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Household Income Dynamics in Rural China

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Abstract

It is well known in theory that certain forms of non-linear dynamics in household incomes can yield poverty traps and distribution-dependent growth. The potential implications for policy are dramatic: effective social protection from transient poverty will be an investment with lasting benefits, and pro-poor redistribution will promote aggregate economic growth. We test for non-linearity in the dynamics of household expenditures and incomes using panel data for rural south-west China. While we find evidence of non-linearity, there is no sign of a dynamic poverty trap. Existing private and social arrangements in this setting appear to protect vulnerable households from the risk of destitution. However, the concavity we find in the recursion diagram does imply that the speed of recovery from an income shock is lower for the poor, and that current inequality reduces growth in mean incomes.

Keywords: income dynamics, poverty, multiple equilibria, China

JEL classification: C23, I32, O15, Q12

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1 Introduction

It is often argued that public transfers targeted to the currently poor provide a short-term palliative in the presence of uninsured risk. Clearly this is a potentially important role for public action in poor, high-risk, settings. However, a body of recent theoretical work in economics has pointed to another potential role of a well-designed public safety net in such settings, namely in alleviating poverty in the longer term.

This new perspective stems from the realization that widespread credit and risk-market failures can entail efficiency enhancing functions for a well-designed safety net. With limited access to credit, or other forms of (formal or informal) insurance, a household will suffer from a transient shock – an unexpected but short-lived drop in income. However, it is also possible in theory that such a shock can cause a previously non-poor family to become poor indefinitely; or cause a moderately poor family to fall into persistent destitution. If this theoretical possibility is borne out by the evidence then there are important implications for knowledge about poverty and anti-poverty policies. Lack of a well-functioning safety net might well be a structural cause of persistent poverty. And there will be large long-term benefits from institutions and policies that protect people from transient shocks.

The long-run effect of a transient shock depends on properties of household income dynamics. And they are properties, which we currently know very little about. Granted, if household incomes follow the simplest type of linear auto-regression then a household that experiences a transient shock will see its income bounce back in due course. The serial dependence will mean that the family stays poor for a longer period than the duration of the shock. Incomes will not adjust instantaneously. Nonetheless, the household will recover from any adverse draw from a distribution of serially independent income shocks.

However, there is no theoretical reason why incomes would behave this way. Linear dynamics is an *ad hoc* assumption. Indeed, economic theory has pointed to the possibilities for poverty traps arising from multiple equilibria in the dynamics such that destitution can arise from short-lived shocks. This is not a new idea. Non-linear dynamic models with multiple equilibria have been widely used in explaining why seemingly similar aggregate shocks can have dissimilar outcomes.[1] A central feature of these models is the existence of a non-convexity in the dynamics of household incomes, giving rise to a low-level unstable equilibrium. The non-convexity can stem from effects of past consumption on current productivity, as in the Efficiency Wage Hypothesis (Mirrlees 1975, Stiglitz 1976). In such models, a vulnerable household may never recover from a sufficiently large but short-lived shock.

1 In macroeconomics, examples can be found in models of the business cycle (Chang and Smyth 1971; Varian 1979) and certain growth models (Day 1992; Azariades 1996). Similar ideas have been employed in modeling micro poverty traps (Dasgupta and Ray 1986; Banerjee and Newman 1994; Dasgupta 1997) and in understanding famines (Carraro 1996; Ravallion 1997).

Whether such non-convexities in the dynamics are important in practice, and constitute a new case for safety net interventions, is a moot point. If multiple equilibria existed then there will be high social returns to arrangements that protect vulnerable households – arrangements that might well be implementable by private means, such as through repeated interaction in risky environments (Coate and Ravallion 1993). It can be conjectured that institutions will develop that assure – possibly imperfectly and at non-negligible cost – that most incomes exceed the low-level unstable equilibrium, thus avoiding the dynamic poverty trap.

Even without poverty traps, it is known that credit market failures can generate non-linear dynamics whereby the rate of growth in an economy depends critically on the initial distribution of income or wealth (Benabou 1996, Aghion and Bolton 1997, Aghion et al. 1999). By implication, redistributive policies can enhance long-term prospects of escaping poverty as long as they do not unduly jeopardize other determinants of growth. The arguments that initial distribution matters to future growth also rest on a type of non-linearity in the dynamics, such that individual income is a concave function of its own lagged value, i.e., a concave recursion diagram. While there is some supportive evidence from cross-country regressions, this is arguably a rather weak basis for testing, given the known problems encountered, such as the potential for spurious correlations between growth and inequality arising from inconsistent aggregation across the underlying microeconomic relationships (Ravallion 1998).

This paper tests for non-linearity in income and expenditure dynamics in rural China. The setting for our empirical work is rural south-west China in the period 1985–90. With Deng's reforms starting in the late 1970s, the collective mode of agricultural production had been disbanded in favour of a household-based responsibility system. These reforms brought rapid rural income growth – initially in agriculture, but in due course helping foster non-farm rural development. But it is likely that the greater self-reliance that came with the break up of the collectives, and more heavy reliance on markets, also left many households facing greater risk.

We analyze a household-level panel data set spanning six years, 1985–90, in four contiguous provinces, Guangdong, Guangxi, Guizhou and Yunnan. From past research (reviewed later) we know that poor farm-households in this setting are exposed to uninsured income and health risks. However, identifying the long-term effects of measured risks is clearly difficult. Six years is not long enough to confidently distinguish a slow process of adjustment after a shock – such that a unique long-run equilibrium is restored – from a more complex dynamic process with multiple equilibria arising from a non-convexity at low incomes.

