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Rural Income Dynamics in Post-Crisis Indonesia

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Abstract: Indonesia is, what the World Development Report 2008 calls, a transforming country characterized by increasing rural-urban income disparities and high poverty rates. Bearing these facts in mind, it is striking how little is known about causes and mechanism of the underlying determinants of poverty in rural Indonesia.

In this study we aim to shed more light on the determinants of rural incomes and poverty in Indonesia. Drawing on a unique and highly detailed rural household panel data set for Central Sulawesi we investigate what are the drivers of rural income growth.

Moreover, exploiting the panel structure of our data set we are able to control explicitly for individual- and time-specific effects and for endogeneity issues in our estimations. In addition, in order to identify whether our findings might hold lessons for all of Indonesia, we upscale our analysis to the national level by comparing our results with the national household data survey SUSENAS.

Our results indicate that a sharp increase in rural incomes took place in the post-crisis period. Moreover, the ability to alleviate poverty and to enjoy income growth has been strongly associated with a household's ability to diversify into the non-farm sector of the economy, to focus on higher value-added agricultural activities and its ability to invest into new production techniques. These results seem to hold for most of rural Indonesia and are robust to various model specifications. (*JEL* O12, O18, Q12, R20)

Keywords: Rural development; Non-farm sector; Agricultural productivity growth; Capital endowment

1. Introduction

After the severe financial crisis in Indonesia in 1998, average income levels saw a healthy recovery to and above pre-crisis levels. Nevertheless, poverty rates in Indonesia are still above pre-crisis levels while rural-urban disparities have been constantly increasing over time (World Development Report, 2008). These developments in turn imply two things: Firstly, potentially high political and social strain, and secondly, that a high incidence of poverty is to be found in rural areas. Provided the substantial number of people living in rural areas in Indonesia, it is one of Indonesia's key challenges to further transform itself, integrating its rural areas into a dynamic economy, thus, raising rural income by increases in productivity levels of the rural poor, whether these are realized in high value added agriculture, rural decentralized non-farm enterprises, by rural-urban migration or a combination of all of the afore. Hence, a central question in Indonesia's near future will be to identify the main factors determining current rural income levels and driving rural income change.

In the respective academic literature and likewise in the World Development Report 2008 several pathways on how rural income growth can be successfully achieved have been proposed and observed. On the one hand, it is clearly acknowledged, that higher agricultural productivity is crucial to raise income in rural agricultural areas and for the poorest of rural households (Mellor, 1976; Ravallion and Datt, 1996, 1998a; Timmer, 1997, 2002, 2004; Huppi and Ravallion, 1991; Suryahadi and Sumarto, 2003; Fan, Zhang and Zhang, 2004; Fan, Gulati, and Thorat, 2007; Thirtle et al., 2003; Majid, 2004). On the other hand, it has become clear, that for agricultural households an engagement in high-productive non-agricultural activities can be most conducive towards income growth and poverty reduction, especially in the absence of physical infrastructure and human capital constraints (Ravallion and Datt, 1996, 1998b, 2002; Lanjouw and Lanjouw, 2001, Elbers and Lanjouw, 2001, Ersado, 2005, Micevska and Rahut, 2008).

This article's principle objective is to examine to what relative extent increases in agricultural productivity and growing diversification into the non-agricultural sector have been responsible for rural Indonesian household's recovery from the economic crisis and subsequent income growth. In particular, the focus is on understanding the determinants of incomes, income growth and income diversification in post-crisis rural Indonesia. In conclusion, the following research questions are of paramount interest to us: (a) How have rural households fared after the crisis? (b) What are the principal socio-economic factors

influencing rural incomes? (c) How has income diversification, in particularly into the non-agricultural sector, helped households to increase incomes? (d) What are the main obstacles for poor rural households to achieve adequate growth of their incomes?

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 Indonesia 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 incorporate 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 suitable land used in agricultural production in addition to relying on the area of land owned by a household. Second, since no alternative household panel data is available for the post-crisis period in Indonesia, this article is the first to investigate 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 simultaneous causality and omitted variables in a much simpler way than it would have been possible for the available cross-sectional data. 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 Indonesian poverty lines and poverty rates. 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 rural incomes increased substantially between 2001 and 2006. We show that the growth in real incomes can be primarily attributed to increased agricultural productivity and the boom in commodity prices. 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. 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 simultaneous causality and omitted variables operating on the household level we find that small household sizes, a high number of men in the household, greater household wealth, lower distance to roads and employment in the non-agricultural sector strongly determine higher incomes and contribute to higher than average income growth. On the other hand, after controlling for the likely endogeneity of households wealth status and including household fixed effects, the educational endowment of a household renders insignificant. When comparing our previous results to various regional settings for SUSENAS 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. Therefore, results from SUSENAS are very likely to overstate the direct effect of educational attainment and the role of the economic sector on income and income growth of rural Indonesian households.

