Courant Research Centre
'Poverty, Equity and Growth in Developing and Transition Countries: Statistical Methods and Empirical Analysis'

Georg-August-Universität Göttingen
(founded in 1737)

Discussion Papers

No. 33

Cash Crop Choice and Income Dynamics in Rural Areas: Evidence for Post-Crisis Indonesia

Stephan Klasen, Jan Priebe, Robert Rudolf

April 2010

Platz der Göttinger Sieben 3 · 37073 Goettingen · Germany
Phone: +49-(0)551-3914066 · Fax: +49-(0)551-3914059

Email: crc-peg@uni-goettingen.de Web: http://www.uni-goettingen.de/crc-peg

Cash Crop Choice and Income Dynamics in Rural Areas: Evidence for Post-Crisis Indonesia*

Stephan Klasen†, Jan Priebe and Robert Rudolf

May 26, 2010

In this paper we investigate the factors affecting income levels, income growth, and poverty reduction in rural Indonesia following the crisis of 1997/98. We particularly investigate the relative roles of non-farm incomes, productivity improvements achieved via changes in crops versus improvements on the same crops, and demographic changes induced by the crisis on income dynamics in rural Indonesia. Using a unique household panel data set for Central Sulawesi that allows us to control for a large set of household and geographical characteristics, household fixed effects as well as endogeneity issues, we find that falling household size and the adoption and intensification of new cash crop varieties can explain a substantial part of the observed post-crisis developments.

Moreover, we compare our results to cross-sectional data from SUSENAS, Indonesia's large scale national household survey. While the overall determinants of rural incomes are very similar across both data sets, we find that the importance of agricultural self-employed income seems to be higher in Central Sulawesi than in most other parts of Indonesia. Although several factors could explain these differences, lessons from our Central Sulawesi data suggests that unexploited potentials in the production of cash crops in other areas of Indonesia might contribute to these findings.

Key words: Crop choice, Income diversification, non-farm sector, rural development, Indonesia.

***JEL* codes:** I31, Q12, Q15, R13.

*We thank the Development Economics Research Group and the Center for Statistics in Göttingen for crucial support. The paper benefited from discussions with Michael Grimm, Martin Qaim, Stefan Schwarze, and Stefan Sperlich. Valuable comments were received at conference presentations at EUDN (Örebro, 2009), Courant Centre (Göttingen, 2009), and the German Economic Association - Research Committee on Development Economics (Frankfurt, 2009). Financial assistance from the German Research Foundation (DFG) for funding STORMA is gratefully acknowledged.

† All authors are based at: University of Göttingen, Center for Statistics and Department of Economics, Platz der Göttinger Sieben 3, 37073 Göttingen, Germany. Corresponding author: Jan Priebe. Email: jpriebe@uni-goettingen.de.

1 Introduction

In the years 1997/98 Indonesia experienced a major economic, financial and political crisis. Over the course of a few days, the exchange rate lost over two-thirds of its value and fell from Rp 4,000 per US$ to Rp15,000 per US$. Moreover, the consumer price index in 1998 increased by around 80 percent, while food prices doubled. The crisis was not just limited to the financial sector. Real GDP per capita fell by about 15 percent and real wages in the urban formal sector declined by 40 percent in 1998 (Thomas et al. (2004)).

Although urban areas were hit hardest during the crisis in economic terms, rural areas which represent approximately 60 percent of the population and 80 percent of the poor in Indonesia were severely affected too. Crisis-induced urban-rural migration (Frankenberg et al. (2004)) in conjunction with the economic and financial crisis seemed to have led to a reversal of the agricultural transformation process with rural households moving back from non-agricultural employment to agricultural activities (WB (2006a)). Moreover, droughts and fires associated with El Niño in 1997/98 depressed agricultural output in many parts of the country and thereby exacerbated the situation of rural households.

Since then the recovery of the Indonesian economy has been comparatively stable with a growth rate of real GDP of about 5 percent annually between 1999 and 2006. Poverty rates at the national level declined substantially from 24.2 to 17.8 percent between 1998 and 2006 and in rural Indonesia from 25.7 to 21.8 percent (BPS (2007)).

However, despite poverty in Indonesia being largely a rural phenomenon, little is known about the underlying factors that determine rural incomes and that have contributed to the observed income growth process in rural areas in the post-crisis period. While macro-economic data and studies suggest that GDP from agriculture increased about 3 percent annually between 1999 - 2006 and that spill-over effects from the urban service sector (Suryahadi et al. (2009)) have contributed to the observed poverty reduction in rural Indonesia, no studies currently exist that examine the particular reasons for the observed growth in agricultural and non-agricultural incomes in the post-crisis period.

Consistent with the literature on the dynamics of rural income growth as well as the effects of the economic crisis, there are three factors that could account for rural income dynamics in Indonesia in the post-crisis period. First, there could simply be a reversal of the impacts of the crisis on rural households. Of particular relevance would be a reversal of migration flows to the more 'normal' rural-urban pattern which reduces household size with positive impacts on per capita incomes. Similarly, the move to non-agricultural activities could resume, reversing the trends during the crisis and allow agricultural households to improve incomes through this diversification process.

Second, longer-term factors associated with the dynamics of rural income growth could be relevant. In the literature, is is clearly acknowledged that higher agricultural productivity is crucial to raise income in rural agricultural areas and for the poorest of rural households (Ravallion and Datt, 1996, 1998a; Timmer, 1997, 2004; Suryahadi and Sumarto, 2003; Fan et al., 2004, 2008). The literature does not distinguish carefully between the type of productivity improvements, differentiating between productivity improvements for the same crops versus shifts to higher productivity crops, an issue that deserves closer attention. Moreover, income dynamics could be influenced by more longer-term trends away from agriculture. Particularly, engagement in high-productivity, non-agricultural activities can be most conducive towards income growth and poverty reduction, especially in the presence of poor physical infrastructure and human capital constraints (Ravallion and Datt, 1996, 1998b, 2002; Lanjouw and Lanjouw, 2001; Elbers and Lanjouw, 2001; Micevska and Rahut, 2008).

This article's principal objective is to examine the sources of income growth in rural Indonesia since the late 1990s. Notably, the following research questions are of paramount interest to us: (a) What have been the main sources of observed income growth in the post-crisis period in rural Indonesia? (b) To what extent have changes in human capital endowment, infrastructure, demographic dynamics, agricultural productivity influenced rural incomes? (c) How has income diversification, in particular into the non-agricultural sector, helped households to increase incomes? (d) What have been the relative importance of productivity improvements of the same crops versus shifts to more lucrative crops in explaining agricultural productivity improvements?

Several contributions set this article apart from others in the literature. First, we use a unique data set based on a household panel survey (STORMA) collected in Central Sulawesi at three different points in time (2001, 2004, 2006). To the best of our knowledge these are the most detailed surveys conducted to investigate the livelihoods of rural households in Indonesia. Hence, compared to other data sets on Indonesia, we are better able to examine the role of infrastructure, type of crops, and household assets into the analysis. Moreover, several variables in our data are measured more accurately than in previous studies. For instance, we explicitly control for agriculturally suitable land used in agricultural production in distinction to relying on the area of land owned by a household. Second, this article is the first to investigate panel-based household income dynamics and the role of income diversification in the post-crisis period of the country. Besides the advantage of tracking the same households over time for descriptive analyses, the panel structure allows us in addition to address estimation problems in the multivariate analyses arising from endogeneity and omitted variables in a much simpler way than it would have been possible for available cross-sectional data. Furthermore, compared to post-crisis panel data analyses on Indonesia using aggregated GDP data, e.g. Suryahadi et al. (2009), we can utilize the detailed nature of STORMA to better understand the sources of income changes. Third, in contrast to other studies that use small scale rural household surveys, we directly compare our findings to those obtained from the analysis on the most important national socio-economic household survey (SUSENAS), which is used to calculate official poverty lines and poverty rates in Indonesia. Therefore, we are able to separate between effects that hold for all of rural Indonesia and those that might be particular to the study area. Moreover, such a comparison helps us understanding to which degree results from SUSENAS might suffer from endogeneity problems in order to assess its reliability to derive policy implications for rural Indonesia.

Our analysis reveals that real incomes increased substantially between 2001 and 2006. We show that the growth in real incomes can be primarily attributed to increases in the value of agricultural production (both in terms of output and yields) which is caused largely by shifts in cropping patterns but not to an increase in the efficiency of agricultural production. In addition, in the context of the nationwide economic recovery, the growth in agricultural incomes was complemented by steady increases in non-agricultural incomes which have become the principal source of income for a rising number of households. Nonetheless, we observe strong entry barriers into the non-agricultural sector with poorer households deriving their income nearly exclusively from agricultural wage or self-employment. Lastly, we find evidence that falling household size in rural areas, also associated with the national recovery, also contributed to rising per capita incomes. Results obtained from the multivariate analysis by and large corroborate previous research but considerably refine our understanding of the factors that have an effect on rural incomes. Controlling for endogeneity and household as well as spatial fixed effects we find that the household's ability and decision to move into the production of cocoa, the most rewarding cash crop, and access to lucrative non-agricultural income sources together with demographic and wealth characteristics strongly determine higher incomes and contribute to higher than average income growth. Although in general our cross-sectional and panel results are quite robust to different specifications, we find that after controlling for the likely endogeneity of households' wealth status and their engagement in the non-agricultural sector, the effect especially of educational attainment on household incomes decreases substantially. When comparing our previous results to the national SUSENAS household survey we find very similar cross-sectional results. Using a reduced set of explanatory variables due to restrictions of SUSENAS we find that the size of most coefficients and its respective significance level increases compared to the full model. Particularly, with respect to education and non-agricultural employment, results from SUSENAS seem to overstate its direct effect on income and income growth of rural Indonesian households, which shows the importance of rich micro data sets of the type we have at hand to study income dynamics in more detail.

The remainder of this article is organized as follows. Section 2 briefly discusses the empirical literature on determinants of income dynamics and poverty alleviation in rural Indonesia. Section 3 presents details about the data sets and main variables used. Moreover, this section outlines the statistical framework utilized for the empirical identification strategy. In section 4 results from the descriptive and multivariate analysis are presented and discussed. Section 5 summarizes and concludes.

2 Literature Review

As outlined above, rural income dynamics could be partly due to a reversal of crisis-induced changes, particularly urban-rural migration and a shift from non-agricultural to agricultural activities (Frankenberg et al., 2004; WB, 2006a). To the extent this is the case, we would therefore expect a migration-induced reduction in household size and a move from agriculture to non-agricultural activities as important drivers of income dynamics in rural Indonesia.

But more longer-term rural income dynamics could also be at play. Recent studies on Southeast Asian countries, e.g. Estudillo et al. (2006) for the Philippines, Cherdchuchai and Otsuka (2006) for Thailand, Nargis and Hossain (2006) for Bangladesh, confirm the growing importance of non-agricultural income sources for rural households as a means to generate income. At the same time, descriptive and multivariate analyses in these studies underscore the remaining importance of agricultural income on the living standard of many households in rural areas.

In the case of Indonesia, few studies have analyzed the link between the sector of employment, individual and household characteristics and how they determine and drive rural incomes. Moreover, due to the absence of household panel data for the post-crisis period until very recently, all of the existing studies that address income dynamics based on household survey data have concentrated on time periods until 2000. In a prominent article on income dynamics, including urban and rural Indonesia, Fields et al. (2003) use panel data from the 1993 and 1997 waves of the Indonesian Family Life Survey (IFLS). They find that changes in the employment sector of the household head, a head's gender, changes in household size and composition as well as initial income levels are the main determinants of per-capita income changes. In a study of rural areas using the 1993 and 2000 IFLS waves,McCulloch et al. (2007) show that while agriculture remains crucial for income growth, in particular for the poorest households, a gradual diversification of economic activities, characterized by a stronger reliance on non-agricultural sources, was taking place. Furthermore, they conclude that it is particularly the shift into non-agricultural income that contributes to rising rural incomes.

