An Empirical Investigation of Risk Sharing among Indonesian Households

Parantap Basu[1] and Sigit S. Wibowo[2]

[1]Dept. of Economics and Finance, Durham University Business School, Durham University, UK

and

[2]Faculty of Economics and Business, Universitas Indonesia, Depok, Indonesia

ABSTRACT

This study investigates the formation of risk-sharing group in circumstances where households face barriers to insurance. We test alternative risk sharing models which include full risk sharing, borrowing-saving and private information about income and efforts. Using the Indonesia Family Life Survey (IFLS) dataset, this study provides evidence that the full risk-sharing hypothesis fails. There is some evidence that IFLS households smooth consumption using the credit market. No evidence is found in favor of risk sharing models with private information about effort and productivity. We then explore the possibility of Indonesian households forming stable informal risk sharing groups to mitigate idiosyncratic consumption risks. We find strong evidence of such endogenous group formation among IFLS households as a vehicle of informal risk sharing.

Subject headings: credit access, risk sharing, endogenous group formation

1. Introduction

Households in developing countries are vulnerable to income risks which could emanate from various sources such as crop failure, job-loss, illness, accident among others. In the presence of full insurance, these idiosyncratic risks can be pooled by the insurance markets and an individual's consumption is freed from dependence on his own income. However, the absence of perfect insurance arrangement is pervasive in many emerging countries due to the lack of a well-developed financial system. Because of the absence of proper insurance markets, households in these economies make informal risk sharing arrangement. There is a growing literature documenting this kind of risk sharing arrangement (see for example, Platteau (1991), Udry (1994), De Weerdt and Dercon (2006), Collins *et al.* (2010), Fafchamps and Ferrara (2012), among others).

In this paper, we investigate the mode of risk sharing among the Indonesian households. As one of the emerging economies, Indonesia has been struggling in developing its financial systems. The majority of its population still have difficulties in accessing financial services. Households, particularly those who are working in the informal sectors and in rural areas, have little or no access to insurance and are often not aware of any basic social security provided by the government. These people are vulnerable not only to idiosyncratic or individual risks, but also to aggregate risks. For example, Thomas and Frakenberg (2007) show that the financial crisis in 1997 has affected the poorest, middle- and upper-income households in Indonesia. They also found that there was a significant increase in the incidence of poverty and a decline in the living standards as the crisis unfolded. The effects were indicated by lower levels of consumption and income, a decrease in households' assets and a reduction in human capital investment.

We use three waves of a rich panel data of 7,224 Indonesian households to test four extant models of risk sharing: (i) full risk sharing, (ii) consumption smoothing models with borrowing constraint, (iii) models of risk sharing with private information, and finally (iv) a relatively recent model of endogenous group formation developed by Bold (2009). Data overwhelmingly reject full risk sharing hypothesis (i). Regarding (ii), there is no compelling evidence in favor of consumption smoothing models with borrowing constraints although some evidence exists in favor of consumption smoothing models particularly among households in agriculture and fishery. Regarding (iii), we find some limited evidence of risk sharing models with private information about income although there is no evidence of risk sharing in the presence of private information about household's effort and type. Regarding (iv), we find strong evidence in favor of endogenous group formation among IFLS households to share risk informally.

Our study is inspired by a closely related work by Kinnan (2014) who performs similar exercise using panel data for Thai households. However, our study differs from Kinnan in three important respects. First, we use Indonesian IFLS dataset to test alternative risk sharing models while Kinnan uses Thai dataset. Second, we use the methodology suggested by Kocherlakota and Pistaferri (2009) to test risk sharing among IFLS households in the presence of private information, which is novel in this empirical risk sharing literature involving micro data of households in emerging country such as Indonesia. Third and most importantly we test models of endogenous group formation as in Bold (2009) which is also new in the risk sharing literature. The IFLS micro dataset is quite rich and detailed to enable us to undertake these tests using relatively recent models of risk sharing in the presence of private information and limited commitment.

2. Related Literature

Some early papers on risk sharing tests assumed complete market hypothesis to explain consumption insurance across households. Moreover, the risk sharing hypothesis at the household level is calibrated and tested using very rich data sources such as US Panel Study Income Dynamics (Cochrane, 1991) and US Consumer Expenditure Survey (Mace, 1991). However, empirical investigations of full risk sharing using micro data tend to reject the efficient risk sharing hypothesis. Using consumption, labor supply and wage data in the United States, Attanasio and Davis (1996) conclude that consumption risk sharing is incomplete.

There is a growing literature on the study of risk sharing arrangement in developing countries. Beck *et al.* (2008) show that many households in low-income countries do not have adequate access to the financial services which are taken for granted by households in developed countries. They found that these barriers have strong linkages with economic development and financial accession measures. Therefore, households need to find an efficient way to smooth their consumption and to insure themselves against idiosyncratic shocks.

Other related studies investigate risk sharing arrangements formed by households within the same unit, such as a village or a community. Within a community, the mechanism may take place between families and friends who facilitate risk sharing between economic agents, for instance between young and old, and between families in specific regions. Simply, this can happen because there is mutual assistance among them. This becomes important particularly for low-income and developing economies where access to finance is absent or limited and risk becomes ubiquitous. The insurance mechanism is usually conducted via state-contingent transfers such as in Townsend (1994) and Udry (1994).

However, such informal risk sharing arrangement is fragile due to the immutable limited commitment of group members. The transfers between households in an implicit contract may not occur perfectly if an individual does not comply with the group's terms and conditions. Another possible reason is that usually there is no collateral when risk sharing groups emerge. Bold (2009) studies how stable risk sharing groups can be endogenously formed among households under limited commitment. In her model, the risk sharing arrangement is sustainable because it is not incentive compatible for agents to deviate and form sub-coalitions or go to autarky. In such a stable risk sharing arrangement, the consumption of incentive constrained households is determined by the history of shocks and the interaction with other such constrained households in terms of the current income. This model also provides an empirical framework for testing endogenous group formation which can be easily implemented using our IFLS dataset.

In the Indonesian context, Ravallion and Dearden (1988) study risk sharing in terms of private transfers between Javanese households in Indonesia using 1981 Susenas data. They find a difference between rural and urban households in terms of transfer behavior. Okten and Osili (2004) utilize IFLS1 and IFLS2 datasets to investigate how consumption smoothing may occur from accessing the credit market. They find that social and community networks are important in gaining access to credit markets. Witoelar (2013) studies how risk sharing emerges within families using IFLS dataset. However, there is hardly any study that investigates the barriers to insurance and endogenous group formation specifically among Indonesian households.

3. A Survey of Alternative Models of Risk Sharing

In this section, we provide a brief survey of four key models of risk sharing which are taken to the data. The main thrust of this brief survey is to understand the structure of the reduced form consumption process of households. This survey highlights that different risk sharing arrangements imply different reduced form consumption processes which are useful for empirical tests.