The remainder of this article is organized as follows. Section 2 briefly discusses the empirical literature on determinants of income dynamics and poverty alleviation concerning 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 the descriptive and multivariate analysis of income and income changes is presented and discussed. The first part of this analysis rests exclusively upon STORMA. In a second step the results obtained are compared to SUSENAS. Section 5 summarizes and concludes.

2. Literature Review

Recent studies on Southeast Asian countries, e.g. Estudillo, Sawada and Otsuka (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 of many households in the 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, all

of the existing studies addressing income dynamics have concentrated on time periods not exceeding the year 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 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, Weisbrod and Timmer (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 worldwide rural households 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 a one time 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[1] sites and deforestation (1992-1996) positively correlate with non-agricultural income. Moreover, they show that overall village welfare rises with higher economic diversity (especially through higher non-agricultural income), agro suitability of land, land use intensity, forest cover in the initial period (1992) and village population size. 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 (World Bank, 2006a, 2006b). 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[2] was conducted (World Bank, 2006c). From these analyses emerges that limited access to formal credits, difficult access to roads, a lack of demand for goods and services, and insufficient vocational training 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. Similarly, Suryahadi et al. (2006a) using district level data on GDP per capita and

[1] Transmigration refers to governmentally induced migration during the 19th (Dutch colonial government) and 20th century in Indonesia. Through several programs aiming for the reduction of poverty and overpopulation on Java, the development of remote islands, and ethnic homogenization of the country, mainly Javanese were encouraged to settle on other islands by providing them with land and housing (see e.g. Fearnside (1997)).

[2] Besides the use of the SUSENAS data from 2002 and earlier years, additional cross-sectional household and enterprise surveys were conducted in 2004 in order to gather relevant information.

a variety of socio-economic and infrastructure variables for the period of 1990 to 2003 find that the highest growth rates were observed in those districts that showed the strongest growth rates in the rural service sector.

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. 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., 2006b; World Bank, 2006c), 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 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[3]. Compared to most other provinces in Sulawesi, Java, Kalimantan, and Sumatra the province depicts 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, Wetterberg and Pritchett (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. The main staple crop in the area is rice while the main cash crop in the 1990s was coffee. In the end of the 1990s the majority of rural households, due to the decline of world coffee prices, switched 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

[3] The surveys were carried out within a large-scale project called STORMA designed to examine the livelihood of rural households in close proximity to rainforest areas. The project was financed by the German Research Foundation (DFG) and its support is gratefully acknowledged.

overall population. A multi-stage sampling design was used based on the proximity of the villages to the LLNP, population density, and ethnic composition[4]. 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 interviewed in all three rounds which gives a total number of 254 households per round[5]. The surveys provide information on agricultural and non-agricultural activities, income sources, income levels, 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 on agricultural sources. In particular, SUSENAS does not entail data on type of crops planted, quantity harvested and respective output prices, but rather asks households generally about their income from agriculture in the respective year. Despite these problems, SUSENAS remains the only alternative household data set available for the post-crisis period in Indonesia and moreover is the principal data source for official poverty statistics and policy designing in Indonesia. For these reasons we use the 2002 and 2005 waves of SUSENAS for our comparison, which are the two latest rounds to include full income and expenditure data.[6]

In the subsequent analyses we mainly distinguish between four types of income sources following Barrett et al. (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

[4] A detailed description of the sampling procedure is provided in Zeller, Schwarze, and van Rheenen (2002).
[5] A simple comparison of characteristics between households that dropped out of the survey and those that remained in the sample between the first and third round, shows that no significant differences exist.
[6] In some articles covering pre-crisis Indonesia household data from the IFLS was used. The IFLS data contains large panel data sets which have the reputation of being of high quality. Unfortunately, no IFLS round is available for the time period after 2000. Furthermore, some researchers like Suryahadi and Sumarto (2003) or Ravallion and Lokshin (2005) complemented their analysis with additional data from national village surveys (PODES). However, PODES village level data cannot compensate for the lacking household level information on important rural variables in SUSENAS. Moreover, it does not remedy the problem regarding the absence of adequate household panel surveys in Indonesia for the post-crisis period.

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 row 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 four sources, the household gets classified as mixed.

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 the head, we follow Basu et al. (1998) 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 indebted to the circumstance that we want to reduce the number of dummy variables included in the multivariate regression analyses.

