

POVERTY AND WELFARE MEASUREMENT ON THE BASIS OF PROSPECT THEORY

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This paper examines the measurement of social welfare, poverty, and inequality, taking into account features that have been found to be important welfare determinants in behavioral economics. Most notably, we incorporate reference-dependence, loss aversion, and diminishing sensitivity— aspects emphasized in Prospect Theory—to social welfare measurement. We suggest a new notion of equivalent income, the income level with which the individual would be as well off, evaluated using a standard concave utility function, as he actually is, evaluated with a reference-dependent utility function. We examine the differences between standard poverty and inequality measures based on observed income and measures that are calculated based on equivalent income. These differences are illustrated using household-level panel data from Russia and Vietnam.

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1. INTRODUCTION

Economists now believe that in many cases non-standard, behavioral economic models help in better predicting how people behave. However, welfare measurement is still mainly conducted using tools that are not informed by these new developments. It is worth asking whether the key results in welfare measurement still remain valid if some of the tenets of behavioral economics are taken

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onboard in welfare analysis. This paper is a contribution to a new research area that tries to bring these two strands of literature together.

In particular, we examine welfare and poverty measurement and inequality analysis based on reference-dependent utility, as suggested by Prospect Theory. This theory, developed by Kahneman and Tversky (1979), is now a prime alternative to the expected utility approach for decision-making under uncertainty, and it has garnered a lot of empirical support.¹ While it was originally developed as a tool for understanding decision-making under uncertainty, its key tenets are also relevant for deterministic frameworks. The main ingredients of Prospect Theory are: (i) reference-dependence, the idea that welfare depends more on deviations from a reference level than on actual levels; (ii) loss aversion, the observation that in real-life situations, losses are felt more strongly than gains of equal size; (iii) the principle of diminishing sensitivity, which implies that preferences could be convex in the loss area; and (iv) subjective probability assessments.

Since Prospect Theory deals with changes in well-being and it is silent on the level of well-being, whereas all conventional poverty and inequality measurement starts from income or utility levels, there is a need to encompass welfare levels in Prospect Theory. Kőszegi and Rabin (2006) develop a hybrid form of preferences, where well-being depends on the utility from current income and the deviation of current income from base income (or reference income). Günther and Maier (2008) use the formulation of Kőszegi and Rabin (2006) and build multi-period poverty and vulnerability (forward-looking poverty) indices based on it. They also discuss the axiomatic properties of the indices they develop and highlight their properties based on numerical examples.

The current paper continues the analysis of Prospect Theory based poverty measurement in the following ways. We first propose a new tool for analysis, a new kind of equivalent income, which is defined as the income level with which the individual would be equally well off, evaluated using a standard concave utility function, as he actually is, evaluated with a reference-dependent utility function. All the standard measures of poverty, including the often-used headcount index and Foster–Greer–Thorbecke (FGT) class of poverty measures, can then be defined on the domain of this equivalent income. In addition, the approach can also be utilized in inequality analysis—for example, the Gini and the Atkinson indices can be calculated based on it. We also combine reference-dependent measurement with a social welfare function approach. The benefits and limitations of the social welfare function based approach to poverty and inequality measurement therefore apply in our context as well, and they are discussed in more detail in the theoretical section. The reference income in the analysis is in most cases determined by the individual's past income, and we will present some evidence for why the earlier income level matters for individual well-being in the theoretical section.²

In addition to these theoretical considerations, a main contribution of our paper is to offer an empirical illustration of the differences between conventional poverty and inequality measurement and indices that are based on reference-dependent utility.

¹For a survey, see Camerer and Lowenstein (2003). A recent paper Booij *et al.* (2009) provides support for a Prospect Theory type of behavior in a representative survey of individuals.

²In the Working Paper version (Jäntti *et al.*, 2012) we also discuss how our approach can be combined to forward-looking analysis of poverty/vulnerability.

For this, we utilize household-level panel data from two different countries, Russia and Vietnam. Russia is a good case to illustrate some of the potential differences because of the large swings in inequality and the heavy losses some individuals suffered during the transition process. In the Vietnamese case, conventionally measured poverty and inequality have consistently dropped in the period we examine, and it is interesting to see whether reference-dependent measures convey a different message in these conditions of a relatively stable progress.