We adopt a different approach that is feasible with the data. Instead of attempting to trace the long-run impacts of measured shocks, we directly study the process of income dynamics to see if it is consistent with the type of non-linearity postulated in the aforementioned theoretical work. With repeated shocks we are presumably observing most households out of their steady-state equilibrium. The time series for each household can then reveal the dynamics of adjustment out of equilibrium. At any given long-run equilbrium, some households will simply be returning to that equilbrium. However, if there is also a low-level unstable equilibrium and sufficiently large uninsured shocks, then we should find both rising and falling incomes amongst the currently poor, with a tendency for incomes to fall amongst the poorest. To make this test feasible with only six years of data, the adjustment process is assumed to be common across households (though allowing for household-specific long-run equilibria). The specification allows the possibility of a low-level unstable equilibrium. In the process, we also see if the recursion diagram is concave, such that current distribution matters to future growth. Our estimation method allows for measurement error in observed incomes and other sources of correlation between lagged incomes and the error term.[2]

The following section describes the setting for our study. Section 3 puts the paper in the context of our other recent work. Section 4 reviews the arguments as to why we might find non-linear dynamics. We then turn to our econometric model (section 5), and results (section 6).

2 The setting and data

The household panel used in this study was constructed from China's Rural Household Surveys (RHS) conducted by the National Bureau of Statistics (NBS) since 1984.[3] The data set covers four contiguous southern provinces. Three of the four provinces (Guangxi, Yunnan and Guizhou) constitute one of China's poorest regions, while the fourth is the prosperous coastal province of Guangdong (Chen and Ravallion 1996). The panel consists of over 6,000 households observed over the period 1985–90 (after which the sample was rotated).

The RHS is a good quality budget and income survey, notable in the care that goes into reducing both sampling and non-sampling errors (Chen and Ravallion 1996). Sampled households maintain a daily record on all transactions, as well as log books on production. Local interviewing assistants (resident in the sampled village, or another village nearby) visit each sampled household at roughly two weekly intervals. Inconsistencies found at the local NBS office are checked with the respondents. The sample frame of the RHS is all registered agricultural households except those who have moved to cities.

Our measure of consumption expenditure includes spending (either in cash or the imputed values of in-kind spending) on food, clothing, housing, fuel, culture and recreation, books, newspapers and magazines, medicines and non-commodity expenditures like transportation and communication, repairs etc. The income variable includes both cash and imputed values for in-kind income from various sources (farm-household production, forestry, animal husbandry, handicrafts, gifts) as well as labour earnings and income received as a gift. It does not include borrowings from (or loans to) informal and/or formal sources.

2 In a linear AR1 model, under (over) estimating the lagged income would lead to over (under) estimation of the subsequent change in income – a source of bias in OLS estimates of dynamic models commonly known as 'Galton's fallacy'. The problem is more complicated in a non-linear dynamic model, but the general concern with measurement error in lagged incomes remain.

3 Further details on this survey, and the way it has been processed for this study, can be found in Chen and Ravallion (1996).

There was very little sample rotation in the RHS between 1985 and 1990. The panel was formed from the sequence of cross-sectional surveys. From discussions with RHS staff we decided that the identifiers in the data could not be trusted for forming the panel. Fortunately, virtually ideal matching variables were available in the financial records, which gave both beginning and end of year balances. Relatively stringent criteria were used in defining a panel household, with extensive cross-checks to assure that the same household was being tracked over time. About one third of the original sample could not be matched by our criteria. Some of this is attrition, but probably the main reason was that the household changed sufficiently for it not to be classified as a panel household by our criteria.

In studying non-linear income dynamics using panel data, there is a concern that attrition may well be endogenous to shocks (Lokshin and Ravallion 2001); for example, with a sufficient negative shock, a household may become destitute and drop out of the panel. We cannot distinguish such households from those that changed too much to keep in the panel or those who were replaced by the surveyors for some other reason. However, endogenous attrition by the poor is probably not a serious concern in this setting. Sampled households in the RHS are paid to participate, and no doubt this encourages continuing participation by the poor. Furthermore, results from Lokshin and Ravallion (2001) indicate that estimates of the non-linearity in income dynamics for Russia and Hungary are robust to allowing for endogenous attrition (through a non-zero correlation between the error terms in the attrition model and the dynamic income regression).

3 Risk and poverty in south-west China

In past research, we have found considerable vulnerability to both idiosyncratic and (village-level) covariate risks in this setting. In Jalan and Ravallion (1999) we tested for systematic wealth effects on the extent of consumption insurance against income-risk. Motivated by the theory of risk-sharing, our tests entailed estimating the effects of income changes on consumption (with current income treated as endogenous), after controlling for aggregate shocks through interacted village-time dummies. We also tested for insurance against covariate risk at village level. To test for wealth effects, we stratified our sample on the basis of household wealth per capita, and whether or not the household resides in a poor area. The full insurance model was convincingly rejected. The lower a household's wealth, the stronger was the rejection, in that the estimated excess sensitivity parameter on changes in current income (implied by the test equation for consumption changes) was higher for less wealthy households.[4] We interpret these results as indicating that, while there are clearly arrangements for consumption insurance in these villages, they work considerably less well for the poor.

4 This conclusion was found to be robust to changes in the set of instruments, and to changes in the wealth measure. It holds for both total consumption and food consumption, although the latter is better protected. There is little sign, however, that living in a poor area enhances exposure to risk at a given level of individual wealth.

It is not then surprising that we also find considerable transient poverty in this setting. Year-to-year fluctuations in consumption account for one third of the mean poverty gap (Jalan and Ravallion 1998). About 40 per cent of the transient poverty is found amongst those who are not poor on average, but almost all of this is for households whose average consumption over time is no more than 50 per cent above the poverty line. A comparison with similar tests for three villages in semi-arid areas of rural India (Chaudhuri and Ravallion 1994) suggests that there is far more transient poverty in this region of rural China.