In light of the increasing awareness that rural households in developing countries engage in a variety of non-agricultural activities to generate income (Lanjouw and Lanjouw (2001), a few articles on the role of the non-agricultural sector for rural households in Indonesia appeared rather recently. Dewi et al. (2005) use their own cross-sectional survey for East Kalimantan in order to investigate the determinants of non-agricultural income at the village level for the period of 1992-1996. The authors find that better infrastructure, the closeness to transmigration sites and deforestation (1992-1996) positively correlate with non-agricultural income. In a larger effort the World Bank conducted several studies on how to revitalize the rural economy in the country with a particular focus on the non-farm sector (WB, 2006a,b). In consequence of these efforts, an assessment of the livelihood in rural areas and the rural investment climate based on cross-sectional data from the post-crisis period was conducted WB (2006c). From these analyses emerges that limited access to formal credits, difficult access to roads and a lack of demand for goods and services are the main constraints to develop high-productive non-farm enterprises. Moreover, the reports conclude that in the long run moving out of agriculture will be the key to growth for most rural areas in the country.

In a recent paper Suryahadi et al. (2009) set up a regional panel using regional GDP data from 1982-2002 supplemented with regional consumption and poverty data from SUSENAS in order to investigate the sector-specific growth effect on poverty in Indonesia. In contrast to the studies on Indonesia cited above, they find that both, growth in the rural services sector as well as growth in the rural agricultural sector, strongly contribute to income growth and poverty reduction in rural Indonesia. However, given the data limitations that they face, the authors are unable to identify the particular sources and mechanisms that have led to the observed growth process in agricultural and non-agricultural incomes.

While the latest research on post-crisis Indonesia, as outlined above, nearly exclusively stresses the importance of non-agricultural income to alleviate poverty and to raise incomes in rural Indonesia, the possibility of increases in agricultural productivity as a means for income growth have been widely disregarded, the exception being Suryahadi et al. (2009). Hence, although it is often acknowledged that the agricultural sector still plays an important role for the rural economy through its size and agricultural multiplier linkages (Suryahadi et al., 2008), its potential to be conducive for future growth in rural areas has been estimated to be low.

3 Data and Methodology

3.1 Data and Variables

Data:

The data comes from three household surveys conducted in the second half of 2001, 2004, and 2006 in the rural areas in the province of Central Sulawesi[1]. Compared to most other provinces in Sulawesi, Java, Kalimantan, and Sumatra the province shows relatively low GDP per capita levels which is partly attributable to its low level of urbanization and industrialization. During the economic crisis of 1998 the province was hit hard but did not suffer as much as most other provinces which is in line with Sumarto et al. (1999) and Ravallion and Lokshin (2007) who find that proportionate impacts of the crisis were largest in initially better off areas. Central Sulawesi (CS) itself is largely agrarian, based on traditional farming methods and terraced slopes. Most production comes from ownership-cultivation on small farms with an average size of two hectare. The main staple crop in the area is rice while the main cash crop in the 1990s was coffee. At the end of the 1990s the majority of rural households, due to the decline of world coffee prices, began switching to the production of cocoa.

Village census data obtained from the Indonesian Central Statistical Office (BPS) shows that the study area around the rainforest zone of the Lore Lindu National Park (LLNP) in CS comprises about 110 villages in four sub-districts (Kecamatan). Out of these 110 villages 12 were chosen randomly for the inclusion into the household surveys. The sample size in each village was determined with respect to the share of the village population in the overall population. A multi-stage sampling design was used based on the proximity of the villages to the LLNP, population density, and ethnic composition[2]. In 2001, 294 households in 12 villages were interviewed. Due to financial and technical problems, only 258 households were interviewed in the 2004 round. In the 2006 round still 271 of the original 294 households could be re-interviewed. Since we are interested in income dynamics, we restrict the analysis to those households that were

[1]The surveys were carried out within a large-scale project called STORMA designated to examine the livelihood of rural households in close proximity to rainforest areas. To refer to the project we use in this paper either 'STORMA' or 'ST'.

[2]A detailed description of the sampling procedure is provided in Zeller et al. (2002).

interviewed in all three rounds which gives a total number of 256 households per round[3]. The surveys provide detailed information on agricultural and non-agricultural activities, demographic status, asset and land holdings, and other attributes of households and household members.

In order to investigate whether insights from STORMA can be generalized to a broader regional setting, we compare STORMA to the all-Indonesian household survey SUSENAS. BPS has been carrying out SUSENAS on an annual basis. However, these surveys comprise larger income and expenditure modules only every three years. Although SUSENAS re-interviews some of the households in the sample in the next two consecutive rounds, no households are kept for two consecutive rounds of the full income and expenditure modules. Moreover, SUSENAS does not capture information on variety of important factors that affect rural incomes, e.g. infrastructure, household assets, access to credit, and detailed income data from agricultural sources. In particular, SUSENAS does not contain data on type of crops planted, quantity harvested and respective output prices, but asks households generally about their income from agriculture in the respective year. Despite these problems, SUSENAS remains the main alternative household data set for the post-crisis period in Indonesia and moreover is the principal data source for official poverty statistics and policy design in Indonesia. For these reasons we use the 2002 and 2005 waves of SUSENAS in our comparison, which are the two latest rounds available to include full income and expenditure data[4].

Variables of Interest:

In the subsequent analyses we mainly distinguish between four types of income sources following Barrett and Aboud (2001) who classify income sources according to sectors (agriculture and non-agriculture) and employment status (wage and self-employment). Concerning the construction of a measure of agricultural self-employed income, to the value of crops and animal products marketed in the last year, we add the implicit income from subsistence production imputed at local prices. From the total value of agricultural production, we subtract the costs of seed, fertilizer, livestock, repairs of machinery, hired labor, and the like. Agricultural and non-agricultural wage incomes include payments in kind, while non-agricultural self-employed income is net of business costs, such as expenditures on raw materials, energy, hired labor, and equipment maintenance. Based on the amount of income received from these four income categories, we classify households into five types. If a household's income from one of these four categories exceeds 50 percent of total household income, a household is classified as agricultural self-employed, agricultural wage, non-agricultural self-employed or non-agricultural wage, respectively. In case a household does not receive an income of more than 50 percent from one of the

[3]The comparison of characteristics between households that could not be interviewed again and those that remained in the sample between the first and third round showed that no statistically significant differences exist.

[4]Some articles covering post-crisis Indonesia used the IFLS data set. Others like Suryahadi and Sumarto (2003) or Ravallion and Lokshin (2007) complemented their analysis with data from the national village surveys (PODES). However, PODES data cannot fully compensate for lacking household information on important variables in SUSENAS

four sources, the household is classified as mixed.

Given the discussion above, household size will be an important covariate. To the extent that the crisis led to an 'artificial' increase in household size in rural areas that was reversed once economic conditions improved, we would expect that large initial household sizes and falling household sizes are factors influencing rural income dynamics.

Level of education of a household can be measured and incorporated in different ways. Since cultural factors in Indonesia often lead to the situation that the oldest person in the household will be considered the head, we follow Basu et al. (2001) to take the highest educational level of an adult in working age, as the educational information most relevant for a household. This way we circumvent the problem that some of the household heads do not contribute to the income generating process of the household anymore. Furthermore, we consider the years of education obtained in contrast to degrees, e.g. no primary education versus primary education or higher. This decision is due to the circumstance that we want to reduce the number of dummy variables included in the multivariate regression analyses.

In most studies, the land area is included. Instead we use the area of agriculturally suitable land a household uses for agricultural production since this is the relevant measure for land being an input into the household's production process. Thus, the land variable further excludes the area dedicated to the housing area of the household since this land cannot be used for agricultural production. In addition, we construct a variable referring to the area of agricultural land devoted to the production of cocoa. Since cocoa is the principal cash crop in the study region, this variable is meant to capture the ability of households to diversify into more economically rewarding agricultural activities compared to subsistence agriculture. In the multivariate analysis both variables are included whereby the inclusion of the area of agriculturally suitable land has in this context the additional role to control for mere size effects in the cocoa variable.

Clearly, the wealth of households determines their ability to invest and produce efficiently, to obtain access to the formal credit market, and to participate in high-productive non-agricultural activities. We include the value of assets a household owns as a proxy for household wealth. The variable comprises productive, consumer and financial assets. Taking sample size limitations into account we decided to focus on this aggregate measure instead of incorporating asset variables for each of the three components.

In our empirical analysis we further control for locational characteristics. Ease of access to infrastructure and proximity to markets is proxied by travel time of households to the next paved road. Given the hilly terrain of the region and the sometimes poor condition of roads, mileage is not an appropriate measure. Instead we rely on time measured in minutes. Moreover, interregional disparities are captured by grouping villages into the four sub-districts (kecamatan) they belong to and using kecamatan-fixed effects accordingly.

The study area exhibits an important geographical feature which can be exploited to construct a suitable instrument for the panel regressions. All study villages are situated in one of the two valleys (Palolo and Kulawi valley) which extend up to 200km south of the provincial capital Palu. Both valleys are connected with paved roads to Palu and for each of the villages Palu is by far the nearest city in the area. Palu itself comprises roughly 250,000 inhabitants and contains the main port in CS which is used to import commodities (durables) and to export, cocoa and coffee primarily to the USA. The distance to Palu matters for rural households mainly in two ways. First of all, Palu offers a variety of non-agricultural employment opportunities. Therefore, households residing closer to the provincial capital are more likely to find or start non-agricultural activities. Thus, distance to Palu proxies the strength of spill-over effects from urban to rural areas. As found in Suryahadi et al. (2009) such spill-over effects are most likely to occur in the rural service sector which in our case is part of the non-agricultural sector. Secondly, the likelihood of possessing production and consumption assets increases with lower distance to Palu. This is because assets are easier to transport and to obtain the closer a household resides to Palu. In addition, asset possession partly mirrors access to credit (in our case both variables are highly correlated) with access to credit being negatively correlated with distance to Palu.

Once we control for asset possession, education, demographic and location characteristics, as well as sector choice in our income regressions, we do not expect that distance to Palu (measured in travel time) exercises any direct influence on household incomes. Furthermore, it is noteworthy that in our case distance to Palu varies on the household level since households usually first need to reach the nearest paved road (which varies from household to household even within a village) in order to get to the main road to Palu.[5]

3.2 Econometric Approach

In order to identify which factors determine rural incomes and contribute to rural income growth we adopt three strategies. In a first step, our aim is to isolate the factors that drive cross-sectional income levels. Thus, we begin our analysis with the estimation of Mincer-type equations for each of the three STORMA waves separately by OLS. In particular, we model log per-capita household income for the respective wave as a function of household characteristics.[6] The estimated model is depicted in equation (1), where Y_i refers to per-capita income of household i, X represents a set of household characteristics for which information is available in SUSENAS and STORMA, and Ψ stands for the set of variables that is available in STORMA but not in SUSENAS[7].

$$log(Y_i) = \alpha + X_i'\beta + \Psi_i'\lambda + u_i \quad (1)$$

However, OLS estimation of (1) can provide inconsistent and inefficient results in the presence of unobserved heterogeneity or endogeneity issues, such as the omission of important variables that correlate with the regressors or simultaneous causality of a specific regressor with the dependant variable. Hence, in a second step we exploit the

[5]A detailed description of variables used in this article is presented in Table A1 in the appendix.