Political economy considerations provide one particular motivation for our research. For example, the views of official organizations on the one hand—including economists working for them—and the general public and NGOs on the other hand often clash on the societal welfare consequences of key policy changes. These disagreements, while by no means uniquely so, are in many cases more prevalent in a developing country context.³ Economists may, for example, point out that there have been reductions in poverty as measured by the headcount rate, and economic policy has, by and large, been a success, whereas those operating in the field say that they have seen increases in poverty among the people they work with or even absolute increases in the number of the poor. One possible source for these disagreements is the phenomenon of “churning,” that is, the movement of people across the poverty line in both directions. Another reason might be that people feel increasingly insecure regarding the risks they face and some of these uncertainties are not fully covered by conventional economic analysis. The incorporation of the features emphasized in Prospect Theory may help to explain these possible disagreements and tensions. A completely different set of issues arises regarding the normative grounds of using reference-dependent preferences in poverty and inequality measurement. These issues are discussed toward the end of our theoretical analysis and in the concluding section, but it is worth mentioning here that we do not necessarily want to take a strong stand on the normative side. Our main point is to highlight what happens to poverty and inequality measurement if, for instance, loss aversion is taken into account. The message from such measures can then be contrasted and pondered against the picture that emerges from conventional measurement. Ravallion (2012) discusses the use of perceived welfare indicators (such as self-assessed happiness) in poverty measurement, and argues that they provide useful complementary information to conventional “objective” measures. Our exercise here is in line with this argument.

In addition to the paper by Günther and Maier (2008), our paper is also related to several earlier works from three broad strands of literature. First, a number of papers have examined backward- or forward-looking welfare and poverty measurement taking changes in the individual’s income level into account. Bossert and D’Ambrosio (2013) allow for loss aversion when building a backward-looking economic insecurity index while Bellani and D’Ambrosio (2011) examine the connections between self-reported life (dis)satisfaction and the deprivation measures suggested by the economic literature.

Second, although the reference income in our analysis will be the individual’s own earlier income, another strand of literature that is relevant for our paper is the

³See Kanbur (2001, 2005) for a more detailed discussion of these disagreements.

work on relative income concerns (social comparison), which can also influence the reference point in a Prospect Theory type of measure.⁴ Castilla (2012) offers an application of poverty analysis that is based on reference-dependent utility formulations. The idea in her paper is to explain subjective poverty reported by individuals in a Mexican cross-sectional survey with three candidates for reference-dependence: the income level of the individuals three years ago, the income level they aspired to acquire, and the contemporaneous income level of a reference group.

Finally, since the poverty and inequality calculations conducted in our paper use panel data, our study is also related to earlier analyses of poverty and inequality that draw on panel data. This literature includes, first, material on chronic poverty measurement that separates poverty into chronic and transient components, either based on the length of spells of poverty (as in Baulch and McCulloch, 1998) or based on over-time mean income and the within-individual variance (as in Jalan and Ravallion, 1998). Calvo and Dercon (2009) offer an axiomatic treatment of chronic poverty measures and Foster (2009) extends the FGT class of poverty measures to an intertemporal setting.⁵ The literature on income mobility—see Shorrocks (1978) for an influential early reference—is also related to our work as it uses longitudinal data. Notice that while income changes are typically seen as positive features in the study of both chronic poverty and income mobility, in the Prospect Theory based poverty measurement undertaken here, income fluctuations tend to lower welfare, since losses weigh more than gains of equal size.

The paper proceeds as follows. Section 2 presents the theoretical basis for our analysis. It also discusses to what extent Prospect Theory based measurement satisfies the standard normative properties set out in the poverty measurement literature. Section 3 presents the empirical applications. Section 4 concludes.

2. THEORETICAL FRAMEWORK

The purpose of this section is to derive poverty and welfare measures that are inspired by Prospect Theory. But it will be useful to start by briefly stating the principles for conventional welfare analysis to provide a comparison point to Prospect Theory based measures.

In conventional welfare analysis, an individual has utility $u(y)$ of consumption y , and one normally assumes that $u' > 0$ and $u'' < 0$. This function both predicts his behavior and measures his well-being. Assuming it to be cardinal and interpersonally comparable, we can get a social welfare function of the type $SWF_t = \sum_i u(y_{i,t})$, where i refers to the individual and t to the period when income or consumption is measured. The key in the analysis that follows will be the measurement of well-being over time, and the difference in welfare over two consecutive periods will be

⁴For a treatment of welfare measurement that is based on relativity concerns, see van Praag (2011). Using data from Malawi, Ravallion and Lokshin (2010) find, however, that relative deprivation was not a main concern among the poor. Relative income concerns can be a more important factor in rich countries.

⁵In addition, Christiaensen and Shorrocks (2012) review the papers that appear in a recent special issue on dynamic poverty measurement.

$$\Delta SWF_t = \sum_i [u(y_{i,t}) - u(y_{i,t-1})].$$

For valuation under uncertainty, one simply replaces the standard utility function with expected utility.