These findings tell us nothing about the long-term consequences of uninsured risk. We have also studied portfolio and other behavioral responses to idiosyncratic risk using the same data set (Jalan and Ravallion 2001). In keeping with past empirical work on precautionary wealth, we extracted a measure of income risk from a first-stage income regression estimated on household panel and then used this measure of risk as a regressor in attempting to explain liquid wealth holdings.[5] Our results suggest that wealth is held in unproductive liquid forms to protect against idiosyncratic income risk. However, we found this effect to be small; indeed, even if all income risk were eliminated, the mean share of wealth held in liquid forms would fall only slightly, from 26.5 per cent to 25.8 per cent. We also found that there is an inverted U relationship between the precautionary wealth effect and permanent income, such that neither the poorest quintile nor the richest appear to hold liquid wealth because of income risk; it is the middle income groups that do so. We suspect that the rich do not need to hold precautionary liquid wealth, and the poor cannot afford to do so. We have found some evidence that liquid wealth is also held as a precaution against risk to foodgrain yields (independently of income risk). We found no clear signs of a precautionary response to health risk, though our measure (based on medical spending) is far from ideal (Jalan and Ravallion 2001). Schooling and (hence) future incomes appear to be protected from both income and health risk. However, greater uncertainty about incomes at home does appear to constrain the temporary out migration of family labour.

In the rest of this paper we turn to yet another possible longer-term implication of risk, such that vulnerable households can never escape from the adverse impact of a short-lived (serially independent) but sufficiently large uninsured shock. We first discuss how this might come about in theory.

4 Theoretical models with non-linear dynamics

Probably the simplest model that can generate a dynamic poverty trap assumes that a family cannot borrow or save and derives income solely from labour earnings, but with a non-convexity at low earnings arising from a dependency of the worker's productivity and (hence) wage rate on consumption. (We discuss alternative interpretations of this non-convexity below.) Non-linear dynamics can be introduced by simply assuming that the wage rate in any period is contracted at the beginning of the period. Finally we assume that this dynamic process of income determination has at least one stable equilibrium.

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5 We extended past methods by allowing for serial dependence in income shocks and by using quantile regression methods that are more robust to the evident non-normality in the data on liquid wealth holdings (Jalan and Ravallion 2001).

Combining these assumptions, the process generating the current income of household i ($y_{it} \geq 0$) with exogenous characteristics x_{it} can be written as the non-linear difference equation:

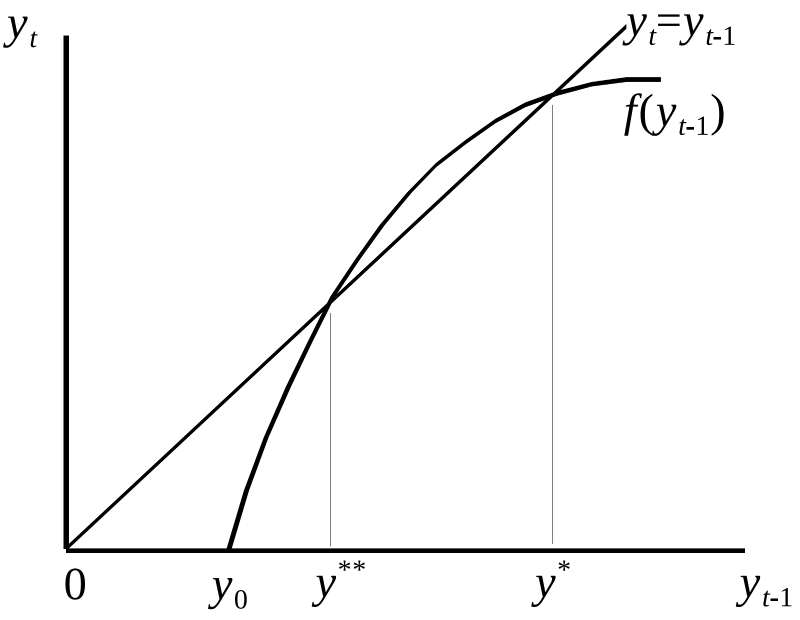
$$y_{it} = f(y_{it-1}, x_{it}) \tag{1}$$

where f is continuous and vanishing for all $y<y_0$ (>0) and the function is increasing and concave in $y_{it\text{-}1}$ for all $y>y_0$. (The control variables x_{it} are of a sufficient dimension that the function f is the same across all i.) An equilibrium of this model is a steady-state solution that varies with x_{it} such that $y = f(y, x_{it})$. It is evident that if there is more than one such solution then there will be an unstable equilibrium. The recursion diagram in Figure 1 illustrates a case of multiple equilibria. There are two attractors, at 0 and y^* (>y_0), while y^{**} is an unstable equilibrium. Consider a household at y^*. With any shock exceeding $y^* - y^{**}$, the household will be driven beyond the unstable equilibrium, and will then see its income decline steadily towards zero. Destitution will be the inevitable result.

One can propose more complicated models. For example, one can allow for some positive lower bound to incomes. Assuming that this lower bound is below y^{**} in Figure 1 there will be a stable equilibrium at the lower bound. Again, with a large negative shock, a household at its high (stable) income will see its income decline until it reaches the lower bound.

Figure 1

Recursion diagram exhibiting non-linear dynamics



There are several possible interpretations of the non-convexity. One is the Efficiency Wage Hypothesis (Mirrlees 1975, Stiglitz 1976, Dasgupta and Ray 1986, Dasgupta 1993). This assumes that labour productivity and earnings are zero at a low but positive level of consumption; only if consumption rises above some critical level, $y_0>0$, will the worker be productive. In the efficiency wage literature, y_0 is usually interpreted as the nutritional requirements for a basal metabolism, which account for about two-thirds of normal nutritional requirements (Dasgupta 1993).