[6]To obtain real incomes we deflate nominal incomes by monthly provincial CPI's as provided by BPS. The base period in all subsequent analyses is September 2001.

[7]We explicitly distinguish between X and Ψ to emphasize the difference in data availability between STORMA and SUSENAS. Moreover, this connotation helps to clarify the empirical strategy to compare findings from STORMA to the national level.

panel structure of STORMA to address these problems accordingly. In order to control for unobserved heterogeneity within our sample, we assume an error components specification of our model which is estimated with fixed and random effects. The standard error components model for fixed and random effects in the presence of individual and time effects can be written as in (2).

$$log(Y_{i,t}) = \Sigma'_{i,t}\gamma + u_{i,t} \tag{2}$$

Where $Y_{i,t}$ is real per-capita income of household i in period t, Σ refers to the full set of variables X and Ψ from (1) and $u_{i,t}$ is the composite error which is determined as follows:

$$u_{i,t} = \mu_i + \lambda_t + v_{i,t} \tag{3}$$

The composite error consists of three components, μ_i denotes the time-invariant unobservable individual effect which could be ability or motivation, λ_t the year-specific effect and $v_{i,t}$ denotes the idiosyncratic part of the error term. Unless μ_i is correlated with the regressors $\Sigma_{i,t}$, that is, $E(\Sigma_{i,t}, \mu_i) \neq 0$, the random effects (RE) estimator is consistent and efficient and therefore the better choice over the fixed effects (FE) specification. Yet, if it is the case that individual errors are correlated with the regressors, then random effects estimates can be biased. With respect to the within-estimator (fixed effects), it usually provides consistent but not necessarily efficient estimates when unobserved individual effects are present. However, since the number of time periods is limited to three waves in the case of our panel, we have much less variation 'within' the records of each individual over time than variation 'between' individuals. Hence, we expect our within-results to have limited explanatory power and thus also the Hausman specification test loses its power. RE estimates, on the contrary, are able to take into account both within and between variation. Yet, they might be inconsistent for the reason stated above. A practical solution is to compare FE, RE and pooled OLS estimates and to see whether directions, magnitudes, and significance levels differ.

In a subsequent step, we analogously use fixed and random effects two-stage least squares (2SLS) estimators in order to correct for potential endogeneity bias stemming from simultaneity. The two potentially endogenous variables (asset ownership, non-agricultural self-employment) will be instrumented by their own lagged values. Moreover, the distance to Palu enters as an additional instrument into the respective first stage regressions.

In a third step, in order to further analyze income dynamics, we investigate drivers of income change. The estimation approach used here is a micro-growth regression as depicted in equation (4) which has been borrowed from the empirical literature on economic growth[8].

[8]Note that in this set-up a common concern is the so called regression towards the mean which states that in the presence of measurement error in the initial income term one obtains a negative coefficient for initial value of log(Y_i). However, it has been shown in other studies, e.g. Woolard and Klasen (2005) that even if such bias exists its effect on the remaining covariates is often negligible.

$$\Delta log(Y_{i,t}) - log(Y_{i,t-1}) = \alpha + log(Y_{i,t-1})'\omega + Z_t'\zeta + \Sigma_t'\varphi + u_{i,t} \quad (4)$$

In (4) $Y_{i,t-1}$ refers to household per-capita income in the period t-1, Z_t refers to the change in the endowment of household characteristics of Σ between period t and t-1. Σ is defined as in equation (2) above. However, not every covariate will be considered for Z_t. In order to avoid problems of overfitting, non-significant variables are thrown out when it is justifiable from a theoretical point of view.

Since we are interested in providing insights beyond STORMA for the national level we compare our results to those obtained from the analysis of SUSENAS. Given that SUSENAS is not a panel data set and lacks information on several important variables, we are restricted to estimating (1) in its reduced form as presented in (5).

$$log(Y_i) = \alpha + X_i'\beta + u_i \quad (5)$$

For the comparison we need to address the two following main issues:

First of all, we need to assess whether households from the STORMA region are comparable to households in other regions in Indonesia. In order to compare households we need to guarantee that variables are measured in the same or similar way. The main difference between variables that are available in STORMA and SUSENAS is found to be in the total household income data. Total household income in SUSENAS contains imputations for rent and housing. Since the exact imputation procedure has not been published by BPS and moreover such an imputation can easily lead to merely adding additional noise to the income variable we subtract this imputed income from the total household income variable in SUSENAS. Moreover, the analysis of SUSENAS confirms that rural households in other areas in Indonesia are often much richer and better endowed when comparing different covariates. Excluding rural Java from the analysis already helps to bring the SUSENAS and STORMA sample closer together. In addition, we decided to drop households in the three highest income deciles from the SUSENAS data set. This procedure is motivated by two aspects. Villages in the STORMA area are comparatively small and are situated in rather remote areas. These villages therefore are far from becoming classified as urban areas within the next decades. In contrast, households in SUSENAS classified as rural are sometimes on the edge of becoming classified as urban as soon as the next census will provide BPS with a new sampling frame. Since urban areas in Indonesia are much richer than rural areas, we expect more populous villages to be richer than villages with a small number of inhabitants. Therefore, we would expect that most of the richer households in the rural SUSENAS sample are located in larger villages. In addition, when comparing demographic and socio-economic characteristics of the households in STORMA and SUSENAS we find that the samples for the two different data sources compare very well, when restricting the SUSENAS sample to households within the 1-7 deciles[9].

[9] Our decision was derived from comparisons based on per-capita income, engagement in the four economic sectors and household size. However, the main results are robust to using the full sample from SUSENAS or choosing different cut-off points (60, 80 or 90%.)

Secondly, we have to evaluate whether estimation of (5) is suited to provide good information for researchers and policy makers alike on income determinants for rural Indonesia. From the analyses of (2) and (4) it will become clear to what extent and in which direction results from (1) are affected by issues of unobserved heterogeneity and simultaneous causality. Moreover, the analysis of (4) will show whether the determinants of income changes differ substantially from those that affect the level of income. If findings from (1) are found to be relatively robust and comparable to (2) or (4), we investigate in a next step the effect of reducing the set of covariates from $X+\Psi$ to merely X. This will finally allow us to assess the goodness of (5).

4 Results

4.1 Descriptive Analysis

During the economic and financial crisis rural areas experienced much lower declines in per-capita income levels in absolute and relative terms than urban areas (Sumarto et al. (1999)). Nonetheless, poverty rates in rural areas increased substantially at that time while in addition it took them much longer to recover from the crisis than urban areas (WB, 2006a, 2008).

The crisis affected rural households in various ways. With the decrease in demand for agricultural products and non-agricultural services income declined accordingly. Besides the economic crisis, the parallel decline of world commodity prices for a variety of crops put further pressure on rural households engaged in agricultural production. As a consequence from these developments, in the late 1990s rural households had to make important decisions on what types of crops to plant, what type of livestock to keep/acquire and whether or how to diversify into alternative income generating activities. Also, the crisis led to a reversal of migration and structural change processes, leading to higher household sizes and a greater prevalence of agricultural activities.

In 2001 recovery from the crisis was already under way in rural Sulawesi. Furthermore, income growth continued substantially between 2001 and 2006 as depicted in Table 1 below.

[insert Table 1]

While in 2001 monthly per capita household income was at 95,076 Rupiah, it increased about 25 percent to 119,586 Rupiah in real terms in 2006. Nonetheless, income growth was not continuous during this period. From 2001 until 2004 households experienced even a decline in per capita income attributable to the restructuring of cropping patterns. Faced with the economic crisis and strong declines in world coffee prices in the late 1990s, households in the STORMA region gradually switched their main cash crop production from coffee to cocoa[10]. In 2004 households were still in the middle of this transformation

[10] Studies from the early 2000s on other coffee growing regions in the world, report similar observations. See, for instance, Bussolo et al. (2007) for a case study on Ugandan households.

process. In particular, cocoa trees had not reached full maturity for production in most cases. Consequently, income from agricultural self-employment and the demand for agricultural wage labor as reflected in declining agricultural wage incomes declined from 2001 to 2004. After 2004 agricultural production increased significantly and in 2006 both agricultural self-employment and agricultural wage incomes show peak values for the whole study period.

The shift to a different cash crop was highly rewarding for rural households. First of all, as Table 2 shows, households harvest more physical output per area (kg/are) with cacao compared to coffee, while at the same time mean farm gate prices per kg of cocoa are clearly above those for coffee. These two things together lead to cocoa yields that are about 90 percent above those from coffee[11]. Moreover, Table 2 demonstrates that increases in real incomes from cocoa between 2001 and 2006 are primarily due to increases in the scale of production (area under cultivation and output per are). In 2001 115 out of the 256 households were engaged in cocoa cultivation while in 2006 already 174 households derived agricultural self-employed income from cocoa. Accordingly the average area of agricultural land devoted to cocoa cultivation increased by about 60 percent. At the same time output of cocoa per are increased due to the circumstance that more cocoa trees reached its production stage. While price effects partly explain the increase in income from cocoa in the period 2001-2004, the price difference of cocoa between 2001 and 2006 is rather small and therefore does not explain much of the observed increase in cocoa income.

[insert Table 2]

A closer look at the composition of incomes from agricultural self-employment further reveals that rural households derive incomes mainly from crops with a minor part coming from other sources like livestock and gathering[12]. Moreover, households gain incomes from perennial and annual crops rather equally. While the income from annual crops, like rice and maize, rather reflects household preferences for food security, it becomes clear from Table 3 that particularly the growth in incomes from perennial crops helps in explaining the growth of agricultural self-employment income with cocoa constituting about 90 percent of perennial crop income.

[insert Table 3]

In contrast to agricultural incomes, non-agricultural incomes do not seem to have been affected much by the shift from coffee to cocoa and grew steadily in accordance with the growing national economy of the post-crisis period. As shown in Table 1

[11] The true difference in terms of outputs is likely to be even larger since only productive coffee plants were still left on the plots, while cocoa plants were sometimes not yet ready for full production.

[12] The decline in incomes from gathering follows from the improvement in economic conditions. Gathering forest products like rattan is time-intensive and dangerous. It is only done by households in times of greatest needs.

non-agricultural self-employed income nearly doubled between 2001 and 2006 and non-agricultural wage income increased by about 50 percent in the same period[13]. In this context, non-agricultural income has become the principal income source for several households in the region. The income source transition matrix in Table 4 shows that the number of households who receive more than half of their income from non-agricultural activities rose from 41 to 54 between 2001 and 2006. Meanwhile, the number of households that generate most of their income from agriculture decreased from 209 to 189[14].

[insert Table 4]

Engagement in non-agricultural activities proved to be strongly beneficial. Table 4 shows that already in 2001 households with mainly non-agricultural self-employed incomes were best off, followed by non-agricultural wage, agricultural self-employed and agricultural wage households. Moreover, the income gap between non-agricultural and agricultural households further broadened in the post-crisis period, when non-agricultural self-employed households' mean incomes rose by 23.8 percent, non-agricultural wage households' incomes by 43.5 percent, agricultural self-employed households' incomes by 18.1 percent and agricultural wage households' incomes by 16.6 percent.