In most studies, the area of land is included. Instead we use the area of agricultural suitable land a household uses for agricultural production. This land variable further excludes the area dedicated to the housing area of the household since this land can not 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 agricultural 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 the ability of households 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. Interregional disparities are captured by classifying villages into the four sub-districts they belong using kecematan dummies.[7]

3.2 Methodology

For the purpose of clarifying 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 simple OLS. In particular, we model log per-capita household income for the respective wave as a function of household characteristics.[8] 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.[9]

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

However, OLS estimation of (1) can provide inconsistent and inefficient results in the presence of unobserved heterogeneity or endogeneity issues, such as simultaneous causality or the omission of important variables that are correlated with the regressors. Hence, in a second step we exploit the panel structure of STORMA to address these problems accordingly. Using panel estimations will also allow us to shed a first dynamic view on rural income drivers. In order to control for unobserved heterogeneity within our sample, we

[7] A detailed description of variables used in this article is presented in table A1 in the appendix.
[8] To obtain real incomes we deflate nominal incomes by monthly provincial CPIs as provided by BPS. The base period in all analyses is September 2001.
[9] We explicitly distinguish between X and Ψ to emphasize the difference in data availability between STORMA and SUSENAS. Moreover, this connotation later on helps to clarify the empirical strategy to upscale findings from STORMA to the national level.

assume an error components specification of our model and estimate it 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).

$$log(Y_{i,t}) = \alpha + \Sigma_{i,t}'\gamma + u_{i,t} \quad (2)$$

$Y_{i,t}$ 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:

$$u_{i,t} = \mu_i + \lambda_t + v_{i,t} \quad (3)$$

The composite error consists of three components, μ_i denotes the unobservable individual effect, λ_t the unobservable time effect and $v_{i,t}$ denotes the idiosyncratic part of the error term.[10] If individual effects μ_i in (3) cannot be rejected by the appropriate LM-test, then pooled OLS ignoring these effects can lead to biased estimates. In order to decide whether to model μ_i as a fixed or random effect we know that as long as individual effects μ_i are not correlated with the regressors $\Sigma_{i,t}$ in (2), i.e. if $E(\Sigma_{i,t}\ \mu_i) = 0$, 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. To decide which specification is best we rely on the Hausman specification test.

With respect to the within-estimator (fixed effects), it will provide consistent but not necessarily efficient estimates when unobserved individual effects are present. The within-estimator controls for unobserved heterogeneity, a property that the between estimator, which sometimes is also subsumed under the term "fixed effects", is not able to do. 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 and more variation 'between' individuals. Hence, we expect our within-results to show a relatively small overall R-squared.

Furthermore, we will use analogous within-, between- and random effects two-stage least squares (2SLS) estimators, in order to control for potential endogeneity (Baltagi, 2005) where the potential endogenous variable will be instrumented by its own lagged value.

[10] In order to decide whether an error decomposition as in (3) is needed, we use the LM test to see whether pooled OLS is the better alternative in the first place.

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[11].

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

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 over-identification, non-significant variables will be 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 no panel data set and lacks some important explanatory variables for rural income generation, 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 pay attention to 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

[11] Note that in this set up a common concern in the literature is the so-called regression towards the mean which states that in the inevitable presence of measurement error in the sample one obtains a negative coefficient for the initial value of $\log(Y_{i,1})$. However, it has been shown in other studies, e.g. Woolard and Klasen (2004), that even if such a bias exists its effect is negligible.

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.

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 substantial 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 from reducing the set of covariates excluding the set of variables denoted by Ψ. 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 lesser declines in per-capita income levels in absolute and relative terms than urban areas (Sumarto, Wetterberg, and Pritchett, 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 (World Bank, 2006b; World Bank, 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 simultaneous 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.

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

Table 1 about here

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 growing coffee to the cultivation of cocoa.[12] In 2004 households were still in the middle of this transformation process. In particular, cocoa plants hadn't reached full maturity for production in many 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. Compared to the cultivation of coffee the shift to cocoa was rewarding for rural households. As table 2 below shows, yields per are were about 60 percent above those from coffee in 2006. Moreover, table 2 demonstrates that increases in incomes from cocoa between 2001 and 2006 are primarily due to increases in production and to a lesser extent to increases in the prices for cocoa between 2001 and 2006.

Table 2 about here

A closer look at the composition of the income of 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.[13] Moreover, households gain incomes from perennial and annual crops rather equally. While the income from annual crops, like rice and

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

[13] The decline in incomes from gathering follows from the improvement in economic conditions for rural households from 2001 to 2006. Gathering forest products like rattan is time-intensive and dangerous and is only done in times of greatest needs.

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.

Table 3 about here

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 booming national economy of the post-crisis period. As shown in Table 1 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.[14] 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 207 to 187.[15]

Table 4 about here

Engagement in non-agricultural activities proves 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.

[14] Provided the smaller share of non-agricultural income on total household income, its average share on total household income increased only slightly from 23% to 27 percent between 2001 and 2006. The share of non-agricultural income on total household income is comparatively small for an Asian region. Reardon, Berdegue and Escobar (2001) calculate that non-agricultural income accounts on average for approximately 40 percent of rural incomes in Latin America, 45 percent in Africa, and 35 percent in Asia. Since 27 percent is not far away from the estimated 35 percent and moreover the STORMA region is remotely located, we consider our estimates to be credible.

[15] Non-agricultural self-employment in the STORMA region consists mainly of opening small shops and restaurants (warungs) and small-scale industries in handicrafts. Wage employment in the non-agricultural sector is usually available in terms of work in the construction and public sector.

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.