Alternatively, one can assume that a minimum expenditure level is necessary to participate in society, including getting a job – in short, avoiding social exclusion requires a minimum consumption level for food and non-food commodities. Higher consumption permits social inclusion, but there are diminishing income returns to this effect. For example, earnings rise but at a declining rate until after some point the productivity effect of consumption vanishes.

Alternatively, we can think of a liquidity-constrained household that faces the choice of investing in (physical or human) capital or consuming all income in a given period. Suppose that the household is only willing to forgo current consumption in order to invest if its income exceeds a critical level y_0 – at anything less than this amount, the need to assure maximum current consumption overrides all else. The investment yields an income at time t of $f(y_{t-1})$ where this function has the same properties as above.

Non-linearity in the dynamics also has implications for the growth rate of mean household income. Mean current income is:

$$\bar{y}_t = \sum_{i=1}^{n} f(y_{it-1}, x_{it})/n \tag{2}$$

If the function f is non-linear in y_{it-1} then initial distribution will matter to future income at given current income. If f is strictly concave in y_{it-1} then the mean current income will be a strictly quasi-concave function of the levels of income in the previous period. By the properties of concave functions, higher initial inequality will entail lower future mean income for any given initial mean, $\bar{y}_{t-1} = \sum_{i=1}^{n} y_{it-1}/n$, holding x_{it} constant for all i.

Recent theoretical papers have shown how concavity of the recursion diagram for income or wealth can arise from credit market failures, given decreasing returns to own capital (Benabou 1996, Aghion and Bolton 1997, Aghion et al. 1999, Banerjee and Duflo 2000).

This type of model has a powerful policy implication. A transfer payment not less than y^{**} will eliminate the low-income unstable equilibrium. The family will be fully protected from the possibility of a transient shock having an adverse long-term effect. Not only will the transfer help protect current living standards, but it will also generate a stream of future income gains. An effective safety net will then be a long-term investment, and with a potentially high return.

5 Econometric model

We now look for evidence in our data of the type of non-linear dynamics discussed above. We introduce the non-linearity in the form of a cubic function of the lagged dependent variable in a panel data model. (Lokshin and Ravallion 2001, further discuss this specification choice.) Another point to note is that we allow for only first-order autoregression in our model. This is done primarily to estimate a parsimonious model given that we have a very short time-series for each household. We also allow for an independent time trend. Thus our general econometric specification for *i* at date *t* is of the form:

$$y_{it} = \alpha + \gamma t + \beta_1 y_{it-1} + \beta_2 y_{it-1}^2 + \beta_3 y_{it-1}^3 + \mu_i + \varepsilon_{it} \quad (i = 1,2..N;\, t = 1,2,..T) \tag{3}$$

where μ_i is an unobserved individual effect, and ε_{it} is an identically and independently distributed innovation error term. We estimate this model for both income and consumption. We eliminate the unobserved fixed effect μ_i which is potentially correlated with lagged income (and its squared and cubed values) by taking the first differences of equation (3), giving:

$$\Delta y_{it} = \gamma + \beta_1 \Delta y_{it-1} + \beta_2 \Delta y_{it-1}^2 + \beta_3 \Delta y_{it-1}^3 + \Delta\varepsilon_{it} \tag{4}$$

This model is estimated with and without the trend in income or expenditure, to see how this affects the estimated dynamics.

Least squares estimation of equation (4) would still yield biased and inconsistent coefficient estimates due to correlation between lagged income changes and the differenced innovation error term. Assuming that the ε_{it}*'s* are serially uncorrelated, the GMM estimator is the most efficient one within the class of instrumental variable (IV) estimators. In estimating (4), we follow standard practice in using y_{it-2} or higher lagged values (wherever feasible) as instrumental variables (Arellano and Bond 1991). (The Appendix gives further details, including on diagnostic testing.) Similar moment conditions are used for Δy_{it-1}^2 and Δy_{it-1}^3. We do not necessarily use all the moment conditions available to us. We choose the most parsimonious set of moment conditions based on the minimum value of the estimated objective function. In checking the validity of our instruments, the null hypotheses of the tests for over-identification and second-order serial correlation were accepted within standard levels of significance (Appendix). Notice that our GMM estimation method allows for serially independent measurement errors.

6 Results

For purely descriptive purposes, Table 1 gives household recovery times following a drop in measured expenditure. We chose all households who had a decline in their real expenditure between the first two years of the surveys and categorized these households according to the time it took them to get back to at least 98 per cent of their expenditure in the first year of the survey.

Table1

Recovery from an initial expenditure contraction

Recovery time after shock	Any shock	Small shock	Medium shock	Large shock
	(percentages)			
1 year	54.53	63.23	31.35	14.39
2 years	15.14	15.58	14.05	9.35
3 years	6.24	5.57	8.84	5.76
4 years	4.38	3.44	7.88	4.32
Never recovered within the period	19.71	12.18	37.14	66.19

Note: Small shock: 5% or lower fall in household expenditure; medium shock: 5–10% fall in household expenditure; marge shock: 10% or higher fall in household expenditure.

We find that slightly more than half of the households that had a negative expenditure change recovered the loss within one year. However, 20 per cent had not recovered within five years. The time it takes to recover depends of course on the size of the initial expenditure contraction. Among households that experienced a decline in expenditure of less than 5 per cent between the first and the second year of the survey, 63 per cent recovered within one year. Among those that lost more than 10 per cent between the first two years of the survey, two-thirds had not recovered after five years.

These calculations might be interpreted as indicating that two types of dynamics exist. For the first type, an initial income shock leads to only a temporary drop in household income. For the second type the shock appears to have been more devastating, putting them on a declining income path possibly leading to chronic poverty.