Although engagement in non-agricultural activities seems to be highly rewarding in order to raise incomes of rural households, gaining access to high-productive non-agricultural income sources strongly depends on a household's income and wealth situation. Dividing the 2001 'cumulative household per capita income distribution' into quintiles, Table 5 shows that in particular households situated in the upper two quintiles receive incomes from non-agricultural sources. While the number of households engaged in some sort of non-agricultural activity increased across quintiles from 2001 to 2006, the share of income derived from these sources is much higher for richer households and only increased for households in the richest three quintiles. In contrast, given the increase of average household incomes across all five quintiles, the share of agricultural self-employed income increased remarkably for poorer households, despite a higher number of poor households being engaged in non-agricultural activities. Thus, the principal source of income growth observed between 2001 and 2006 differs between initially poor and richer households. Income growth among poor households can be primarily attributed to increases in agricultural self-employed income due to increases in crop output, shifting cultivation patterns and favorable price developments, while richer households in addition seem to have benefited from strong increases in non-agricultural incomes.

[insert Table 5]

[13]The share if non-agricultural income on total household income is comparatively small for an Asian region. Reardon et al. (2001) report that non-agricultural income accounts on average for approximately 40 percent of rural incomes in Latin America, 45 percent in in Africa and 35 percent in Asia. Since the STORMA region is rather remotely located, we consider our estimates (27 percent) to be in line with these findings.

[14]Non-agricultural self-employment in the STORMA region consists mainly of small trading shops, restaurants (warung) and small-scale handicrafts. Wage employment in the non-agricultural sector is available in terms of work in the construction and public sector.

Besides its effect on incomes, income diversification, and cropping patterns the crisis manifested itself in the composition of households. Sumarto, Wetterberg, and Pritchett (1999) and Frankenberg, Smith and Thomas (2004) report that male family members often returned back to their families from urban to rural areas. Once the economic situation improved, well-educated young men were likely to migrate back to the urban areas. Moreover, the growing labor demand in agriculture but particularly in the non-agricultural sector might have led young men to leave the household. This can explain why we observe in Table 1 declining household sizes over the study period which are accompanied by a decrease in the number of men in the households and lowered education levels of those left behind. Clearly, the post-crisis period led to a return to the normal patterns of rural-urban migration.

Table 1, Table 2 and Table 3 provide further insights into the reasons for the observed growth in rural incomes. First of all, the area of land devoted to agriculture in the sample remained roughly constant between 2001 - 2006. Thus, income growth is not caused by higher land availability. Secondly, the growth in the area of cocoa mirrors the reduction in the area devoted to coffee production. Hence, we do not observe much change in the average area devoted to the production of cash crops. Accordingly, we observe no difference in the area devoted to rice which is the main perennial crop in research area. Thirdly, we do not find any evidence for improvements in agricultural technology. Both of our proxies (share of rice fields with technical irrigation systems and expenditures on fertilizer/pesticides) remain rather unchanged. On the other hand improvements in the local infrastructure (Distance to paved roads and share of households connected to electricity) can be found. Lastly, we can rule out from the tables above that changes in the production of livestock or in the endowment with human capital have induced the observed income growth.

4.2 Determinants of Rural Incomes

We start by estimating simple OLS income regressions as specified under equation (1). The obtained estimates for each of the three cross-sections (Table 6) confirm that non-agricultural income, both as non-agricultural wage and non-agricultural self-employed income, is strongly associated with higher income levels. Coefficients on these two variables turn out to be significant in ten out of twelve cases at the 5 percent level. Taking into account that the reference category is agricultural wage income, the coefficient on agricultural self-employed income is positive in four out of six cases and highly significant for 2004. However, effects of agricultural self-employment on per-capita incomes are not only captured by the sector dummy variable, but also by the variables on agricultural land and the area of cocoa. Controlling for the total area of land suitable for agriculture, the ability to shift into cash crops, cocoa in our case, has a positive and significant impact on per-capita incomes[15]. Furthermore, the ability of households to invest and produce efficiently, as partially proxied by the value of assets a household owns, influences incomes positively; note that this variable is potentially endogenous, an issue that

[15]The insignificant value on the area of cocoa coefficient in the 2001 round is most likely to be attributable to the circumstance that some cocoa areas were not yet in full production.

we address below[16]. Regarding socio-economic individual and household characteristics, we find that the sex of the household head, experience, as modeled with the age and age squared terms of the household head, and the highest education level available within a household do not seem to affect rural income levels[17]. In contrast, a high household size and a low number of men in a household are associated with lower income levels, which support the contention that urban-rural migration was one transmission channel of the crisis to rural areas; whether households benefited from the recovery by being able to send people again to urban areas appears to be an important factor driving income levels in the post-crisis period[18]. It is worth noting that in the 2004 survey wave the education coefficient is both positive and significant. Moreover, the size of the coefficients on non-agricultural employment is highest in this round. These results are in line with the findings from the previous section which showed that the transformation process was at its peak in 2004, accompanied by a decline in agricultural incomes and a simultaneous rise particularly in non-agricultural wage incomes.

[insert Table 6]

The results obtained from Table 6 are very stable and similar among each of the three cross-sections. Moreover, we present different estimates for village fixed effects (Columns 1-3) and kecamatan (sub-district) fixed effects (Columns 4-6). As depicted in Table 6 both specifications show very similar results in terms of the magnitude, direction and significance level in the various coefficients. In the subsequent analyses we use the 'kecamatan-specification' for the following two reasons: First of all, we save degrees of freedom for the estimation of other coefficients and most importantly the use of the 'kecamatan-specification' will allow us to use the distance to Palu as an instrument in the respective panel specifications[19].

Besides, as pointed out before, the estimation of equation (1) can suffer from unobserved heterogeneity or endogeneity issues leading to biased and inefficient estimates. To address issues of unobserved heterogeneity we assume the error component specifica-

[16]The selection of covariates into (1) was based on theoretical and empirical considerations. In alternative specifications we included variables on social capital, migration, vocational training, access to extension officers and access to credits. None of these variables showed significant values in any of the three rounds and were therefore excluded. Moreover, the excess to credit variables were highly correlated with the asset value a household owns which resulted in problems of multi-collinearity.

[17]Obtaining an insignificant value on the education variable is not uncommon in the relevant literature. Moreover, the sign of the education coefficient on rural incomes have even been found to be negative in some cases, e.g. Adams (1995) on the value of wheat, sugarcane, and rice production in Pakistan or Rosegrant and Evenson (2001) on total factor productivity in India. In our case, the correlation of the education variable with non-agricultural activities and the value of assets, is likely to cause the observed results.

[18]The negative and significant effect of household size on income levels remains even when using adult equivalence scales. In alternative specifications we run the same regressions using adult equivalence scales as provided in Deaton and Zaidi (1999) and results did not change in an important way.

[19]Since we use distance to the next road as an explanatory variable, a measure for local infrastructure, we would run into multi-collinearity problems when using the village fixed effects specification together with household fixed effects and the distance to Palu variable.

tion as summarized under (2) and (3)[20]. The Hausman test rejects the null hypothesis of no systematic differences in the coefficients, which indicates that the random effects estimator can be inconsistent. Yet, this result might be driven by the scarcity of within-variation in our data given that the number of time periods is limited to three. Hence, we find it adequate to compare the outcomes of several panel estimators in Table 7.

[insert Table 7]

Results from Table 7 (columns 2, 3, and 4) by and large confirm the findings from the cross-sectional regressions. The pooled OLS, RE, and FE estimators all yield a high degree of overlap in the coefficients' sign and significance and show fairly comparable magnitudes in the crucial variables. In particular, the robust ordering of the economic sectors in terms of its importance to generate rural incomes remains. Estimation over all three periods, controlling for individual- and time-specific effects, shows that households mainly engaged in the non-agricultural wage sector earn most, followed by non-agricultural self-employed, agricultural self-employed and agricultural wage households. In addition, positive and significant coefficients for the area of cocoa re-confirm that agricultural transition towards higher yielding cash crops rewarded agricultural households[21].

In a further step we try to control for reversed causality. Therefore we apply instrumental variables (IV) using two-stage least squares (2SLS) techniques. Analogously to the panel techniques presented above, we use a FE and a random effects-2SLS specification Baltagi (2005).

The covariates that most probably present a violation of the exogeneity assumption on the right hand side of our model are the variables referring to household wealth, measured in terms of value of assets, and to a household's engagement in non-agricultural self-employment. On the one hand, higher wealth will help a household to invest and produce more efficiently, as stated before, and therefore contribute to higher income. On the other hand, it seems plausible that higher income levels will lead to higher wealth. A similar reasoning applies to non-agricultural self-employment. While access to this additional source of income unambiguously increases household incomes, it seems that especially richer households have access to this source.

In order to address these issues we use lagged values of each of the two variables as instruments. However, these two variables alone might not make a strong exogenous prediction, especially since they follow a relatively persistent pattern over time. Therefore, as discussed above, we include the distance to Palu as an additional identifying

[20] The LM test indicates that after pooling the three waves, residuals of the OLS estimation are not i.i.d. which leads us to consider the random and fixed effect model under (3). However, results of the pooled OLS estimation are presented for comparisons.

[21] We also test for problems of heteroskedasticity and serial correlation. We find that heteroskedasticity does not present an important problem to our data. Nevertheless, we apply robust t-statistics. Allowing for an AR(1) error term does not change our results either, which indicates that serial correlation is not inherent in our data.

instrument[22]. Columns 5 and 6 of Table 7 report the results of the FE- and RE-2SLS regressions[23]. The obtained estimates widely confirm our previous findings: First of all, the magnitude and direction of the coefficients on the respective income sectors does not alter much compared to the models that do not control for simultaneous causality. Second, coefficients on the area of cocoa stay very stable in magnitude and significance across the different estimators when we control for endogeneity.

The results from the analysis on the determinants of rural incomes in the STORMA region demonstrate that engagement in non-agricultural incomes explains an important part of differences in incomes between rural households controlling for a variety of individual and household characteristics. Besides the importance of non-agricultural incomes, our analysis reveals that households who are able to diversify agricultural production into cash crops generate comparatively higher incomes. In addition, a higher wealth stock of households, smaller household sizes, and a higher number of men are found to be beneficial for higher incomes. The results obtained are remarkably stable over all three survey rounds and across different specifications. Utilizing the panel structure of the data set in combination with appropriate panel techniques to take endogeneity issues into account does not alter the general results obtained from the cross-sectional OLS regressions on (1). In fact, the size of coefficients and its significance level remains remarkably stable.

4.3 Explaining Income Growth in the post-crisis period

Complementing the analysis of rural income determinants, we explicitly investigate which factors have been most responsible for causing the observed income growth process in the period 2001-2006. For this purpose, a more thorough understanding of the role of households' initial wealth endowment, sectoral activities and land use changes on subsequent income growth is of strong importance. The chosen statistical approach rests upon the estimation of micro-growth regressions, as described in (4).

Table 8 below shows the respective estimation results (column 1, 2, and 3) covering three different time periods (2001 to 2006, 2001 to 2004, and 2004 to 2006). Several interesting findings emerge. First, demographic effects affect income dynamics considerably. In particular, small initial household size and small dependency ratios as well as reductions in both have helped households improve their incomes. This suggests that households that were able to benefit from the opportunities afforded by the economic recovery through migration experienced significant income growth. Moving into non-agricultural activities, partly a reversal of crisis-induced trends and partly a longer-term development, as well as a higher wealth endowment are associated with higher income growth, ceteris paribus. The size and significance levels of the respective coefficients are robust over all three time periods. Moreover, households who stayed in non-agricultural

[22]The instruments used seem to fulfill the necessary conditions of relevance (on the first stage) and uncorrelatedness (with the error term on the second stage). See also Hansen test results in Table 7.

[23]Although the statistical tests indicate that we can rely on the RE assumption, we prefer to present results on FE and RE specifications, since from an Economists point of view the RE assumption might still be violated. In both cases, the results are very similar leading to the same conclusions.

employment fared on average better than their agricultural counterparts at least in the period 2001-2004 and the entire period 2001-2006[24].

