Self-Production, Friction, and Risk Sharing against Disasters: Evidence from Vietnam*

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August 2011

Abstract

This paper uses a unique household data set collected in Vietnam to empirically test the necessary conditions for an extended version of the consumption risk-sharing hypothesis. The test explicitly incorporates self-production and uses natural disasters such as avian influenza, droughts, and floods to identify the effectiveness of market and non-market risk-sharing mechanisms. With these additional treatments, full risk sharing cannot be rejected, which suggests the presence of omitted variable bias in existing studies that reject full risk sharing. We also find that credit constraints have a significant impact, although limited commitment is not necessarily serious.

Keywords: consumption risk sharing; self-production; credit constraints; and limited commitments.

* This paper was written as part of a research project under the Research Institute of Economy, Trade and Industry (RIETI). We acknowledge financial support from RIETI. We would like to thank Dang Kim Son, Nguyen Ngoc Que, Truong Thi Thu Trang, and Phung Duc Tung for their invaluable collaboration in the household survey. We would also like to thank Sarah Bales, Bob Baulch, John Gibson, Masahisa Fujita, Paul Glewwe, Takashi Kurosaki, and Kozo Oikawa for their useful suggestions and comments. The usual disclaimers apply.

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1. Introduction

In the past fifteen years, there has been a remarkable progress in formulating and testing the full consumption risk-sharing hypothesis (Townsend, 1987; Mace, 1991; Cochrane, 1991; Townsend, 1994; Udry, 1994; Hayashi, Altonji, and Kotlikoff, 1996; Ligon, 1998; Dercon and Krishnan, 2000; Ogaki and Zhang, 2001; Murgai et al., 2002; Fafchamps and Lund, 2003; Dubois et al., 2008; Ligon, 2008; Kinnan, 2010; Laczo, 2010; Attanasio and Pavoni, 2011). According to the canonical model of consumption risk sharing, idiosyncratic changes in household income should be absorbed by all other members within the same risk sharing network when the market is complete. Thus, when aggregate shocks are controlled for, idiosyncratic income shocks should not affect consumption when risk sharing is efficient. Existing studies on the full risk-sharing hypothesis typically use changes in household income, employment status, and health status from multipurpose household panel survey data as a proxy for idiosyncratic shock variables.

Because tests of the full risk-sharing hypothesis using data from developing countries tend to reject the hypothesis, researchers have elaborated on models incorporating various sources of friction to account for the partial risk sharing that is evident in the data (Ligon, 2008). Such friction includes limited commitment constraints and moral hazard arising from information asymmetry. Ligon (1998) uses panel data from India to test a moral hazard–constrained insurance model against the canonical full insurance and permanent income models. Dubois et al. (2008) use Pakistani household panel data to develop and test a model with limited commitment and incomplete formal contracts. Using panel data from rural Thailand to construct models of limited commitment, moral hazard, and hidden income to explain the incomplete nature of informal insurance, Kinnan (2010) finds that the predictions of the hidden income model are supported by the data. Using data from UK, Attanasio and Pavoni (2011) obtain supportive evidence of risk sharing under a moral hazard problem with hidden saving.

An alternative strategy for explaining the lack of full consumption risk sharing is to mitigate estimation biases arising from various econometric problems (Ravallion and Chaudhuri, 1997; Ogaki and Zhang, 2001).[1] By relaxing assumptions on the functional form of utility, Ogaki and Zhang (2001) find evidence in support of the full risk-sharing hypothesis at the village level. However, they replicate the results of the previous research, that is, the full risk-sharing hypothesis is rejected with a constant relative risk aversion utility, a functional form that is widely used in the literature. Their results suggest that errors due to econometric specification are not negligible.

In the present paper, we use a unique data set collected in Vietnam to make three main contributions to the literature. First, we mitigate a possibly important source of a specification error: a lack of distinction between purchased goods consumption and self-produced goods consumption. More specifically, we apply Lewis's (1996) framework, which investigates international risk sharing with non-tradable goods, in the context of a village economy. Based on this framework, the canonical test of consumption risk sharing is likely to suffer from an omitted variable bias, and the direction of the bias is positive if income changes and changes in self-produced goods consumption are positively correlated. Indeed, the bias arising from the lack of

[1] Yet, Ravallion and Chaudhuri (1997) found that the existing studies may involve a bias toward the null hypothesis of full-insurance.

distinction between self-produced and purchased goods consumption may be serious, since self-produced goods consumption is usually substantial in (rural) village economies in the developing countries.[2] Although de Janvry and Sadoulet (2011) pointed out the importance of home production for consumption as a means to cope with negative shocks especially for the poor, such a role of self-production has been otherwise largely neglected in the existing literature. To implement our framework empirically, we use a unique data set from Vietnam that explicitly distinguishes purchased goods consumption from self-produced goods consumption.

Second, we use information about natural disasters as sources of exogenous variations to test the consumption risk-sharing hypothesis. Existing studies on risk sharing typically use income changes as the idiosyncratic shock variables to test the full consumption risk-sharing hypothesis.[3] However, these variables are not necessarily exogenous to households, resulting in possible estimation biases arising from endogeneity, measurement error, and/or problems with private information (Ravallion and Chaudhuri, 1997; Ligon, 1998, 2008). Natural disasters provide an exceptionally clean experimental situation for at least three reasons. First, occurrence of natural disasters is intrinsically exogenous and cannot be affected by households (Kahn, 2005). Second, natural disasters can cause large enough losses that the noise-to-signal ratios in the disaster-related shock variables are significantly small and the data are less susceptible to attenuation biases arising from measurement errors. Third, whereas the

[2] As Deaton (1997; page 28) points out, home-produced items, often referred to as *autoconsommation*, need to be taken a particular care in village economies, where home production may account for a large share.

[3] Strictly speaking, the term *full* risk sharing is not precise, since the risk concerning consumption of self-produced goods is not shared in our model below. However, we use the term *full* risk sharing by following the convention in the literature.

shock variables in existing studies are likely to be private information (e.g., income), losses caused by natural disasters are typically large enough to be visible and easily verifiable. Hence, the assumption of perfect information is less problematic. Because Vietnam has experienced a variety of natural disasters and epidemics, such as avian influenza, typhoons, floods, and droughts, it provides ample data related to natural disasters that can be used in empirical analyses.[4]

Finally, in order to explore the reasons behind the acceptance of the full consumption risk-sharing hypothesis, we incorporate two sources of friction, that is, limited credit access and limited commitment. Unlike existing studies such as Kinnan (2010) and Laczo (2010), our strategy is to use direct information on commitment constraints as well as credit constraints.

With an explicit consideration of self-production and the use of natural disaster shocks as instrumental variables for income changes, we find that the full consumption risk-sharing hypothesis cannot be rejected. Our results suggest that the results of the previous studies, which have tended to reject the full risk-sharing hypothesis, involve omitted variable bias arising from the lack of distinction between self-produced goods and purchased goods consumption.

This paper is organized as follows. In Section 2, we present the theoretical and econometric framework for our analysis. In Section 3, we explain the survey data, and in Section 4, we present the empirical results. In Section 5, we present the results based

[4] United Nations International Strategy for Disaster Reduction (2009) categorized countries in the world into 5 groups according to their vulnerability and resilience to disaster loss and their developmental limitations, particularly their capacity to benefit from international trade. Vietnam is categorized as a member of Group 4, that is, countries that are highly vulnerable economically to natural hazards.

on empirical models with limited credit access or limited commitment. This is followed by concluding remarks in Section 6.