That interpretation is questionable, since there are other ways one might explain Table 1. Possibly the households that had not recovered, experienced other shocks in the intervening period. Or possibly they were returning more slowly to their steady state equilibrium. Or possibly the first shock was not transient, and lasted for many years. Or the shock may have been transient, but the recursion process is linear with a slow speed of adjustment due to lagged effects of past incomes on current incomes.

For these reasons, one cannot conclude from Table 1 that short-lived shocks have long-lived impacts. We need to use our model of the dynamics to see if the structural process generating consumption and income is consistent with the type of non-linearity whereby sufficiently large shocks can create long-term poverty.

Turning to the model of income dynamics, Table 2 gives our estimates of equation (4) without the trend (suppressing the constant term in 4).[6] Table 3 gives the results including the trend. The trend coefficient (i.e. the constant term) is not significantly different from zero for income, but it is for expenditure. Our preferred model for income is that without the trend while for expenditure it is the model with a trend.

Table 2

Non-linear dynamic model without trend

	Expenditure	Income
Δy_{it-1}	0.2468 (11.989)	0.5441 (14.240)
Δy^2_{it-1}	$0.0113\text{x}10^{-2}$ (4.067)	$-0.0116\text{x}10^{-2}$ (-5.228)
Δy^3_{it-1}	$-0.0146\text{x}10^{-6}$ (-1.1211)	$-0.0376\text{x}10^{-6}$ (-5.439)

Note: t-statistics in parentheses; higher lags used as instruments.

Table 3

Non-linear dynamic model with trend

	Expenditure	Income
Trend	3.3894 (4.936)	-0.0316 (-0.027)
Δy_{it-1}	0.1613 (6.428)	0.5251 (13.339)
Δy^2_{it-1}	$-0.0893\text{x}10^{-3}$ (-2.420)	$-0.0101\text{x}10^{-2}$ (-4.539)
Δy^3_{it-1}	$-0.0115\text{x}10^{-5}$ (-9.003)	$-0.0481\text{x}10^{-6}$ (-7.246)

Note: t-statistics in parentheses; higher lags used as instruments.

6 Pooling years and households, the sample mean annual income is Yuan 446 per capita at 1985 prices (with a standard deviation of 264), while the corresponding mean for expenditure is Yuan 345 (standard deviation of 166).

