Poverty and Welfare Measurement on the Basis of Prospect Theory

Markus Jäntti (Stockholm University)

Ravi Kanbur (Cornell University)

Milla Nyyssölä (Aalto University School of Economics)

Jukka Pirttilä (University of Tampere)

Motivation

- Many of the findings of behavioural economics research are highly relevant for developing countries (see e.g. Mullainathan 2007)

- On the other hand, there is a huge literature on poverty, inequality and welfare measurement in economics and its application in developing countries

- This paper is a contribution to the literature that brings together these two strands. Does it in a specific way by incorporating features emphasised in Prospect Theory (reference dependence, loss aversion, and subjective probabilities) to poverty and welfare measurement.

- Incorporating these allows us to address issues that are likely to be of importance for e.g. understanding the perceptions about economic development among the general public
    - A significant amount of losers, resistance to change + loss aversion => a reduction of societal welfare even if conventional measures would suggest a welfare increase

UNIVERSITY OF TAMPERE

To be more exact, what does this paper do?

- Examines poverty, inequality and welfare measurement if individuals' perception on wellbeing can be described using Prospect Theory
- We need to have a concept of Prospect Theory motivated welfare level
- We use a hybrid utility function
  - welfare = utility from the actual income + valuation of the deviations from the reference income
- Key notion is equivalent income
  - the income level with which the individual would be equally well off, evaluated using a standard concave utility function, than he or she actually is, evaluated with a reference-dependent utility function.
- All standard poverty and inequality indices can be calculated for the distribution of this notion of equivalent income
- Illustrate the use of these new measures using individual-level panel data from Russia (during a period with a large restructuring and many with falling incomes)

Some earlier literature

- One strand of literature is measurement of economic vulnerability, as some of the papers build on behavioural economics foundations
  - Dutta, Foster and Mishra (2011): allow for reference dependence on the measurement of future poverty
  - Bossert and D'Ambrosio (2011): allows for loss aversion
- Literature on the use of relative income comparisons in welfare measurement (a recent survey by van Praag 2011). We abstract from these.
- Closest paper: Günther and Maier (2008)
  - Use the reference-dependent preferences by Köszegi and Rabin (2006) to calculate multi-period poverty and vulnerability indices
- Difference between our paper and that of Günther and Maier (2008)
  - We use the notion of equivalent income to calculate also inequality and social welfare indices
  - Apply these indices using real world data
  - Look at implications of differences between subjective and objective probability weighting

Welfare changes based on Prospect Theory

- Ingredients in Kahneman's and Tversky's (1979) Prospect Theory (Reference dependence, loss aversion, diminishing sensitivity, use of subjective probabilities)

- In conventional welfare measurement, an often used specification is the CRRA form. In Prospect Theory, it could be

$$\sum_i \frac{(y_i - \bar{y}_i)^{1-\eta}}{1-\eta} \qquad for \quad y_i > \bar{y}_i$$

$$0 \qquad for \quad y_i = \bar{y}_i$$

$$-a\sum_i \frac{(\bar{y}_i - y_i))^{1-\eta}}{1-\eta} \qquad for \quad y_i < \bar{y}_i$$

- Implies that reshuffling of income among households, holding the overall income constant, reduces wellbeing and tends to increase poverty (Our **Result 1**)

- Can help to understand the consequences of 'churning' – movements around the poverty line

Introducing the level of welfare

- Prospect Theory deals with changes, while conventional poverty and welfare measurement starts from levels.
- A way to introduce levels to the analysis is to use the hybrid form

$$h(y_{i,t}) = u(y_{i,t}) + v(y_{i,t} - \bar{y}_{i,t})$$

- Based on the formulation in Köszegi and Rabin (2006)
- Useful to define equivalent income as

$$u(y_{i,t}^{*}) = h(y_{i,t}) = u(y_{i,t}) + v(y_{i,t} - \bar{y}_{i,t})$$

- One interpretation: welfare from constant income
- All standard poverty, inequality and welfare indices can be calculated for the equivalent income (**Result 2**). Examples:
  - Headcount poverty: poor if y* < poverty line
  - Equally distributed equivalent income in the Atkinson index calculated for y*

Extension to the case with income uncertainty

- Vulnerability measurement deals with expected future low welfare
- Prospect Theory can be used in this context, too
- Expected welfare (Social Value Function)

$$E(SVF) = \sum_i E[h(y_{i,t})]$$

$$= \sum_i \left[\int_0^\infty u(y_{i,1}) p(y) dy + \int_{-\infty}^0 v(y_{i,1} - y_{i,0}) \pi(c) dc + \int_0^\infty v(y_{i,1} - y_{i,0}) \pi(c) dc \right]$$

- Where π(c) is subjective probability distribution function of income changes
- For rare large negative changes in income, i.e. for large losses π is larger than objective changes
- **Result 3**: Because of the overestimation of large losses, Prospect Theory based ex ante social welfare measures can be smaller than social welfare calculated with objective probabilities.

