39.1 to 28.6 percent for entrants and increased slightly from 46.8 to 47.9 percent for never poor households. percent in 2006) for cocoa cultivation. Chronic poor households reduced their share of cocoa area from 33.3 to 30.5 percent.

Table VI.7 **Characteristics of Households by Poverty Transition Status, 2006-2013**

Characteristics	Mover		Entrant		Chronic Poor		Never Poor	
	2006	2013	2006	2013	2006	2013	2006	2013
Income Sources								
HH income, p.c.	215,874	2,128,128	2,418,914	456,576	493,860	479,091	2,305,006	4,052,233
Demographics								
HH size	5.55	4.99	4.80	6.30	5.57	5.83	4.97	4.61
Share of children	0.35	0.27	0.27	0.30	0.34	0.25	0.26	0.21
Share of adults	0.61	0.67	0.69	0.66	0.61	0.67	0.70	0.71
Share of elderly	0.04	0.06	0.04	0.04	0.05	0.08	0.04	0.08
Human Capital and Labor								
Workforce Age	25.71	37.77	32.18	39.88	29.19	36.35	28.60	40.16
Max Education of HH is secondary school	0.33	0.31	0.15	0.20	0.24	0.17	0.24	0.23
Max Education of HH is tertiary schooling	0.00	0.03	0.00	0.05	0.00	0.00	0.05	0.07
Share of employed	0.24	0.42	0.36	0.36	0.27	0.39	0.31	0.44
Share of unemployed	0.34	0.05	0.25	0.09	0.36	0.10	0.26	0.05
Natural Capital								
Area owned	168.98	192.30	154.33	172.78	152.70	177.89	275.47	304.92
Cocoa area	77.16	92.39	60.39	49.48	50.81	54.19	128.80	145.98
Distance to next paved road	1.00	0.65	0.04	0.19	0.60	0.99	0.49	0.83
Physical Capital								
ln (value of assets)	1,418,827	4,133,284	4,139,655	6,793,541	644,319	1,481,823	5,453,097	10,200,000
Access to electricity	0.61	0.89	0.60	0.90	0.57	0.84	0.82	0.97
Financial Capital								
Access to formal credit	0.17	0.24	0.30	0.25	0.16	0.03	0.40	0.30
Social Capital								
Number of organisations the HH is a member of	2.95	0.55	2.45	0.50	1.78	0.34	2.53	0.50
Shocks								
Crop Failure	0.31	0.21	0.20	0.10	0.34	0.28	0.33	0.26
Illness/Accident	0.07	0.20	0.05	0.15	0.12	0.10	0.05	0.20
Number of observations	75	75	20	20	58	58	111	111

Notes: All monetary values are real Indonesian Rupiahs with base year 2001, using the provincial CPI for Palu provided by BPS. Incomes are yearly. Local land units are measured in *are*. One *are* is equal to 100 m2. See *Appendix A.2* for definition of variables.
Source: Author's calculation based on STORMA and EFFORTS data

Hence never poor households allocated almost half of their owned land to cocoa cultivation. This is also observed for movers, who deploy 48.1 percent of owned land in 2013 (from 45.7 percent in 2006) for cocoa cultivation. Chronic poor households reduced their share of cocoa area from 33.3 to 30.5 percent.

All households experienced a substantial accumulation of assets between 2006 and 2013 and increasing access to electricity. Again never poor households have the highest number of households who accessed credits in both years, but an increasing number of movers also relied on credits. It is striking that chronic poor households faced significant barriers to the financial market with almost no credits being accessed at the end of the time period.

The change over time illustrates a substantial decline of memberships in organizations for all groups. Similarly, the incidence of crop failure does not differ substantially between the respective groups.

VI.2.3 Summary

The descriptive assessment of poverty dynamics and their socioeconomic determinants exemplified some characteristic features of movers, entrants, chronic poor and never poor households over both time periods. Whereas the chronic poor and movers were the source of growth in household per capita income between 2001 and 2006, the period between 2006 and 2013 significantly benefitted the movers and never poor households.

Movers are characterized by changes in demographics towards smaller households with a lower share of children. Furthermore they experience favorable changes in the labor market with a positive and increasing ratio of employed over unemployed household members. In comparison to chronic poor households trapped in poverty, they have higher initial levels of natural and physical capital, which both also depict positive changes over time.

The entrants of poverty are characterized by an initially high or increasing household size as well as an increase in the share of children. The period between 2001 and 2006 is dominated by a negative ratio of employed over unemployed household members with deteriorating natural and physical capital assets. The declining share of entrants having access to formal credit between 2001 and 2006 is a factor especially interesting in light of possible income shocks such as crop failure and unemployment that entrants might have faced.

Never poor households are small households, with low shares of children and a high share of adults with considerable labor market experience. They are furthermore more educated with higher shares of households having at least one household member with a completed tertiary education. They have favorable employment shares as well as high levels of physical and natural capital. In addition, they have better access to the credit market.

Chronic poor households on the other hand are large households, with a high share of children, and a low natural and physical capital endowment. Furthermore they comprise only few households with access to the credit market, especially at the end of the survey period in 2013.

Overall, we observe considerably low levels of education with only about one third of households in each group reporting a household member with a degree in secondary or tertiary schooling. We also observed a strong shift towards the cultivation of cocoa over all comparison groups between 2001 and 2006. This development is furthermore enhanced in the groups of movers and never poor households over the second time period, each allocating 48.1 and 47.9 percent of the total area to cocoa respectively. On the contrary, in 2013 the area cultivated with cocoa only constitutes 28.6 percent in the group of entrants and 30.5 percent in the group of chronic poor respectively. In addition, our descriptive comparison of household groups depicts a tendency towards the convergence of demographics and labor market experience across the complete sample.

VI.3 A Static and Dynamic Assessment of Rural Income Determinants

After studying the transitions of poverty, we now want to assess empirically the role of socioeconomic determinants in generating rural income growth over time. *Table VI.8* presents the results for the static (equation IV.7) and dynamic income regressions (equation IV.8). Former illustrate the determinants of household per capita income levels and the latter assess the determinants of household per capita income changes.

We observe large differences in the coefficients of the static estimators, some even having opposite signs. Because only the FE estimator controls for unobserved heterogeneity that is correlated with the regressors, the differences between the two estimates could suggest that unobserved heterogeneity is creating a bias in this sample. On the other hand, moving from FE to RE reduces the estimated standard errors for most regressors and provides more

precise estimates. To test whether the differences between the two estimates, either based on an omitted variable bias in RE or a measurement error bias in FE, are statistically significant and therefore systematic, we conduct a robust Hausman specification test according to Kaiser (2014). The attained p-value of 0.07 is above the 5 percent significance level and hence we have reason to maintain the null hypothesis that the difference in coefficients is not systematic. This would suggest that the RE estimator's assumption of no correlation between v_i and the regressors does hold. The higher precision and efficiency of the RE estimator and the importance of the between-household variation for our analysis, considering that we only have three time periods, furthermore speak in its favor. Several of our variables will depict only marginal within-variations over time and this might lead to biased estimates in the FE estimator (Klasen et al., 2013). Nickell (1981) shows that the FE estimator will be biased downwards and subject to efficiency problems in short panels such as ours. Hence, it is often a question of whether one assigns more weight to the efficiency of the RE model or the consistency of the FE model. We are willing to accept some degree of bias in the parameter estimates if it is accompanied by a sufficient gain in efficiency. Hence we prefer the random effects estimator which might be the better estimator in our context because it makes use of both, within- and between-household variation.

The signs of the coefficients in our static models are all as expected except for the social capital proxy and the share of adults in both estimators. The negative social capital coefficient actually reflects the fact that higher civic participation is associated with lower levels of income. Membership in one additional organization would lead to an income that is about 4.4 percent lower, ceteris paribus. Woolcock and Narayan (2000) for example show that social capital can also have negative aspects, placing non-economic claims on members' obligation and commitment. Group loyalties may be so strong that they isolate members from information about employment opportunities. Furthermore, networks also involve aspects of dependency and a loss of autonomy. Portes (1998) denominates the risk and liabilities of social networks as negative social capital, which requires investment of scarce resources such as time, energy or money. On the other hand, one could also suspect social networks to be endogenous to households' economic position because poor households rely on social support or access to more informal forms of insurance and credit. Omitting social capital from our regression however does not change our results.