[insert Table 8]

Likewise, cocoa cultivation does not only have an effect on income levels, but also is a driver of the observed income growth process. Both the amount of area under cocoa cultivation as well as the growth in cocoa area itself seems to have a positive and significant effect on households' income growth. In addition, it appears that households who were better educated and worked as self-employed managed to secure largest income gains, ceteris paribus.

The results from the analysis of the income growth process point to the same factors that have been identified as determining the levels of income in the STORMA area. In particular, the importance of household composition, of the non-agricultural sector, of the ability to produce cash-crops, and of the wealth of households has been confirmed as key factors in the dynamic process. Thus these factors do not only explain income differentials across rural households, but also help to explain success or failure of households to improve their livelihood during the post-crisis recovery period.

4.4 Lessons for all of rural Indonesia

In a last step we examine whether the findings obtained from STORMA can be generalized to a larger geographical setting covering substantial parts of rural Indonesia. In a first test, we compare STORMA data with descriptive statistics for different regional aggregates based on SUSENAS (Table 9), we find that STORMA households compare favorably with rural households in Indonesia except to those residing on Java. Rural Javanese households tend to have lower household sizes, lower educational attainments, but a much higher share of total income coming from non-agricultural sources than the rest of rural Indonesia which might be due to the much higher degree of urbanization and the higher population density on the island. Moreover, agricultural self-employment is much less important on Java compared to the rest of Indonesia. In contrast, agricultural wage labor on Java seems to play a much more important role than in the rest of rural Indonesia, which might be due to larger farm sizes and the existence of large agricultural corporations.

[insert Table 9]

Moreover, Table 9 shows that for a few variables small differences between STORMA and the regional aggregates on Central Sulawesi, Sulawesi, and Indonesia except Java exist. Household sizes together with the number of men in a household are higher in the STORMA region than in the different regional SUSENAS aggregates. This is likely

[24] The coefficient on wage labor is positive and significant for the period 2001-2004. Since agricultural wage labor declined in this period, this effect is clearly attributable to the growth of outside-agricultural wage employment as described in section 3.1.

to mirror the circumstances that STORMA households, due to their proximity to the rainforest and lower integration into urban areas, are on average poorer and embedded in a more traditional society, and therefore tend to have larger households. In addition we observe declining household sizes in STORMA over time which is likely related to the reversal of migration flows associated with the economic recovery[25].

Bearing in mind that household characteristics and income levels for different regional aggregates of the reduced SUSENAS sample compare favorably with STORMA, we continue by investigating the determinants of rural incomes for the different regional settings. Unfortunately, we cannot estimate equation (1) due to the lack of the set of covariates described with Ψ in SUSENAS. Therefore, we are left with the estimation of the reduced form in equation (5). Results on (5) are depicted in Table 10 for STORMA 2001 and SUSENAS 2002 rounds respectively.

[insert Table 10]

Comparing OLS estimates of SUSENAS with STORMA shows that the effects of most of the included covariates are very similar. Key determinants of the income generating process are in both data sets a subset of the household characteristics, in particular household size and composition (captured by the number of men in a household and the dependency ratio) and the education variable, all of which are statistically significant and take signs as expected from economic theory. Furthermore, engagement in the specific economic sectors plays an important role whereby households that are predominantly engaged in the non-agricultural sector seem to do much better than households deriving most of their incomes from the agricultural sector. We therefore conclude that the same functional relationship seems to exist in most of rural Indonesia except Java[26].

Similarly to the estimation of (1), the estimation of (5) can lead to biased and inefficient estimates in the presence of endogeneity. While the investigations in section 4.2 showed that in our case the cross-sectional income regressions (1) do not seem to suffer much from issues of reversed causality or omitted variable bias, this is less clear for the estimation of (5). In particular, we know that we have to leave out the set of variables included Ψ which will affect parameter estimates of β.

Moreover, leaving out Ψ makes the interpretation of β more difficult. On the one hand estimates of β might now be biased simply because of leaving out important variables. On the other hand, changes in β might indicate that we obtain an estimate of the aggregated direct and indirect effect of the particular covariate and the variables left out in Ψ. To assess the effect of switching from (1) to (5) we re-estimate STORMA regressions.

[25] Our data from SUSENAS on Central Sulawesi and Indonesia suggests that most of the back migration from rural to urban areas occurred between 1999 and 2002. However, given the remoteness of STORMA villages and the high economic growth rates in the provincial capital Palu, we observe continuing rural-urban migration in STORMA in the 2004-2006 period.

[26] In the regional SUSENAS specifications we observe that the significance level of a variety of covariates improves, when going to higher regional aggregates. This points to the circumstance that sample size issues are responsible for the observed differences in significance levels between the distinct SUSENAS specifications and STORMA.

The results for 2001 and 2002 are depicted in column 1-3 in Table 10 from which three key messages emerge[27]. First of all, the exclusion of Ψ leads to a strong reduction in the overall explanatory power, between 2 and 14 percentage points in the adjusted R-squared[28]. Secondly, the effect of education on per-capita household income strongly increases in accordance with a higher significance level. Hence a substantial part of the effect of education in these reduced form regressions seems to operate through the omission of Ψ, particularly through asset ownership which had the largest impact out of the four variables included in Ψ.

Since common findings suggests that better educated households are wealthier and that wealthier households obtain higher education levels, we think that the change in the education coefficient rather reflects the incorporation of direct and indirect effects of education on per-capita income levels. Provided the same or at least similar underlying income generating process between STORMA and SUSENAS, results from SUSENAS for higher regional aggregates therefore seem to overstate the direct effect of education on income. Thirdly, the coefficient on agricultural self-employment becomes positive, larger and significant for each of the three rounds. Therefore not controlling for the potential of rural households to diversify into cash crops and to overcome capital constraints, leads to an unambiguously positive effect of agricultural self-employment on household income. On the other hand this finding implies that an important difference between STORMA and other Indonesian regions exists. Since agricultural self-employment is estimated to be inferior compared to agricultural wage employment in the multivariate context based on SUSENAS, either a much stronger correlation between income from agricultural self-employment and other variables included in X prevails in other areas of Indonesia or agricultural productivity in the rest of the rural economy is substantially lower than in the STORMA area.

Comparing STORMA and SUSENAS we find that a very similar income generating process seems to exist in all over rural Indonesia, the exception being rural Java. Following this result we study the effect of omitted variables on the estimation of (5) which is the best income regression possible for data coming from SUSENAS. Our results indicate that the SUSENAS specification particularly overstates the direct effect of education on household income. Moreover, our results show that an interesting difference between SUSENAS and STORMA households exist concerning the importance of agricultural self-employment and agricultural wage employment. While for STORMA households, agricultural self-employment is clearly superior over agricultural wage employment, this relationship reverses for SUSENAS households.

5 Conclusion

Drawing on a new household panel data set for Central Sulawesi collected in the years 2001, 2004 and 2006 we find that both the growth in, and the level of, rural incomes in

[27]Table A2 in the appendix provides results for STORMA 2004, STORMA 2006 and SUSENAS 2005.

[28]Corresponding F-Tests confirm this result. When comparing (1) to (5) for each cross-section the validity of (5) is rejected on the 1 percent significance level.

the post-crisis period, can be explained by a common set of factors.

Firstly, in the wake of the general recovery of the Indonesian economy, non-agricultural household incomes increased constantly over the considered period of time. While we observe that more and more households derive part of their incomes from this sector, significant entrance barriers for poorer households to become engaged in profitable non-agricultural activities remain. Thus, in contrast to Suryahadi, A., Suryadarma, D. and Sumarto, S (2009), we do not observe a significant link between the observed recent growth in the rural non-agricultural sector in Indonesia with declining poverty rates in rural areas.

Secondly, rural income dynamics were partly driven by a reversal of demographic trends in the post-crisis period, leading to smaller households and out-migration from rural areas. Improvements in rural incomes are partly the result of falling household sizes.

Thirdly, we find that incomes from agriculture still constitute the financial backbone of rural households across the entire income distribution. Moreover, in contrast to the majority of the existing literature on rural Indonesia, we observe even strongly growing incomes from agricultural production which contributed to the observed increases in total household incomes. Consequently, the principal source of income growth between 2001 and 2006 differs between initially poor and rich households. Income growth among poor households can be primarily attributed to increases in agricultural self-employed income while richer households in addition could benefit from strong increases in non-agricultural incomes.

Investigating the reasons behind the unexpected high growth rate in agricultural incomes, we show that incomes from agriculture increased due to a shift in cropping patterns, particularly cash crops, in our case from coffee to cocoa. Higher output volumes and more favorable commodity prices for cocoa than coffee help to explain most of the increase in agricultural incomes. The change from coffee to cocoa instructively shows how switching cropping patterns can be a crucial strategy in order to achieve income growth particularly for the poorer section of the rural population. Moreover, it shows that the observed increases in the value of agricultural production at the regional level in Indonesia can partly be explained by local innovations and experimentation in the choice of crops, and not only by forest clearing, increases in world commodity prices or increases in production efficiency.

The results presented above are robust to various econometric specifications. We find that estimates obtained from simple cross-sectional OLS regressions do not change much when exploiting the panel structure of the data in order to control for individual unobserved heterogeneity and reversed causality in household wealth and non-agricultural self-employment. In a further step we examine whether results from STORMA hold lessons for a larger regional context. Extending our previous investigations to the national level by analyzing data from SUSENAS, we find the following: (a) The basic income relationships obtained from STORMA can be found all over rural Indonesia, the exception being rural Java which depicts a much larger share of non-agricultural income sources than the other areas in Indonesia. (b) One important difference between STORMA and SUSENAS concerns the role of the agricultural self-employed sector. While this sector has been an important element towards income growth in the STORMA area, its effect on rural incomes seems to be smaller in other parts of rural Indonesia. (c) Studying the impact of omitted variables on cross-sectional income regressions based on SUSENAS we show with the help of STORMA that most of the effect of neglecting to explicitly control for household wealth and the ability to diversify into cash crops operates through the education variable. Therefore, results from SUSENAS are very likely to overstate the direct effect of educational attainment on income and income growth on rural Indonesian households.

While we are confident about our main findings, we should also point to limitations of our assessment. The comparatively small sample size in STORMA affects the standard errors of the estimated regression coefficients which makes the evaluation of significance levels sometimes difficult. Moreover, since the panel data set was collected between 2001 and 2006, only a later part of the transformation process from coffee to cocoa production could be observed. Therefore, the effect of switching from coffee to cocoa is likely to represent only a partial effect. For instance, higher incomes from cocoa than coffee could have lifted the capital constraint of households already before 2001 which then enabled them to or to engage in non-agricultural activities.

Additionally, the generalization of our findings to other rural areas in Indonesia is constrained by data availability issues in SUSENAS. Since SUSENAS does not allow to: a.) decompose agricultural self-employed income into its sub-components (perennial crops, annual crops, livestock income, etc.) and b.) know the specific type of crops a household grows (coffee, cocoa, rice, etc.), the scope and potential for improving cropping patterns in other areas of rural Indonesia is difficult to assess. However, other examples from Indonesia's recent history (shifting from rubber to palm oil production) seem to underscore the relevance and scope for improving rural incomes by changing cash crop patterns.

References

Adams, R. H. "Agricultural Income, Cash Crops, and Inequality in Rural Pakistan." *Economic Development and Cultural Change* 43, April: (1995) 467–491.

Baltagi, B. H. *Economic Analysis of Panel Data.* Chichester: Wiley - Third Edition, 2005.