2. The Theoretical and Econometric Frameworks

In this section, we explain the theoretical and econometric frameworks that are used in testing the full risk-sharing hypothesis in this paper. We first explain the theoretical framework, followed by the econometric framework.

In the standard framework, full consumption risk sharing can be characterized as the solution to a benevolent social planner's problem that maximizes the weighted sum of people's lifetime utilities given social resource constraints (Mace, 1991; Cochrane, 1991; Townsend, 1994). Lewis (1996), however, incorporates the consumption of non-tradable goods in testing the international consumption risk-sharing hypothesis. We apply this framework in the village economy set-up by distinguishing between purchased goods consumption and self-produced goods consumption. Such a distinction is crucial in a village economy, because consumption of self-produced goods accounts for a substantial portion of the total consumption. As will be explained below, ignoring the consumption of self-produced goods (or non-traded goods) may lead to an omitted variable bias.

Consider an economy, which can be a village or a district, that is composed of J infinitely lived households, each facing serially independent income draws. We let $\mathbf{J}$ = {1, 2, …, J} denote the set of households within the economy, with j being the typical element of $\mathbf{J}$. Assume also that no storage of the goods is possible, which rules out the possibility of self-insurance over time. We set up a social planner's problem for an economy with J infinitely lived households with consumption of self-produced goods that provides conditions for full consumption risk sharing, although we relegate the justification for the formulation in the Appendix. The problem is analogous to the one in Lewis (1996), in which a distinction between tradable and non-tradable goods is present:[5]

$$\max_{\{c_j^T(s_t),\, c_j^N(s_t)\}_{j,s_t}} \sum_{j\in \mathrm{J}} \lambda_j \sum_{t=0}^{\infty} \left(\frac{1}{1+\delta}\right)^t \sum_{s_t} \pi(s_t) u_j \left[c_j^T(s_t),\ c_j^N(s_t)\right]$$

(1)

$$\text{s.t.} \quad \sum_{j\in \mathrm{J}} c_j^T(s_t) \le \sum_{j\in \mathrm{J}} y_j^T(s_t),\ \forall s_t,$$

$$c_j^N(s_t) \le y_j^N(s_t),\ \forall j \in \mathrm{J},\ s_t,$$

where λ_j is the Pareto-Negishi weight attached to household j; t denotes time; $\pi(s_t)$ is the probability of state s_t in time t; δ is a subjective discount rate; u_j is j's utility function; $c^T{}_j(s_t)$ and $c^N{}_j(s_t)$ are j's purchased goods consumption (or *tradables*) and consumption of self-produced goods (or *non-tradables*) in state s_t, respectively; $y^T{}_j(s_t)$ is j's tradable portion of the initial endowment; and $y^N{}_j(s_t)$ is j's self-produced or non-tradable portion of the initial endowment.

The first-order conditions of this problem with respect to purchased goods consumption are as follows:

$$\left(\frac{1}{1+\delta}\right)^t \lambda_j\ \pi(s_t) \frac{\partial u\left[c_j^T(s_t),\ c_j^N(s_t)\right]}{\partial c_j^T(s_t)} = \mu^{\mathrm{J}}(s_t),\ \forall s_t,$$

5 In the context of agricultural household models, de Janvry, Fafchamps, and Sadoulet (1991) refer to self-production as non-tradables.

where $\mu^{\mathbf{J}}(s_t)$ is the Lagrangian multiplier associated with the purchased goods consumption constraint for state s_t in problem (1). Following Baxter and Jermann (1999) and Lewis (1996), a log-linearization of these first-order conditions gives the following testable equation: for every $j \in \mathbf{J}$,

$$\Delta \ln c_{jt}^{T} = \alpha^{\mathrm{J}} + \beta_1^{\mathrm{J}} \Delta \ln c_{jt}^{N} + \beta_Z^{\mathrm{J}} \Delta \ln y_{jt} + u_{jt}^{\mathrm{J}}, \tag{2}$$

where Δ denotes the first-order difference (e.g., $\Delta \ln c_{jt}^{T} = \ln c_{jt}^{T} - \ln c_{jt-1}^{T}$), $\alpha^{\mathbf{J}}$ corresponds to the Lagrange multiplier $\mu^{\mathbf{J}}(s_t)$ (hence, it is a function of the network **J**), and the state-contingent variables are replaced by observed variables (or realized values) by defining $c^{T}_{jt} = c^{T}_{j}(s_t)$, $c^{N}_{jt} = c^{N}_{j}(s_t)$, and $y_{jt} = y^{N}_{j}(s_t) + y^{T}_{j}(s_t)$ for all s_t; and $u_{jt}^{\mathbf{J}}$ is a well-behaved error term. Note that this formulation assumes that the income changes Δy_{jt} are idiosyncratic, which is a typical assumption made in the existing studies on consumption risk sharing. Note that the consumption risk-sharing hypothesis is supported when $\beta_Z^{\mathbf{J}} = 0$ is satisfied. In equation (2), $\alpha^{\mathbf{J}}$ represents the *average* growth rate of tradable goods consumption within the risk sharing network **J**. Another important coefficient to be estimated is $\beta_1^{\mathbf{J}}$, which involves the share of expenditures on tradable goods (against total expenditures) and the elasticity of substitution between tradables and non-tradables. By following Baxter and Jermann (1999) and equation (8) of Lewis (1996) in particular, we can approximate each household j's elasticity of substitution between tradables and non-tradables by $\left(1-\beta_1^{\mathrm{J}}\right)\left(1-x_j\right) \Big/ \left[\gamma\left(\beta_1^{\mathrm{J}} x_j + 1 - x_j\right)\right]$, where x_j is household j's share of expenditures on tradable goods against its total expenditures and γ is the coefficient of relative risk aversion.

Because the total consumption expenditure consists of expenditures on tradables and non-tradables, we can use the geometric weighted average of the two to express the total consumption c_{jt}; that is, $\ln c_{jt} = w_j \ln c^T_{jt} + (1 - w_j) \ln c^N_{jt}$, where w_j is the weight for household j. Then, by following Backus and Smith (1993), equation (2) can be rewritten as follows: for every $j \in \mathbf{J}$,

$$(3) \qquad \Delta \ln c_{jt} = a_j + b^{\mathbf{J}}_{j1} \Delta \ln c^N_{jt} + b^{\mathbf{J}}_{jZ} \Delta \ln y_{jt} + \varepsilon^{\mathbf{J}}_{jt},$$

where $a_j = w_j \alpha^{\mathbf{J}}$, $b^{\mathbf{J}}_{j1} = w_j \beta^{\mathbf{J}}_1 + 1 - w_j$, and $b^{\mathbf{J}}_{jZ} = w_j \beta^{\mathbf{J}}_Z$. In equation (3), the full consumption risk-sharing hypothesis is represented by the condition $b^{\mathbf{J}}_{jZ} = 0$. Note that equation (3) is directly testable only when a_j, $b^{\mathbf{J}}_{j1}$, and $b^{\mathbf{J}}_{jZ}$ are not functions of j. This is the case when w_j is independent of j, otherwise equation (3) should be further rearranged as follows:

$$(4) \qquad D_{jt} - \overline{D^{\mathbf{J}}_{jt}} = \beta^{\mathbf{J}}_1 \cdot \left(\Delta \ln c^N_{jt} - \overline{\Delta \ln c^N_{\mathbf{J}t}} \right) + \beta^{\mathbf{J}}_Z \cdot \left(\Delta \ln y_{jt} - \overline{\Delta \ln y_{\mathbf{J}t}} \right) + \hat{\varepsilon}^{\mathbf{J}}_{jt},$$

where $D_{jt} = \dfrac{\Delta \ln c_{jt} - (1 - w_j) \Delta \ln c^N_{jt}}{w_j}$, $\overline{D_{\mathbf{J}t}} = \dfrac{1}{J} \sum_{j \in \mathbf{J}} D_{jt}$, $\overline{\Delta \ln c^N_{\mathbf{J}t}} = \dfrac{1}{J} \sum_{j \in \mathbf{J}} \Delta \ln c^N_{jt}$, $\overline{\Delta \ln y_{\mathbf{J}t}} = \dfrac{1}{J} \sum_{j \in \mathbf{J}} \Delta \ln y_{jt}$, and $\hat{\varepsilon}^{\mathbf{J}}_{jt}$ is an error term. Because the canonical test of consumption risk sharing excludes the term for non-tradables $\Delta \ln c_{jt}^{N}$, such a test may involve an omitted variable bias arising from self-production/non-tradables under non-separable utility.

However, income changes variables are not necessarily exogenous to a household, resulting in possible estimation biases arising from endogeneity, measurement errors, and/or problems with private information. To mitigate such problems, when estimating equations (2), (3) and (4), we use natural disaster shock information as instrumental variables for income changes as well as self-production changes. As an unexpected, exogenous event that cannot be affected by households, a natural disaster provides a clean experimental situation in which one can test whether households are able to insure.[6] Moreover, a disaster can cause large enough damages so that the noise-to-signal ratio in the disaster-related shock variable is significantly small and the data are less susceptible to attenuation biases arising from measurement errors. Also, unlike the shock variables in existing studies that are likely to be private rather than public information, damages caused by natural disasters are visible and easily verifiable. Hence, the assumption of perfect information is less problematic.

3. Data and Descriptive Statistics

In the present study, we use a combination of two data sets: (1) the Vietnam Household Living Standards Survey (VHLSS) 2006 data and (2) data from a resurvey

[6] The severity of damages to the households caused by natural disasters may be determined endogenously, since more prosperous households would live in areas less prone to natural disasters. However, this does not comprise the feature of an ocurrence of natural disasters as an exogenous shock.

of VHLSS 2006 respondents (hereafter, the RIETI-CAP data) collected jointly by the Research Institute of Economy, Trade and Industry (RIETI) and the Center for Agricultural Policy in Vietnam (CAP).

The VHLSS is a biennial, nationally representative, rotating-panel household survey conducted by Vietnam's General Statistics Office with technical assistance from United Nations Development Programme (UNDP) and the World Bank. This multipurpose household survey covers a variety of topics, such as household characteristics, expenditures, income, health, and education. Enumeration areas are chosen randomly from the 1999 Population Census enumeration areas, and households are selected randomly from each enumeration area. VHLSS 2006 covers approximately 46,000 households, of which approximately 9,000 include both the income and expenditure modules (the rest include only the income module) apart from other basic information.

The income module identifies the amounts and sources of income that each household member received in the form of salary/wage or through self-employment from a variety of industries, such as agriculture, fishery, forestry, industry, construction, and trade and services, as well as from other sources, for example, remittance. The expenditures module provides very detailed information on purchased or bartered items as well as the consumption of self-produced items and gifts. These data include both aggregate as well as categorized/itemized data.

The RIETI-CAP survey was designed to resurvey subsamples of VHLSS 2006 households from late February 2008 through early April 2008. We looked at past losses from avian influenza and flooding, which is one of the most common natural disasters in Vietnam. As a result, the following four provinces were chosen for the resurvey: (1)

Ha Tay (hit only by avian influenza), (2) Nghe An (hit only by flooding), (3) Quang Nam (hit by both avian influenza and flooding), and (4) Lao Cai (hit by neither avian influenza nor flooding).[7] The RIETI-CAP survey includes households both with and without the VHLSS 2006 expenditures module. The survey covers around 500 households for each province, for a total of 2,018 households. The survey includes a variety of data, such as annual changes in income and in expenditures, annual changes in asset holdings, insurance subscriptions, borrowing situations, past losses due to epidemics and natural disasters, willingness to pay for various hypothetical insurance schemes, and preferences regarding uncertainty and time. The income and the expenditures modules of the survey were designed to be compatible with VHLSS 2006, although the data are not as detailed as VHLSS data: Rather than asking about levels, the RIETI-CAP survey contains data regarding the rates of the annual changes in income (total and itemized) and in expenditures/consumption (total and itemized) in the past year.[8]

Table 1 reports the descriptive statistics of the variables used in this paper. Note that the variables regarding natural disasters and epidemics are the numbers of occurrence of disasters or epidemics experienced in the past five years (as of 2008). Among them, the variable "typhoons" includes hail as well as typhoons, and the variable "epidemics" includes all epidemics, including but not limited to avian influenza. Household size (num_2006) is the number of household members. Figure 1 shows the

[7] In Vietnam, provinces (the first-tier administrative unit) are divided into districts (the second-tier administrative unit), and districts are divided into communes (the third-tier administrative unit). Each commune may consist of several hamlets or villages.

[8] To mitigate potential biases from retrospective questions on change rates, we follow a procedure suggested by Nakata et al. (2010) and include household size as a control variable.

distribution of the share of the value of self-produced goods consumption in the total value of consumption across households.

4. Empirical Results

Table 2 reports the estimation results for equation (2). In the simple ordinary least squares estimate (specification [1]), the coefficient of income becomes significant; thus, the consumption risk-sharing hypothesis is rejected. To mitigate endogeneity bias, we also conduct instrumental variable estimations by using two sets of instruments: first, total number of disasters in 2006 and 2007 (specification [A]); and second, total number of landslides, typhoons, floods, droughts, epidemics and other disasters in 2006 and 2007 (specification [B]). We also include value of real estate in 2006, value of capital assets in 2006, and household size in 2006 as additional instrumental variables. The qualitative results remain the same even if we use instrumental variable (IV) estimations for self-production and income change variables (specifications [2] and [3]), or even if we include district fixed effects (specifications [4], [5], and [6]) on top of that.[9]

The last two specifications [8] and [9] in Table 2, however, indicate otherwise. Namely, when the commune fixed effect is taken into account, the income coefficient becomes statistically insignificant. In these cases, we cannot reject the full consumption risk-sharing hypothesis, suggesting that the risk sharing networks function effectively at the commune level.

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[9] The first-stage regression results for self-production and income variables are available upon request from the corresponding author.

Table 3 reports the estimation results using the total consumption expenditure as the dependent variable based on the canonical specification used by Townsend (1994) with or without district/commune fixed effects. This model corresponds to equation (3) with common parameters, a_j, $b^{\mathbf{J}}_{j1}$, and $b^{\mathbf{J}}_{jZ}$, for all j. The results are by and large in line with the existing results: Coefficients of the income change variables are statistically significant in all cases.