Table VI.8 Determinants of Household per Capita Income and Income Growth, 2001-2013

	Income	Income	Income Growth
	(1)	(2)	(3)
Controls	FE	RE	System GMM
Initial Income			
Lagged HH per capita income			-1.191***
			(0.106)
Demographics			
Share of children	-1.130**	-0.552*	-0.825**
	(0.519)	(0.331)	(0.386)
Share of adults	-0.361	-0.165	-0.472
	(0.475)	(0.344)	(0.404)
Human Capital and Labor			
Workforce Age	-0.000964	0.000623	0.00452
	(0.004)	(0.003)	(0.003)
Max Education of HH is secondary school	0.239**	0.188**	0.0797
	(0.120)	(0.083)	(0.111)
Max Education of HH is tertiary schooling	0.0977	0.567***	0.577**
	(0.305)	(0.212)	(0.265)
Share of employed persons in HH	0.438*	0.343	0.399
	(0.252)	(0.214)	(0.263)
Share of unemployed persons in HH	-0.178	-0.317	-0.473
	(0.278)	(0.232)	(0.296)
Natural Capital			
Area owned	0.000213	0.000493***	0.000381*
	(0.000)	(0.000)	(0.000)
Distance to next paved road	-0.0230	0.0104	-0.000839
	(0.020)	(0.013)	(0.016)
Physical Capital			
log (value of assets)	0.102***	0.176***	0.108***
	(0.033)	(0.022)	(0.038)
Access to electricity	0.110	0.114	0.215*
	(0.124)	(0.095)	(0.127)
Financial Capital			
Access to formal credit	0.181**	0.209***	0.271*
	(0.086)	(0.070)	(0.147)
Social Capital			
Number of organisations the HH is a member of	-0.0453**	-0.0443***	-0.0421**
	(0.022)	(0.016)	(0.017)
Observations	792	792	251
R-squared	0.258		
Hansen test (*p*-value)			0.158

Notes: Income refers to yearly log household per capita income. All monetary values were included in real terms with base year 2001. Further controls include subdistrict and time dummies. A common intercept is included. Significance levels: ***/**/* denote 0.01, 0.05, and 0.1. Robust standard errors used. For further definition of variables see *Appendix A.2*.
Source: Author's calculation based on STORMA and EFFORTS data

The negative signs for the share of adults could be explained by the fact that the addition of an adult produces both positive and negative effects, depending on an individual's characteristics especially in terms of their economic capacity. Widyanti et al. (2009) point out that the addition of an adult in working age will have a positive effect on a household's per capita income through the additional earnings brought to the household. On the other hand, an additional household member will also increase the household's consumption needs. In our case, the burden on household income seems to exceed the earning capacity of an additional adult and therefore the net effects turns out negative. We will however not expand on this subject, since the share of adults does not yield a significant coefficient.

The demographic variables show the expected negative effect of an increase in the share of children on the level of income. The share of children is expressed in decimals, therefore a change of 0.1 (10 percent) in the share of children is associated with a level of income that is 5.52 percent lower.

The significantly strong education coefficients reflect the importance of education for rural incomes. Attaining a maximum level of education in secondary schooling is associated with a level of income that is 100[exp(0.188)-1] = 20.68 percent higher.

Tertiary schooling shows an even larger coefficient, leading to an income level that is (100[exp(0.567)-1] = 76.3 percent higher, ceteris paribus. This underlines the crucial importance of education for pathways out of poverty, which could either have a positive effect on agricultural productivity especially through the adoption of new technologies or improve households' access to rural non-farm employment. We observe statistically significant positive correlations between the level of income and natural, physical and financial capital. With respect to the effect of land ownership on household incomes, we find that owning land boosts income by 0.05 percent per are. Given that households had on average about 212.47 are under cultivation across 2001 and 2013, this effect implies that on average households were able to achieve approximately 10.6 percent higher incomes due to land ownership, holding everything else constant. If one were to increase the value of assets by 10 percent, we would expect incomes to increase by 1.8 percent, ceteris paribus. Furthermore, the access to credits also strongly relates to higher levels of income, boosting income by 100[exp(0.209)-1] = 23.24 percent.

Since our analysis is especially concerned with changes in income, based on our concept of rural growth, we turn to the dynamic empirical growth model defined by equation IV.8

in Chapter IV.3. The dynamic specification of our panel regression analysis relates the changes in income to our set of control variables and initial income. In addition, we address potential endogeneity issues that could be of concern for some of our regressors. The GMM specification allows us to include in addition the lagged differences as well as lagged levels as instruments for our potentially endogenous variables, such as initial income. Furthermore, we instrument the value of assets, land owned and access to credit with their lagged levels and differences since we believe that they could potentially be endogenous. The endogeneity stems from the bias created by simultaneity, when one or more regressors are jointly determined with the dependent variable (Woolridge, 2006). We believe that assets, land and credit might also be function of income, with income determining the value of household assets, the amount of land a household owns and whether a household has access to credits. Past endowments of assets and land as well as the access to credit however are believed to be exogenous to current levels or changes in income.

The system GMM shows that lagged income is statistically significant and has a negative coefficient, suggesting a tendency towards the convergence of household per capita incomes. Thus the lower the past household per capita income, the more likely the household is to experience an increase in welfare. This supports the results from the previous chapter, where we identified a dynamic upward mobility as well as a large number of households in transient poverty. A 10 percent higher initial income reduces income growth by almost 11.9 percent.

Among the household composition variables, we observe that the share of children still maintains its significantly negative coefficient, which is only slightly larger than in the RE estimator. Thus, we find a situation what one could describe as a demographic poverty trap in the sense that households with a large share of children are less likely to escape poverty (Woolard and Klasen, 2005). This confirms previous observations with respect to poverty dynamics. Reductions in household size and a lower share of children were largely characteristic of movers and never poor households with entrants and chronic poor households facing a particularly higher demographic burden.

Again we observe that tertiary education has a strong and significant effect on income growth, leading to an increase in income growth of 100[exp(0.577)-1] = 78.07 percent, ceteris paribus. The coefficient for secondary schooling no longer turns out significant.

Hence higher levels of education improves the upward mobility in our sample. This could represent evidence of a poverty trap associated with education (Woolard and Klasen, 2005). Similar to Deininger and Okidi (2003), we find that households' asset endowment in the form of education is a significant determinant of the growth performance and poses an additional hurdle for poor households to overcome.

The inclusion of dynamics into the model leads to slight changes in the size of the coefficients of our instrumented regressors and reduces the level of statistical significance of land and access to credit. This underlines the potential role of endogeneity in our static regression models.

We still find a positive impact of land on household per capita income. Given that land boosts income growth by 0.04 percent per are, this effect implies that on average households were able to achieve approximately 8.5 percent higher income growth due to land ownership, ceteris paribus. The instrumented value of assets only has a small effect on income growth with a 10 percent increase in the value of assets leading to a 1.11 percent increase in income growth.

The access to electricity strongly benefits income growth, yielding 100[exp(0.215)-1] = 23.99 percent higher income growth. Deininger and Okidi (2003) illustrate the fact that education needs to be complemented by access to other infrastructure such as electricity in order to become fully effective. The most direct link of infrastructure to income growth and poverty reduction is through its effect on agricultural and economic productivity, time budgets and opportunities for income generation. Access to electricity could raise the productivity and spread the development of private investments in productive activities (Khandker et al., 2008; Cook, 2011).

The access to credit plays an additional crucial role in the rural non-farm economy. The instrumented variable still shows a strong and significant coefficient with the access to credit being associated with an increase in income growth of 100[exp(0.271)-1] = 31.13 percent. Financial market imperfections, such as informational asymmetries, transactions costs, and contract enforcement costs, are especially detrimental to households in poverty who lack collateral, credit histories, and connections (Beck et al., 2005). Hence financial development may reduce poverty by relaxing credit constraints on the poor, improving the allocation of capital and accelerating growth. One must however keep in mind that there

are only few formal institutions providing credit in our study's research area and households mainly depend on informal money lenders (Nuryartono, 2005).
The vulnerability to economic shocks such as unemployment does not turn out to be a significant detriment to income growth and the level of income. This might well be a more characteristic determinant of short-run movements in and out of poverty. We also included other shocks such as crop failure and illness/accidents in our analysis but none of them turned out significant.

Summary

Our multivariate framework of economic mobility shows that households with a higher share of children, lower levels of education, and a poor natural, physical and financial asset base face the greatest difficulties in improving income. The level of education is by far the most important asset in our sample region and generated significantly higher income growth. Furthermore, the access to the financial market as well as infrastructural determinants such as the access to electricity determine a successful growth path. These could be considered to be essential complements to education, by creating a productive environment within which the potential of income growth is fully realized. Whereas these factors were strongly associated with higher income growth in the Lore Lindu region, they also represent a possible barrier to the upward mobility of extremely poor households with low levels of education and constrained access to credit and electricity, which furthermore aggravates their status of poverty. The share of children and the total area owned are further significant determinants of income growth.