3.1. Full Risk Sharing

The perfect risk sharing model is based on the assumption of complete markets given in Arrow and Debreu (1954) and Arrow (1964), widely known as the Arrow-Debreu model. Under full insurance, each household's consumption does not move in unison with its own income because households can use the asset markets to pool individual income risks. To test this, we can use Townsend's (1994) standard test of full risk sharing using each of wave of data. The relevant reduced form regression is given by

$$\ln c_{i,t} = \alpha \ln y_{i,t} + \theta_i + \varepsilon_{i,t} \tag{1}$$

where $c_{i,t}$ is household i's consumption at date t, $y_{i,t}$ is household i's income at date t and θ_i is a household-fixed effect and $\varepsilon_{i,t}$ is the error term. Following Kinnan (2014), we add a community-wave dummy variable δ_{kt} to capture the changes in households' consumption due to changes in aggregate resources as follows:

$$\ln c_{ik,t} = \alpha \ln y_{ik,t} + \theta_{ik} + \delta_{kt} + \varepsilon_{ik,t}. \tag{2}$$

Community-wave dummy is added to capture the role of community in risk sharing mechanism. Under full risk sharing hypothesis, the term α should equal zero. If the term α is significant, it implies that household i's income tracks its consumption. This means rejection of full risk sharing hypothesis.

3.2. Consumption Smoothing

If full risk sharing breaks down, there is a possibility that households may operate in an incomplete market environment with an access to borrowing and lending at a risk-free rate. We call these models *consumption smoothing models* because these models are mostly designed to smooth consumption over time in the spirit of traditional permanent income hypothesis.[1] Hall (1978) shows that in such an environment marginal utility follows a random walk. This means that previous marginal utility of consumption is able to sufficiently capture information at date $t-1$ in forecasting today's marginal utility of consumption. Following Garcia *et al.* (1997), the relevant regression equation is given by

$$\ln c_{i,t} = \alpha_0 + \alpha_1 \ln c_{i,t-1} + \theta_i + \delta_t + \varepsilon_{i,t} \tag{3}$$

where δ_t denotes time-fixed effects and θ_i denotes household-fixed effects.

3.2.1. Liquidity Constraints

However, when households are only able to save but not to borrow (liquidity constrained), the standard Euler equation is not applicable because of liquidity constraints. This leads to a saving-only model where income in the previous period may contain information that cannot be captured by consumption in the same period. The model can be examined by

$$\ln c_{i,t} = \alpha_0 + \alpha_1 \ln y_{i,t-1} + \theta_i + \delta_t + \varepsilon_{i,t}. \tag{4}$$

Following Deaton (1991) under the saving-only model, current consumption should be negatively correlated with income in the previous period. The underlying rationale is that if income is a mean reverting process, a low income shock last period may indicate that a liquidity constrained household who cut back last period consumption would increase today's consumption to smooth consumption over time.

---

[1] Of course the notion of consumption smoothing can be broadened to include full risk sharing models where the consumption smoothing happens across states.

3.3. Models of Risk Sharing with Private Information

We next consider alternative risk sharing arrangements where participants in a risk sharing arrangement may have private information of some kind. Consider first the case when households' efforts are observable but their income and asset returns are private information. In this case, households have an incentive to hide income from other community members in the risk sharing group to free-ride in such arrangement.

3.3.1. Hidden Income

To test the hidden income hypothesis, we utilize household i's consumption and income in a two-step test. Following Kinnan (2014), the first step is to regress the consumption against its lag in which the specification is given by (3). The second step is to derive residuals which are estimated from

$$\hat{\varepsilon}_{i,t} \equiv \ln c_{i,t} - \widehat{\varphi} \ln c_{i,t-1} - \widehat{\delta}_t$$

and then regress it against previous log income $y_{i,t-1}$ as follows

$$\hat{\varepsilon}_{i,t} \equiv \varphi_0 + \varphi_1 \ln y_{i,t-1} + u_{i,t}. \tag{5}$$

Under hidden income hypothesis, φ_1 should not be different from zero. The positive and negative signs of φ_1 have different implications. If φ_1 is negative, it implies borrowing constraint. If it is positive, it implies hidden income. If the household hides information about his income, residuals of the results in consumption smoothing should be positively correlated with past income.

3.3.2. Hidden Effort and Productivity

We next outline an alternative scenario where the households join a community and agree to exert effort to produce output for the community. An example is the case of households forming an informal group to cultivate crop for the community. Household's income is not private information but its effort and productivity is. In such a scenario, the household has an incentive to shirk (moral hazard) or misrepresent its type (adverse selection).

Kocherlakota and Pistaferri (2009) derive the efficient contracting arrangement of this scenario by setting up a constrained social planning problem where the social planner offers a contract of consumption and work effort to the participating households in a community which maximizes their expected utility subject to two constraints, namely (i) a participation constraint ensuring not to walk away to an autarky, and (ii) a truth telling constraint which means that the household has no incentive to shirk or misrepresent its type. The first order condition gives rise to a well known inverse Euler equation similar to Rogerson (1985).

Invoking the law of large numbers, Kocherlakota and Pistaferri derive the following stochastic discount factor ($sdf_{t-1,t}$) based on cross sectional raw moments of consumption of the households in the community between dates $t-1$ and t which they call Private Information Pareto Optimal (PIPO) sdf:

$$sdf_{t-1,t} = \frac{C_{t-1}^{\gamma}}{C_t^{\gamma}} \tag{6}$$

where C_{t-1}^{γ} is the γ^{th} cross sectional raw moment in the community at date $t-1$ and γ is the relative risk aversion parameter. Due to the application of law of large numbers, this *sdf* is robust to the stochastic process generating household's hidden skills and thus it does not depend on household's longitudinal history of characteristics. In addition, it is robust to possible mismeasurement of consumption.

The PIPO sdf can be applied to a wide class of incomplete market environments.[2] Applying this to a simple credit market environment as in the preceding consumption smoothing model where households have access to borrowing and lending at a gross risk free rate R, the standard Euler equation can be written as:

$$E_{t-1}\frac{RC^{\gamma}_{t-1}}{C^{\gamma}_{t}} = 1 \tag{7}$$

which E_{t-1} is the expectation operator at date $t-1$. Taking the log-transform and assuming homoskedastic errors, we can rewrite (7) as a regression equation as log-linear random walk process for the γ^{th} cross-sectional raw moment of consumption,

$$\ln C^{\gamma}_{t} = a + \ln C^{\gamma}_{t-1} + \varepsilon_t \tag{8}$$

where a denotes a constant and ε_t denotes the residual error. Motivated by this random walk specification of the cross sectional raw moments, we propose the following regression to test Kocherlakota and Pistaferri's risk sharing model of private information (2009):

$$\ln\left(\frac{\sum_{i=1}^{N_k} c^{\gamma}_{ik,t}}{N_k}\right) = \alpha_0 + \alpha_1 \ln\left(\frac{\sum_{i=1}^{N_k} c^{\gamma}_{ik,t-1}}{N_k}\right) + \alpha_2 \ln y_{k,t-1} + \theta_k + \varepsilon_{k,t} \tag{9}$$

where $c_{ik,t}$ is household i's per capita consumption in community k at date t, $y_{k,t}$ denotes average income at community k at date t, θ_k denotes the community-fixed effect, and $\varepsilon_{k,t}$ denotes error terms. N_k is different from community to community. If this risk sharing environment is true, α_1 should be close to unity and no other variables such as past income of the community should have any additional explanatory power in determining the left hand side cross sectional raw moment which means that α_2 should equal zero for a plausible range of risk aversion parameter, γ.