Table 5 about here

Besides its effect on incomes, income diversification, and cropping patterns the crisis manifested itself in the composition of households. Sumarto, Wetterberg, and Pritchett (1999) report that male family members often returned back from urban areas to their families in 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 might 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.

4.2 Determinants of Rural Income

We start with the estimation of simple income regression by OLS as specified under (1) in section 3.2 for each of the three STORMA waves. Estimates for thethree cross-sections

(Table 6) confirm that non-agricultural income, both as non-agricultural wage and non-agricultural self-employed income, is the most conducive form to obtain high levels of income. Coefficients on these two variables turn out to be significant in five out of six cases at the 1 percent level. Taking into account that the reference category is agricultural wage income, the coefficient on agricultural self-employed income is positive in two out of three cases and highly significant for 2004. However, effects of agricultural self-employment on per-capita incomes are not exclusively 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.[16] Thus, not only non-agricultural income offers to be a means to higher rural incomes. Furthermore, the ability of households to invest and produce efficiently, as measured by the value of assets, influences incomes positively.[17] 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.[18] In contrast, a high household size and a low number of men in a household are associated with lower income levels.[19] It is worth to note that in the 2004 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.

Table 6 about here

[16] The insignificant value of 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.

[17] The selection process of covariates into (1) was based on theoretical and empirical considerations. In alternative specifications we included variables on social capital, migration, professional training, access to extension officers, access to credits and the quality of irrigation systems. None of these variables showed significant values in any of the three rounds and were therefore excluded.

[18] Obtaining an insignificant value on the education variable is not uncommon in the literature. Moreover, the sign of the education coefficient on rural incomes have even been found to be negative in some studies, e.g. Adams (1995) on the value of wheat, sugarcane, and rice production in Pakistan, Rosegrant and Everson (1992) on total factor productivity in India. In our case, multicollinearity issues of the education variable with non-agricultural activities and the value of assets, is likely to cause the observed results.

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

The results obtained from Table 6 are very stable and similar among each of the three cross-sections. Nonetheless, as pointed out before, the estimation of (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 specification 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.

Table 7 about here

Results from Table 7 (estimations 2, 3, and 4) by and large confirm the findings from the cross-sectional regressions. The RE-, within, and between 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 want 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 the within-, the between- and the random effects-2SLS estimator (Baltagi, 2005). The covariate that most probably presents a violation of the exogeneity assumption on the right hand side of our model is the variable referring to household wealth, measured in terms of value of assets. On the one hand, higher wealth will help a household to invest and produce efficiently, as stated before, and therefore contribute

[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 effects model under (3). Results of the pooled OLS are still reported in column 1 of Table 7.

[21] We also tested for potential 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 which do not harm our significance levels in turn. Allowing for an AR(1) error term does not change our results either, which indicates that serial correlation is not inherent in our data.

to higher income. On the other hand, it seems plausible that higher income levels will lead to higher stocks of assets. We use lagged asset values as instruments. Columns 5 to 7 of Table 7 report the results of the between-, within- and RE-2SLS regressions. The obtained estimates confirm the previous findings: First of all, ranking and size of coefficients of respective income sectors do not alter compared to the cross-sectional analyses. Second, coefficient on the area of cocoa are very stable across the three different estimators. Yet, in contrast to the cross-sectional estimation of (1) and the basic panel-regressions in columns 2 to 4 of Table 7, controlling for endogeneity leads to strong increases in size of the value-of-asset coefficients.[22]

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). With the exception of one endogenous variable, the size of coefficients and its significance level remains very 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).[23]

[22] Only in case of the within-estimations, both normal and 2SLS, we do not observe a significant asset coefficient. This might be due to the fact that during the considered period 2001-2006 not much asset variation occurs within households.

[23] An advantage of the micro-growth regression framework is that by controlling for initial values we can partly correct for potential endogeneity bias.

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. Moving into non-agricultural activities and higher wealth endowment are associated with a more than average increase in 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 employment fared on average better than their agricultural counterparts at least in the period 2001-2004 and the entire period 2001-2006.[24]

Table 8 about here

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

4.4 Lessons for all of rural Indonesia

In a last step we want to analyze the possibility to generalize the findings attained in the STORMA context to a larger geographical scope covering substantial parts of rural Indonesia. We start the analysis by comparing STORMA 2001 data with simple descriptive statistics for different regional aggregates based on SUSENAS 2002 (Table 9). We find that STORMA households compare favorably well with rural households in Indonesia except to

[24] Interestingly, 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.

those residing on Java.[25] 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 very high population density on the island. Moreover, agricultural self-employment on Java is much less important 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 much larger farm sizes and the existence of large agricultural corporations on Java.

Table 9 about here

Moreover, Table 9 shows that for a few number of 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 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, it might be that STORMA households were affected comparatively strong by the economic crisis with households absorbing other family members. This later argument might explain why in Table 1 household sizes in STORMA decrease substantially between 2001 and 2006 reaching values very similar to those found in SUSENAS.