Figure 2

Expenditure model without trend

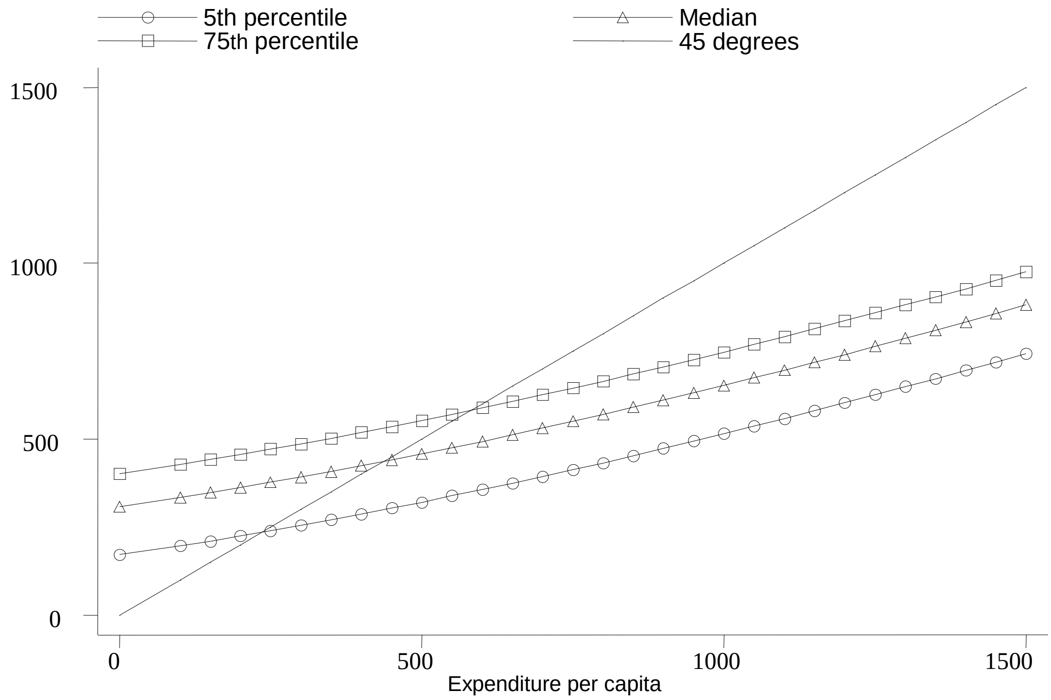


Figure 3

Expenditure model with trend

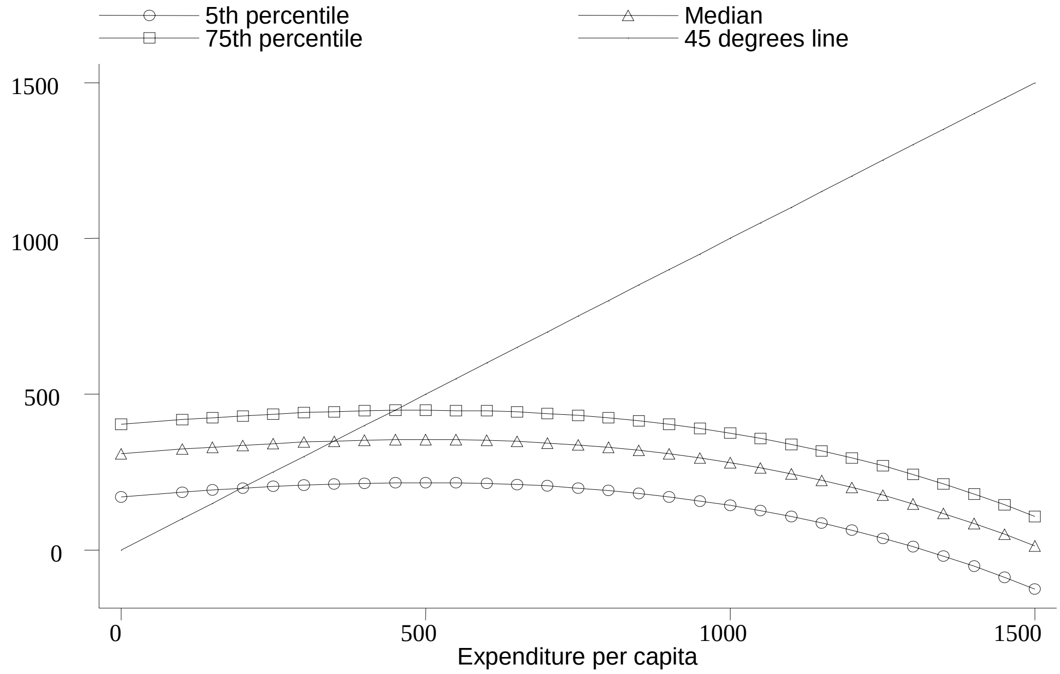


Figure 4

Income model without trend

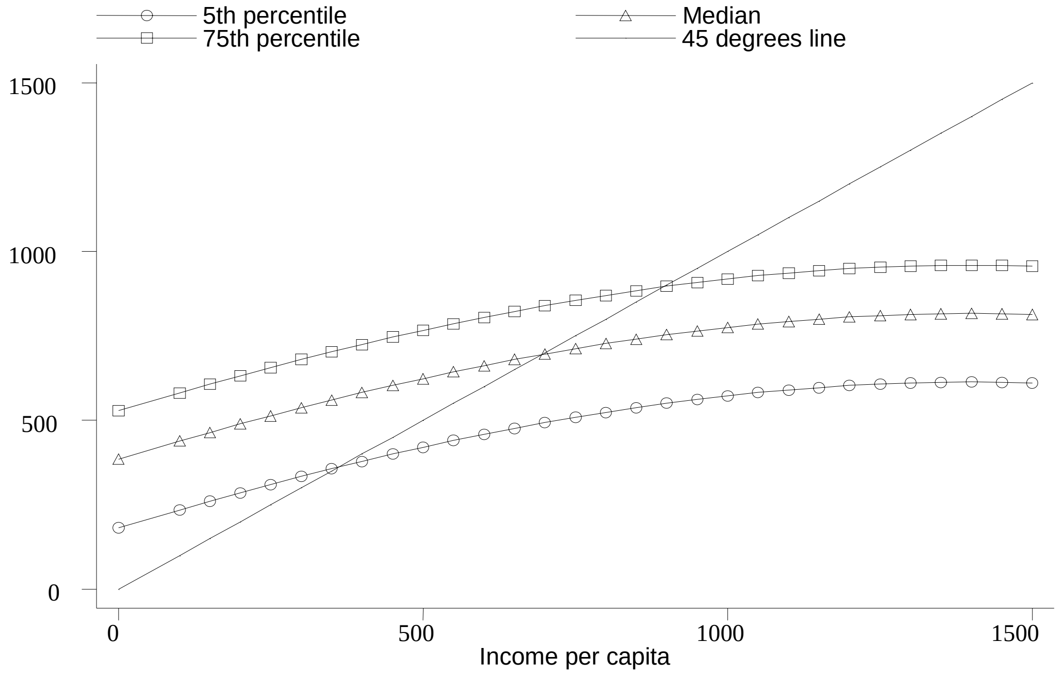
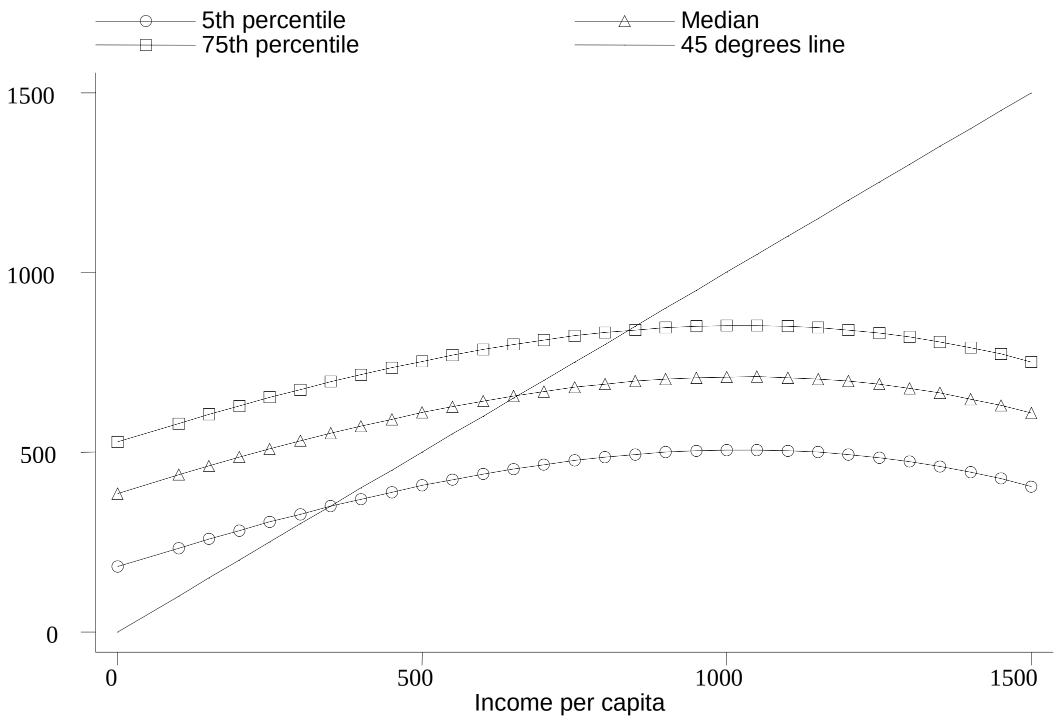