The contract stipulated by Kocherlakota and Pisteferri (2009) is, however, based on full commitment assumption and thus it is not time consistent. Agents can sign such a

[2]Basu *et al.* (2011) apply this PIPO discount factor to international risk sharing models.

contract at date zero but renege on it at a later date due to limited commitment. This limitation of Kocherlakota and Pistaferri (2009) model leads us to consider alternative risk sharing models with limited commitment.

3.4. Endogenous Group Formation

We consider a variant of limited commitment models where households can form a risk sharing group when formal insurance market does not exist. In many developing countries, this can be done by forming a risk sharing group or coalition through a contractual agreement between them: the contract may be implicit or explicit. However, such a risk sharing network is highly fragile because a subgroup of households can defect from the network and form a coalition to reap private benefits. Bold (2009) derives conditions for a coalition-proof group formation where it is not incentive compatible for agents to defect in this manner. To derive such coalition-proof contracting arrangement, she formulates a constrained social planning problem subject to a set of promise keeping and enforcement constraints on agents from not forming a collusion and defect from the risk sharing arrangement. The first order conditions of this constrained social planning problem give rise to a history dependent ratio of marginal utilities of the two groups. With a logarithmic utility function, this means that the past history of relative consumption of groups must influence current relative consumption. In addition, individual income should also influence the current relative consumption. This history dependence of the consumption share of each group in the community stands in sharp contrast with the constant consumption share of each group in a complete market full risk sharing setting.

In the spirit of Ligon *et al.* (2002), Bold proposes the following two specifications for testing the existence of such endogenous group formation:

$$\frac{c_{1,t}}{c_{2,t}} = \phi_0 + \phi_1 \frac{c_{1,t-1}}{c_{2,t-1}} + \phi_2 \log y_{1,t} + \phi_3 \log y_{2,t} + \phi_4 \log Y_t + \varepsilon_t \tag{10}$$

$$\frac{c_{1,t}}{c_{2,t}} = \phi_0 + \phi_1 \frac{c_{1,t-1}}{c_{2,t-1}} + \phi_2 \log y_{1,t} + \phi_3 \log y_{2,t} + \phi_4 \log Y_t + \phi_5 \left(\left(\frac{c_{1,t-1}}{c_{2,t-1}} - 1 \right)^2 \times \log y_{2,t} \right) + \varepsilon_t \tag{11}$$

where $\frac{c_{1,t}}{c_{2,t}}$ denotes the ratio between household 1's consumption and household 2's consumption at date t, $\frac{c_{1,t-1}}{c_{2,t-1}}$ denotes the ratio between household 1's consumption and household 2's consumption at date $t-1$, $\log y_{1,t}$ and $\log y_{2,t}$ denote log income of households 1 and 2 at date t respectively, and $\log Y_t$ denotes log income for respective community at date t. If these two households form a defection-free coalition, in an efficient contract, a household with a higher consumption share at date $t-1$ must be awarded a higher payoff so that he continues to enjoy a higher consumption share at date t. Otherwise the household with a high consumption share at date $t-1$ will defect and form a coalition with another group besides 2. This makes ϕ_1 coefficient positive and significant if 1 and 2 form a stable coalition. If groups are exogenously formed, the coefficient for $c_{1,t-1}/c_{2,t-1}$ is statistically insignificant. In the second regression (11), the interaction term $\left(\frac{c_{1,t-1}}{c_{2,t-1}} - 1\right)^2 \times \log y_{2,t}$ is introduced to pick up further nonlinearity in the effect of past relative consumption share which interacts with the second agent's income. For example, under endogenous group formation, the effect of a change in the type 2 agent's income on the current marginal utility ratio may depend on the past marginal utility ratio of these two groups.

In Table 1, we summarize the reduced form regression equations and testable restrictions of five alternative risk sharing models surveyed in section 3 which we take to the data.

(INSERT TABLE 1 HERE)

4. Data

The data are gathered from the Indonesia Family Life Survey. These longitudinal surveys consist of two levels: community and household surveys where the latter can be decomposed into individual and family levels. There are four waves available: IFLS1 in 1993, IFLS2 in 1997, IFLS3 in 2000, and IFLS4 in 2007. In IFLS, around 90% of sample households are retained from the first wave until the latest which is considered to be the advantage of using this dataset to make an economic analysis of risk sharing and related testable implications. For this study, we only use IFLS data up until Wave 3.[3] As of 2000 or in IFLS3, the majority of people in the IFLS are working in the agricultural sector: this comprises 35% of the total sample. Furthermore, in rural areas 51% of the IFLS samples are working in the agricultural sector. Most of these households also live in rural area. Based on the community data, more than 55% of the IFLS communities are located in rural area. The similar figures can be also found in IFLS1 and IFLS2.

For the empirical analysis, we make sure that the data fulfill some basic conditions: (1) all necessary information regarding household variables are available, meaning that only households that exist for all waves are considered, (2) these relevant variables, particularly consumption and income, do not take extreme values; and (3) households stay within their villages for the whole period. The extreme values should be necessarily trimmed down in order to get rid of potential measurement problems, particularly in the case for endogenous group formation tests. In most cases, we use around forty five percent of available data within IFLS households due to incomplete information.

The consumption is measured by per capita expenditure (PCE) and the income is also

[3]We cannot utilize IFLS4 data due to inadequate information about the consumption data making it difficult to compare with other waves.

measured by per capita income (PCI). This means that the consumption and income for each household is divided by the number of people living in that household. For the last two waves, around one third of IFLS households have five or more persons living within a household. Households with 2 persons, 3 persons and 4 persons are relatively similar for the last two wave surveys where each consists of around twenty percent of total IFLS households. The descriptive statistics for relevant analysis are given in Table 2. Figure 1 plots the community averages of consumption and income as a summary description of the data.

(INSERT TABLE 2 AND FIGURE 1 HERE)

To examine private information model with hidden efforts, we use information at community level by summing up all household consumption and income within a community. We then compute raw moments for all communities in IFLS using (9) in order to assess risk sharing model with private information. Figure 2 plots community raw moments of consumption for different γ values.

(INSERT FIGURE 2 HERE)

To test endogenous group formation as formulated in (10) and (11), we use community as a risk sharing unit. We use community data that consist of at least three households. This leaves us with 231 communities for this test. The average number of households within a community is 12 person with standard deviation of 4.73 and the maximum observation is 24 households within a community. Given this fact, it is adequate to perform endogenous group formation tests using IFLS households.

However, two potential problems may arise if ordinary least squares (OLS) estimators are applied to estimate equations that include consumption and income, namely the endogeneity of income change and income measurement error. This problem may emerge in household level analysis. To address these potential problems, we use two instruments for household level tests: asset and health measures. The justification for using these two variables as instruments is that households with greater physical and human assets are likely to have higher income. The first instrument is household assets which include current and fixed assets. In the IFLS, these household assets include the house, vehicles, appliances, savings, jewelry, furniture and utensils. We also include assets that are used by households for farming and non-farming businesses.