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 (1) due to the lack of the set of covariates described with Ψ. Therefore, we are left with the estimation of the reduced version, (5). Results on (5) are depicted in Table 10 for STORMA 2001 and SUSENAS 2002 rounds respectively.

Table 10 about here

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

[25] This statement holds bearing in mind that the top three deciles of the income distribution for each of the regional aggregates were excluded for the reasons discussed in 3.2.

process are in both data sets a subset of the household characteristics, in particular household size, the number of men in a household and the education variable, all of which are statistically significant and take signs as expected from economic theory. Furthermore, the belonging of a household to a specific economic sector 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 clearly affect parameter estimates for λ and β. To assess the effect of switching from (1) to (5) we re-estimate STORMA regressions. The results are depicted in column 1-3 in Table 10 from which four key messages emerge. First of all, the exclusion of Ψ leads to a strong reduction of the overall explanatory power, between 2 and 14 percentage points in the adjusted R^2. 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, whereby especially through asset ownership which had the largest impact out of the four variables included in Ψ. Provided the same or at least very similar underlying income generating process between STORMA and SUSENAS, results from SUSENAS for higher regional aggregates exaggerate the pure 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

[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 different regional SUSENAS specifications as well as for STORMA. Moreover, a difference between the two data sets seems to be that agricultural self-employment in SUSENAS seems to be less rewarding than agricultural wage employment which is in contrast to the findings from STORMA.

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 other areas of rural Indonesia is substantially lower than in the STORMA area. Fourthly, the effect of the dependency rate on household per-capita income becomes smaller due to the fact that households with a high demographic burden are on average less endowed with physical or agricultural assets. On the other hand, no important changes can be observed in the coefficients and significance levels on the other demographic variables.

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 overstates the direct effect of education and some further covariates 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

This article re-confirms that rural households in Indonesia have experienced substantial income growth in the period following the financial and economic crisis of 1997/98 and provides new insights and robustness checks into the determinants of this development.

Drawing on the unique STORMA 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 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. Secondly, we find that incomes from agriculture still constitute the financial backbone of rural households across the entire income distribution. Moreover, in contrast to

the existing literature on rural Indonesia, we observe even 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 growth in agricultural incomes, we show that agricultural productivity 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 therefore 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.

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. Controlling for a potential endogenous asset-income relationship even reveals a stronger than before influence of assets on incomes. Focusing on income growth instead of income levels leads to similar results.

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) While we obtain similar estimates in most of the covariates between STORMA and SUSENAS, one important difference concerns the importance of the agricultural self-employed sector. While this sector has been conducive towards income growth in the STORMA area, this seems to have not been the case in most other areas of Indonesia. (c) Studying the impact of omitted variables on cross-sectional income regressions based on SUSENAS we show by analyzing STORMA data 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.

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Table 1: Demographic and Income Means of STORMA households

	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	0.70	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	95076	93187	119586
	(106003)	(131061)	(123391)
Agricultural Self-employed Income, per capita	60266	52751	68005
	(68679)	(77544)	(81073)
Agricultural Wage Income, p.c.	8319	4820	8200
	(17016)	(11164)	(18353)
Non-Agricultural Self-employed Income, p.c.	10906	11062	19678
	(64371)	(40068)	(68299)
Non-Agricultural Wage Income, p.c.	15583	23652	22659
	(46465)	(102055)	(63891)
Area Owned (are)	202.40	195.55	208.26
	(215.16)	(205.23)	(204.13)
Area Cocoa (are)	68.95	85.56	84.55
	(97.90)	(117.15)	(102.22)
Distance to road (hours)	0.95		0.73
	(2.76)		(2.76)
Value of assets (2001 IDR)	2,540,766	2,711,764	4,014,757
	(6,793,056)	(10,000,000)	(8,533,662)
N	254	254	254

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. Shares of the four income sources are with respect to total household income, *not* per capita.

Table 2: Cocoa and coffee production

	STORMA '01	STORMA '04	STORMA '06
Cocoa			
Output (kg/are)	0.36	0.26	0.29
Price (per kg)	5841	6553	5249
Yield (per are)	2075	1735	1518
Area cocoa (are)	68.95	85.56	84.55
Coffee			
Output (kg/are)	0.25	0.20	0.23
Price (per kg)	4653	2664	4032
Yield (per are)	1153	543	911
Area coffee (are)	47.07	21.00	14.68

Monetary values are real Indonesian Rupiahs with base year 2001 and use the provincial CPI for Palu provided by BPS. Yields are monthly household averages based on all farmers active in the particular crop. Area cocoa is the average area planted with cocoa calculated over all 254 households.