The addition of self-produced goods consumption in the specification makes the coefficient of the income change variable systematically smaller (Table 4). This suggests that the omission of the non-tradable goods variable involves an omitted variable bias. Indeed, the correlation between $\Delta \ln c^N_j$ and $\Delta \ln y_j$ is positive (0.3183) and is statistically significant. As a consequence, the coefficient of the income change variable would have an upward bias in the short specifications without non-tradable goods. More importantly, with commune fixed effects, estimated income change coefficients become statistically insignificant, suggesting full consumption risk sharing within each commune.

Finally, Table 5 reports the estimation results of equation (4) with or without district/commune fixed effects by allowing heterogeneity of the coefficients, a_j, $b^{\mathbf{J}}_{j1}$, and $b^{\mathbf{J}}_{jZ}$, in equation (3).[10] The coefficient of the income change variable is statistically significant in most cases. However, it is statistically insignificant when the commune fixed effect is introduced (specifications [8] and [9]). This result implies that although

[10] We also estimate equation (3) within coefficient heterogeneities across j using generalized method of moments (GMM). Unfortunately, estimations with commune fixed effects are unfeasible due to singularity of the weighting matrix arising from the relatively small number of samples per commune.

the risk sharing networks may function effectively within each commune, the inter-commune risk sharing mechanism is weak. Moreover, comparisons of corresponding specifications in tables 3 and 5 show that the addition of the self-produced goods consumption in the specification makes the coefficient of the income change variable systematically smaller, although the coefficients in table 3 ($w_{\mathbf{J}}\beta_Z^{\mathbf{J}}$) are supposed to be smaller than the corresponding ones in table 5 ($\beta_Z^{\mathbf{J}}$). This provides a further piece of evidence that the omission of self-produced goods consumption would lead to a serious omitted variable bias.

In sum, our estimation results indicate that the full consumption risk-sharing hypothesis holds for commune level risk-sharing networks. However, for larger networks (e.g., at the province level), our results do not support full risk sharing. Although we could replicate the results found by Townsend (1994), the results change once we include self-production according to equation (4). These results suggest that the canonical consumption risk sharing test *à la* Townsend (1994) would be involving an omitted variable bias arising from the omission of self-production.

Estimation of the Elasticity of Substitution

As noted above, each household *j*'s elasticity of substitution between tradable goods and non-tradable goods can be identified by the formula $\left(1-\beta_1^{\mathrm{J}}\right)\left(1-x_j\right)\Big/\left[\gamma\left(\beta_1^{\mathrm{J}}x_j+1-x_j\right)\right]$. Hence, we need data on the relative risk aversion parameter γ to identify the elasticity of substitution. In order to elicit risk preference parameters, we followed Anderson et al. (2004) in designing our questionnaire as follows:

"Imagine a fair coin flip. Choose the option that you prefer by circling (a) or (b) for each pair below.

- *4-1 (a) Whatever the outcome (heads or tails), you receive 30,000 VND (Vietnamese Dong); or (b) If the outcome is heads, you receive 60,000 VND, but you receive nothing if it is tails.*
- *4-2 (a) Whatever the outcome (heads or tails), you receive 30,000 VND; or (b) If the outcome is heads, you receive 75,000 VND, but you receive nothing if it is tails."*

By assuming a constant relative risk aversion utility function, we can identify the ranges of the relative risk-aversion parameter γ by using the responses to the above questions. The summary of the observed relative risk aversion parameter is shown in Table 6. For more than 60 percent of respondents, the relative risk aversion parameter exceeds 0.24. Tanaka et al. (2010) conducted artefactual field experiments among respondents to the 2002 Vietnam Living Standard Measurement Survey. Their results indicate relative risk aversion parameters of 0.37 for respondents in the south and 0.41 for those in the north. To account for possible measurement error, we use a range of risk aversion parameters, namely, 0.4, 1, 2, and 4, to compute each household's elasticity of substitution.[11]

The distributions of the elasticity of substitution across households are shown in Figure 2. As can be seen from this figure, the elasticity is in general very small. This implies that purchased goods consumption and self-produced goods consumption are imperfect substitutes, suggesting the importance of distinguishing between the two.

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[11] For the coefficient of non-tradable consumption, $\beta_1^{\mathbf{J}}$, we use the result from specification [9] in Table 2.

5. Friction to Perfect Consumption Risk Sharing

In order to explore the reasons behind the apparent acceptability of the full consumption risk-sharing hypothesis, we incorporate two potential sources of friction, that is, limited credit access and limited commitment.

Limited Credit Access

We first test the validity of the consumption risk sharing framework among those who are credit constrained from formal and informal sources. For the households that are credit constrained, a credit constraint such that $c^T_{jt} \leq y^T_{jt} + B_{jt}$ added to the optimization problem (1) is binding, where B_{jt} is the borrowing limit for household j in period t. If the constraint is binding, i.e., for the credit constrained households, we should observe $\beta_Z > 0$ in equation (2).

To elicit the credit constraint information, we followed Scott (2000) to design the questionnaire so that the credit constraints can be identified directly from the data. More specifically, we first asked whether a household had attempted to obtain a loan in 2006 and in 2007 separately. Then, for those who had tried to borrow money in each year, we asked whether the household was able to borrow the full amount requested. If the answer was yes, we identified the household as being unconstrained in the year concerned. If the loan requests had been rejected or accepted only partially, we identified those households as being credit constrained in the year concerned. Also, we asked respondents who had not attempted to borrow about the reason for not availing themselves of a bank loan in each year. Those who selected “no need for credit” from among the answer choices were considered as being unconstrained with regard to formal and/or informal credit sources. Based on these classifications, we define two dummy variables of credit constraints: The strong credit constraint dummy is for those who faced binding constraints in both 2006 and 2007; and the weak credit constraint dummy is for those who faced binding constraints in either 2006 or 2007, or both.

The estimation results of equations (2) and (4) reported in Table 7 are only based on the credit-constrained respondents in accord with the weak credit constraint dummy. These results indicate that the full consumption risk-sharing hypothesis is now rejected among those who are credit constrained in two out of four “full” specifications; the specifications in which self-production is controlled for and natural disaster shocks are used as instrumental variables for self-production and income changes.[12] This result suggests that the credit market imperfection is a likely source of incomplete consumption risk sharing.

Limited Commitment

The primary risk sharing arrangements tend to be informal in many village economies in developing countries. However, there is a potential issue of limited commitment for such informal arrangements, because informal risk-sharing arrangements are unlikely to be enforced by a third party in practice (Kocherlakota,

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[12] Although the full consumption risk-sharing hypothesis is rejected among those who are credit constrained (Table 7), the hypothesis is not rejected when we estimate an interaction variable of a credit constraint dummy and income. The latter result is not presented in the paper, but is available upon request.