Our second instrument is activities of daily living (called ADL hereafter). ADL is a measure that indicates the physical ability of an individual to perform daily living activities. The reliability and validity of ADLs have been tested extensively, mainly in the United States and Southeast Asia.[4] The ADL is transformed into an index as follows:

$$\frac{ADL\ Score - Min.\ Score}{Max.\ Score - Min.\ Score}.$$

The ADL index takes on values from 0 to 1, where zero is when the individual cannot perform any ADLs at all and one is when the individual can easily perform all of the ADLs.[5]

---

[4]Gertler and Gruber (2002) provide more explanation about the reliability and validity of ADLs in this regard.

[5]In IFLS, the ADLs are divided into several components. These are namely, ability to carry a heavy load for 20 meters, ability to walk for 5 kilometers, ability to walk for 10 kilometers, ability to bow, squat and kneel, ability to sweep the house floor, ability to draw a pail of water from a well, ability to stand up from sitting on the floor without help, ability to stand up from sitting position in a chair without help, ability to bathe without help, and ability to dress without help. The first four activities are classified as intermediate ADLs, while the last five activities are classified as the basic ADLs.

To assess risk sharing within communities, the IFLS provides information about community participation known as Rotating Saving and Credit Associations (ROSCA for short) for each respondent along with individual social and economic characteristics. ROSCAs (or *Arisan*) have long been known in Indonesia as a part of the social and economic tradition. Indonesian households use various forms of ROSCA to share their risk. With diverse demographic characteristics, ROSCAs are generally formed by group of people who usually congregate weekly and pass part of the pooled assets in certain ways using either a random pot or a systematic rotation scheme. Since ROSCAs use a simpler approach to conducting financial contract than formal financial institutions, a lot of people, especially those who are credit constrained, prefer to use it as a risk sharing vehicle. This makes ROSCAs specifically a good candidate for testing endogenous group formation as opposed to a full sample of households who may or may not participate in ROSCAs. Unfortunately, IFLS1 does not have information about ROSCAs. In view of this, for tests of endogenous risk sharing, we use the data from IFLS3 and IFLS2 to form a cross section sample of households.

5. Empirical Results

5.1. Full Risk Sharing Tests

We undertake tests given in (1) and (2) are employed. The results are presented in Table 3. For regression with a household-fixed effect, the elasticity of consumption to income is 0.114 (see Column (1)). Then by adding the community effect, this elasticity decreases to 0.0535 (see Column (2)).

(INSERT TABLE 3 HERE)

To mitigate the problem of endogeneity, we use instruments such as ADLs and log of household asset with respect to log per capita income. The validity of these instruments is checked by using the Sargan tests. For the third regression without fixed effects, these instruments are weak since it does not pass Sargan test. After adding community-wave dummy, these two instruments are found to be valid as they pass the Sargan endogeneity tests. To test the joint significance of community-wave effects, F statistics are found to be statistically significant. This also provides a strong indication that indeed communities play important role in providing insurance mechanisms for households.

Comparing the instrumental variables (IV) estimates in Column (3) and Column (4) we find that consumption elasticity decreases from 0.355 to 0.102. This provides an indirect evidence that community (indicated by community-wave indicators) may provide more insurance to households. However, the risk sharing is still incomplete because the estimates are statistically significant.

5.2. Consumption Smoothing Tests

In Table 4, we present results for the borrowing-saving, and saving only tests. Column (1) provides the results from borrowing-saving test given by (3). Since the lagged consumption term is statistically significant, this means that households can partially smooth their consumption by performing transactions in credit markets. The column (2) of Table 4 provides the results for the saving only model as given in (4). Although the lagged income term is negative it is statistically insignificant which alludes to rejection of saving only hypothesis.

(INSERT TABLE 4 HERE)

Robustness issues may arise because of limited number of waves in or panel. There are three waves of IFLS1 (1993), IFLS2 (1997), and IFLS3 (2000) which are three and two years apart respectively. For full risk sharing tests reported in the preceding section, this is not a problem because left hand side and right hand side variables are both contemporaneous. However, for test results involving lagged dependent variables a legitimate concern arises about the consistency of the series across waves. It is possible that a household surveyed in one wave might have changed its occupation or profession in the subsequent wave because several years have passed between two waves. Therefore, the risk sharing arrangement of households across different waves might not represent the risk sharing arrangement portrayed by the theoretical model, which assumes identical households across waves. This is an endemic problem to any panel study with a limited number of waves.[6]

To deal with this problem, this study conducts robustness checks for consumption smoothing tests using households' occupations. Households' occupations are classified and the same battery of tests is run for each occupation to see whether similar result holds. Table 5 summarizes the results. Agriculture and forestry accord well with earlier risk sharing result for both robustness checks. This means that on average people who are working in agriculture, forestry, and fishery sector tend to smooth consumption using banks and other credit institutions. Given that agriculture and forestry comprise about 76% of the sample, we consider this as an adequate robustness check of our basic test results. Table 6 reports the robustness checks for saving-only models which echo the same pattern for the full sample as in Table 4. Lagged income is found mostly to be statistically insignificant.

(INSERT TABLE 5 HERE)

(INSERT TABLE 6 HERE)

[6]A recent example of such problems can be found in Fichera and Savage (2015).

5.3. Testing Private Information Risk Sharing Models

Table 7 reports the results of the tests for hidden income hypothesis for the full sample. Since the lagged income coefficient is small and statistically insignificant, it suggests rejection of hidden income hypothesis. Similar robustness checks have also been carried out using occupational data for testing hidden income hypothesis because lagged term is involved on the right hand side. Since the hidden income test is quite similar to the borrowing-saving and saving only tests, the year gap may also become a problem to the estimation results due to the nature of IFLS data. There are two occupations or industry classifications that have similar results in the initial hidden income test reported in Table 7. These are namely, (a) agriculture, forestry, and fishery and (b) social services.

(INSERT TABLE 7 HERE)

(INSERT TABLE 8 HERE)

Table 9 provides the results for moral hazard tests of the random walk specification of the γth non-central cross section moments of consumption as specified in Equation (9) for a plausible range of risk aversion coefficients γ between 1 and 2. Although the lagged raw moment is significant, the lagged average consumption is also significant. This suggests that the private information models of Kocherlakota and Pistaferri (2009) is rejected by the IFLS households. Given different parameter values, the results imply that moral hazard is not able to explain the failure of full risk sharing in the community.

(INSERT TABLE 9)

5.4. Endogenous Group Formation Tests

In order to estimate the existence of endogenous group formation, we need to define type 1 and type 2 household. Type 1 households (high consumption type) are defined as the households who experience an increase of their consumption compared to the previous period while type 2 (low-consumption type) have constant or a decrease in their consumption from the previous period. The rationale for using change in consumption instead of income as a criterion for defining types is that income appears on the right side on the regression.

In order to run the regressions (10) and (11), each low-consumption type household in a community is paired with a high-consumption type household within the same community in our IFLS dataset. Each observation is thus a pair of low and high-consumption household within the same community. It is important to note that since our sample consists of paired households for two waves (wave 2 and wave 3 only) due to nonavailability of ROSCA households in wave 1, the data structure becomes cross section not a panel unlike the previous regressions.