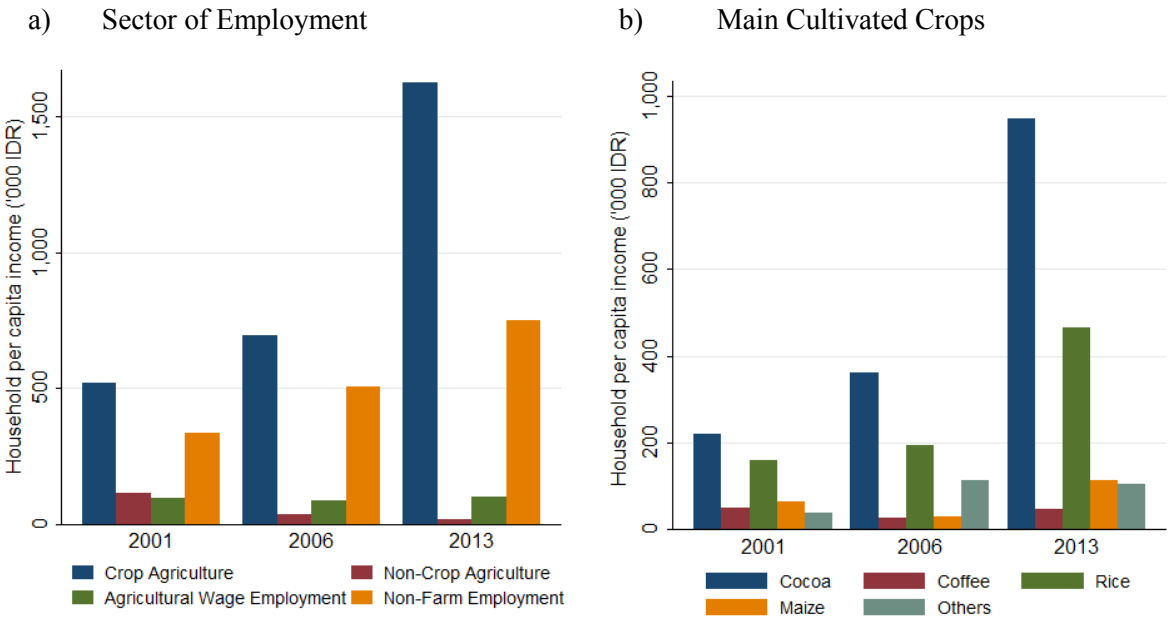
VI.4 The Sectoral Pattern of Rural Growth

While the previous chapter was concerned with the determinants of poverty dynamics and income growth, we will now turn towards the drivers of rural growth by relating the relative contributions of changes in poverty within sectors to changes in aggregate poverty. In line with our conceptual framework, we will divide our sample into sectors of employment to gain insight into the relative importance of the agricultural and non-agricultural pathways out of poverty. We will furthermore establish a link between the

determinants and drivers of rural growth by considering the sectoral pattern observed in each of the four poverty categories outlined in Chapter VI.2.2.

To gain an idea of the general sectoral trends in our region, *Figure VI.4* provides a first overview of the mean income derived from various sectors over time. Clearly, crop agriculture is the sector with the highest potential for rural growth. It is not only the most important household income source relative to all other sectors, increasing its share of mean household per capita income from 48.8 to 65.3 percent, but also experienced the highest increase over time with an annual growth of 35.7 percent. Non-crop agriculture and agricultural wage employment only represent marginal sources of income for our sample households. The income derived from the non-farm employment sectors grew by 20.9 percent annually. Hence we observe that in addition to crop agriculture, non-farm activities could also have played a significant role in poverty reduction.

Figure VI.4 **Mean Household per Capita Income by Sector of Employment and Main Cultivated Crops, 2001-2013**



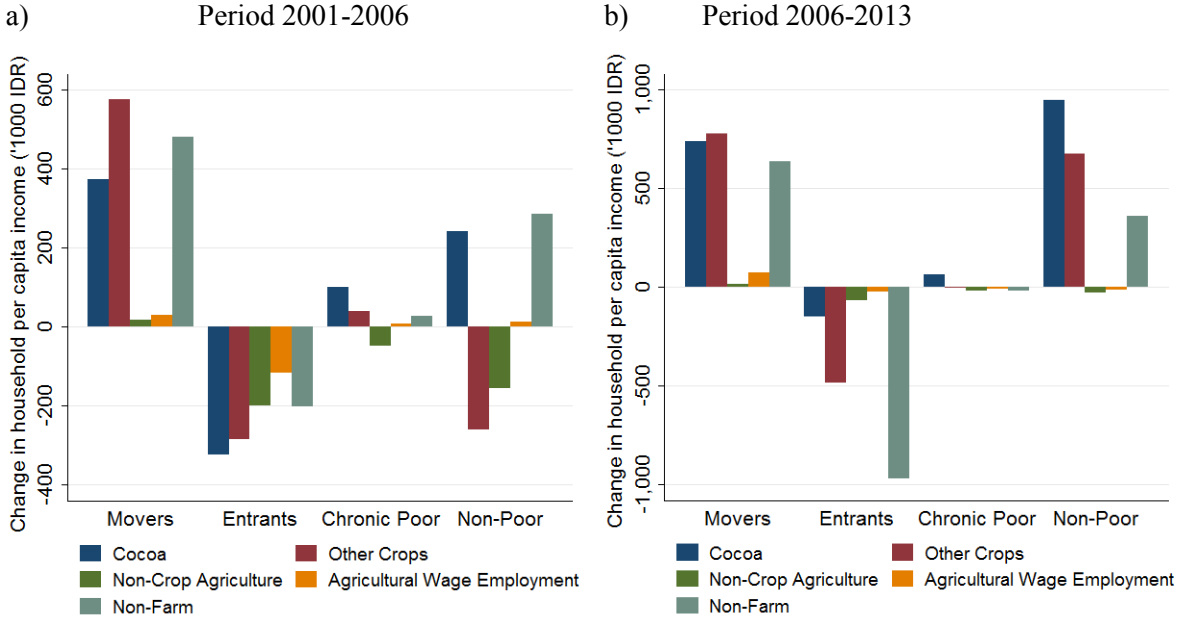
Notes: Monetary values are real Indonesian Rupiahs with base year 2001, using the provincial CPI for Palu provided by BPS. Incomes are yearly.
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

The income derived from crop agriculture is furthermore decomposed in the second graph of *Figure VI.4*, which depicts household per capita income derived from the four major crops in our sample region. We observe a large increase in cocoa income over time,

representing an annual growth of 55.5 percent. This led to an increasing gap between cocoa income and all other crop incomes. Rice, the second most important crop, also increased substantially (32.5 percent annually) but only generates roughly half of the income generated by cocoa cultivation. All others crops display only minor income changes in relative terms and did not contribute significantly to increases in income.

Figure VI.5 provides an overview of the mean changes in each of the income sectors across the different poverty groups. The figure shows that chronic poor households almost solely depended on agricultural sources of income between 2001 and 2006 with the largest share of income growth being derived from cocoa. Movers and never poor households display a more diversified portfolio of income generation. Whereas latter actually derives the majority of positive income changes from the non-farm sector followed by cocoa, movers derived 65 percent of income increases from crop agriculture, of which 26.3 percentage points originated in the cultivation of cocoa.

Figure VI.5 **Changes in Mean Household per Capita Income by Transition Status, 2001-2013**



Notes: Monetary values are real Indonesian Rupiahs with base year 2001, using the provincial CPI for Palu provided by BPS. Incomes are yearly.
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

Nevertheless, non-farm sources of income have played an almost equally important role for movers and again shows that both cocoa and the rural non-farm economy has played a factor in poverty reduction. For entrants, losses experienced in the cultivation of cocoa and other crops has led to significant reductions in income. Our data shows that these losses in cocoa are not due to crop failure or increases in agricultural costs but based on reductions in cocoa area and yield, which decreased by 24.4 and 68.4 percent respectively. This is the case for all households that witnessed losses in cocoa income between 2001 and 2006.

For the period between 2006 and 2013, we observe that crop agriculture paid the highest contribution to income increases for movers (70.1 percent) and never poor households (87.5 percent). Never poor households experienced substantial welfares increases based on cocoa cultivation (55.6 percent). Movers' increases in income is almost equally divided between the cultivation of cocoa (33.6 percent), the cultivation of other crops (36.5 percent) and non-farm employment (26.7 percent). The only positive change in income for chronic poor households originates in cocoa. Otherwise, all other sectors remain rather stagnant with even small declines. Entrants' reduction in income was especially driven by negative income changes in the non-farm sector, which our data reveals to be due to losses in sales in the non-farm self-employment sector as well as a reduction in the number of businesses per household.

We now relate the sectoral changes in income to the poverty reduction in our sample. *Table VI.9* provides a sectoral poverty profile and a decomposition into intra-sectoral, population-shift and interaction effects. In addition to the sectors of income, we will also provide a decomposition of population subgroups based on livelihood and crop strategies to render a more detailed description of the respective pathways chosen.

Income Sector

In order to account for the high degree of income diversification in our sample, all households were assigned the income sector which generated at least half of the household income. Household that derive income from several income sectors, where no sector earns more than half of household per capita income, are included the mixed sector employment category.