2.1. *Preliminary Considerations*

Now let us contrast this conventional approach with Prospect Theory. The key tenets in it are the following:

- (1) Reference-dependence. Welfare measurement is not based on levels of income, but on changes from a reference point. The reference point could, for example, be one’s past consumption level or perhaps also the poverty line in the economy.
- (2) Loss aversion. Negative changes have a greater impact on welfare than gains of equal magnitude.
- (3) Diminishing sensitivity. This means that the value function could be convex in the loss area. There are doubts as to what extent this feature is relevant for losses of significant size.
- (4) Use of subjective instead of objective probability distributions. The probabilities of very rare outcomes are overweighed and frequent outcomes are underweighed.

While Prospect Theory was developed to describe decision making under uncertainty, features 1–2 and possibly 3 are also relevant for choices in a deterministic framework. In Prospect Theory, the utility function is replaced by a value function that is determined over changes in income levels from a reference point. Denote the value function with $v(c)$, where $c_i = y_i - \bar{y}_i$ is the change in income from the reference point, denoted by \bar{y}_i . The shape of the value function is governed by the following properties:

- (1)
 - (i) $v' > 0$
 - (ii) $v'(-c) \geq v'(c)$
 - (iii) $v'' > 0$ for $c < 0$, $v'' < 0$ for $c > 0$.

Assumption (ii) captures the principle of loss aversion: “losses loom larger than corresponding gains” (Tversky and Kahneman, 1992, p. 303). Assumption (iii) refers to “diminishing sensitivity for losses and gains,” i.e. a diminishing marginal utility for losses and diminishing marginal disutility for losses. The specification in (ii) allows for a non-differentiability in $v(c)$ at $c = 0$. In other words, there is a kink at the point where the income change is zero.

In what follows, we often work with a specified functional form that captures the essential features of Prospect Theory. This is because we want to relate the analysis to welfare indices that also use specific functional forms. The functional form also offers the basis for our empirical application. An often-used welfare measure is one based on the constant relative risk aversion (CRRA) class of utility functions.

$$(2) \quad SWF = \sum_i \frac{y_i^{1-\eta}}{1-\eta} \text{ if } \eta \neq 1 \quad \text{and} \quad \sum_i \ln(y_i) \text{ otherwise.}$$

This is the basis of, for example, the Atkinson (1970) inequality index.

Suppose we replace this functional form with

$$(3) \quad \begin{aligned} & \sum_i \frac{c_i^{1-\eta}}{1-\eta} && \text{for } c_i > 0 \\ & 0 && \text{for } c_i = 0 \\ & -a \sum_i \frac{(-c_i)^{1-\eta}}{1-\eta} && \text{for } c_i < 0 \end{aligned}$$

and accordingly for $\eta = 1$. Here $a > 1$ refers to a loss aversion parameter.

This captures features 1–3 of Prospect Theory, including diminishing sensitivity since the second derivative is positive in the loss area. One possibility is to abandon the idea of diminishing sensitivity, for which the evidence is not as strong as for loss aversion. In that case, the function above would be replaced with a simple linear function ($-ac_i$) in the loss area. This specification would then satisfy features 1–2 of Prospect Theory.

One basic property of welfare measurement along the lines of Prospect Theory is the following. Consider reshuffling of income between two persons who are at the same income level. First, income is changed so that $dc_i > 0$, $dc_j < 0$ and $dc_i = -dc_j$. After this, a reverse transfer takes place ($dc_i < 0$, $dc_j > 0$) and income is returned to the original level for both persons. Then a standard welfare measure would remain unchanged. However, because of the presence of loss aversion parameter a , the overall well-being is reduced if the reference point changes before the second transfer.⁶ Although we come back to the formal definition of poverty below, if the persons subject to this income change are both located below the poverty line, well-being among the poor declines. This feature is summarized below.

Proposition 1. *When welfare measurement takes into account loss aversion, reshuffling of income among households, holding overall income constant, reduces well-being and tends to increase poverty.*

2.2. The Basic Framework

Prospect Theory based measurement is, in its purest form, only related to changes in welfare; it is silent about the level of welfare. This leads to immediate problems for both poverty and welfare measurement, since both are specified in terms of levels. Building on the reference-dependent utility function formulation of Kőszegi and Rabin (2006), we therefore adopt the following hybrid form:

$$(4) \quad h(y_{i,t}) = u(y_{i,t}) + v(y_{i,t} - \bar{y}_{i,t}).$$

⁶Another way to see this is to simply swap two people at the same income level. Then Prospect Theory based welfare measurement will change if the individuals' reference income levels differ.