(INSERT TABLE 10 HERE)

Table 10 presents the results of endogenous group formation test of the IFLS households. Columns 1 and 2 report the regression results of Equation (10) and (11) that involve full sample of 27,881 observations of paired households. The lagged consumption share is significant at 1% level for both regressions. The interaction term is also significant at 1% level. These results are indicative of endogenous group formation among these households for the full sample. However, the estimates are biased because of the presence of the endemic heteroskedasticity problem in any cross section regression. The Chi-square statistic reported in the table indicates this presence of heteroskedasticity.

To overcome the heteroskedasticity problem, we run iterative tests of heteroskedasticity to find a threshold value for $c_{1,t-1}/c_{2,t-1}$ above which heteroskedasticity becomes a problem based on standard tests of heteroskedasticity.[7] The cut-off value for $c_{1,t-1}/c_{2,t-1}$ is found to be 1.26. The observations above this value are dropped. Columns 3 and 4 report the same for the sub-sample of households above the 1.26 cut-off value of $c_{1,t-1}/c_{2,t-1}$ after treating the heteroskedasticity problem. This subsample consists of 12,665 observations of paired households. In Columns 5 and 6, we report the same regressions for a further restricted subsample of households who participate in ROSCAs only. There are 231 communities used in the analysis after treatment and 36 communities in which households participate in ROSCA. In these communities, we observe a cross section of 399 paired households which we use as units of analysis. All the latter regressions reported in Columns 3 through 6 have passed the heteroskedasticity tests.

All these regressions show positive and significant coefficients for $c_{1,t-1}/c_{2,t-1}$. In addition, the interaction term is significant except the regression based on ROSCA households. Since the past history of consumption share is significant, it suggests the presence of endogenous group formation in all cases. For ROSCA households, although the lagged consumption share is significant, the interaction term is not. In addition, the community income is insignificant in determining consumption share for these ROSCA households. One expects that when endogenous group formation exists, intergroup income transfer makes community income less important in determining relative consumption share. In all cases, the income coefficients of households 1 and 2, have predictable signs as

---

[7]Thus endogeneity is less of a concern than heteroskedasticity for cross-section regressions here. We use Durbin-Wu-Hausman procedure to check whether endogeneity exists and we observed that OLS estimates derived from endogenous group formation regressions are consistent.

in Bold (2009) simulation. Our IFLS ROSCA households exhibit small coefficients of type 1 and type 2 households' income levels. This basically suggests that the endogenous group formation lowers the importance of individual income shocks.

In summary, including ROSCA and non-ROSCA households, we find robust evidence of endogenous group formation for the IFLS households. Given our limited sample of ROSCA households it is difficult to draw a definitive conclusion whether ROSCA households do a better risk sharing than others. This can be a future research question if more observations for ROSCA households are available.

6. Concluding Remarks

This study starts by examining whether full risk sharing exists between IFLS households. We find that our IFLS households do not share risks conforming with the full risk sharing hypothesis. This finding is indicative of barriers to risk sharing. These barriers may be due to (i) borrowing constraint, (ii) hidden income and (iii) private information. Based on the extant literature of risk sharing, we run reduced form regressions using the consumption and income data of IFLS household panel data. Our results do not strongly subscribe to the presence of frictions such as (i) and (iii) although there is some evidence of (ii).

Given the fact that limited commitment is endemic in any risk sharing arrangement, we investigate further the possibility of informal risk sharing arrangements among households without an incentive to renege. We fall back on a relatively recent theory of endogenous group formation to test for such informal risk sharing arrangement. The power of these tests depends on the identification of constrained and unconstrained households. The study finds that endogenous group formation exists between the IFLS households within their community. The evidence of such risk sharing is robust among various subsamples of IFLS households including ROSCA. Our study suggests that the risk sharing arrangements among Indonesian households is rather informal and is not necessarily driven by formal market forces. This is not surprising given the pervasive failure of formal credit and insurance markets in these economies.

REFERENCES

Kenneth J. Arrow. The role of securities in the optimal allocation of risk-bearing. *The Review of Economic Studies*, 31(2): 91–96, 1964.

Kenneth J. Arrow and Gerard Debreu. Existence of an equilibrium for a competitive economy. *Econometrica*, 22(3): 265–290, 1954.

Orazio P. Attanasio and Steven J. Davis. Relative wage movements and the distribution of consumption. *Journal of Political Economy*, 104(6): 1227–1262, 1996.

Parantap Basu, Andrei Semenov and Kenji Wada Uninsurable Risk and Financial Market Puzzles, *Journal of International Money and Finance*, 30(6): 1055-1089, 2011.

Thorsten Beck, Asli Demirgüç-Kunt, and Maria Soledad Martinez Peria. Banking services for everyone? Barriers to bank access and use around the world. *The World Bank Economic Review*, 22(3): 397–430, 2008.

Tessa Bold. Implications of endogenous group formation for efficient risk-sharing. *The Economic Journal*, 119(536): 562–591, 2009.

John H. Cochrane. A simple test of consumption insurance. *Journal of Political Economy*, 99(5): 957–976, 1991.

Daryl Collins and Jonathan Morduch and Stuart Rutherford and Orlanda Ruthven. *Portfolios of the Poor: How the World's Poor Live on $2 a Day*. Princeton University Press, New Jersey, 2010.

Joachim De Weerdt and Stefan Dercon. Risk-sharing networks and insurance against illness. *Journal of Development Economics*, 81(2): 337-356, 2006.

Angus Deaton. Saving and liquidity constraints. *Econometrica*, 59(5): 1221–1248, 1991.

Marcel Fafchamps and Eliana La Ferrara. Self-help groups and mutual assistance: Evidence from Urban Kenya. *Economic Development & Cultural Change*, 60(4): 707–733, 2012.

Elizabeth Frankenberg and Lynn A. Karoly. The 1993 Indonesian Family Life Survey: Overview and Field Report. RAND Working Paper DRU-1195/1-NICHD/AID, 1995.

Elizabeth Frankenberg and Duncan Thomas. The Indonesian Family Life Survey (IFLS): Study design and results from Waves 1 and 2. RAND Working Paper DRU-2238/1-NIA/NICHD, 2000.

Eleonora Fichera and David Savage. Income and health in Tanzania. An instrumental variable approach. *World Development*, 66(0): 500–515, 2015.

René Garcia, Annamaria Lusardi, and Serena Ng. Excess sensitivity and asymmetries in consumption: An empirical investigation. *Journal of Money, Credit and Banking*, 29(2): 154–176, 1997.

Paul Gertler and Jonathan Gruber. Insuring consumption against illness. *American Economic Review*, 92(1): 51–70, 2002.

Robert E. Hall. Stochastic implications of the life cycle-permanent income hypothesis: Theory and evidence. *Journal of Political Economy*, 86(6): 971–987, 1978.

Cynthia G. Kinnan. *Distinguishing barriers to insurance in Thai villages*. working paper, 2014, http://faculty.wcas.northwestern.edu/ cgk281/BtI.pdf.

Narayana Kocherlakota and Luigi Pistaferri. Asset pricing implications of Pareto optimality with private information. *Journal of Political Economy*, 117(3): 555–590, 2009.