Table VI.9 Sectoral Decomposition of Poverty Changes, 2001-2013

	Population Share			Poverty Incidence			Intra-Sectoral Effect		Population-Shift Effect		Interaction Effect	
	2001	2006	2013	2001	2006	2013	'01-'06	'06-'13	'01-'06	'06-'13	'01-'06	'06-'13
Income Sector												
Farm Sector												
Cocoa	13.66	25.41	35.87	56.94	64.90	30.63	1.09	-8.71	6.69	6.79	0.94	-3.59
Rice	14.64	17.55	17.26	61.16	63.71	40.26	0.37	-4.12	1.78	-0.18	0.07	0.07
Other Crop Agriculture	16.73	9.34	7.92	68.75	60.61	33.96	-1.36	-2.49	-5.08	-0.86	0.60	0.38
Non-Crop Agriculture	10.39	1.20	0.37	59.75	82.35	0.00	2.35	-0.99	-5.49	-0.68	-2.08	0.68
Wage Employment	13.73	3.11	4.41	86.19	86.36	83.05	0.02	-0.10	-9.15	1.12	-0.02	-0.04
Non-Farm Sector												
Self-Employment	5.23	4.88	4.86	41.25	15.94	21.54	-1.32	0.27	-0.14	0.00	0.09	0.00
Wage Employment	11.37	11.18	11.29	38.51	22.15	26.49	-1.86	0.49	-0.07	0.02	0.03	0.00
Diversification												
Mixed Sector Employment	14.25	27.32	18.01	72.48	50.78	38.17	-3.09	-3.44	9.47	-4.73	-2.84	1.17
Total Effect							-3.80	-19.09	-1.99	1.48	-3.20	-1.33
Livelihood Strategy												
Cocoa Agriculture												
Specialized	4.18	19.89	14.87	45.31	58.01	25.13	0.53	-6.54	7.12	-2.91	1.99	1.65
In combination with…												
Farm Work	6.34	12.46	15.55	72.16	73.30	42.79	0.07	-3.80	4.41	2.26	0.07	-0.94
Non-Farm Work	6.27	14.30	19.36	42.71	24.26	20.85	-1.16	-0.49	3.43	1.23	-1.48	-0.17
Farm and Non-Farm Work	1.31	6.86	5.01	60.00	59.79	44.78	0.00	-1.03	3.33	-1.11	-0.01	0.28
Other Crop Agriculture												
Commercial Rice	5.03	1.20	4.86	81.82	64.71	46.15	-0.86	-0.22	-3.13	2.36	0.66	-0.68
Commercial Other Crops	11.31	6.65	5.16	86.13	70.21	57.97	-1.80	-0.81	-4.01	-1.05	0.74	0.18
Subsistence	15.16	6.02	4.78	55.60	65.88	25.00	1.56	-2.46	-5.09	-0.81	-0.94	0.50
In combination with…												
Farm Work	18.89	8.99	8.00	77.85	77.17	43.93	-0.13	-2.99	-7.71	-0.76	0.07	0.33
Non-Farm Work	17.39	11.04	12.78	42.11	29.49	32.75	-2.19	0.36	-2.67	0.51	0.80	0.06
Farm and Non-Farm Work	7.45	3.89	2.54	56.14	32.73	20.59	-1.74	-0.47	-2.00	-0.44	0.83	0.16
No Crop Agriculture												
Pure Laborer	6.67	8.70	7.10	70.59	57.72	54.74	-0.86	-0.26	1.44	-0.93	-0.26	0.05
Total Effect							-6.59	-18.71	-4.88	-1.64	2.47	1.42

Notes: Calculated using DASP (Distributive Analysis Stata Package) developed by Araar Abdelkrim and Jean-Yves Duclos (2007). Households are grouped into income sectors according to their principal activity (more than 50% of income from this sector). Households who do not earn income of more than 50% in any of the income sectors are grouped into the mixed category. Differentiation between cocoa and other households is based on the share of cocoa area in the total crop area (more than 50 % of crop area is cultivated with cocoa). Differentiation between commercial and subsistence households is based on the share of crop production sold on the market (more than 50 % of crop production is sold).
Source: Author's calculation based on STORMA and EFFORTS data

Crop agriculture is by far the most important sector in our sample region and increased its population share by 16.03 percentage points from 2001 to 2013, incorporating 61.06 percent of sample households in 2013. This increase in households employed in crop agriculture is largely due to an increasing number of households concentrating in cocoa cultivation over both time periods. Whereas in 2001, 13.66 percent of households derived the majority of their income from cocoa, this number increased up to 35.87 percent in 2013. Thus there is a tendency towards an increasing dependence on cocoa income. Whereas the share of non-farm employment sectors remained fairly constant over time, the increase in households cultivating cocoa largely originates in the declining population shares of other crop agriculture (-7.39 percentage points), non-crop agriculture (-9.19 percentage points) and agricultural wage employment (-10.61 percentage points) between 2001 and 2006 as well as the mixed sector income (-9.31 percentage points) between 2006 and 2013.

The poverty incidence in all crop agriculture categories decreased by over 20 percentage points between 2001 and 2013. Households dependent on agricultural wage employment are the poorest households in our sample but also represent one of the lowest shares of the population sample. The non-farm employment sectors accommodate the group of households with the lowest incidence of poverty.

Between 2001 and 2006, the overall reduction in poverty is almost equally divided between the intra-sectoral , population-shift and interaction effects with -3.8, -1.99 and -3.2 percentage points respectively. Mixed sector employment (-3.09 percentage points) as well as the two non-farm sectors (-3.18 percentage points) contributed most to poverty reduction, which is however partly mitigated by the increase in poverty within non-crop agriculture and cocoa.

The simultaenous changes in poverty and the distribution of households across the different crops played a considerable role. By moving out of other crop agriculture and agricultural wage employment, households moved out of sectors with a high poverty incidence. Furthermore, households shifted away from non-crop agriculture where poverty was rising over time. The population shift away from these sectors had a strong poverty-reducing effect and is reflected in the negative signs of the population-shift effect as well as a strong negative interaction effect, resulting from the fact that households moved out of sectors with a high poverty incidence and/or rising poverty into the mixed sector

employment where poverty was falling and cocoa cultivation where the initial incidence of poverty was lower. Overall we can observe that households increasingly shifted towards cocoa cultivation and mixed sector employment. This shift, together with the poverty-reducing effect of non-farm employment and mixed sector employment, played a major role in the reduction of poverty between 2001 and 2006. Performing the sectoral decomposition of poverty reduction based on the poverty gap and squared poverty gap index, does not a have a significant impact on our results with respect to cocoa but shows that other crop agriculture combined with farm work is more relevant in the context of reducing the gap towards the non-poor households as well as the inequality among the poor households.

The picture changes drastically over the second time period. We observe that the population-shift and interaction effects declined to a negligible level compared to the overall intra-sectoral effect, hence shifts between sectors with different levels of poverty do not explain the vast reduction of poverty over this time period. The majority of poverty reduction originated within crop agriculture. Keeping the distribution of income constant, the reduction of poverty within crop agriculture contributed 80.2 percent to the overall reduction in poverty with cocoa cultivation alone contributing 45.6 percent. The population-shift and interaction effects are clearly dominated by the substantial poverty reduction within cocoa and the cultivation of other crops.

Livelihood Strategies

Whether households combine different income generating activities or concentrate on solely one activity is closely interlinked with the concept of pathways out of poverty and allows us to narrow down the sources of poverty reduction in greater detail. Cocoa households are those households in our sample that cultivate more than half of their crop area with cocoa. These households are further decomposed into cocoa households, whos only income source is crop agriculture and specialized into cultivating cocoa, and diversified cocoa households that in addition derive income from other sectors of employment. Similarly, the households active in other crop agriculture as their only income source are decomposed into commercial farmers, who sell more than half of their produced crops, and subsistence farmers. Finally, the pure laborers are households that do

not derive any income from farming and are solely active in agricultural wage or non-farm employment.

There are several prominent changes in the population shares of the livelihood strategies that one needs to take into account.

Firstly, we observe a major shift towards cocoa-based livelihood strategies with 54.78 percent of farming households allocating more than half of their crop area to cocoa. Cocoa is also the most important commercial crop among pure farmers. The low share of households in commercial rice in contrast to the significant growth in the production of rice over time (see *Figure VI.4*) shows that rice is largely grown for own consumption. Secondly, the percentage of pure farming households that solely rely on subsistence production dropped substantially, especially between 2001 and 2006.

Thirdly, the rural non-farm economy has significantly grown in importance. Whereas the shares of households combining farming with either farm work or non-farm work were relatively equal in 2001, we observe that farmers increasingly turned towards non-farm employment as a supplementary income source. Fourth, there is a high degree of diversification in our household sample with 63.23 percent of households combining farming with another or several other sectors of employment.