Barrett, C.B., and M. Aboud. "Income diversification, poverty traps and policy shocks in Côte d'Ivoire and Kenya." *Food Policy* 26, 4: (2001) 367–384.

Basu, K., A. Narayan, and M. Ravallion. "Is literacy shared within households? Theory and evidence for Bangladesh." *Labour Economics* 8, 6: (2001) 649–665.

BPS. "Poverty Rate in Indonesia 2007." Technical report, Badan Pusat Statistik, 2007.

Bussolo, M., O. Godart, J. Lay, and R. Thiele. "The impact of coffee price changes on rural households in Uganda." *Agricultural Economics* 37, 2-3: (2007) 293–303.

Cherdchuchai, S., and K. Otsuka. "Rural income dynamics and poverty reduction in Thai villages from 1987 to 2004." *Agricultural Economics* 35, s3: (2006) 409–423.

Deaton, A., and S. Zaidi. "Guidelines for constructing consumption aggregates for welfare analysis." *World Bank Policy Research Working Paper* 135.

Dewi, S., B. Belcher, and A. Puntodewo. "Village economic opportunities, forest dependence, and rural livelihoods in East Kalimantan, Indonesia." *World Development* 33, 9: (2005) 1419–1434.

Elbers, C., and P. Lanjouw. "Intersectoral Transfer, Growth, and Inequality in Rural Ecuador." *World Development* 29, 3: (2001) 481–496.

Estudillo, J.P., Y. Sawada, and K. Otsuka. "The green revolution, development of labor markets and poverty reduction in the rural Philippines." *Agricultural Economics* 35, s3: (2006) 399–407.

Fan, S., A. Gulati, and S. Thorat. "Investments, subsidees and pro-poor growth in rural India." *Agricultural Economics* 39, 2: (2008) 163–170.

Fan, S., L. Zhang, and X. Zhang. "Reforms, investment and poverty in rural China." *Economic Development and Cultural Change* 52, 2: (2004) 395–421.

Fields, G.S., P.L. Cichello, S. Freije, M. Menéndez, and D. Newhouse. "For Richer of for Poorer? Evidence from Indonesia, South Africa, Spain and Venezuela." *Journal of Economic Inequality* 1: (2003) 67–99.

Frankenberg, E., J. Smith, and D. Thomas. "Economic Shocks, Wealth and Welfare." *Journal of Human Resources* 38, 2: (2004) 280–321.

Lanjouw, J.O., and P. Lanjouw. "The rural non-agricultural sector: Issues and evidence from developing countries." *Agricultural Economics* 26, 1: (2001) 1–23.

McCulloch, N., J. Weisbrod, and C.P. Timmer. "Pathways out of poverty during an economic crisis: An empirical assessment of rural Indonesia." *World Bank Policy Research Paper* 4173.

Micevska, M., and D.B. Rahut. "Rural nonfarm employment and incomes in the Himalayas." *Economic Development and Cultural Change* 57, 1: (2008) 163–193.

Nargis, N., and M. Hossain. "Income dynamics and pathways out of rural poverty in Bangladesh." *Agricultural Economics* 35, s3: (2006) 425–435.

Ravallion, M., and G. Datt. "How important to India's poor is the sectoral composition of economic growth?" *World Bank Economic Review* 10, 1: (1996) 1–25.

———. "Farm productivity and rural poverty in India." *Journal of Development Studies* 34, 4: (1998a) 62–85.

———. "Why have some Indian states done better than others at reducing rural poverty?" *Economica* 65, 2: (1998b) 17–38.

———. "Why has economic growth been more pro-poor in some states of India than in others?" *Journal of Development Economics* 68, 2: (2002) 381–400.

Ravallion, M., and M. Lokshin. "Lasting Impacts of Indonesia's Financial Crisis." *Economic Development and Cultural Change* 56, 1: (2007) 27–56.

Reardon, T., J. Berdegue, and G. Escobar. "Rural nonfarm employment and incomes in Latin America: Overview and Policy Implications." *World Development* 29, 3: (2001) 395–409.

Rosegrant, M.W., and R.E. Evenson. "Agricultural Productivity and Sources of Growth in So." *World Development* 29, 3: (2001) 395–409.

Sumarto, S., A. Wetterberg, and L. Pritchett. "The social impact of the crisis in Indonesia: Results from a nationwide Kecamatan survey." *SMERU Working Paper* 29.

Suryahadi, A., and S. Sumarto. "Poverty and vulnerability in Indonesia before and after the economic crisis." *Asian Economic Journal* 17, 1: (2003) 45–64.

Suryahadi, A., D. Suryadarma, and S. Sumarto. "The effects of location and sectoral components of economic growth on poverty: Evidence from Indonesia." *Journal of Development Economics* 89: (2009) 109–117.

Suryahadi, A., D. Suryadarma, S. Sumarto, and J. Molyneaux. "Agricultural Demand Linkages and Growth Multiplier in Rural Indonesia." In *Rural Investment Climate in Indonesia*, edited by N. McCulloch. Singapore: Institute of Southeast Asian Studies, 2008.

Thomas, D., K. Beegle, E. Frankenberg, B. Sikoki, J. Strauss, and G. Teruel. "Education in a crisis." *Journal of Development Economics* 74: (2004) 53–85.

Timmer, C.P. "Farmers and markets: The political economy of new paradigms." *American Journal of Agricultural Economics* 79, 2: (1997) 621–627.

———. "The road to pro-poor growth: The Indonesian experience in regional perspective." *Bulletin of Indonesian Economic Studies* 40, 2: (2004) 177–207.

WB. "1: Making the new Indonesia work for the poor.", 2006a. The World Bank, Washington, D.C.

———. "2: Indonesia: Revitalizing the rural economy.", 2006b. The World Bank, Washington, D.C.

———. "3: Indonesia: Rural investment climate assessment report.", 2006c. The World Bank, Washington, D.C.

———. "World Development Report: Agriculture for Development.", 2008. The World Bank, Washington, D.C.

Woolard, I., and S. Klasen. "Determinants of Income Mobility and Household Poverty Dynamics in South Africa." *Journal of Development Studies* 41, 5: (2005) 865–897.

Zeller, M., S. Schwarze, and T. van Rheenen. "Statistical Sampling Frame and Methods used for the Selection of Villages and Households in the Scope of the Research Program on Stability of Rainforest Margins in Indonesia." *STORMA Discussion Paper Series* 1: (2002) STORMA, University of Goettingen.

Table 1: Summary Statistics (Means) on STORMA

	STORMA '01	STORMA '04	STORMA '06
Household Size	5.42	5.19	4.56
	(2.00)	(1.96)	(1.93)
Age of HH Head	43.8	46.5	48.1
	(14.0)	(14.1)	(13.6)
Sex of HH Head	0.95	0.93	0.91
	(0.21)	(0.26)	(0.29)
Dependency Ratio	0.7	0.75	0.74
	(0.58)	(0.60)	(0.70)
Number of Men	1.85	1.86	1.37
	(1.03)	(1.10)	(0.87)
Years of Schooling of HH Head	6.77	6.79	6.78
	(3.36)	(3.37)	(3.35)
Max. Years of Schooling of a HH Member	8.68	8.67	8.43
	(2.87)	(2.89)	(2.87)
Total Per-Capita Income	95,076	93,187	119,586
	(106,003)	(131,061)	(123,391)
Agricultural Self-employed Income, p.c.	60,266	52,751	68,005
	(68,679)	(77,544)	(81,073)
Agricultural Wage Income, p.c.	8,319	4,820	8,200
	(17,016)	(11,164)	(18,353)
Non-Agricultural Self-employed Income, p.c.	10,906	11,062	19,678
	(64,371)	(40,068)	(68,299)
Non-Agricultural Wage Income, p.c.	15,583	23,652	22,659
	(46,465)	(102,055)	(63,891)
Gini Index (income, p.c.)	0.49	0.54	0.48
Area Owned (are)	202.4	195.55	208.26
	(215.16)	(205.23)	(204.13)
Area Cocoa (are)	50.57	77.12	81.43
	(91.70)	(103.25)	(99.37)
Distance to paved road (hours)	0.95	0.85	0.73
	(2.76)	(2.65)	(2.46)
Access to electricity	0.66	0.66	0.71
	(0.48)	(0.48)	(0.45)
Expenditures on fertilizer/pesticides	12,333	12,590	9,975
	(24,072)	(36,434)	(19,474)
Share of rice fields without irrigation	0.57	0.57	0.57
	(63.2)	(63.2)	(63.2)
Share of rice fields with simple or Semi-technical irrigation	0.32	0.32	0.32
	(46.6)	(46.6)	(46.6)
Share of rice fields with technical irrigation	0.11	0.11	0.11
	(31.76)	(31.76)	(31.76)
Value of assets	2,540,766	2,711,764	4,014,757
	(6,793,056)	(10,000,000)	(8,533,662)
Value of livestock	1,375,301	1,331,491	1,259,397
	(2,571,215)	(5,738,906)	(2,491,986)
N	256	256	256

All monetary values are real in Indonesian Rupiahs with base year 2001 and use regional CPIs provided by BPS. Incomes are monthly. Standard deviations in parentheses.

Table 2: Cocoa and coffee production

	STORMA 2001	# of obs.	STORMA 2004	# of obs.	STORMA 2006	# of obs.
Cocoa						
Output (kg/are)	0.19	115	0.20	132	0.30	174
Price (per kg)	5,000	115	6,254	132	5,307	174
Yield (IDR/are)	964	115	1,307	132	1,596	174
Area cocoa (are)	50.57	256	77.12	256	81.43	256
Coffee						
Output (kg/are)	0.14	97	0.13	60	0.20	45
Price (per kg)	4,500	97	2,779	60	4,189	45
Yield (IDR/are)	541	97	301	60	838	45
Area coffee (are)	47.07	256	21.00	256	14.68	256

Monetary values are real Indonesian Rupiahs with base year 2001 and use the provincial CPI for Palu provided by BPS. Output, price and yields are median values per month based on all farmers active in the particular crop

Table 3: Agricultural Diversification - Mean Incomes of Self-employment

Sector	STORMA '01	STORMA '04	STORMA '06
Livestock	6,190	3,350	5,026
Gathering	10,527	4,249	2,931
Cropping	44,752	46,549	60,048
-Annual crops	21,859	18,588	26,146
-Perennial Crops	22,892	27,961	33,901
-Cocoa	13,278	24,280	28,307
-Coffee	5,405	1,752	2,861
N	256	256	256

All values are monthly in per-capita terms and real Indonesian Rupiahs with base year 2001. Provincial CPIs for Palu were provided by BPS.

Table 4: Income Sector Transition Matrix

			STORMA 2006 Agric. Self-employed		Agricultural Wage		Non-Agric. Self-employed		Non-Agric. Wage		Mixed	
STORMA 2001	Starting Income	# of obs.	Income	# of obs.	Income	# of obs.	Income	# of obs.	Income	# of obs.	Income	# of obs.
Agricultural Self-employed	87,580	180	105,969	135	65,992	14	198,022	12	180,752	12	87,955	7
Agricultural Wage	52,744	29	76,603	17	52,292	4	423,417	1	81,924	4	72,583	3
Non-Agric. Self-employed	178,477	15	153,616	6		0	243,471	4	142,350	5		0
Non-Agric. Wage	129,681	26	72,397	8	35,164	1	224,819	2	239,930	13	87,608	2
Mixed	163,616	6	120,554	4		0	195,338	1		0	72,661	1
		256	103,448	170	61,486	19	220,927	20	186,104	34	83,178	13

Note: Incomes are monthly, real Indonesian Rupiahs with base year 2001 and provincial CPI for Palu.