Ethan Ligon, Jonathan P. Thomas, and Tim Worrall. Informal insurance arrangements with limited commitment: Theory and evidence from village economies. *The Review of Economic Studies*, 69(1): 209–244, 2002.

Lars Ljungqvist and Thomas J. Sargent. *Recursive Macroeconomic Theory.* The MIT Press, Cambridge, MA, 2012.

Barbara J. Mace. Full insurance in the presence of aggregate uncertainty. *Journal of Political Economy*, 99(5): 928–956, 1991.

Cagla Okten and Una Okonkwo Osili. Social networks and credit access in Indonesia. *World Development*, 32(7): 1225–1246, 2004.

Jean-Philippe Platteau. Traditional systems of social security and hunger insurance: Past achievements and modern challenges. In Ehtisham Ahmad and Jean Dréze and John Hills, and Amartya Sen, editors, *Social Security in Developing Countries*, pages 112–170. Clarendon Press, Oxford, 1991.

Martin Ravallion and Lorraine Dearden. Social security in a "moral economy": An empirical analysis for Java. *Review of Economics and Statistics*, 70(1): 36–44, 1988.

William P. Rogerson. Repeated Moral Hazard. *Econometrica*, 53(1): 69-76, 1985.

John Strauss, Kathleen Beegle, Bondan Sikoki, Agus Dwiyanto, Yulia Herawati, and Firman Witoelar. The Third Wave of the Indonesia Family Life Survey (IFLS3): Overview and Field Report. RAND Working Paper WR-144/1-NIA/NICHD, 2004.

John Strauss, Firman Witoelar, Bondan Sikoki, and Anna Marrie Wattie. The Fourth Wave of the Indonesia Family Life Survey (IFLS4): Overview and Field Report. RAND Working Paper WR-675/1-NIA/NICHD, 2009.

Duncan Thomas and Elizabeth Frankenberg. Household responses to the financial crisis in Indonesia: Longitudinal evidence on poverty, resources, and well-being. In Ann Harrison, editor, *Globalization and Poverty*, pages 517–560. The University of Chicago Press, Chicago, 2007.

Robert M. Townsend. Risk and insurance in village India. *Econometrica*, 62(3): 539–591, 1994.

Christopher Udry. Risk and insurance in a rural credit market: An empirical investigation in Northern Nigeria. *The Review of Economic Studies*, 61(3): 495–526, 1994.

Firman Witoelar. Risk sharing within the extended family: Evidence from the Indonesia Family Life Survey. *Economic Development & Cultural Change*, 62(1): 65–94, 2013.

This manuscript was prepared with the AAS LaTeX macros v5.2.

Table 1. Summary of Risk Sharing Hypotheses and Related Tests

	Specification		Expected Sign
Full risk sharing	$\ln c_{ik,t} = \alpha \ln y_{ik,t} + \theta_{ik} + \delta_{kt} + \varepsilon_{ik,t}$	(2)	$\alpha = 0$
Borrowing-saving	$\ln c_{i,t} = \alpha_0 + \alpha_1 \ln c_{i,t-1} + \theta_i + \delta_t + \varepsilon_{i,t}$	(3)	$\alpha_1 \neq 0$
Saving only	$\ln c_{i,t} = \alpha_0 + \alpha_1 \ln y_{i,t-1} + \theta_i + \delta_t + \varepsilon_{i,t}$	(4)	$\alpha_1 < 0$
Hidden income	$\hat{\varepsilon}_{i,t} = \varphi_0 + \varphi_1 \ln y_{i,t-1} + u_{i,t}$	(5)	$\varphi_1 > 0$
Private information	$\ln \left(\frac{\sum_{i=1}^{N} 1/c_{ik,t}^{-\gamma}}{n} \right) = \alpha_0 + \alpha_1 \ln \left(\frac{\sum_{i=1}^{N} 1/c_{ik,t-1}^{-\gamma}}{n} \right) + \alpha_2 \ln y_{k,t-1} + \theta_k + \varepsilon_{k,t}$	(9)	$\alpha_1 \neq 0,\ \alpha_2 = 0$
Endogenous	$\frac{c_{1,t}}{c_{2,t}} = \phi_0 + \phi_1 \frac{c_{1,t-1}}{c_{2,t-1}} + \phi_2 \log y_{1,t} + \phi_3 \log y_{2,t} + \phi_4 \log Y_t + \varepsilon_t$	(10)	$\phi_1 \neq 0$
group	$\frac{c_{1,t}}{c_{2,t}} = \phi_0 + \phi_1 \frac{c_{1,t-1}}{c_{2,t-1}} + \phi_2 \log y_{1,t} + \phi_3 \log y_{2,t} + \phi_4 \log Y_t$	(11)	$\phi_1 \neq 0, \phi_5 \neq 0$
formation	$+\phi_5 \left(\frac{c_{1,t-1}}{c_{2,t-1}} - 1 \right)^2 \times \log y_{2,t} + \varepsilon_t$		

Table 2: Summary Statistics of Key Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
IFLS1 − 1993					
log(Asset)	2983	16.4163	1.8059	9.1528	22.6116
log(PCE)	3014	11.9606	0.7678	9.4761	15.6449
log(PCI)	3014	10.4283	2.0057	0.9641	18.6922
ADLs	3014	0.7593	0.0697	0.1667	1
IFLS2 − 1997					
log(Asset)	2824	16.9993	1.8739	7.6834	23.2693
log(PCE)	3014	12.3732	0.7711	9.9135	17.2958
log(PCI)	3014	11.5175	1.4156	-1.5757	18.8558
ADLs	3014	0.9679	0.0846	0	1
IFLS3 − 2000					
log(Asset)	2897	16.9239	1.8724	6.2146	22.4968
log(PCE)	3014	12.3829	0.7116	10.2886	15.5103
log(PCI)	3014	11.5690	1.1714	5.6268	17.2419
ADLs	3014	0.9607	0.0976	0	1

Note. — Per capita income and per capita consumption figures are in monthly and in 2000 Indonesia rupiah. The values are transformed into logarithmic values. ADLs denote activities of daily living index. Log of household assets are calculated from total value of assets for each household in 2000 Indonesia rupiah. *Source*: authors' calculations from IFLS dataset.

Table 3: Full Risk Sharing: Individual and Community Level

	Log of per capita expenditure			
	(1)	(2)	(3)	(4)
Log of per capita income	0.114***	0.0535***	0.355***	0.102**
	(0.0047)	(0.0050)	(0.0140)	(0.0465)
Households	3014	3014	2946	2946
Observations	9042	9042	8644	8644
Community-wave fixed effect	No	Yes	No	Yes
Estimation method	OLS	OLS	IV	IV
Sargan statistic			17.290	0.2940
p-value			0.000	0.5877
R^2	0.090	0.236	-0.324	0.185

Note. — The household consumptions and incomes are deviations from means of respective household variables. All variables are in 2000 Indonesian rupiah. In Column (3) and (4), ADLs of the household's head and log of household assets are used as instruments and passed the endogeneity test for final estimation (Column (4)). Standard errors are reported in parentheses. Coefficients significant at the 10% level are denoted by * , at the 5% level by **, and at the 1% level by ***. *Source*: authors' calculations from IFLS dataset.