1996; Ligon, Thomas, and Worrall, 2002; Ligon, 2008; Kinnan, 2010; Laczo, 2010). Limited commitment arises when some households receive unusually high incomes. This is simply because such households are required to make large transfers to others under full insurance arrangements, which in turn gives them an incentive to leave the insurance network. To analyze the effects of limited commitment, we need to formulate a risk sharing model with a limited commitment constraint as the ones in Kocherlakota (1996), Ligon, Thomas, and Worrall (2002), Kinnan (2010), and Laczo (2010). To this end, we need to add the following constraint to problem (1):

$$\sum_{t=0}^{\infty}\left(\frac{1}{1+\delta}\right)^{t}\sum_{s^t}\pi(s_t)u_j\left[c_j^T(s_t),\ y_j^N(s_t)\right] \geq \sum_{t=0}^{\infty}\left(\frac{1}{1+\delta}\right)^{t}\sum_{s^t}\pi(s_t)u_j\left[y_j^T(s_t),\ y_j^N(s_t)\right].$$

This constraint requires that the expected utility of a household from staying within the insurance network (LHS of the inequality) is not smaller than the expected utility under autarky (RHS of the inequality). A testable implication of the model is that idiosyncratic income shocks and individual consumption should co-move because households with higher income shocks should be given larger consumption to stay within the insurance network.

Unlike Kinnan (2010) and Laczo (2010), our strategy is to use direct information on commitment constraints. From the commune data from VHLSS 2006, we can identify the communes that experienced internal conflicts. We presume that such communes are facing commitment problems. More specifically, the survey includes the following question: “What are the current most thorny social issues in the commune?” If the answer to this question includes “burglary” or “conflict/disunity,” the commitment constraint dummy's value is unity.

Our empirical approach is to include the dummy variable for binding commitment constraints in risk sharing equations (2) and/or (4) to estimate the coefficient of an interaction variable of the dummy and income change variables. If the estimated coefficient is positive and statistically significant, then the result is consistent with consumption risk sharing under the binding commitment constraint. Table 8 reports the estimation results. The interaction terms of the limited commitment dummy and income change variables are positive in three out of four specifications, but these coefficients are statistically insignificant.[13] This result suggests that limited commitment is not necessarily serious for village economies in Vietnam. Moreover, the result is consistent with the finding for villages in Thailand by Kinnan (2010).

6. Concluding Remarks

In this paper, we use unique household data from Vietnam collected by resurveying respondents to the VHLSS 2006. The data allows us to statistically test the necessary conditions for consumption risk sharing in details. The main contributions of our study are threefold. First, we augmented the canonical approach in testing the full consumption risk-sharing hypothesis by explicitly distinguishing consumption of

[13] For a robustness check of the results, we estimate the model by using two different subsamples; (a) households from communes where the either burglary or conflict/disunity is the most serious issue in the commune, and (b) households from communes where either burglary and/or conflict/disunity is among the most three serious issues in the commune. In either case, the consumption risk sharing model is not rejected. These results are available upon request.

self-produced goods from that of purchased or bartered goods. Second, we used clean instrumental variables in the tests: natural disasters such as avian influenza, droughts, and floods. Third, we examined the effects of two potential sources of friction—limited credit access and limited commitment—on full consumption risk sharing within a commune.

With the explicit treatment of self-production and the use of natural disaster shocks as instrumental variables for income changes, we find that the full consumption risk-sharing hypothesis cannot be rejected. Our results suggest that the results of previous studies that have tended to reject the full risk-sharing hypothesis involve an omitted variable bias arising from the lack of an explicit distinction between consumption of self-produced goods and that of purchased or bartered goods. We also find that credit access is an important source of friction, while limited commitment is not necessarily serious in Vietnamese communes.

Our results may suggest that the lack of efficient informal insurance mechanisms is compensated for by self-production (de Janvry and Sadoulet, 2011). Because industrialization may lessen this role of self-production as a self-insurance device, it is important to mitigate risks associated with self-production by designing formal *ex ante* risk-management mechanisms against natural disasters. For example, the role of the development of markets for index-type insurance associated with agricultural production in facilitating consumption risk sharing would be an important topic in future research.

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Appendix: Justification of the Social Planner Problem

Consider an economy with J households (indexed by j = 1, 2, …, J) and I goods (indexed by i = 1, 2, …, I). Suppose that each household j has its home production function f^H_{ji} for each good i (we call this a *home production function*). The home production function maps the labor input z^H_{ji} to its output, which is denoted by y^H_{ji}. However, another set of technologies uses the labor input of multiple households, which we call the *industrialized production*. Let z^M_{ji} denote household j's labor input for the production of good i. Then the industrialized production function for good i is $f^M_i(z^M_{1i}, z^M_{2i}, \ldots, z^M_{Ji})$ with $y^M_i = f^M_i(z^M_{1i}, z^M_{2i}, \ldots, z^M_{Ji})$, where y^M_i is the output of the industrialized production of good i.

Let c_{ji} denote household j's consumption of good i. The feasibility constraint of the economy will therefore be

$$\text{(A-1)} \qquad \sum_{j=1}^{J} c_{ji} \le \sum_{j=1}^{J} y^H_{ji} + y^M_i, \quad \forall i.$$

Now, let c^H_{ji} denote household j's consumption of its own home production of good i. Note that by definition, $c^H_{ji} \le y^H_{ji} = f^H_{ji}\left(z^H_{ji}\right)$, household j will be self-sufficient concerning good i if $c_{ji} = c^H_{ji}$. Moreover, household j does not trade (i.e., buy or sell) good i if $c_{ji} = c^H_{ji} = y^H_{ji}$. This leads to the following definitions:

(a) *Good i is <u>non-tradable for household j</u> if* $c_{ji} = c^H_{ji} = y^H_{ji}$ *holds.*

(b) *Good i is <u>non-tradable</u> if* $c_{ji} = c^H_{ji} = y^H_{ji}$ *holds for all j.*

(c) *Good i is <u>fully tradable</u> if it is non-tradable for no j.*

(d) *Good i is <u>partially tradable</u> if it is non-tradable for some j.*

Note that if good i is non-tradable, then y^M_i = 0 holds as long as no free disposal is allowed. Now, if all goods are non-tradable (i.e., if there is autarky), it is easy to see that condition (A-1) must be replaced with $c_{ji} = y^{\mathrm{H}}_{\mathrm{ji}}$ for all i, j. Clearly, the condition $c_{ji} = y^{H}_{ji}$ for all i, j implies condition (A-1) but not vice versa; that is, the autarky condition is more restrictive than condition (A-1).