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

Sector	STORMA '01	STORMA '04	STORMA '06
Livestock	6190	3350	5026
Gathering	10527	4249	2931
Cropping	44752	46549	60048
Annual crops	21859	18588	26146
Perennial Crops	22892	27961	33901
Cocoa	13278	24280	28307
Coffee	11433	1752	2861
N	254	254	254

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	
			Starting Inc.	# of obs.	Income	# of obs.	Income	# of obs.	Income	# of obs.	Income	# of obs.	Income	# of obs.
STORMA	2001	Agricultural Self-employed	87580	178	105969	133	65992	14	198022	12	180752	12	87955	7
		Agricultural Wage	52744	29	76603	17	52292	4	423417	1	81924	4	72583	3
		Non-Agric. Self-employed	178477	15	153616	6		0	243471	4	142350	5		0
		Non-Agric. Wage	129681	26	72397	8	35164	1	224819	2	239930	13	87608	2
		Mixed	163616	6	120554	4		0	195338	1		0	72661	1
				254	103448	168	61486	19	220927	20	186104	34	83178	13

Incomes are monthly, real Indonesian Rupiahs with base year 2001 and use the 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	.1920948	.1949167	.1647923	.1128348	.0464585
Share Agricultural Self (AS) 01	.7041695	.6109392	.7238572	.6834868	.632793
Share Non-agricultual Wage (NW) 01	.0429983	.1095552	.076982	.1740353	.1940811
Share Non-agricultural Self 01 (NS)	.0607374	.0845889	.0343685	.029643	.1266674
# Households in AW 01	23	25	26	22	13
# Households in AS 01	48	49	50	50	48
# Households in NW 01	5	7	8	15	19
# Households in NS 01	4	6	6	5	15
2006					
Av. Total Per-capita income 06	23,768.98	51,381.06	75,717.27	130,600.1	320,399.9
Share Agricultural Wage 06	.1397861	.1636555	.1534393	.1114321	.0168434
Share Agricultural Self 06	.7723993	.6866251	.6539566	.6314978	.5063809
Share Non-agricultual Wage 06	.0794851	.0751273	.1091357	.1447372	.2574226
Share Non-agricultural Self 06	.0378302	.0441275	.0752748	.1070249	.2107809
# Households in AW 06	21	24	27	17	5
# Households in AS 06	50	49	45	51	49
# Households in NW 06	9	8	15	14	21
# Households in NS 06	3	6	9	12	20
N	51	51	51	51	50

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

	LN REALPERCAPITAINCOME		
	STORMA '01	STORMA '04	STORMA '06
Sex	-0.006	0.026	-0.286
Age	0.018	0.011	0.061
Age²	-0.000	-0.000	-0.001
Maxeducation	0.097	0.060*	-0.065
HH Size	-0.155***	-0.232***	-0.158***
Dependencyratio	-0.098	0.176*	-0.185***
Numberofmen	0.097	0.221**	0.168**
Agriselfemployed	0.341	0.499**	-0.179
Nonagriwage	0.881***	1.155***	0.534**
Nonagriselfemployed	0.515	1.031***	0.623**
Mixed	1.049***	0,891***	-0.565
Area Owned	0.001	0.001	0.000
Area Cocoa	0.001	0.003***	0.002**
ln real Value of Assets	0.022*	0.023**	0.14***
Distance to road	-0.009	-0.025	-0.001***
_cons	10.656***	9.896***	9.573***
N	254	254	254
Adj. R-squared	0.12	0.34	0.25

Significance levels: ***/**/* denote 0.01, 0.05 and 0.1 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.

Table 7: Panel Regressions

	LN REALPERCAPITAINCOME						
	1	2	3	4	5	6	7
	Pooled OLS	Between	Within	RE	Between IV[2]	Within IV[2]	RE IV[1,2]
Age	0.035	0.026	0.061	0.038**	0.023	0.093	0.031
Age²	-0.0004	-0.0004	-0.0006	-0.0004**	-0.0003	-0.001	-0.0004*
Sex	-0.124	-0.138	-0.697**	-0.161	-0.093	-0.565	-0.145
Maxeducation	0.014	-0.007	-0.002	0.017	-0.027	0.020	-0.016
HH Size	-0.175***	-0.187***	-0.159***	-0.172***	-0.179***	-0.137*	-0.176***
Numberofmen	0.146***	0.278***	-0.047	0.110*	0.203**	-0.147	0.125
Dependencyratio	-0.100	-0.027	-0.158*	-0.111	-0.051	-0.094	-0.061
Agriselfemployed	0.262*	0.222	0.193	0.252*	-0.097	0.168	0.057
Nonagriselfemployed	0.822***	0.574*	0.845***	0.843***	0.498	0.826**	0.674***
Nonagriwage	0.950***	0.788***	0.911***	0.956***	0.548	0.864**	0.683***
Mixed	0.277	-0.015	0.293	0.287	-0.246	-0.164	-0.101
Area Owned	0.0004*	0.0001	0.0001	0.0005*	0.0004	0.0001	0.0004
Area Cocoa	0.0021***	0.0024***	0.0013*	0.0020***	0.0020**	0.0022*	0.0021***
Distance to road	-0.0008***	-0.001	-0.0005	-0.0008*	-0.0013*	-0.0001	-0.0007
ln real Value of Assets	0.033***	0.078***	-0.008	0.023**	0.163***	-0.060	0.141***
2004 Dummy	-0.294***		-0.153	-0.262***		-0.221	-0.123***
2006 Dummy	-0.027		0.042	-0.006			
_cons	10.325***	10.158***	11.092***	10.362***	9.539***	10.843***	9.476***
N	762	762	762	762	508	508	508
R²	0.24	0.20	0.13	0.24	0.26	0.10	0.28