UNIVERSITY
OF TAMPERE

Properties of Prospect Theory based poverty measurement

- Sen's axioms for poverty measurement
    - 1) The focus axiom (income of the non-poor should not count)
    - 2) The monotonicity axiom (a loss of income among the poor should raise poverty)
    - 3) The weak transfer axiom (a regressive transfer among the poor should raise poverty).
- 1 and 2 hold for Prospect Theory type of measures
- Weak transfer axiom does not hold (**Result 4**):
    - Income of a person who is very poor, i.e. whose income is already well below the reference point, is reduced
    - income of those who are closer to the poverty line is increased (but who still stay below the poverty line),
    - aggregate poverty drops because of the presence of diminishing sensitivity.
- The same reasoning holds for ex ante poverty / vulnerability measures

UNIVERSITY
OF TAMPERE

An empirical illustration

- We use Russian individual-level panel data from the RLMS to illustrate the differences between conventional poverty and welfare measurement and Prospect Theory based measures

- Why Russia?
  - Panel data available, not so common for developing / emerging countries
  - Large changes in economic development
    - After the collapse of the Soviet Union, a large reduction in economic activity. Many losers.
    - Fast GDP growth after the Russian crisis in 1998. Poverty, measured in conventional fashion, fell. Does this also hold for Prospect Theory measures?

Data and methods

- Data on eight waves during 1995-2002 and is further divided into two parts
  - 1995-1998 (downturn)
  - 1999-2002 (growth)
- Sample size: 8,342–10,636 individuals depending on the wave
- We first calculate conventional poverty and inequality measures
- We then use the following functional form to calculate Prospect Theory based equivalent income

- Gainers: $\ln(y_{98}) + [\ln(y_{98}) - \ln(y_{94})]^{\beta}$

- Losers: $\ln(y_{98}) - 2*[\ln(y_{94}) - \ln(y_{98})]^{\beta}$

- This is a CRRA motivated form with η set to 1, the loss aversion parameter to 2 and the weight of the gain-loss utility (β) to 0.5
- We check sensitivity with respect to the parameterisation

UNIVERSITY
OF TAMPERE

Some data description

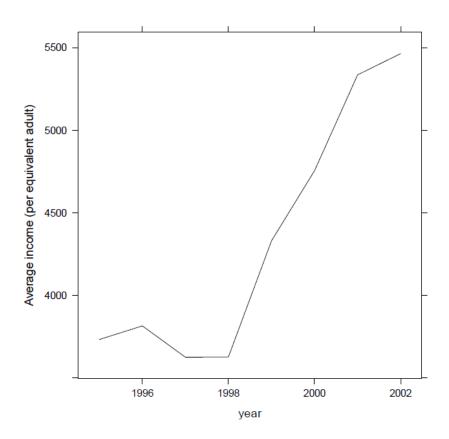**Figure 1** Average income (per equivalent adults in population) in real 1992 prices)

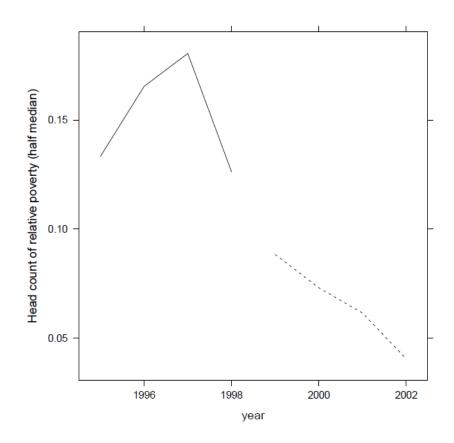**Figure 4** Head count of relative poverty by period in Russia – RLMS rounds

UNIVERSITY
OF TAMPERE

Panel B. Poverty among winners and loser				
	Head count		Poverty gap	
	1998	2002	1998	2002
Ln(income)				
all	0.3393	0.1338	0.0273	0.0083
Gainer	0.1863	0.0754	0.0095	0.0028
Loser	0.5000	0.2804	0.0460	0.0220
Pt eq. income				
all	0.4699	0.2432	0.1081	0.0427
Gainer	0.0404	0.0084	0.0021	0.0004
Loser	0.9208	0.8325	0.2193	0.1489

Main results

Table 4 Inequality and poverty in Russia 1998 and 2002 using income and prospect theory income (log exponent) – measured on the income scale (exp of pt utility compared to income in levels); $\beta = 0.5$, $a = -2$

Index	Equivalent income		Income	
	1998	2002	1998	2002
Inequality				
Gini coefficient	0.714	0.603	0.418	0.386
Atkinson (eta=1)	0.749	0.592	0.280	0.234
Atkinson (eta=2)	0.992	0.982	0.626	0.499
Poverty				
Head count poverty	0.470	0.243	0.339	0.134
Poverty gap	0.330	0.147	0.126	0.040

Summary of empirical results

- Poverty and inequality higher under Prospect Theory measures
  - Especially so among losers
  - Especially so if the loss aversion parameter increases
- Results robust to changes in the weight of gain-loss utility
- Main point: direction of welfare change can differ depending on whether one uses conventional or Prospect Theory measures
- In multi period welfare changes
  - Reference point can either be the immediate past or the distant past, depending on the speed of adaptation
- To be done: Forward-looking poverty / vulnerability
  - Predict poverty based on the observable characteristics of the households
  - Perhaps change probability weights to take into account subjective probability weights

Conclusions

- This paper derived poverty, inequality and welfare measures that take into account reference dependence, loss aversion and diminishing sensitivity

- Showed how, with a significant number of losers, the direction of welfare changes can change, depending on the type of measures used

- Results can help to understand differing viewpoints on economic policy and political economy constraints to economic reforms

- We do not want to take a normative stance on whether one should use conventional or Prospect Theory measures

- Indeed, the government may want to act in a non-welfarist way by not taking into account some features (such as a diminishing sensitivity). Subject to future work.