Let $\mathbf{J} = \{1,\ 2,\ ...,\ J\}$ and $\mathbf{J}_i = \{j \in \mathbf{J} : c_{ji} = y_{ji}^H\}$, that is, the set of households for whom good i is non-tradable. Also, let $\mathbf{I} = \{1,\ 2,\ ...,\ I\}$ and $\mathbf{I}^N = \{i \in \mathbf{I} : \mathbf{J}_i \text{ is non-empty}\}$, that is, the set of goods that are partially tradable or non-tradable. Now, if there is some good i that is partially tradable, that is, $\mathbf{I}^N$ is non-empty, then condition (A-1) must be replaced with

$$\text{(A-2)} \qquad \sum_{j=1}^{J} c_{ji} \le \sum_{j=1}^{J} y_{ji}^H + y_i^M, \quad \forall i \in \mathbf{I} \setminus \mathbf{I}^N,$$

$$\text{(A-3)} \qquad \sum_{j \in \mathbf{J} \setminus \mathbf{J}_i} c_{ji} \le \sum_{j \in \mathbf{J} \setminus \mathbf{J}_i} y_{ji}^H + y_i^M, \quad \forall i \in \mathbf{I}^N,$$

$$\text{(A-4)} \qquad c_{ji} = y_{ji}^H, \quad \forall j \in \mathbf{J}_i, \forall i \in \mathbf{I}^N.$$

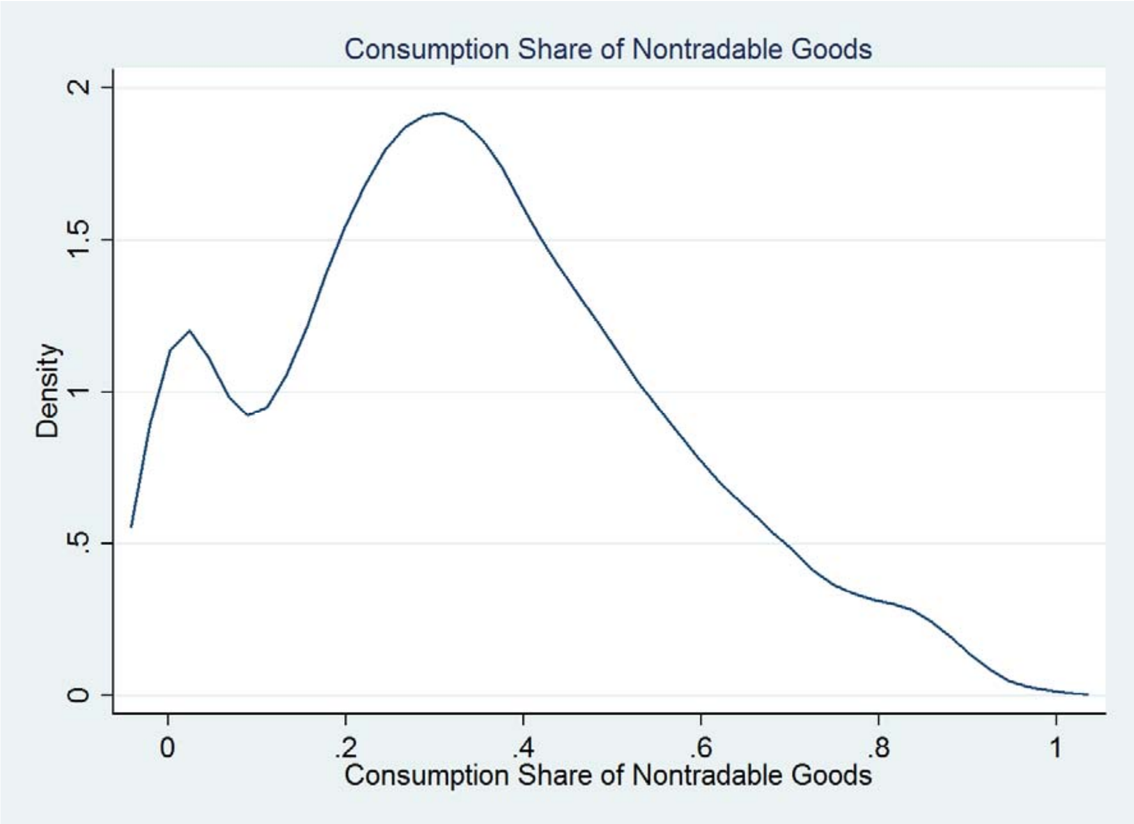
Note that condition (A-2) is for fully tradable goods, condition (A-3) is for partially tradable goods, and condition (A-4) is for partially tradable or non-tradable goods. Observe that conditions (A-2), (A-3), and (A-4) imply condition (A-1) but not vice versa. In other words, the three conditions are more restrictive than condition (A-1).

The social optimum of the economy with the presence of some partially tradable goods will be characterized as the solution to the following social planner's problem (given the optimal production):

$$\max_{(c_{ji})_{i,j}} \sum_{j=1}^{J} \lambda_j U_j \left(c_{j1}, c_{j2}, \ldots, c_{jI}; L_j\right) \quad \text{subject to (A - 2), (A - 3) and (A - 4),}$$

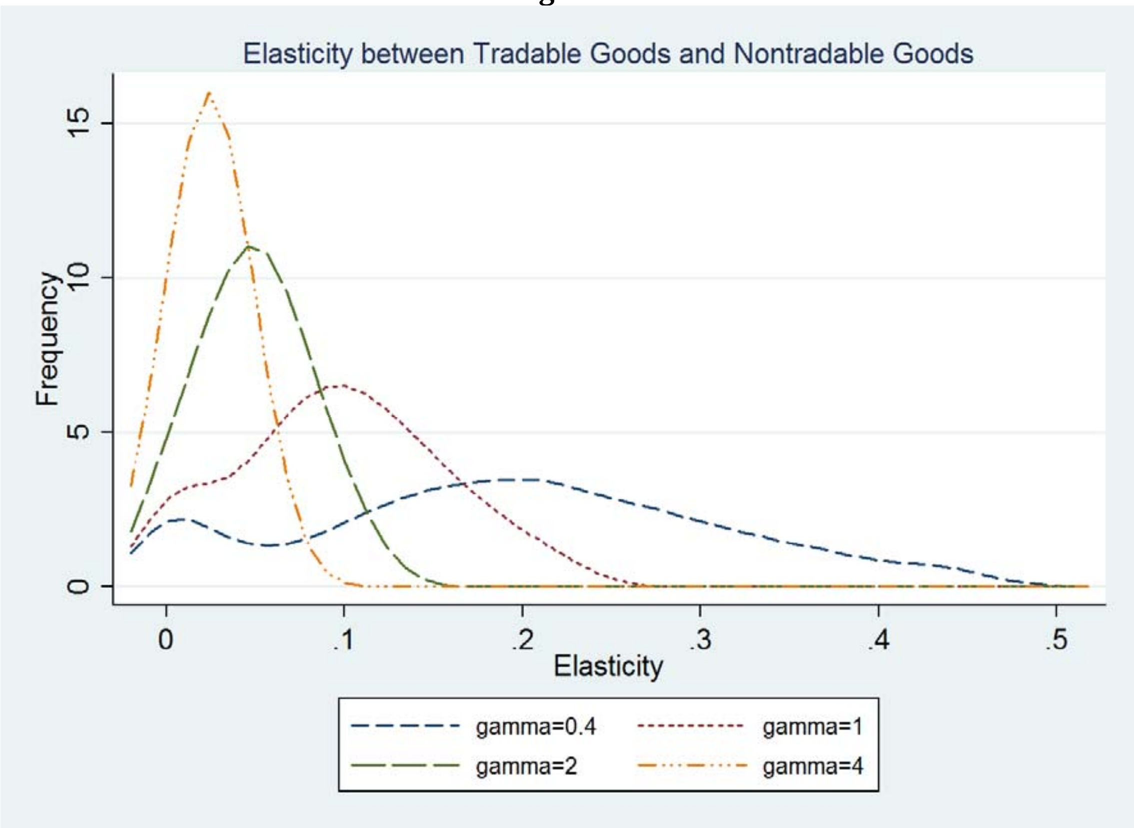
where λ_j is some positive weight (Pareto-Negishi weight) and L_j is household j's leisure, that is, time available minus labor. Now, as long as $\mathbf{I}^N$ is non-empty, condition (A-4) is present, and good $i \in \mathbf{I}^N$ is non-tradable for at least some households. It follows that a generic form of the social planner's problem in Lewis (1996) applies here, unless all goods are perfect substitutes. Note that this holds true even if the same good is non-tradable for some households but not for other households, that is, only the existence of a partially tradable good is enough, if not non-tradable (for all households).