All livelihood strategies depict a stark decline in the poverty headcount index, converging to more similar levels of poverty at the end of the time period. Households that depend on specialized cocoa or on farming combined with non-farm employment have historically been the groups with the lowest poverty incidence. The highest incidence of poverty can be found among farmers who were also employed on other farms, pure laborers, and commercial farmers that did not cultivate cocoa.

Between 2001 and 2006, the size of the intra-sectoral, population-shift and interaction effects are all of considerable magnitude, with -6.59, -4.88 and 2.47 percentage points respectively. We observe that farmers employed in the non-farm economy contributed almost half of the intra-sectoral reduction in poverty. Furthermore, we observe that non-cocoa farmers actually made the highest contributions to poverty reduction between 2001 and 2006. This is in line with our previous observations related to *Figure VI.5*, where we noted that movers indeed experienced significant increases in cocoa income but these were largely overturned by losses in the cocoa income of entrants. The population-shift effect is clearly dominated by the shift of households towards cocoa agriculture and contributed

significantly to poverty reduction over this time period. The overall negative population-shift effect indicates that households generally moved away from sectors with higher initial poverty into sectors with lower poverty incidence, which is especially the case for specialized cocoa. On the other hand, the simultaenous changes in poverty and the distribution of households across the different livelihood groups had a poverty-increasing effect. The period between 2001 and 2006 is dominated by substantial population-shifts and simultaneous changes of population-shifts and intra-sectoral changes, which makes it particularly hard to disentagle the exact sources of poverty reduction. Nevertheless we discovered that non-cocoa households and farmers employed in non-farm activities were the groups most involved in the poverty reduction in this time period.

The picture changes over the second time period. Similar to the previous decomposition of income sectors, the intra-sectoral effect clearly dominates with the most substantial intra-sectoral reduction in poverty being observed among cocoa households. In total, 63.4 percent of intra-sectoral poverty reduction originated among cocoa households. Specialized cocoa (34.9 percent) and cocoa farmers also employed in farm work (20.3 percent) made the highest contributions to intra-sectoral poverty reduction. We furthermore note that the group of farmers who were also dependent on farm work were especially successful among farmers with diversification strategies. The population-shift and interaction shift only had minor impacts on overall poverty reduction over this time period but are characterized by shifts away from specialized cocoa towards more diversified cocoa strategies.

Summary

The sectoral decomposition of poverty reduction in the rural economy shows that growth in crop agriculture has been the most important source of household per capita income. This is accompanied by an increasing number of households concentrating in cocoa cultivation over both time periods. Whereas in 2001, 13.66 percent of households derived the majority of their income from cocoa, this number increased up to 35.87 percent in 2013. Thus, our region is characterized by an increasing dependence on cocoa income. This is furthermore supported by a major shift towards cocoa-based livelihood strategies

with 54.78 percent of farming households in 2013 allocating more than half of their crop area to cocoa.

The period between 2001 and 2006 is a period of transformation, driven by the shift of households towards the cultivation of cocoa. While movers out of poverty generated a large percentage of income growth through cocoa, we also registered substantial losses in cocoa income for entrants of poverty. The shift of households towards cocoa, together with the poverty-reducing effect of non-farm employment and mixed sector employment, characterize the rural economy between 2001 and 2006.

The period between 2006 and 2013 is driven by significant welfare increases based on cocoa cultivation. Keeping the distribution of income constant, the reduction of poverty within crop agriculture contributed 80.2 percent to the overall reduction in poverty, with cocoa cultivation alone contributing 45.6 percent. Specialized cocoa farmers, who's only income source is farming, contributed around half of the poverty reduction originating in cocoa cultivation. The other cocoa households combine cocoa with either or both farm or non-farm employment, which reflects the general high degree of diversification in our household sample. This is furthermore reflected in the fact that increases in income for movers out of poverty are almost equally divided between the cultivation of cocoa (33.6 percent), the cultivation of other crops (36.5 percent) and non-agricultural employment (26.7 percent).

Thus, both a specialization in commercial farming based on cocoa as well as diversification strategies that combine farming with farm and non-farm work were successful strategies in poverty reduction.

VI.5 Cocoa: An Assessment of Income Changes and Livelihoods

The importance of cocoa cultivation as a commercial crop as well as part of a diversified livelihood strategy neccessitates us to further disentangle the factors driving changes in cocoa income. Based on the substantial impact of cocoa cultivation on household per capita income and poverty reduction, we now assess the source of changes in the gross income generated from cocoa. Minot et al. (2006) provide a simple decomposition technique that decomposes agricultural growth into changes in the cultivated area, output and price as well as a residual that represents the interaction of these three sources of growth.

Furthermore, they add a component to account for the changes in the crop portfolio so as to assess the degree of diversification into higher-value crops. As our previous results show, the shift in crop choice in favor of cocoa was a key driver of changes in cropping patterns between 2001 and 2006. The crop choice, i.e. the effect of reallocating land to cocoa, holding prices, output, and total area constant, will give us an indication whether the mere reallocation of crop area towards cocoa can serve as a sufficient explanation for the substantial increases in cocoa income or whether increases in productivity or prices also played a role.

One has to keep in mind, that these four components of crop income growth are influenced by various other factors. According to Minot et al. (2006), changes in total crop area could also reflect changes in weather, population growth, and migration, among other trends. Changes in output are also determined by several other factors such as the introduction of new varieties or weather events. Prices are influenced by trade and agricultural prices policies, changes in world prices, in conjunction with other variables. Finally, the share of land allocated to each crop is influenced by relative prices, input costs or extension programs along with other factors. Nevertheless, we are certain that our decomposition provides a suitable overview to assess the relative importance of these different components of crop income over time and serves as a starting point for more sophisticated empirical methods in future research.

The contribution of changes in the area, output, prices, and crop choice to growth in gross cocoa income using the method described by Minot et al. (2006) is calculated as follows. If A_{it} is the total cultivated area per household i at time period t, a_{it} is the share of cocoa in the total cultivated area A_{it}, Y_{it} is the production per unit area, and P_{it} is the real price per unit of production, then the gross income or revenue (R_{it}) from producing cocoa is given as:

$$R_{it}^{*} = a_{it} A_{it} Y_{it} P_{it} \qquad (VI.1)$$

We now want to measure the change in cocoa income that is attributable to either one of the four components. Inspired by Schotte (2014), we will perform the decomposition by simulating the cocoa income change over the respective time period from t to t', scaling up for each household i the respective component (for example the share of cocoa a_{it}) at the beginning of the period, using the growth rate in means:

$$(VI.2) \qquad a^*_{it'} = a_{it} * g_k \text{ with } g_k = \frac{\overline{a_{t'}}}{\overline{a_t}} \text{ and } \overline{a_t} = \frac{1}{N_t}\sum_{i=1}^{N_t} a_i$$

where *N* is the total number of observations for the share of cocoa *a* in year *t* and *a** is the simulated value of the share of cocoa at time *t'*. Using this technique, we estimate the extent to which gross cocoa income would have changed between *t* and *t'*, given the growth rates in means of crop area, yields, prices and the share of land allocated to cocoa. The simulation therefore approximates the variation in cocoa income that can be attributed to changes in either one of the respective sources of cocoa income, taking year *t* as our base year.

The approximation is calculated as follows:

$$(VI.3) \qquad \Delta R_i = a^*_{it'} A_{it} Y_{it} P_{it} + a_{it} A^*_{it'} Y_{it} P_{it} + a_{it} A_{it} Y^*_{it'} P_{it} + a_{it} A_{it} Y_{it} P^*_{it'}$$

The first term on the right-hand side of equation denotes the change in the gross cocoa income due to changes in the share of cocoa in the total cultivated area. The second term describes how changes in total crop area contributed to changes in gross cocoa income. The third term captures the effect of a change in crop output. The fourth term captures the effect of changes in real prices.

So far, our decomposition technique takes time *t* as the base year and simulates the changes in cocoa income until the end of the period, holding initial conditions constant. We now take the final year as a reference point and estimate the variation in cocoa income that can be attributed to either one of the components, keeping the conditions in our final year constant. We can approximate the later variation of our decomposition technique by scaling down the returns from each component (taking the share of cocoa *a* as an example) in the final year *t'*, given the growth rate in means:

$$(VI.4) \qquad a^*_{it} = \frac{z'_{it}}{g_z}$$

where a^*_{it} is the simulated change from the share of cocoa *a* in time *t*. Hence we would attain

$$(VI.5) \qquad \Delta R_i = a^*_{it} A_{it'} Y_{it'} P_{it'} + a_{it'} A^*_{it} Y_{it'} P_{it'} + a_{it'} A_{it'} Y^*_{it} P_{it'} + a_{it'} A_{it'} Y_{it'} P^*_{it}$$

Finally, we take the average of the two approaches and calculate the standard deviation, where only the interaction for the time period 2006-2013 turns out insignificant. One has

to keep in mind that the decomposition is only approximate because there is an interaction effect that reflects, for example, the correlation between higher cocoa output and the additional area planted with cocoa. In cases where one of the factors changes by a large percentage, the interaction effect can become significantly large (Minot et al., 2006).