Table 4: Borrowing-Saving and Saving Only Tests

	Log of PCE	
	(1)	(2)
Lag of log per capita expenditure	0.358***	
	(0.0118)	
Lag of log per capita income		-0.00678
		(0.00541)
Households	3014	3014
Observations	6028	6028
Community fixed effect	Yes	Yes
Overall R^2	0.3782	0.0009

Note. — All variables are in 2000 Indonesian rupiah. PCE is per capita expenditure which represents per capita consumption for each household. The OLS method is used in this analysis. There is no endogeneity problem in both regressions. Standard errors are reported in parentheses. Coefficients significant at the 10% level are denoted by * , at the 5% level by **, and at the 1% level by ***. *Source*: authors' calculations from IFLS dataset.

Table 5: Borrowing-Saving Models: Tests Based on Households' Occupation

	(1)	(2)	(3)	(4)	(5)	(6)
Lag of log PCE	0.285***	-0.067	-0.122	0.071	-0.155	-0.048
	(0.024)	(0.063)	(0.079)	(0.041)	(0.084)	(0.047)
Household	830	149	91	367	79	291
Observations	1660	298	182	734	158	582
Overall R^2	0.349	0.672	0.721	0.430	0.803	0.583

Note. — This table provides the first robustness check for estimation results of borrowing-saving test in Table 4 Column (1). The low number of observations as in Column (2), (4), and (8) indicate low number of the head of households who work in these sectors as provided by IFLS data. The column number represents the field of work or industry where the head of the household works: (1) agriculture, forestry, and fishery, (2) manufacturing, (3) construction, (4) wholesale, retail, restaurants and hotels, (5) transportation, storage and communication, and (6) social services. Coefficients significant at the 10% level are denoted by * , at the 5% level by **, and at the 1% level by ***. *Source*: authors' calculations from IFLS dataset.

Table 6: Saving-Only Models: Tests Based on Household Occupation

	(1)	(2)	(3)	(4)	(5)	(6)
Lag of log PCI	0.008	-0.010	-0.027	-0.031	-0.008	-0.002
	(0.101)	(0.021)	(0.023)	(0.019)	-0.033	(0.015)
Household	830	149	91	367	79	291
Observations	1660	298	182	734	158	582
Overall R^2	0.006	0.006	0.015	0.005	0.034	0.004

Note. — This table provides the first robustness check for estimation results of saving-only test in Table 4 Column (2). The low number of observations as in Column (2), (4), and (8) indicate low number of the head of households who work in these sectors as provided by IFLS data. The column number represents the field of work or industry where the head of the household works: (1) agriculture, forestry, and fishery, (2) manufacturing, (3) construction, (4) wholesale, retail, restaurants and hotels, (5) transportation, storage and communication, and (6) social services. Coefficients significant at the 10% level are denoted by *, at the 5% level by **, and at the 1% level by ***. *Source*: authors' calculations from IFLS dataset.

Table 7: Hidden Income Test

	Residuals
Lag of log per capita income	0.0238***
	(0.00398)
Households	3014
Observations	6028
Community fixed effect	No
Overall R^2	0.0055

Note. — All variables are in 2000 Indonesian rupiah. PCE is per capita expenditure which represents per capita consumption for each household. The OLS method is used in this analysis. Standard error is reported in parentheses. Coefficients significant at the 10% level are denoted by * , at the 5% level by **, and at the 1% level by ***. *Source*: authors' calculations from IFLS data set.

Table 8: Hidden-Income Models: Tests Based on Household Occupation

	(1)	(2)	(3)	(4)	(5)	(6)
Lag of log PCI	0.025**	0.0098	0.006	0.019	0.029	0.023*
	(0.008)	(0.012)	(0.182)	(0.012)	(0.018)	(0.011)
Household	830	149	91	367	79	291
Observations	1660	298	182	734	158	582
Overall R^2	0.007	0.022	0.001	0.003	0.018	0.008

Note. — This table provides the first robustness check for estimation results of hidden-income test in Table 7. The low number of observations as in Column (2), (4), and (8) indicate low number of the head of households who work in these sectors as provided by IFLS data. The column number represents the field of work or industry where the head of the household works: (1) agriculture, forestry, and fishery, (2) manufacturing, (3) construction, (4) wholesale, retail, restaurants and hotels, (5) transportation, storage and communication, and (6) social services. Coefficients significant at the 10% level are denoted by * , at the 5% level by **, and at the 1% level by ***. *Source*: authors' calculations from IFLS dataset.

Table 9: Moral Hazard Tests Using Raw Moments

	Consumption moment					
	(1)	(2)	(3)	(4)	(5)	(6)
γ value	1.00	1.20	1.40	1.60	1.80	2.00
Log of previous	-0.577***	-0.609***	-0.628***	-0.638***	-0.644***	-0.646***
consumption moment	(0.0537)	(0.0539)	(0.0538)	(0.0535)	(0.0534)	(0.0533)
Average log of	0.174***	0.219***	0.264***	0.307***	0.350***	0.392***
previous income	(0.0231)	(0.0292)	(0.0358)	(0.0429)	(0.0504)	(0.0583)
Community	310	310	310	310	310	310
Observations	620	620	620	620	620	620
Adjusted R^2	0.480	0.508	0.520	0.522	0.518	0.512
$F-$statistic	57.72	63.69	68.17	71.06	72.68	73.46
$p-$value	0.00	0.00	0.00	0.00	0.00	0.00

Note. — This table presents simulation results based on (9). All variables are in 2000 Indonesian rupiah. The constants and coefficients for log income are increasing as the parameters of γ are decreasing. Robust OLS estimation with fixed-effects are employed. Standard errors are reported in parentheses. Coefficients significant at the 10% level are denoted by * , at the 5% level by **, and at the 1% level by ***. *Source*: authors' simulation using IFLS dataset.

Table 10: Empirical Tests of Endogenous Group Formation

	Full samples		After treatment		Rosca only	
	(1)	(2)	(3)	(4)	(5)	(6)
$c_{1,t-1}/c_{2,t-1}$	0.0855***	0.199***	0.291***	0.133***	0.276***	0.346*
	(0.0031)	(0.00491)	(0.00829)	(0.0193)	(0.055)	(0.134)
Household 1's income	0.471***	0.430***	0.0384***	0.0384***	0.0565***	0.0572***
	(0.0106)	(0.0105)	(0.00246)	(0.00245)	(0.0163)	(0.0163)
Household 2's income	-0.120***	-0.111***	-0.00858***	-0.00366	-0.0507***	-0.0534***
	(0.0104)	(0.0103)	(0.00232)	(0.00238)	(0.0135)	(0.0143)
Community income	-0.0993***	-0.0872***	-0.00836***	-0.00921**	-0.0369	-0.0369
	(0.0147)	(0.0151)	(0.00326)	(0.00325)	(0.0256)	(0.0257)
$((c_{1,t-1}/c_{2,t-1}) - 1)^2 \times y_{2,t}$		-0.000112***		-0.0198***		0.00874
		(0.00000415)		(0.00218)		(0.0152)
Observations	27881	27881	12665	12665	399	399
Adjusted R-square	0.099	0.126	0.112	0.117	0.159	0.157
Ramsey RESET tests						
F-value	402.28	328.06	21.27	3.84	2.66	2.27
Prob>F	0.0000	0.0000	0.0000	0.0092	0.0482	0.0418
Heteroskedasticity tests						
$\chi^2(1)$	20734.20	15905.79	2.43	2.69	0.53	0.44
P-value	0.0000	0.0000	0.1191	0.1011	0.467	0.5064
Mean VIF	1.08	1.09	1.09	2.89	1.17	3.29