Table 5: Income Quintile Statistics

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
2001					
Av. Total Per-capita income 01	13,364	40,006	67,362	108,628	249,039
Share Agricultural Wage (AW) 01	0.19	0.19	0.16	0.11	0.046
Share Agricultural Self (AS) 01	0.7	0.61	0.72	0.68	0.63
Share Non-agricultual Wage (NW) 01	0.043	0.11	0.08	0.17	.19 .
Share Non-agricultural Self 01 (NS)	0.06	0.08	0.03	0.03	0.13
# of Households in AW 01	23	25	26	22	13
# of Households in AS 01	48	49	50	50	48
# of Households in NW 01	5	7	8	15	19
# of Households in NS 01	4	6	6	5	15
2006					
Av. Total Per-capita income 06	23,769	51,381	75,717	130,600	320,400
Share Agricultural Wage 06	0.14	0.16	0.15	0.11	0.017
Share Agricultural Self 06	0.77	0.69	0.65	0.63	0.51
Share Non-agricultual Wage 06	0.08	0.08	0.11	0.14	0.26
Share Non-agricultural Self 06	0.04	0.04	0.08	0.11	0.21
# of Households in AW 06	21	24	27	17	5
# of Households in AS 06	50	49	45	51	49
# of Households in NW 06	9	8	15	14	21
# of Households in NS 06	3	6	9	12	20
N	52	51	51	51	51

Note: Quintile classification is based on 2001 household per-capita income distribution. Quintile 1 refers to the poorest quintile.

Table 6: STORMA - Full Model Level-Regressions

Dependent Variable: LN(INCOME PER CAPITA)						
	STORMA '01 - vil	STORMA '04 - vil	STORMA '06 - vil	STORMA '01 - kec	STORMA '04 - kec	STORMA '06 - kec
Sex	0.000	0.168	-0.372	0.008	0.085	-0.334
Age	0.004	0.003	0.052	0.012	0.002	0.055
Age^2	0.000	0.000	-0.001	0.000	0.000	-0.001
Max Education	0.012	0.068**	0.086	0.012	0.067**	0.083
HH Size	-0.105**	-0.190***	-0.140**	-0.108***	-0.190***	-0.159**
Dependency Ratio	-0.181	0.104	-0.233*	-0.191	0.112	-0.215*
Number of Men	-0.026	0.112	0.138*	-0.064	0.112	0.173*
Agriselfemployed	0.188	0.628***	-0.080	0.257	0.548***	-0.246
Nonagriselfemployed	0.207	1.122***	0.718***	0.360	1.163***	0.658***
Nonagriwage	0.753**	1.219***	0.652***	0.748***	1.218***	0.520***
Mixed	1.013***	1.097***	-0.630***	1.030***	1.083	-0.615
Area Owned	0.001**	0.001**	0.000	0.001	0.001*	0.000
Area Cocoa	0.001	0.003***	0.002***	0.002*	0.003***	0.002***
Access to Electricity	0.225	0.002	0.214	0.272	0.093	0.466*
Distance to Road	-0.089	0.051	-.002***	0.002	-0.017	-0.001***
Ln real Value of Assets	0.019	0.028	0.123***	0.018	0.026	0.103***
Constant	10.915***	9.564***	10.175***	10.806***	9.670***	10.153***
N	256	256	256	256	256	256
Adj. R-squared	0.17	0.34	0.29	0.14	0.33	0.27

*Significance levels: ***/**/* denote .01, .05 and .1 respectively (robust t-statistics used). We control for spatial differences using village fixed effects (vil-specification) or kecamatan f.e. (kec-specification). Incomes are real monthly Indonesian Rupiahs with base year 2001 and use regional CPIs provided by BPS.*

Table 7: Panel Regressions

Dependent Variable:LN(INCOME PER CAPITA)						
	(1) Pooled OLS (vil)	(2) Pooled OLS	(3) FE	(4) RE	(5) FE-IV	(6) RE-IV
Age	0.034	0.036	0.060	.039**	0.024	0.035
Age^2	-0.0004	-0.0004	-0.0007	-.0004**	-0.0003	-.0004*
Sex	-0.094	-0.101	-0.680*	-0.134	-0.125	-0.126
Max Education	0.007	0.012	-0.003	0.014	-0.030	-0.015
HH Size	-0.166***	-0.174***	-0.154***	-0.171***	-0.179***	-0.174***
Number of Men	0.127**	0.141***	-0.050	0.105*	0.136**	0.116
Dependency Ratio	-0.115	-0.103	-0.148	-0.113	-0.056	-0.062
Agriselfemployed	0.339**	0.278**	0.207	0.270*	0.377	-0.115
Nonagriselfemployed	0.793***	0.835***	0.864***	0.858***	1.288	0.330
Nonagriwage	1.006***	0.965***	0.925***	0.972***	1.016	0.493
Mixed	0.277	0.292	0.307	0.304	0.216	-0.266
Area Owned	0.001***	0.001**	0.000	0.001**	0.001	0.001
Area Cocoa	0.002***	0.002***	0.001*	0.002***	0.002***	0.002***
Distance to Road	-0.055*	-0.031***	-0.048	-0.034*	-0.033**	-0.031
Ln real Value of Assets	0.027***	0.031***	-0.008	0.022**	0.154	0.143***
2004 Dummy	-0.257***	-0.287***	-0.150	-0.254***	-0.073	-0.081
2006 Dummy	-0.035	-0.065	0.019	-0.041		
Constant	10.375***	10.347***	11.120***	10.388***	9.292***	9.511***
N	768	768	768	768	512	512
F-test	13.75	16.77	4.94	195.46 (Wald)	13.5	9.51
Hansen test (p-value)					0.105	

Note: Column (5) and (6) present instrumental variable specifications. Instrumented variables: ln real value of assets and nonagriselfemployed. Instruments: time lags of endogenous covariates plus distance to Palu.
*Significance levels: ***/**/* denote .01, .05 and .1 respectively (robust t-statistics used)*
We control for spatial differences using kecamatan (sub-district) fixed effects for the estimations 2-6. Estimation 1 uses village fixed effects. Incomes are real monthly Indonesian Rupiahs with base year 2001 and use provincial CPIs provided by BPS.

Table 8: Micro-Growth Regressions

Dependent Variable: Difference Log Real Income per Capita						
	(1) 2001-06	(2) 2001-04	(3) 2004-06	(4) 2001-06	(5) 2001-04	(6) 2004-06
Initial ln Real Income per Capita	-0.75	-0.74	-0.879	-0.686	-0.683	-0.779
	(6.12)***	(12.33)***	(5.65)***	(5.68)***	(12.54)***	(5.60)***
Sex	0.155	0.137	-0.151	0.187	0.151	-0.125
	(0.62)	(0.67)	(0.81)	(0.77)	(0.67)	(0.73)
Age	0.029	0.000	0.023	0.031	-0.01	0.019
	(0.54)	(0.01)	(0.65)	(0.59)	(0.40)	(0.56)
Age^2	0.000	0.000	0.000	0.000	0.000	0.000
	(0.65)	(0.05)	(0.91)	(0.65)	(0.42)	(0.77)
Number of Men	-0.006	0.121	0.039	0.005	0.148	0.04
	(0.08)	(1.33)	(0.30)	(0.07)	(1.42)	(0.32)
Maxeducation	-0.042	0.067	-0.048	-0.006	0.093	-0.023
	(0.96)	(2.44)**	(1.01)	(0.14)	(3.76)***	(0.56)
Difference in Household Size	-0.139	-0.167	-0.17	-0.12	-0.15	-0.169
	(1.90)*	(5.00)***	(4.08)***	(1.66)*	(4.41)***	(3.99)***
Household Size	-0.093	-0.165	-0.085	-0.073	-0.146	-0.056
	(1.82)*	(3.74)***	(0.95)	(1.4)	(3.14)***	(0.59)
Difference in Dependency Ratio	-0.281	-0.069	-0.133	-0.323	-0.145	-0.137
	(2.16)**	(0.63)	(0.97)	(2.41)**	(1.23)	(0.96)
Dependency Ratio	-0.417	0.082	-0.451	-0.479	0.008	-0.536
	(1.61)	(0.54)	(1.49)	(1.84)*	(0.05)	(1.66)*
Move to Nonagriculture	0.426	0.792	0.623	0.439	0.802	0.647
	(1.34)	(3.19)***	(2.89)***	(1.35)	(3.11)***	(2.84)***
Stay in Nonagriculture	0.519	0.702	0.437	0.641	0.788	0.469
	(2.27)**	(2.83)***	(1.28)	(2.77)***	(3.30)***	(1.30)
Move to Agriculture	-0.296	-0.342	0.139	-0.025	-0.095	0.149
	(1.26)	(1.34)	(0.73)	(0.12)	(0.35)	(0.77)
Move to Selfemployment	-0.182	0.216	-0.369	-0.069	0.18	-0.224
	(0.72)	(0.78)	(0.76)	(0.26)	(0.61)	(0.48)
Stay in Selfemployment	-0.373	0.606	-0.244	-0.083	0.796	-0.094
	(1.44)	(2.41)**	(0.85)	(0.31)	(3.16)***	(0.36)
Move to Wageemployment	-0.376	0.601	-0.152	-0.224	0.717	-0.157
	(1.59)	(2.12)**	(0.42)	(0.98)	(2.47)**	(0.42)
Area Cocoa	0.002	0.002	0.001			
	(1.99)**	(2.84)***	(2.20)**			
Area Owned	0.000	0.000	0.000			
	(0.93)	(1.32)	(0.51)			
Difference in Area Cocoa	0.001	0.002	0.001			
	(1.65)*	(2.33)**	(1.28)			
Distance to Road	-0.043	-0.034	-0.031			
	(2.31)**	(1.61)	(1.56)			
Ln real Value of Assets	0.033	0.016	0.072			
	(3.75)***	(1.57)	(2.29)**			
Constant	8.772	7.086	9.967	7.618	6.471	9.373
	(6.05)***	(7.92)***	(6.09)***	(5.36)***	(7.52)***	(6.30)***
Observations	256	256	256	256	256	256
Adj. R-squared	0.33	0.56	0.36	0.3	0.51	0.34

Robust t-statistics in parentheses . Significance levels: ***/**/* denote .01, .05 and .1 respectively. We control for spatial differences using kecamatan (sub-district) dummies. Incomes are real monthly Indonesian Rupiahs with base year 2001 and use regional CPIs provided by BPS.