Table VI.10 **Composition of Growth in Cocoa Income, 2001-2013**

	2001	**2006**	**2013**	**2001-2006**	**2006-2013**
Gross Cocoa Income	1,169,335	1,949,212	5,259,051	100	100
Crop Area (are)	205.09	172.54	167.03	-35.5	-3.86
Output (kg/are)	3.6	4.3	8.8	31.4	**79.96**
Price (IDR per kg)	5621	5440	6425	-13.6	19.05
Crop Choice (% share of cocoa)	0.41	0.66	0.72	**93.0**	10.63
Interaction	-	-	-	24.7	-5.78

Notes: Monetary values are real Indonesian Rupiahs (IDR) with base year 2001, using the provincial CPI for Palu provided by BPS. Local land units are measured in *are*. One *are* is equal to 100 m^2. All
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

The performed gross cocoa income simulation in *Table VI.10* highlights the effect of shifts in crop choice towards cocoa, which exhibits the largest positive effect on cocoa income between 2001 and 2006. This confirms findings from Klasen et al. (2013) that the cocoa area is a key determinant of income changes over this time period. In line with our decomposition results in *Table VI.9*, the transformation process and gradual shift to cocoa has been highly rewarding in the second time period. Historical data shows that the life cycle of cocoa trees amounts to about 25 years but cocoa only becomes productive after 3 to 5 years (Rice and Greenberg, 2000; Ruf and Schroth, 2004; Clough et al., 2009). Juhrbandt's (2010) study on the economic valuation of forest conversion and agroforestry intensification at rainforest margins in Indonesia gathered weekly data for a total of 144 cocoa plots in 2007 in our sample area and projected average cocoa yields to peak at the age of 15 and decline thereafter for all simulated land use scenarios. The cocoa trees in our sample just reached their full maturity for production in 2006 and developed their full productive potential in the following period (*see Appendix A.3*). Hence a substantial part of the increases in output can be explained by the fact that farmers only started to yield the returns from cocoa cultivation at the end of the first time period. On the other hand, increases in productivity could also be driven by improvements in the agricultural production technology. *Table VI.11* shows that the evidence for an increase in the use of

fertilizer is mixed but we observe general tendency for an increase in the use agricultural production technology.

The sectoral decomposition of poverty reduction not only underlined the substantial shift towards cocoa cultivation, but also the trend towards two types of cocoa livelihood strategies, the specialized and the diversified cocoa farmer. *Table VI.11* substantiates this finding. Whereas the level of household per capita income does not differ greatly between these two groups, the composition of income discloses a high degree of specialization and diversification. The specialized farmer almost exclusively depends on cocoa income in 2013, with 81 percent of household per capita income originating in cocoa cultivation. The diversified cocoa farmer displays a broad portfolio of income sectors but largely depends on two sources of income, cocoa and non-farm employment. It appears that these two shares largely complemented each other in 2001 but show variations over time. While non-farm employment was the dominant income source in 2006, cocoa significantly expanded its share of income in 2013.

Table VI.11 **Comparison of Cocoa Livelihood Strategies by Income and Crop Production, 2001-2013**

	Specialized Cocoa Farmer			**Diversified Cocoa Farmer**		
	2001	*2006*	*2013*	*2001*	*2006*	*2013*
Household per Capita Income	1,337,054	1,136,536	2,172,170	1,419,957	1,361,649	2,169,195
Income Shares						
Cocoa	0.61	0.71	0.81	0.41	0.28	0.41
Other Crop Agriculture	0.18	0.21	0.16	0.04	0.08	0.19
Non-Crop Agriculture	0.21	0.05	0.00	0.03	0.02	0.01
Agricultural Wage Employment	0.00	0.00	0.00	0.10	0.09	0.05
Non-Farm Employment	0.00	0.00	0.00	0.41	0.44	0.31
Cocoa Production						
Crop Area (are)	206	251	234	235	146	170
Price (IDR per kg)	5,659	5,826	6,517	5,549	5,504	6,409
Output (kg/are)	4.65	4.79	8.96	2.36	3.77	5.91
Crop Choice (% share of cocoa)	0.75	0.82	0.90	0.74	0.83	0.81
Fertilizer use per are (kg)	1.75	2.44	1.83	0.98	1.31	3.73

Notes: Monetary values are real Indonesian Rupiahs (IDR) with base year 2001, using the provincial CPI for Palu provided by BPS. Local land units are measured in *are*. One *are* is equal to 100 m^2.
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

The specialized cocoa farmer is characterized by an expansion of crop area over time with 90 percent of this area being dedicated to cocoa cultivation. Furthermore, specialized cocoa

farmers yield a significantly higher output than diversified cocoa farmers. Diversified farmers on the other hand are characterized by a contraction of crop area, of which 81 percent was cultivated with cocoa in 2013.

Summary

We determined that cocoa income growth in the first period was greatly driven by the shift towards the cultivation of cocoa whereas improvements in the productive capacity, either through the full maturity of cocoa trees for production and/or through increasing use of agricultural production technology, played a larger role in the following time period. Furthermore, a comparison of the two groups of specialized and diversified cocoa households substantiates our finding that these households follow significantly different livelihood strategies. Whereas the former group is almost exclusively dependent on income derived from cocoa cultivation, the latter equally depend on cocoa and non-farm income.

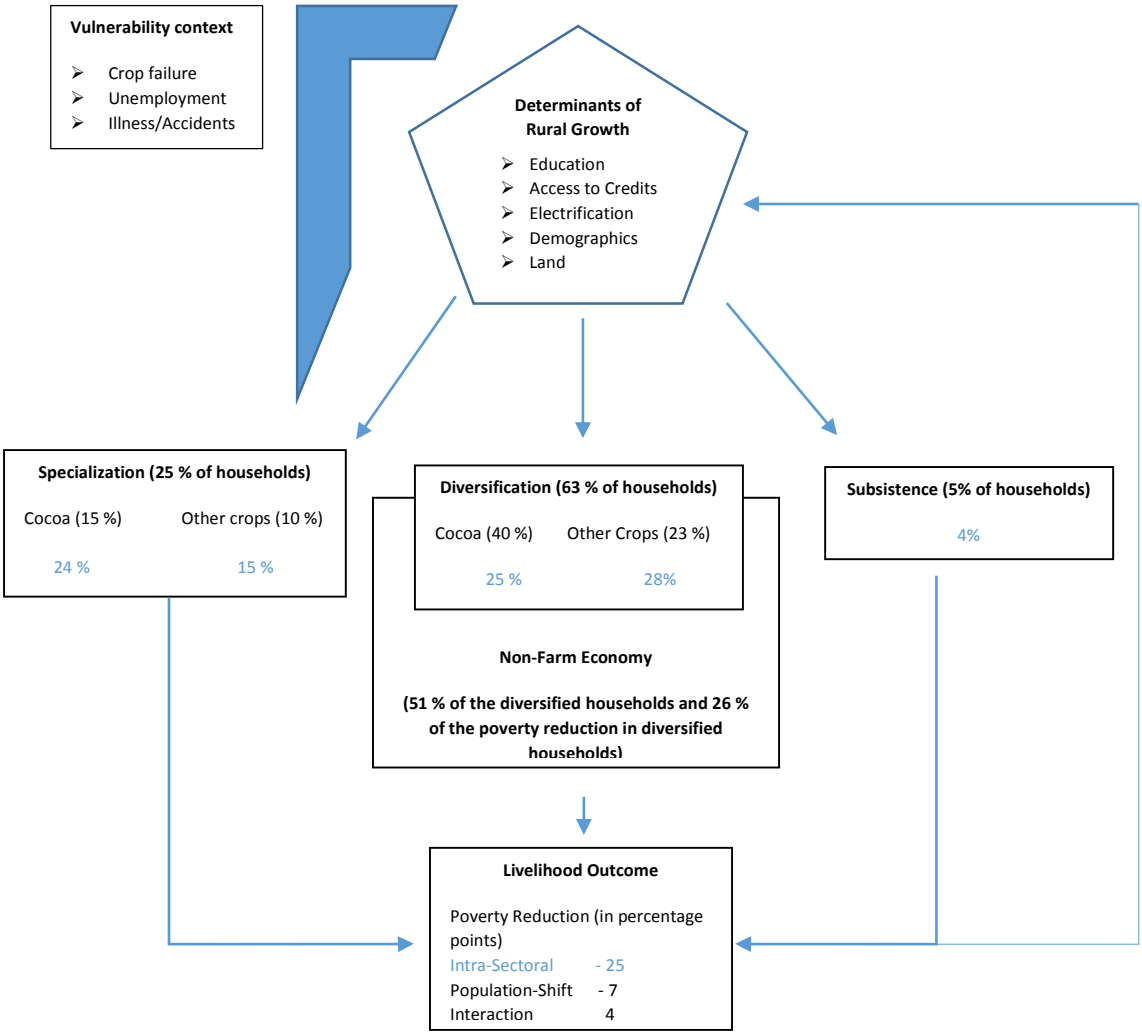
VII A Reconsideration of the Determinants and Drivers of Rural Poverty Reduction in the Lore Lindu Region

Following our separate analysis of the determinants and drivers of rural growth in our sample region of Central Sulawesi, it is now our aim to merge and reevaluate these findings in light of the conceptual framework developed in Chapter III. Our sectoral decomposition highlights the fact that all pathways out of poverty in our sample region led through crop agriculture, which is also supported by the fact that owned land was a strong determinant of both the level of income and income growth in our multivariate analysis of economic mobility. This pathway however is characterized by a significant heterogeneity of livelihood strategies as presented in *Figure VII.1*.