Figure 5

Income model with trend



Figures 2 to 5 give the recursion diagrams in all four cases. To retrieve the recursion diagram from the estimated parameters of (4) we treat the distribution of time-mean incomes and expenditures as the distribution of long-run (steady) state values. Thus the recursion diagram for the *p*'th percentile with income $\bar{y}_p$ is:

$$y_{pt} = \bar{y}_p + \beta_1(y_{pt-1} - \bar{y}_p) + \beta_2(y_{pt-1} - \bar{y}_p)^2 + \beta_3(y_{pt-1} - \bar{y}_p)^3 \quad (5)$$

Figures 2 to 5 indicate that there is non-linearity in the range of the data, with concavity suggested in all cases except the expenditure model without trend. However, there is no sign of a non-convexity.

The concavity in the recursion diagram implies that higher initial income inequality (in the sense of mean-preserving spreads) will reduce future mean income at a given current mean. We can construct a natural measure of the contribution of inequality to growth as:

$$I_t = f[M(y_{it})] - M[f(y_{it})] \quad (6)$$

where *M*[.] denotes the mean of the term in brackets (the mean being taken over all *i* at date *t*). This must be positive whenever *f* is concave. Using the models without trend, our estimates of (6) represent 4.1 per cent of mean income and 1.7 per cent of mean expenditure; in the models with trend, the corresponding numbers are 6.5 per cent and 2.1 per cent.

A further implication of concavity in the recursion diagram is that the speed of adjustment will be lower for households with lower steady-state incomes. The speed of recovery from an income loss is $1 - \partial y_{it} / \partial y_{it-1}$. At one extreme, if a serially-independent transient shock to a household at date *t*-1 has no impact on the household's period *t* income then the speed of adjustment is unity. At the other extreme, if income at data *t* is lower than it would have been otherwise by the full amount of the shock at *t*-1 then the speed of recovery is zero. Given that *f* is strictly concave, the speed of recovery must be a strictly increasing function of y_{it-1}.

Figure 6 gives the speed of recovery as a function of y_{it-1} for income (using the preferred model without trend). For a household at zero income, the speed of recovery is 0.45. For a household with annual income of around 240 Yuan per capita (around the mean poverty line across the four provinces, as estimated by Chen and Ravallion 1996) the speed of recovery is 0.52. For household with an income of 900 Yuan per capita (roughly the 95th percentile) the speed of recovery from a shock rises to about 0.76, while it reaches unity at around 1,400 Yuan (the 99th percentile is at 1,441 Yuan), at which point the shock has no effect beyond the current year.

Figure 7 gives the corresponding figure for expenditures (based on the preferred model, with trend). At given y_{it-1}, the speeds of recovery are considerably higher for expenditures, reflecting consumption smoothing. The value of $\partial y_{it} / \partial y_{it-1}$ becomes negative at high expenditures (Figure 3), implying speeds of recovery over unity, which would seem unlikely and may well reflect a problem with the model specification for consumption dynamics. However, the bulk of the data (about 90 per cent) is in the region with speeds of recovery below unity. As we saw for income, the speed of expenditure recovery is lower for households with lower initial per capita spending.

Figure 6

Speed of recovery from a transient income shock

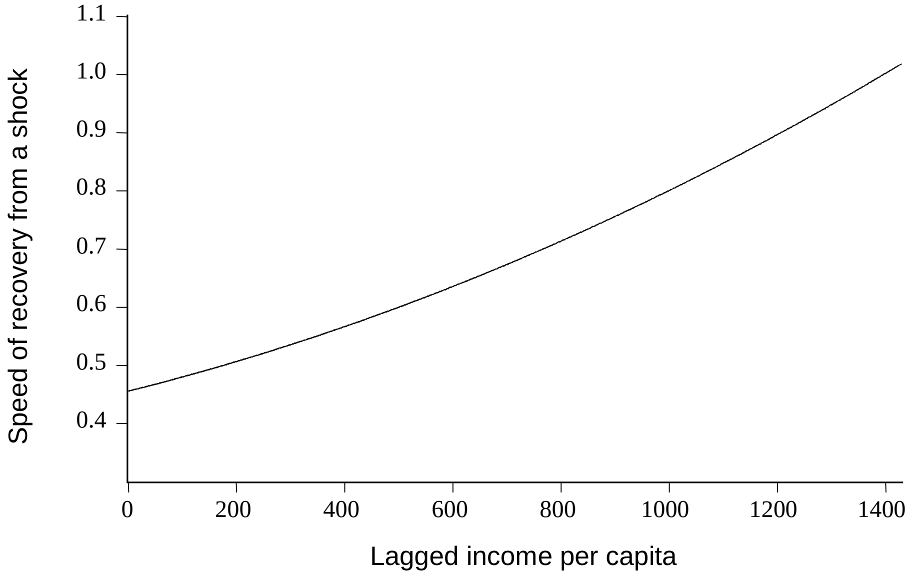
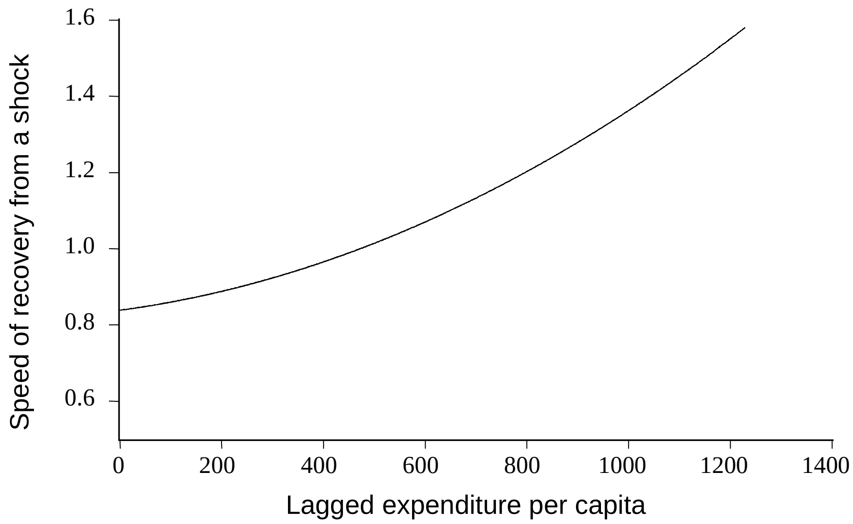