[1] = Baltagi's EC2SLS estimator, [2] = instrumented variable: ln real value of assets. Significance levels: ***/**/* denote 0.01, 0.05 and 0.1 respectively (robust t-statistics used). We control for spatial differences using kecamatan (sub-district) dummies. Incomes are real monthly in Indonesian Rupiahs with base year 2001 and use regional 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	-0.750	-0.740	-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	-0.010	0.019
	(0.54)	(0.01)	(0.65)	(0.59)	(0.40)	(0.56)
Age²	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	0.040
	(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	-0.170	-0.120	-0.150	-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)	(1.40)	(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	0.180	-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	254	254	254	254	254	254
Adj. R-squared	0.33	0.56	0.36	0.30	0.51	0.34

Robust t-statistics in parentheses . *** significant at 10% level; ** significant at 5% level; *** significant at 1% level. 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 '01	SUSENAS '02* Rural Central Sulawesi	SUSENAS '02* Rural Sulawesi	SUSENAS '02* Rural Indonesia minus Java	SUSENAS '02* 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	0.70	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 of HH Head	6.77	5.97	5.28	5.14	4.66
	(3.36)	(3.82)	(4.04)	(4.02)	(3.77)
Max. Years of Schooling of a HH Member	8.68	7.84	7.67	7.45	6.96
	(2.87)	(3.22)	(3.53)	(3.49)	(3.31)
Total Per-Capita Income	95076	96197	100031	107400	102846
	(106003)	(29569)	(31176)	(33735)	(30244)
Agricultural Self-employed Income, per capita	60266	60651	66961	66812	49517
	(68679)	(42831)	(45208)	(49004)	(45651)
Agricultural Wage Income, p.c.	8319	12397	7660	12349	15064
	(17016)	(27955)	(23961)	(30776)	(31656)
Non-Agricultural Self-employed Income, p.c.	10906	13307	15560	14640	19886
	(64371)	(30015)	(32885)	(33715)	(37579)
Non-Agricultural Wage Income, p.c.	15583	9842	9428	13208	17943
	(46465)	(28030)	(28503)	(34940)	(37987)
Share of Agricultural Self-employed Income	0.67	0.64	0.68	0.64	0.50
	(0.37)	(0.39)	(0.39)	(0.41)	(0.42)
Share of Agricultural Wage Income	0.14	0.14	0.08	0.12	0.15
	(0.24)	(0.29)	(0.23)	(0.27)	(0.30)
Share of Non-Agric. Self-employed Income	0.07	0.13	0.15	0.13	0.18
	(0.22)	(0.27)	(0.30)	(0.28)	(0.33)
Share of Non-Agricultural Wage Income	0.12	0.09	0.09	0.11	0.16
	(0.28)	(0.25)	(0.25)	(0.28)	(0.33)
N	254	523	2342	10729	17535

* SUSENAS means cover the deciles 1 to 7 of the original income distribution. Deciles 8 to 10 were dropped due to comparability reasons.
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 with respect to total household income, *not* per capita.

Table 10: Regional Multivariate Regression-Comparison I

	LN REALPERCAPITAINCOME				
	STORMA 2001	SUSENAS 2002 Rural Central Sulawesi	SUSENAS 2002 Rural Sulawesi	SUSENAS 2002 Rural Indonesia minus Java	SUSENAS 2002 Rural Indonesia
Sex	0.096	0.034	0.058**	0.074***	0.076***
Age	0.024	-0.003	-0.001	0.004***	0.004***
Age²	-0.000	0.004	0.002	-0.003*	-0.004***
Maxeducation	0.452	0.018***	0.013***	0.010***	0.011***
HH Size	-0.155***	-0.073***	-0.068***	-0.072***	-0.070***
Dependencyratio	-0.125	-0.009	-0.040***	-0.053***	-0.050***
Numberofmen	0.108	0.036	0.024*	0.015***	0.013***
Agriselfemployed	0.523**	-0.015	-0.055**	-0.054***	-0.020***
Nonagriwage	1.006***	0.180***	0.132***	0.134***	0.144***
Nonagriselfemployed	0.860**	0.142**	0.062**	0.097***	0.111***
Mixed	1.280***	0.198***	0.119**	0.099***	0.114***
_cons	10.337***	11.847***	11.947***	11.771***	12.013***
N	254	523	2342	10729	17535
Adj. R-squared	0.10	0.30	0.35	0.42	0.38

SUSENAS regressions estimate over the deciles 1 to 7 of the original income distribution for the respective geographical area. Deciles 8 to 10 were dropped due to comparability reasons. Significance levels: ***/**/* denote 0.01, 0.05 and 0.1 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.