One avenue of rural growth was the specialization and intensification of farming in either cocoa or a variety of other crops. Specialized cocoa farmers were particularly successful in escaping poverty with 24 percent of total poverty reduction over the complete time period between 2001 and 2013 being generated by this group of households. In contrast, farmers who specialized in other crops contributed 9 percentage points less to overall poverty reduction, which illustrates the potential of cash crops as the more effective avenue for poverty reduction.

Another avenue of rural growth is the diversification of incomes by engaging not only in farming but also in agricultural wage employment or non-farm activities. This pathway includes by far the majority of households. The group of households following this pathway can be divided into those households that remain in the agricultural sector and are additionally employed on other farms, and those that diversify into non-farm activities. The latter only contributed 26 percent to the poverty reduction generated by all diversified households. Given the low poverty incidence in the non-farm sectors of employment, it is striking that no substantial shifts of poor households into these sectors are observed. The income sector decomposition depicted largely stagnant population shares for non-farm income, while the decomposition of livelihood strategies only shows a relatively small increase in farmers diversifying into non-farm activities. Concluding from our multivariate analysis, we observe that the poor may face significant entry barriers to participating in non-farm activities.

Figure VII.1 **Pathways out of Poverty in the Rural Economy of the Lore Lindu Region, 2001-2013**



Note: Figures cover complete time period. Population shares in parenthesis. Blue percentages describe the livelihoods' contributions to total poverty reduction.
Source: Author's calculation and graphical representation based on STORMA and EFFORTS data

Non-farm activities are often associated with skilled labor and relatively high levels of education if it were to be a permanent and reliable source of income and poverty reduction. Considering the low level of education and the minor contribution of non-farm income to mean income changes among our chronic poor households, many of the poor households in our sample are likely to only have access to less productive rural non-farm activities, which may serve as form of safety net to ensure against shocks but not as a driver of upward mobility. These observations are for example also reflected in research undertaken by

Barrett et al. (2001), who find that entry into the non-farm economy demands sufficient access to necessary financial and human resources, with poorer, more illiquid, uneducated and unskilled smallholders' having only constrained access to many of the more lucrative non-farm activities. Thus, while households that achieved a higher maximum level of education were also strongly associated with higher levels of income and growth, the rural non-farm economy may be a potential driver of rural growth for relatively well-endowed households but to a lesser extent of broad-based poverty reduction.

The adoption of a cash crop such as cocoa may thus be a more promising pathway out of poverty for poor households and entail a higher pro-poor potential, based on its economic returns, low labor requirements and absence of seasonality. Both livelihood strategies among cocoa farmers were equally important in total poverty reduction, the specialized cocoa farmer, who almost exclusively depends on cocoa income, and the diversified cocoa farmer, who equally depends on non-farm and cocoa incomes.

One must however underline the fact that the contribution of income generated by diversified cocoa farmers to overall poverty reduction is largely similar to that of diversified households cultivating other crops. This points to the fact that the improvements in household income for diversified households is also a consequence of the merits related to income diversification as such, mitigating the vulnerability to income shocks.

VIII Summary and Conclusions

This paper set out to investigate the potential of cash cropping as a pathway out of rural poverty in Central Sulawesi, Indonesia, drawing on a unique household panel survey collected in the vicinity of the Lore Lindu National Park in the years 2001, 2006, and 2013. We will first recapitulate the findings from our various strands of analysis before we conclude with a discussion on the possible implications of our findings for future research and policies.

First, our sample region is characterized by a gradual improvement in the situation of the poor households. Income growth contributed to substantial reductions in the incidence, depth and severity of poverty. Whereas the first period is characterized by an improvement in incomes of extremely poor households, many poor households that were located just below the poverty line at the end of the first period in 2006 managed to escape poverty in the following period. Chronic poor households and movers out of poverty especially benefitted from growth in household per capita income between 2001 and 2006, while the period between 2006 and 2013 significantly benefitted the movers and never poor households. This culminated in a substantial upward mobility with less households falling back into poverty and more households escaping extreme and moderate poverty. Our data however also suggests that households still remains highly vulnerable, with the majority of household incomes being located close to the US 1$/day and US 2$/day poverty lines. The vulnerability is furthermore substantiated by the fact that we register large swings in incomes and a high degree of transition into and out of poverty. We also note that richer households generated the highest growth rates over the second time period with roughly a third of our sample remaining below the US 1$/day poverty line.

Second, our descriptive assessment of the determinants of poverty transitions as well as our multivariate framework that links rural growth to household endowments in a dynamic system GMM panel regression shows that households with a higher share of children, lower levels of education, and a poor natural, physical and financial asset base face the greatest difficulties in improving income. The level of education, access to credit as well as electrification are by far the most important assets in our sample region and generated significantly higher income growth. We identify these factors as potential barriers to the upward mobility of extremely poor households.

Third, the rural economy of the Lore Lindu region is largely dependent on crop agriculture as a source of livelihood and primary driver of poverty reduction and rural growth. Growing incomes from agricultural production contributed most to the observed increases in total household incomes of poor households. Within the agricultural sector, a structural change towards a commercialization of smallholder farming in the form of a wide-spread adoption of the cash crop cocoa characterizes the substantial increases in crop income over time. This shift in cropping patterns towards cocoa cultivation largely dominates the time period between 2001 and 2006, where only marginal changes in the incidence of poverty are observed, and led to substantial reductions in poverty between 2006 and 2013.

Fourth, we identify two complementary pathways out of poverty, which are characterized by a markedly different reliance on cash cropping as a source of livelihood. The specialized farmer, who almost exclusively depends on crop income, and the diversified farmer, who equally depends on either farm and non-farm employment and crop incomes. The specialized cocoa farmer depicts a significantly lower poverty incidence than other commercial farmers and also generated a higher contribution to the overall reduction in poverty over time. While specialized cocoa cultivation was the single most important livelihood strategy for poverty reduction between 2006 and 2013, the share of cocoa farmers that solely rely on cocoa income is comparatively small in comparison to the increasing number of households who follow a diversification strategy based on farm and non-farm employment. Although the rural non-farm economy made a significant contribution to increases in income, our data suggests that these gains were largely attained by richer households in our sample, with limited effects on poverty reduction. These findings also point to significant entry barriers for poor households to enter the rural non-farm economy.

Our results consolidate some of the findings identified in the literature on rural pathways out of poverty and highlights the elementary role of agriculture in long-term poverty reduction in rural economies. Especially the potential role of cash cropping as a lucrative pathway out of poverty for poor smallholders with a limited asset endowment and constrained credit opportunities is underlined, given its wide-spread adoption among poor farming households and its tremendous increases in output observed over the second time period. Nevertheless, we observe a high degree of income diversification in our sample

and the majority of cash cropping households follow a complementary pathway into the rural non-farm sector. While the inclusive pro-poor effect of cash cropping is markedly higher, the accumulation of assets especially in education could furthermore intensify the diversification of previously poor households into the rural non-farm economy and thereby generate potential synergetic effects on land and labor productivity.

Several of our findings call for further future assessments to disentangle the direction of causality between the determinants and drivers of poverty reduction.

The high returns to education raise questions about their interlinkage to observed improvements in the agricultural output as well as the diversification into non-farm activities.

Furthermore, the improvements in the productive capacity of cocoa production need to be put into relation to the adoption and use of agricultural production technologies and innovations. This is of especial importance considering that the majority of cocoa trees reached their full productive capacity over the second time period. Yields will dwindle as cocoa trees age and pest and disease pressure increases (Clough et al., 2009). An intensified cultivation of cocoa with no shade trees, which is largely observed for our region (Clough et al., 2009; Juhrbandt, 2010), will increase the amounts of inputs (e.g. fertilizer and pesticides) required and thus investments to sustain cocoa yields will be inevitable.