Figure 7

Speed of recovery from a transient expenditure shock



7 Conclusions

We have tried to assess whether existing (private and social) arrangements within a poor rural economy are able to avoid what is possibly the worst potential manifestation of uninsured risk, namely that a sufficiently large transient shock might drive a household into permanent destitution. This requires a specific kind of non-linearity in the dynamics of household incomes. Economic theory offers little support for the common assumption of linear dynamics, whereby households inevitably bounce back in time from a transient shock. Theoretical work has pointed to the possibility of a low-level non-convexity in the recursion diagram, such that a short-lived uninsured shock can have permanent consequences. It is an empirical question whether the dynamics found in reality exhibit such properties.

Our test entails estimating a dynamic panel data model in which income (or expenditure) is allowed to be a non-linear function of its own lagged values. As is invariably the case, we have had to impose a structure on the data. The most restrictive assumption we have had to make is that, while long run-equilibria differ across households, the out-of-equilbrium adjustment process is common to all households. Our household panel is not short by developing-country standards, but in order to relax this restriction, more time series observations would be needed to relax this restriction.

On calibrating the model to household panel data for rural areas southern China, we do find some evidence of non-linearity in the dynamics. However, we find no evidence of low-level non-convexities. The data are not consistent with the existence of an unstable equilibrium for the poor. This suggests that households in this setting tend to bounce back in due course from transient shocks. Our results are broadly consistent with those of Lokshin and Ravallion (2001) using panel data for Russia and Hungary. While we do not find evidence of a poverty trap arising from non-linear dynamics, in other work we have found strong signs of geographic poverty traps in these data, whereby location matters crucially to prospects of escaping poverty at given (latent and observed) household characteristics (Jalan and Ravallion 2002).

We find evidence of concavity in the recursion diagram. One implication of this finding is that the speed of recovery from a transient shock is lower for those with lower initial income. The differences in recovery speeds between the ‘poor’ and ‘rich’ appear to be sizable, particularly for incomes. So, while our results suggest that the poor eventually bounce back from short-lived shocks, the adjustment process is slower than for the non-poor.

The type of non-linearity that we find also suggests that the growth rate of household incomes in this setting will depend on higher moments of the initial distribution than its mean. Depending on the model specification, we find that inequality contributes 4–7 per cent to mean income and about 2 per cent to mean expenditure. These figures are appreciably lower than those obtained by Lokshin and Ravallion for Russia and Hungary, where inequality appears to be more costly to growth.

Appendix

GMM estimation of the non-linear dynamic model

The GMM estimator for the parameter vector $\hat{v} = (\gamma, \beta_1, \beta_2, \beta_3)$ is defined as:

$$\hat{v} = (q'wa_n w'q)^{-1}(q'wa_n w'\Delta y)$$

where q = [e, $\Delta y_{-1}, \Delta y_{-1}^2, \Delta y_{-1}^3$]$N$, is the set of regressors with eN a vector of ones, w is the matrix of instrumental variables, a_n is the weighting matrix, and Δy is the ($NTx1$) vector of the first differences of the dependent variable. The optimal choice of a_n (in the sense of giving the most efficient estimator asymptotically) is proportional to the inverse of the asymptotic covariance matrix (Hansen 1982).[7] Heteroscedastic consistent standard errors are computed using the residuals from a first-stage regression to correct for any kind of general heteroscedasticity.

Inferences on the estimated parameter vector $\hat{v}$ are appropriate provided the moment conditions are valid. Sargan's (1958) and Hansen's (1982) chi-square test of the over-identifying restrictions was implemented to check whether the exclusion restrictions are consistent with the data. The degrees of freedom for this test are calculated as the difference between the number of columns in the instrument matrix and the number of parameters to be estimated in the model. A second-order serial correlation test was also constructed, given that the consistency of the GMM estimators using twice (or higher) lagged dependent variables as instruments for the first differenced model depends on the assumption that $E(\Delta\varepsilon_{it}\Delta\varepsilon_{it-2}) = 0$ (the test-statistic is normally distributed).[8] Both tests passed at the 5 per cent level.

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7 In the just-identified case (i.e. in the case where the number of moment conditions are exactly equal to the number of parameters to be estimated), the parameter estimates do not depend on the weighting matrix and hence the choice of a_n is redundant.

8 There may be some first-order serial correlation, i.e., $E(\Delta\varepsilon_{it}\Delta\varepsilon_{it-1})$ may not be equal to zero since $\Delta\varepsilon_{it}$ are the first differences of serially uncorrelated errors.

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