Figure 1



Consumption Share of Nontradable Goods
Density
0
.5
1
1.5
2
0
.2
.4
.6
.8
1
Consumption Share of Nontradable Goods

Figure 2



Elasticity between Tradable Goods and Nontradable Goods
Frequency
0
5
10
15
0
.1
.2
.3
.4
.5
Elasticity
gamma=0.4
gamma=1
gamma=2
gamma=4

Table 1: Descriptive Statistics

Variable	Code	Obs.	Mean	Std. Dev
Variables for the main equation				
First difference of log tradable consumption	tradable	2003	0.112	0.109
First difference of log non-tradable consumption	non-tradable	1850	0.080	0.122
First difference of log total income	income	2006	0.101	0.098
First difference of log total consumption	total	1847	0.104	0.100
Ratio of tradable goods consumption to total consumption	ratio	2009	0.662	0.217
Instrumental variables				
Total number of disasters in 2007	disaster_2007	4010	0.290	0.545
Total number of disasters in 2006	disaster_2006	4010	0.174	0.412
Number of landslides in 2007	landslide_2007	4010	0.002	0.050
Number of landslides in 2006	landslide _2006	4010	0.001	0.035
Number of typhoons in 2007	typhoon_2007	4010	0.051	0.220
Number of typhoons in 2006	typhoon_2006	4010	0.078	0.270
Number of floods in 2007	flood_2007	4010	0.098	0.301
Number of floods in 2006	flood_2006	4010	0.025	0.156
Number of droughts in 2007	drought_2007	4010	0.017	0.131
Number of droughts in 2006	drought_2006	4010	0.006	0.080
Number of epidemics in 2007	epidemic_2007	4010	0.084	0.287
Number of epidemics in 2006	epidemic_2006	4010	0.058	0.238
Number of other disasters in 2007	other_2007	4010	0.037	0.192
Number of other disasters in 2006	other_2006	4010	0.005	0.074
Value of real estate in 2006 (in thousand VND)	land_2006	2014	2722.815	21656.110
Value of capital assets in 2006 (in thousand VND)	asset_2006	2014	22251.570	47480.960
Household size in 2006	num_2006	2014	4.252	1.716
Friction variables				
Credit constraint dummy (which takes 1 if credit constraint is binding in either 2006 or 2007)	credit	2014	0.408	0.492
Limited commitment dummy (which takes 1 if a limited commitment constraint is binding)	commitment	4171	0.122	0.327

Table 2: Test of Consumption Risk Sharing

[Based on Equation (2), Dependent Variable: $\Delta \ln c_j^T$]

Specification	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Method	OLS	IV	IV	OLS	IV	IV	OLS	IV	IV
District fixed effect	No	No	No	Yes	Yes	Yes	No	No	No
Commune fixed effect	No	No	No	No	No	No	Yes	Yes	Yes
Specification of the first-stage regression		(A)	(B)		(A)	(B)		(A)	(B)
$\Delta \ln c_j^N$ +	0.330***	0.507***	0.509***	0.310***	0.469	0.677***	0.321***	0.684	0.791***
	[0.067]	[0.106]	[0.088]	[0.063]	[0.307]	[0.157]	[0.064]	[0.444]	[0.174]
$\Delta \ln y_t$ +	0.303***	0.581***	0.565***	0.240***	0.945**	0.451**	0.191***	0.511	0.253
	[0.040]	[0.165]	[0.130]	[0.049]	[0.425]	[0.208]	[0.033]	[0.569]	[0.212]
Constant	0.053***	0.01	0.01	0.061***			0.065***		
	[0.005]	[0.013]	[0.010]	[0.004]			[0.006]		
Number of observations	1839	1813	1813	1839	1813	1813	1839	1812	1812
R-squared	0.28	0.14	0.15	0.22	0.28	0.04	0.22	0.13	0.13
Hansen J statistic		5.54	19.55		0.94	22.62		2.08	9.5
P-value (Hansen J-test)		0.14	0.11		0.82	0.05		0.56	0.73
1st Stage F statistics (nontradable/income)		13.13/7.26	10.63/6.65		6.05/5.86	3.6/3.23		4.93/5.73	2.49/2.72
[P-values]		[0.00/0.00]	[0.00/0.00]		[0.00/0.00]	[0.00/0.00]		[0.00/0.00]	[0.00/0.00]
Number of districts				34	34	34			
Number of communes							134	132	132

Robust standard errors are in brackets. + represents an endogenous variable.

** significant at 5%; *** significant at 1%

Table 3: Test of Consumption Risk Sharing

[Based on Equation (3), Dependent Variable: $\Delta \ln c_j$]

Specification	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Method	OLS	IV	IV	OLS	IV	IV	OLS	IV	IV
District fixed effect	No	No	No	Yes	Yes	Yes	No	No	No
Commune fixed effect	No	No	No	No	No	No	Yes	Yes	Yes
Specification of the first-stage regression		(A)	(B)		(A)	(B)		(A)	(B)
$\Delta \ln y_j +$	0.447***	0.973***	1.033***	0.352***	1.482***	1.067***	0.301***	1.330***	0.959***
	[0.037]	[0.150]	[0.109]	[0.051]	[0.287]	[0.178]	[0.040]	[0.266]	[0.181]
Constant	0.059***	0.007	0.006	0.069***			0.074***		
	[0.004]	[0.015]	[0.011]	[0.005]			[0.004]		
Number of observations	1839	1813	1813	1839	1813	1813	1839	1812	1812
R-squared	0.19	0.07	0.13	0.12	0.13	0.09	0.09	0.1	0.15
Hansen's J statistic		23.02	29.84		1.02	21.34		2.32	18.58
[P-values]		[0.00]	[0.01]		[0.8]	[0.07]		[0.68]	[0.18]
1st Stage F statistics (nontradable/income)		13.13/7.26	10.63/6.65		6.05/5.86	3.6/3.23		4.93/5.73	2.49/2.72
[P-values]		[0.00/0.00]	[0.00/0.00]		[0.00/0.00]	[0.00/0.00]		[0.00/0.00]	[0.00/0.00]
Number of districts				34	34	34			
Number of communes							134	132	132

Robust standard errors are in brackets. + represents an endogenous variable.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 4: Test of Consumption Risk Sharing

[Based on Equation (3), Dependent Variable: $\Delta \ln c_j$]