Finally, the direct interlinkages and synergetic effects of the agricultural sector and rural non-farm economy call for more sophisticated econometric methods to identify the potential complementary effects of rural non-farm employment on productivity improvements in the agricultural sector. On the other hand, increased incomes derived from cocoa cultivation could spark off and facilitate the transformation of and participation in the rural non-farm economy.

Our assessment of the determinants of rural income growth shows that improvements in education, increased access to credits and electricity as well as the reduction in household size, particularly in the number of children, is the most crucial factor in the rural development of the Lore Lindu region. They are also essential ingredients to overcome the poverty traps as well as existing entry barriers to higher return activities in the rural economy. Furthermore, the importance of crop agriculture calls for a rural development strategy that addresses the productivity in crop production and its long-term sustainability.

A Appendix

A.1 The Gini-Coefficient

Figure A.1 **Gini-Coefficient, 2001-2013**

	2001	2006	2013
Gini Coefficient	0.53	0.48	0.53

Source: STORMA and EFFORTS data

A.2 The Selection of Variables for Data Analysis

Demographics

Widyanti et al. (2009) outline the role of a household's demographic composition. A typical household usually consists of several individuals with different characteristics, including economic capacity, which ultimately determine the economic capacity of the household as a unit. Consequently, a change in a household's composition will affect its economic capacity and condition. The degree to which a household's economic capacity and condition change due to a change in household composition depends very much on the nature of the change in composition.

Our first proxy for changes in the demographic composition is the household size. The influence of household size as a barrier to income growth has received extensive support in the poverty literature (see for example Widyanti et al. (2009) and van Edig and Schwarze (2011) for Indonesia). Jalan and Ravallion (1998) for example find that an increase in household size is likely to place an extra burden on the family and is expected to have a positive relationship with chronic poverty.

As Widyanti et al. (2009) points out, it is most likely however that a change in household composition will simultaneously produce both positive and negative effects on a household's economic capacity and condition. The death of an adult in the working age will have a negative effect on a household's economic capacity through the loss of earning capacity of the deceased individual. At the same time, however, it will have a positive effect on the household's economic capacity through the loss of the deceased individual's consumption needs. Having a large number of younger children is not only associated with lower income, but also with slower growth (Deininger and Okidi, 2003). Thus, it appears that the prospects are particularly poor if household size is large due to presence of many

children (Woolard and Klasen, 2005). Van Edig and Schwarze (2011) find for Indonesia that the regarding the presence of dependents in a household concur with our finding; higher numbers of small children and elderly people increase the likelihood of poverty, especially chronic poverty. We therefore include information on the share of children (below the age of 15), share of adults (between 15 and 65 years of age) and elderly (above 65 years) in our analysis.

Physical capital

A household's wealth determines its ability to invest, to obtain access to the formal credit market, and to participate in high-productivity non-agricultural activities (Klasen et al., 2013). Deininger and Okidi (2003) point out that credit market imperfections might put households without a minimum level of assets at a disadvantage. Thus, initial asset endowments will have a significant impact on changes in household income and poverty. We therefore include the value of household assets to test whether higher initial endowments have been associated with income growth and poverty reduction. The variable comprises over thirty different household assets that include productive, consumer, and financial assets covering transportation, housing and agricultural tools amongst others. Furthermore, the availability of electricity is considered to be a another suitable proxy for physical capital (Deininger and Okidi, 2003; Khandker et al., 2009; Klasen et al., 2013)

Natural capital

Low endowments of land have played a leading role in explaining asset-based changes in poverty dynamics (Baulch, 2011). Following Klasen et al. (2013), we use the area of arable land a household uses for agricultural production, since this is the more relevant measure for the impact of land endowments on household's income generating process. Accordingly, this variable excludes the area dedicated to lahan pekarangan, which is a patch of land used for housing and does not have any productive value.

Adverse geography has been identified as a crucial factor in the presence of poverty traps (Bloom et al., 2003). We proxy adverse geography by travel time of households to the next paved road, measured in minutes.

Human capital and labor

Our conceptual framework of pathways out of poverty is especially focused on the household's economic capacity. The average age of household members in working age (between 15 and 65 years old) and active in the workforce provides a telling picture of the productivity of a household. Feyer (2007) for example shows that changes in the demographic structure of the workforce will also lead to changes in human capital in the form of experience. They furthermore outline that low productivity levels in poor countries may be associated with workforces that are very young.

The lack of education is a crucial maintainer of chronic poverty and little or no education is a significant correlate of chronic poverty (Dercon et al., 2007). Education is important in the respect that it provides access to formal employment and the establishment of successful non-farm businesses. Furthermore, education has been found to be especially positively associated with increases in agricultural productivity. In a review provided by Reimers and Klasen (2013), education is found to be crucial for farmers to enhance their decision-making, improve their access to information, adopt new technologies faster and as a consequence of these three transmission channels, better evaluate implied opportunities and risks of riskier production technologies that typically promise higher returns. In our case the level of household education is proxied by the highest achieved education level of an adult household member in working age.

Woolard and Klasen (2005) point out the role of changes in household employment in explaining economic mobility and poverty dynamics. They find that labor market changes were the most common reason for a significant change in household wellbeing. In addition, they show that the acquisition of employment explains a much greater deal of changes in household income and movements out of poverty than changes in the earnings from employment. Hence, information on the employment of household members can provide us with crucial information on the increases or losses in household welfare due to economic shocks such as the loss or acquisition of employment. We therefore include the share of employed and unemployed members of a household in our analysis.

Financial capital

We also include a dummy describing whether the households have access to formal or informal credits. Haughton and Khandker (2009) argue that any household that is credit-

constrained, and this is especially true for poor households, will be limited in the extent to which it can smooth consumption over its lifecycle. Credits, on the one hand, can mitigate the vulnerability to income shocks but they can also provide opportunities for private investments such as microenterprises. The World Bank (2006) argues that improving the investment climate, providing access to commercial credit for small businesses and facilitating the access to marketing and technology is an essential component of growth in the non-farm sector.

Social capital

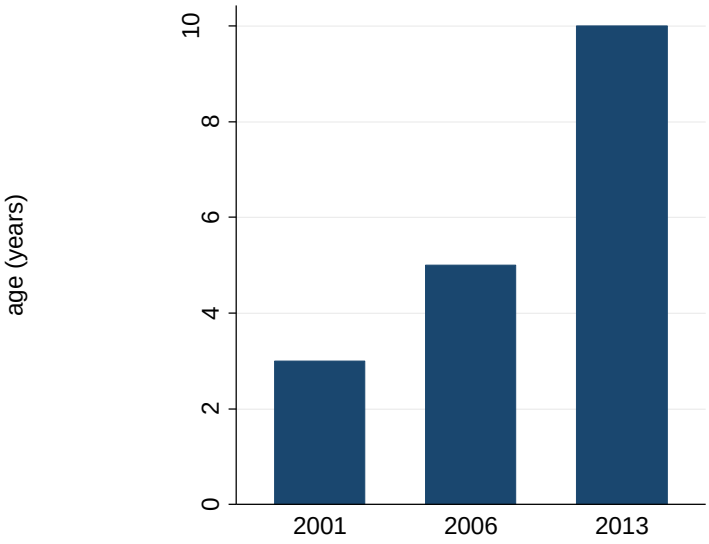
Baulch and Hoddinott (2000) argue that social capital is a major omitted variable in most studies of economic mobility. A reason could be that social capital is highly context-specific and manifold. A wide range of social capital-related variables have been constructed and included in country-level growth regressions (Aron, 2000). Fafchamps and Minten (2001) show that social networks can facilitate entering into and conducting economic transactions. They can provide improved access to information, especially in imperfect markets, and to material and financial resources (Rooks et al., 2009). It can also provide a form of social protection and assistance in the case of unexpected negative shocks and thereby reduce the risk of poverty (Gertler et al., 2006). Van Edig and Schwarze (2011) confirm these findings and show that lacking social capital fosters chronic poverty. Social capital is proxied by the number of organizations a household is a member of.

Shocks

The long-term role of both positive and negative shocks is often underrepresented in studies on economic mobility, despite the fact that their impact on the welfare trajectory may well be large. Baulch (2011) argues that households who escape poverty are not households who are unaffected by shocks but those who are more able to cope with them. The factors which promote household resilience to shocks (such as assets and education) often overlap with the factors which allow households to take advantage of opportunities. We include negative shocks such as crop failure and illness/accident of a household member as well as several positive shocks related to the improvement in infrastructure.

A.3 The Age of Cocoa Trees in the Lore Lindu Region, 2001-2013

Figure A.2 **Median Cocoa Tree Age, 2001-2013**



Source: STORMA and EFFORTS data

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