Note. — This table presents the testable implications of endogenous group formation. The dependent variable is $c_{1,t}/c_{2,t}$. Only communities with at least three households are included in the tests using IFLS2 and IFLS3. Column (1) and (2) provide the results before the treatment applied to the data. The treatment is conducted by dropping observations where ratio of $c_{1,t}/c_{2,t}$ is above 1.26. The tests for full samples after treatments are given in Column (3) and (4) while Column (5) and (6) present the results for those who join ROSCAs. All regressions are estimated using OLS methods. IFLS2 (1997) and IFLS3 (2000) are employed for these tests. All variables are in 2000 Indonesian rupiah and per capita. Standard errors are reported in parentheses. Coefficients significant at the 10% level are denoted by * , at the 5% level by **, and at the 1% level by ***. *Source*: authors' calculations from the IFLS dataset.

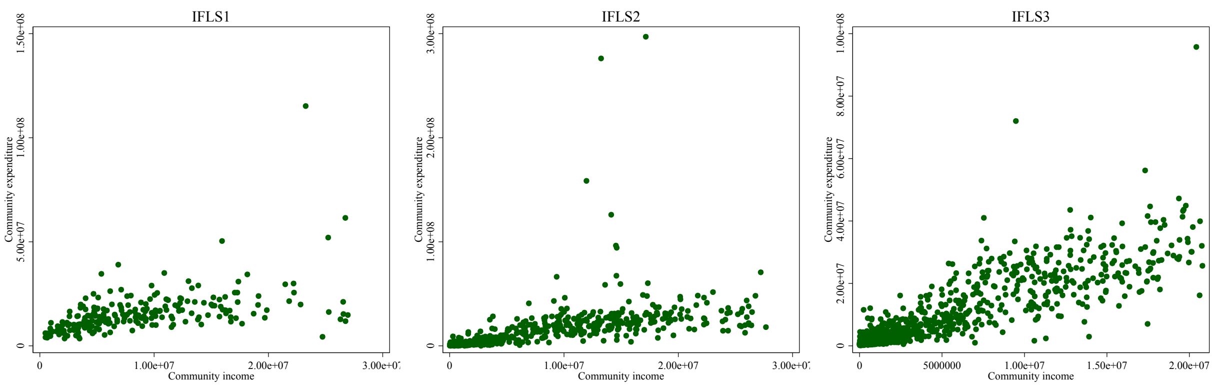

Fig. 1.— The community averages of consumption and income. *Source*: authors' calculations from IFLS dataset.

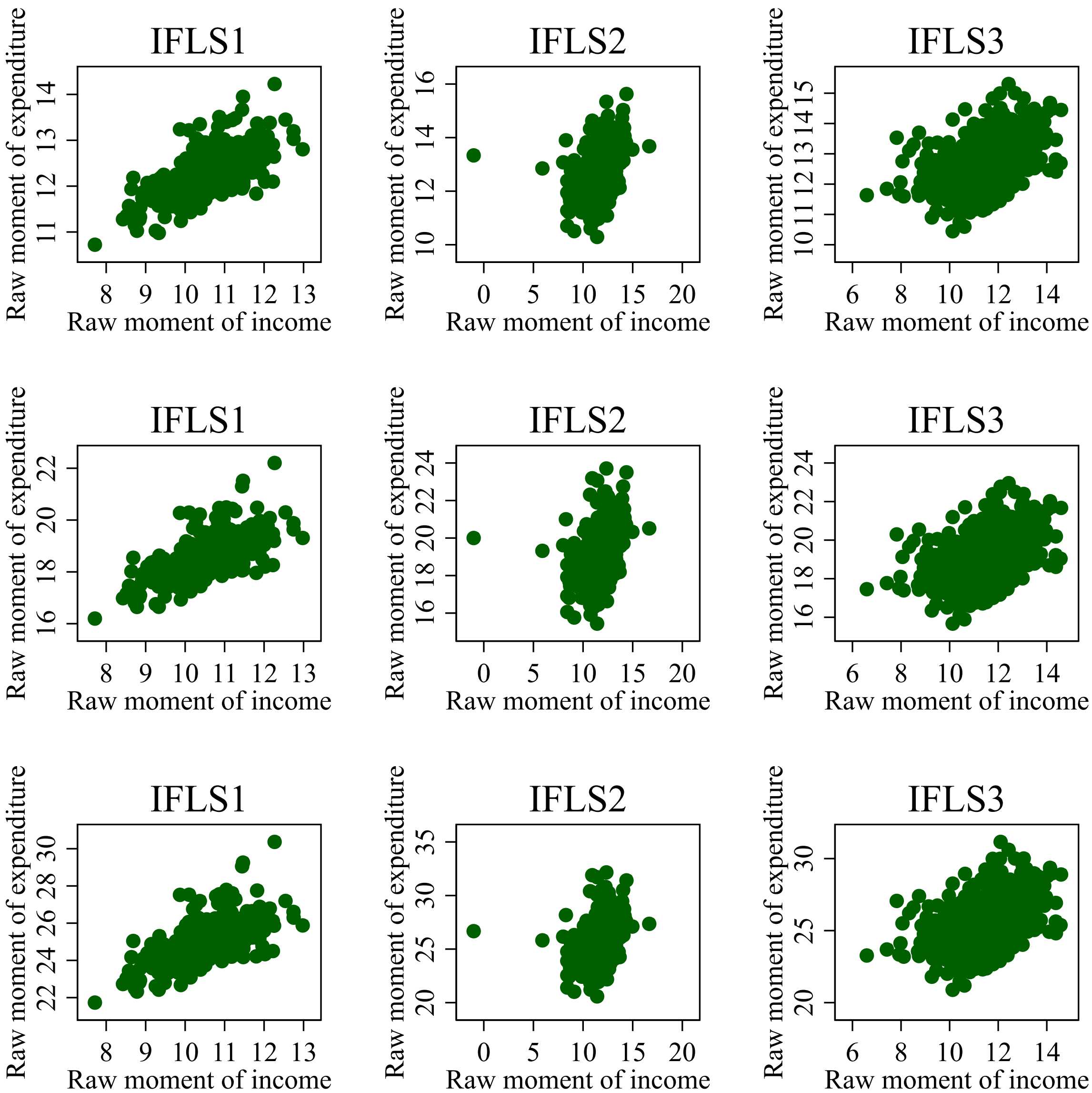

Fig. 2.— Raw moment of income and raw moment of expenditure at community level. The top figures are based on $\gamma = 1$, the middle are based on $\gamma = 1.5$ and the bottom are based on $\gamma = 2$. *Source*: authors' calculations from IFLS dataset.