Specification	[1]	[2]	[3]	[4]	[5]	[6]	7]	[8]	[9]
Method	OLS	IV	IV	OLS	IV	IV	OLS	IV	IV
District fixed effect	No	No	No	Yes	Yes	Yes	No	No	No
Commune fixed effect	No	No	No	No	No	No	Yes	Yes	Yes
Specification of the first-stage regression		(A)	(B)		(A)	(B)		(A)	(B)
$\Delta \ln c_j^N$ +	0.471***	0.638***	0.658***	0.456***	0.503*	0.752***	0.463***	0.777**	0.899***
	[0.073]	[0.078]	[0.064]	[0.077]	[0.271]	[0.125]	[0.073]	[0.337]	[0.119]
$\Delta \ln y_j$ +	0.258***	0.469***	0.430***	0.211***	0.952**	0.409**	0.164***	0.436	0.171
	[0.037]	[0.137]	[0.100]	[0.043]	[0.378]	[0.164]	[0.024]	[0.440]	[0.145]
Constant	0.040***	0.006	0.007	0.046***			0.050***		
	[0.005]	[0.011]	[0.008]	[0.003]			[0.006]		
Number of observations	1839	1813	1813	1839	1813	1813	1839	1812	1812
R-squared	0.49	0.37	0.38	0.43	0.12	0.21	0.45	0.14	0.11
Hansen J statistic		5.97	19.56		1.02	20.63		1.12	8.67
P-value (Hansen J-test)		0.11	0.11		0.8	0.08		0.77	0.8
1st Stage F statistics		13.13/7.26	10.63/6.65		6.05/5.86	3.6/3.23		4.93/5.73	2.49/2.72
[P-values]		[0.00/0.00]	[0.00/0.00]		[0.00/0.00]	[0.00/0.00]		[0.00/0.00]	[0.00/0.00]
Number of districts				34	34	34			
Number of communes							134	132	132

Robust standard errors are in brackets. + represents an endogenous variable.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5: Test of Consumption Risk Sharing

[Based on Equation (4), Dependent Variable: $D_j - \overline{D_{\mathbf{J}}}$]

Specification	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Method	OLS	IV	IV	OLS	IV	IV	OLS	IV	IV
District fixed effect	No	No	No	Yes	Yes	Yes	No	No	No
Commune fixed effect	No	No	No	No	No	No	Yes	Yes	Yes
Specification of the first-stage regression in Tables 8 and 9		(A)	(B)		(A)	(B)		(A)	(B)
$\left(\Delta \ln c_j^N - \overline{\Delta \ln c_{\mathbf{J}}^N}\right)$ +	0.297***	0.619***	0.592***	0.270***	0.461	0.664***	0.281***	0.667	0.765***
	[0.074]	[0.090]	[0.079]	[0.072]	[0.310]	[0.162]	[0.062]	[0.452]	[0.180]
$\left(\Delta \ln y_j - \overline{\Delta \ln y_{\mathbf{J}}}\right)$ +	0.319***	0.21	0.380***	0.257***	0.948**	0.456**	0.207***	0.532	0.28
	[0.043]	[0.190]	[0.126]	[0.037]	[0.429]	[0.214]	[0.037]	[0.579]	[0.217]
Number of observations	1839	1813	1813	1839	1813	1813	1839	1812	1812
R-squared	0.49	0.12	0.11	0.43	0.12	0.21	0.45	0.19	0.18
Hansen J statistic		10.05	22.51		1.02	20.63		2.03	9.08
P-value (Hansen J-test)		0.02	0.05		0.8	0.08		0.57	0.77
1st Stage F stat(nontradable/income)		13.13/7.26	10.63/6.65		6.05/5.86	3.6/3.23		4.93/5.73	2.49/2.72
P-value (1st Stage F stat(nontradable/income)		0/0	0/0		0/0	0/0		0/0	0/0
Number of districts				34	34	34			
Number of communes							134	132	132

Robust standard errors are in brackets. + indicates an endogenous variable for IV specifications.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6: Ranges of the Relative Risk Aversion Parameter

Range of γ	Frequency	Percentage
$\gamma < 0$	505	25.91
$0 < \gamma < 0.24$	265	13.6
$\gamma > 0.24$	1179	60.49
Total	1949	100

Table 7: Test of Consumption Risk Sharing for the Credit-Constrained Group

Specification	[1]	[2]	[3]	[4]
Dependent Variable	$\Delta \ln c_j^T$	$\Delta \ln c_j^T$	$\left(D_j - \overline{D_{\mathbf{J}}}\right)$	$\left(D_j - \overline{D_{\mathbf{J}}}\right)$
Method	IV	IV	IV	IV
District fixed effect	No	No	No	No
Commune fixed effect	Yes	Yes	Yes	Yes
Specification of the first-stage regression	(A)	(B)	(A)	(B)
$\Delta \ln c_j^N$ +	0.806	0.511***		
	[0.500]	[0.114]		
$\left(\Delta \ln c_j^N - \overline{\Delta \ln c_{\mathbf{J}}^N}\right)$ +			0.748	0.458***
			[0.499]	[0.125]
$\Delta \ln y_j$ +	0.162	0.413*		
	[0.696]	[0.229]		
$\left(\Delta \ln y_j - \overline{\Delta \ln y_{\mathbf{J}}}\right)$ +			0.236	0.471*
			[0.697]	[0.247]
Number of observations	527	527	527	527
R-squared	0.02	0.25	0.02	0.22
Hansen J statistic	3.23	12.87	3.28	12.58
P-value (Hansen J-test)	0.36	0.46	0.35	0.48
1st Stage F stat(nontradable/income)	4.93/5.73	2.49/2.72	4.93/5.73	2.49/2.72
P-value (1st Stage F stat(nontradable/income)	0/0	0/0.06	0/0	0/0.06
Number of communes	100	100	100	100

Robust standard errors are in brackets. + indicates an endogenous variable.

* significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8: Test of Consumption Risk Sharing under Limited Commitment Constraints

Specification	[1]	[2]	[3]	[4]
Dependent Variable	$\Delta \ln c_j^T$	$\Delta \ln c_j^T$	$\left(D_j - \overline{D_J}\right)$	$\left(D_j - \overline{D_J}\right)$
Method	IV	IV	IV	IV
District fixed effect	No	No	No	No
Commune fixed effect	Yes	Yes	Yes	Yes
Specification of the first-stage regression	(A)	(B)	(A)	(B)
$\Delta \ln c_j^N +$	0.677	0.780***		
	[0.506]	[0.210]		
$\left(\Delta \ln c_j^N - \overline{\Delta \ln c_J^N}\right) +$			0.644	0.747***
			[0.453]	[0.186]
$\Delta \ln y_j +$	0.361	0.248		
	[0.652]	[0.222]		
$\left(\Delta \ln y_j - \overline{\Delta \ln y_J}\right) +$			0.644	0.184
			[0.453]	[0.186]
$\Delta \ln y_j \cdot \text{commitment} +$	2.345	0.076		
	[1.941]	[1.213]		
$\left(\Delta \ln y_j - \overline{\Delta \ln y_J}\right) \cdot \text{commitment}^+$			0.227	0.148
			[0.675]	[0.417]
Number of observations	1812	1812	1812	1812
R-squared	0.49	0.11	0.15	0.07
Hansen J statistic	0.2	8.97	1.95	8.89
P-value (Hansen J-test)	0.9	0.71	0.37	0.71
1st Stage F stat(nontradable/income)	4.93/5.73/5.45	2.49/2.72/3.27	4.93/5.73/5.45	2.49/2.72/3.27
P-value (1st Stage F stat(nontradable/income)	0/0/0	0/0/0	0/0/0	0/0/0
Number of communes	132	132	132	132

Robust standard errors in brackets. + indicates an endogenous variable.

** significant at 5%; *** significant at 1%.