Appendix

Table A1: Description of variables of interest

Variable	Characteristic	Database	Level
Individual characteristics			
Age	Age of household head	STORMA, BPS	HH Head
Sex	Sex of household head (1=male; 0=female)	STORMA, BPS	HH Head
Years of Schooling of HH Head	Years of schooling completed by hh head	STORMA, BPS	HH Head
Household characteristics			
Household Size	No. of household members	STORMA, BPS	Household
Dependency Ratio	No. of economic non-active hh members (age<15 or >60) divided by no. of economic active hh members	STORMA, BPS	Household
Number of Men	No. of men in a household	STORMA, BPS	Household
Maxeducation	Maximum years of schooling of a household member	STORMA, BPS	Household
Income variables			
Real per-capita Income	HH income divided by hh size and deflated with provincial CPI data in IDR	STORMA, BPS	Household
Agricultural self-employed income	HH income from self-employment in the agricultural sector	STORMA, BPS	Household
Agricultural wage income	HH income from wage-employment in the agricultural sector	STORMA, BPS	Household
Non-agricultural self-employed income	HH income from self-employment in the non-agricultural sector	STORMA, BPS	Household
Non-agricultural wage income	HH income from wage-employment in the non-agricultural sector	STORMA, BPS	Household
Livestock income	HH income from livestock farming	STORMA	Household
Gathering income	HH income from gathering	STORMA	Household
Cropping income	HH income from crop production	STORMA	Household
Annual cropping income	Annual e.g. rice, maize	STORMA	Household
Perennial cropping income	Perennial e.g. cash crops like coffee, cocoa	STORMA	Household
Cocoa income	HH income from cocoa cultivation	STORMA	Household
Coffee income	HH income from coffee cultivation	STORMA	Household
Productivity variables			
Cocoa yield per are	Cocoa income divided by area cocoa	STORMA	Household
Coffee yield per are	Coffee income divided by area coffee	STORMA	Household
Price variables			
Cocoa price per kilo	Reported farm gate prices per kilo in IDR	STORMA	Household
Coffee price per kilo	Reported farm gate prices per kilo in IDR	STORMA	Household
Sector dummies			
Agricultural self-employed	HH income from this sector > 50%: no(0), yes(1)	STORMA, BPS	Household
Agricultural wage	HH income from this sector > 50%: no(0), yes(1)	STORMA, BPS	Household
Non-agricultural self-employed	HH income from this sector > 50%: no(0), yes(1)	STORMA, BPS	Household
Non-agricultural wage	HH income from this sector > 50%: no(0), yes(1)	STORMA, BPS	Household
Mixed	HH income from non of the above sectors > 50%: no(0), yes(1)	STORMA, BPS	Household
Additional variables			
Area owned	Landholding in are	STORMA	Household
Area cocoa	Land planted with cocoa in are	STORMA	Household
Value of assets	Value of physical and financial assets in IDR	STORMA	Household
Distance to road	Distance to the next paved road in minutes	STORMA	Household

Table A2: Regional Multivariate Regression-Comparison II

	LN REALPERCAPITAINCOME					
	STORMA 2004	STORMA 2006	SUSENAS 2005 Rural Central Sulawesi	SUSENAS 2005 Rural Sulawesi	SUSENAS 2005 Rural Indonesia minus Java	SUSENAS 2005 Rural Indonesia
Sex	0.102	-0.180	0.065	0.240***	0.155***	0.142***
Age	-0.006	0.070	0.009	0.004	0.006***	0.003*
Age^2	0.000	-0.001	-0.009	-0.004	-0.007***	-0.004**
Maxeducation	0.837***	-0.019	0.007	0.014***	0.014***	0.015***
HH Size	-0.224***	-0.142**	-0.091***	-0.076***	-0.077***	-0.075***
Dependencyratio	0.087	-0.287**	0.009	-0.059***	-0.068***	-0.065***
Numberofmen	0.273***	0.161*	0.056	0.035**	0.029***	0.033***
Agriselfemployed	0.786***	0.310*	-0.112**	-0.237***	-0.247***	-0.242***
Nonagriwage	1.413***	1.026***				
Nonagriselfemployed	1.263***	1.109***	0.083	-0.025	-0.013	0.009
Mixed	1.169***	-0.036	0.290	-0.064	0.085**	0.052**
_cons	10.141***	10.233***	11.906***	11.762***	12.630***	11.679***
N	254	254	530	2968	12866	22125
Adj. R-squared	0.20	0.16	0.31	0.39	0.46	0.40

SUSENAS regressions estimate over the deciles 1 to 7 of the original income distribution for the respective geographical area. Deciles 8 to 10 were dropped due to comparability reasons. Significance levels: ***/**/* denote 0.01, 0.05 and 0.1 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 here is thus total wage income.