Table 9: Comparison of Regional Means

	STORMA 2001	SUSENAS 2002 Rural Central Sulawesi	SUSENAS 2002 Rural Sulawesi	SUSENAS 2002 Rural Indonesia minus Java	SUSENAS 2002 Rural Indonesia
Household Size	5.42	4.49	4.63	4.65	4.34
	(2.00)	(1.58)	(1.65)	(1.63)	(1.53)
Age of HH Head	43.8	40.3	41.8	41.7	42.4
	(14.0	(12.6)	(12.3)	(11.8)	(11.9)
Sex of HH Head	0.95	0.96	0.94	0.94	0.94
	(0.21)	(0.21)	(0.24)	(0.24)	(0.23)
Dependency Ratio	0.7	0.77	0.81	0.84	0.77
	(0.58)	(0.63)	(0.67)	(0.68)	(0.62)
Number of Men	1.85	1.39	1.39	1.37	1.32
	(1.03)	(0.79)	(0.81)	(0.81)	(0.75)
Years of Schooling	6.77	5.97	5.28	5.14	4.66
of HH Head	(3.36)	(3.82)	(4.04)	(4.02)	(3.77)
Max. Years of Schooling	8.68	7.84	7.67	7.45	6.96
of a HH Member	(2.87)	(3.22)	(3.53)	(3.49)	(3.31)
Total Per-Capita Income	95,076	96,197	100,031	107,400	102,846
	(106,003)	(29,569)	(31,176)	(33,735)	(30,244)
Agricultural Self-employed Income,	60,266	60,651	66,961	66,812	49,517
per capita	(68,679)	(42,831)	(45,208)	(49,004)	(45,651)
Agricultural Wage Income, p.c.	8,319	12,397	7,660	12,349	15,064
	(17,016)	(27,955)	(23,961)	(30,776)	(31,656)
Non-Agricultural	10,906	13,307	15,560	14,640	19,886
Self-employed Income, p.c.	(64,371)	(30,015)	(32,885)	(33,715)	(37,579)
Non-Agricultural , p.c.	15,583	9,842	9,428	13,208	17,943
Wage Income	(46,465)	(28,030)	(28,503)	(34,940)	(37,987)
Share of Agricultural	0.67	0.64	0.68	0.64	0.5
Self-employed Income	(0.37)	(0.39)	(0.39)	(0.41)	(0.42)
Share of Agricultural	0.14	0.14	0.08	0.12	0.15
Wage Income	(0.24)	(0.29)	(0.23)	(0.27)	(0.30)
Share of Non-Agric.	0.07	0.13	0.15	0.13	0.18
Self-employed Income	(0.22)	(0.27)	(0.30)	(0.28)	(0.33)
Share of Non-Agricultural	0.12	0.09	0.09	0.11	0.16
Wage Income	(0.28)	(0.25)	(0.25)	(0.28)	(0.33)
N	256	523	2,342	10,729	17,535

Note: SUSENAS means cover the deciles 1 to 7 of the original income distribution. Monetary values are real in Indonesian Rupiahs with base year 2001 and use regional CPIs provided by BPS. Incomes are monthly. Standard deviations in parentheses. Shares of the four income sources are it with respect to total household income, not per capita.

Table 10: Regional Multivariate Comparison

	LN(INCOME PER CAPITA)				
	STORMA 2001	SUSENAS 2002 Rural Central Sulawesi	SUSENAS 2002 Rural Sulawesi	SUSENAS 2002 Rural Indonesia minus Java	SUSENAS 2002 Rural Indonesia
Sex	0.124	0.034	0.058**	0.074***	0.076***
Age	0.017	-0.003	-0.001	0.004***	0.004***
Age^2	0.000	0.004	0.002	-0.003*	-0.004***
Max Education	0.033	0.018***	0.013***	0.010***	0.011***
HH Size	-0.102**	-0.073***	-0.068***	-0.072***	-0.070***
Dependency Ratio	-0.230*	-0.009	-0.040***	-0.053***	-0.050***
Number of Men	-0.059	0.036	0.024*	0.015***	0.013***
Agriselfemployed	0.465*	-0.015	-0.055**	-0.054***	-0.020***
Nonagriselfemployed	0.697*	0.180***	0.132***	0.134***	0.144***
Nonagriwage	0.875***	0.142**	0.062**	0.097***	0.111***
Mixed	1.237***	0.198***	0.119**	0.099***	0.114***
Access to Electricity	0.293*				
Constant	10.541***	11.847***	11.947***	11.771***	12.013***
N	256	523	2,342	10,729	17,535
Adj. R-squared	0.11	0.30	0.35	0.42	0.38

Note: SUSENAS regressions estimates are over the deciles 1 to 7 of the original income distribution. Significance levels: ***/**/* denote .01, .05 and .1 respectively(robust t-statistics used). We control for spatial differences using kecamatan (sub-district) dummies. Incomes are real monthly Indonesian Rupiah with base year 2001 and use regional CPIs provided by BPS.

Table A1: Description of variables of interest

Variable	Characteristic	Database	Level
Individual characteristics			
Age	Age of household head	ST, BPS	HH Head
Sex	Sex of household head (1=male; 0=female)	ST, BPS	HH Head
Years of Schooling of HH Head	Years of schooling completed by hh head	ST, BPS	HH Head
Household characteristics			
Household Size	No. of household members	ST, BPS	Household
Dependency Ratio	No. of economic non-active hh members divided by No. of economic active hh members (14 $<$ age $<$60)	ST, BPS	Household
Number of Men	No. of men in a household	ST, BPS	Household
Max Education	Maximum years of schooling of a household member	ST, BPS	Household
Income variables			
Real per-capita Income	HH income divided by hh size and deflated with provincial CPI data in IDR	ST, BPS	Household
Agricultural self-employed income	HH income from self-employment in the agricultural sector	ST, BPS	Household
Agricultural wage income	HH income from wage-employment in the agricultural sector	ST, BPS	Household
Non-agricultural self-employed income	HH income from self-employment in the non-agricultural sector	ST, BPS	Household
Non-agricultural wage income	HH income from wage-employment in the non-agricultural sector	ST, BPS	Household
Livestock income	HH income from livestock farming	ST	Household
Gathering income	HH income from gathering	ST	Household
Cropping income	HH income from crop production	ST	Household
Annual cropping income	Annual e.g. rice, maize	ST	Household
Perennial cropping income	Perennial e.g. cash crops like coffee, cocoa	ST	Household
Cocoa income	HH income from cocoa cultivation	ST	Household
Coffee income	HH income from coffee cultivation	ST	Household
Productivity variables			
Cocoa yield per are	Cocoa income divided by area cocoa	ST	Household
Coffee yield per are	Coffee income divided by area coffee	ST	Household
Cocoa output per are	Amount of cocoa harvested per month per area of cocoa	ST	Household
Coffee output per are	Amount of cocoa harvested per month per area of coffee	ST	Household
Price variables			
Cocoa price per kilo	Reported farm gate prices per kilo in IDR	ST	Household
Coffee price per kilo	Reported farm gate prices per kilo in IDR	ST	Household
Sector dummies			
Agricultural self-employed	HH income from this sector $>$ 50%: no(0), yes(1)	ST, BPS	Household
Agricultural wage	HH income from this sector $>$ 50%: no(0), yes(1)	ST, BPS	Household
Non-agricultural self-employed	HH income from this sector $>$ 50%: no(0), yes(1)	ST, BPS	Household
Non-agricultural wage	HH income from this sector $>$ 50%: no(0), yes(1)	ST, BPS	Household
Mixed	HH income from non of the above sectors $>$ 50%: no(0), yes(1)	ST, BPS	Household
Additional variables			
Area owned	Agriculturally suitable in are	ST	Household
Area cocoa	Agricultural land planted with cocoa in are	ST	Household
Area coffee	Agricultural land planted with coffee in are	ST	Household
Expenditures on fertilizer/ pesticides	HH expenditures on fertilizer and pesticides per month	ST	Household
Share of rice fields with irrigation	Share of rice fields with no, semi-technical or technical irrigation system	ST	Household
Value of assets	Estimated value of physical and financial assets	ST	Household
Value of livestock	Estimated value of livestock	ST	Household
Distance to road	Distance to the next paved road in hours	ST	Household
Access to electricity	Household is connected to electricity: no(0), yes(1)	ST, BPS	Household
Distance to Palu	Distance to the provincial capital Palu in hours	ST	Household

Table A2: Regional Multivariate Regression-Comparison II

	LN(INCOME PER CAPITA)					
	STORMA 2004	STORMA 2006	SUSENAS 2005 Rural Central Sulawesi	SUSENAS 2005 Rural Sulawesi	SUSENAS 2005 Rural Indonesia minus Java	SUSENAS 2005 Rural Indonesia
Sex	0.196	-0.267	0.065	.240***	.155***	.142***
Age	0.027	0.051	0.009	0.004	.006***	.003*
Age	0	-0.001	-0.009	-0.004	-.007***	-.004**
Max Education	.083**	-0.056	0.007	.014***	.014***	.015***
HH Size	-.159***	-.141**	-.091***	-.076***	-.077***	-.075***
Dependency Ratio	-0.012	-.321**	0.009	-.059***	-.068***	-.065***
Number of Men	0.138	.152*	0.056	.035**	.029***	.033***
Agriselfemployed	.722***	0.096	-.112**	-.237***	-.247***	-.242***
Nonagriwage	1.215***	.994***				
Nonagriselfemployed	1.317***	.827***	0.083	-0.025	-0.013	0.009
Mixed	1.172***	-0.289	0.29	-0.064	.085**	.052**
Access to Electricity	0.129	.680**				
Constant	10.350***	10.910***	11.906***	11.762***	12.630***	11.679***
N	256	256	530	2968	12,866	22,125
Adj. R-squared	0.19	0.21	0.31	0.39	0.46	0.4

Note: SUSENAS regressions estimates are over the deciles 1 to 7 of the original income distribution. Significance levels: ***/**/* denote .01, .05 and .1 respectively (robust t-statistics used). We control for spatial differences using kecamatan (sub-district) dummies. Incomes are real monthly Indonesian Rupiahs with base year 2001 and use regional CPIs provided by BPS. Note that SUSENAS 2005 does not disaggregate wage income into agricultural and non-agricultural wage. Reference category is total wage income.

Table A3: Comparison of Regional Means II

	STORMA '04	STORMA '06	SUSENAS '05 Rural Indonesia minus Java	SUSENAS '05 Rural Indonesia
Household Size	5.19	4.56	4.62	4.30
	(1.96)	(1.93)	(1.70)	(1.61)
Age of HH Head	46.5	48.1	43.9	45.2
	(14.1)	(13.6)	(12.7)	(12.7)
Sex of HH Head	0.93	0.91	0.90	0.90
	(0.26)	(0.29)	(0.30)	(0.30)
Dependency Ratio	0.75	0.74	0.83	0.76
	(0.60)	(0.70)	(0.68)	(0.64)
Number of Men	1.86	1.37	1.36	1.30
	(1.10)	(0.87)	(0.84)	(0.79)
Years of Schooling of HH Head	6.79	6.78	6.68	6.16
	(3.37)	(3.35)	(3.17)	(2.98)
Max. Years of Schooling of a HH Member	8.67	8.43	8.8	8.25
	(2.89)	(2.87)	(2.82)	(2.80)
Total Per-Capita Income	93,187	119,586	106,566	100,373
	(131,061)	(123,391)	(44,673)	(39,364)
Agricultural Self-employed Income, per capita	52,751	68,005	57,646	40,004
	(77,544)	(81,073)	(52,287)	(44,898)
Non-Agricultural Self-employed Income, p.c.	4,820	8,200	15,368	19,695
	(11,164)	(18,353)	(36,662)	(38,895)
Agricultural Wage Income, p.c.	11,062	19,678		
	(40,068)	(68,299)	47,997	59,351
Non-Agricultural Wage Income, p.c.	23,652	22,659	(74,304)	(72,337)
	(102,055)	(63,891)		
Share of Agricultural Self-employed Income	0.65	0.67	0.58	0.43
	(0.54)	(0.55)	(0.43)	(0.42)
Share of Non-Agric. Self-employed Income	0.08	0.09	0.13	0.18
	(0.29)	(0.23)	(0.30)	(0.34)
Share of Agricultural Wage Income	0.14	0.11		
	(0.43)	(0.25)	0.28	0.38
Share of Non-Agricultural Wage Income	0.13	0.11	(0.40)	(0.42)
	(0.29)	(0.41)		
N	256	256	12,866	22,125

Monetary values are real values and in Indonesian Rupiahs. Standard deviations in parentheses.
SUSENAS means cover the deciles 1 to 7 of the original income distribution.