In other words, an individual’s well-being is a sum of the utility from current income plus departures from the reference income. The reference income is often determined by the earlier income/consumption level of the individual (habit formation) or some measure of relative income concerns (such as mean income in society). While relative-income concerns are no doubt important as well, in this paper we assume for brevity that the reference income is determined by the individual’s own past consumption. Bartolini *et al.* (2011) provide evidence on the importance of past income level for individuals’ well-being using well-known SOEP data from Germany, and Graham *et al.* (2004, table 4) show the same using data from one of the countries we consider, Russia.

Notice that from this we can calculate an equivalent income function y^* defined by

$$(5) \quad u(y_{i,t}^*) = h(y_{i,t}) = u(y_{i,t}) + v(y_{i,t} - \bar{y}_{i,t}),$$

which tells how much the actual income plus the change in income is worth in terms of the level of current income. To understand the conceptual basis for this formulation, consider first the case where income remains constant over time, i.e. $u(y_{i,t}^*) = h(y_{i,t}) = u(y_{i,t})$. Then the equivalent income and the actual income are the same, and thus the conventional utility function u is a special case of h . When income fluctuates, $y_{i,t}^*$ gives the constant income equivalent of the actual income $y_{i,t}$ and the income change that generates the utility. This idea of “steady income equivalent” creates a theoretical basis for the use of the notion of equivalent income.

Once we assume that the function v has the properties outlined in the formulae in (1), the equivalent income for those who experience a loss is less than the actual income, in other words $u(y_i^*) < u(y_i)$ for all $y_i < y_{i-1}$.

Kőszegi and Rabin (2006) suggest that the utility function could take a form where $h(y_{i,t}) = u(y_{i,t}) + \mu[u(y_{i,t}) - u(\bar{y}_{i,t})]$, in which μ is a function that satisfies the properties of Prospect Theory, such as those in the formulae in (1). The idea is that one uses the same utility function within the gain/loss part as in the conventional, level, part. One way to parameterize the hybrid function, which comes close to the formulation in Günther and Maier (2008) is

$$(6) \quad \begin{aligned} h(y_{i,t}) &= \frac{y_{i,t}^{1-\eta}}{1-\eta} + \left[\frac{y_{i,t}^{1-\eta}}{1-\eta} - \frac{\bar{y}_{i,t}^{1-\eta}}{1-\eta} \right]^\beta \quad \text{for } y_{i,t} \geq \bar{y}_{i,t} \\ h(y_{i,t}) &= \frac{y_{i,t}^{1-\eta}}{1-\eta} - a \left[\frac{\bar{y}_{i,t}^{1-\eta}}{1-\eta} - \frac{y_{i,t}^{1-\eta}}{1-\eta} \right]^\beta \quad \text{for } y_{i,t} < \bar{y}_{i,t} \end{aligned}$$

Here, the “conventional part” of the utility representation is of the CRRA form, loss aversion is again represented by the parameter $a > 1$, and $0 < \beta < 1$ gives the relative weight of the loss or gain part in overall utility. These parameter restrictions imply that the gain/loss part satisfies the properties of loss aversion and diminishing sensitivity. For η equal to unity, the CRRA function is just the log function.

The use of a “steady income equivalent” type of measure clearly implies that any poverty or inequality metric will depend on the chosen functional form that is used to generate the equivalent income. Our analysis therefore belongs to the strand of work that uses (social) welfare functions in examining poverty/inequality, such as the Atkinson inequality index. This approach has certain drawbacks (it is not entirely desirable to impose a functional form to capture people’s perceived well-being), but it is difficult to see how one might otherwise capture the features suggested by Prospect Theory in welfare measurement. The equations in (6) are a way to model the requirements implied by the theory regarding the utility function, and the signs and strengths of the impact of income changes from the reference level on people’s well-being. In addition, the step to equivalent income is a practical way to incorporate the features of reference-dependent preferences on poverty and inequality measurement. It is clearly desirable to examine the sensitivity of the derived measures against changes in the functional form and parameter choice, and we explore some of these sensitivity checks in our empirical applications.

Assuming $h(y_i)$ to be cardinal and interpersonally comparable, we can get a social valuation function of the type:

$$(7) \quad SVF_t = \sum_i h(y_{i,t}).$$

The use of a social valuation/welfare function is a logical continuation of the fact that individuals’ well-being is assessed using a utility function—the social welfare function is then just an aggregation device. This requires that interpersonal comparisons need to be made, but as Sen (1973, p. 14) argues: “If the approach of using social welfare functions is to give us any substantial help in measuring inequality, or in evaluating alternative measures of inequality, then the framework must be broadened to include interpersonal comparisons.” Our approach necessitates that interpersonal comparisons can also be made when individuals’ utility depends also on gains and losses; we can see no *a priori* reason why this extension could not be made.

The benefit of the notion of equivalent income is that it allows poverty and inequality measurement (in levels) that nevertheless take into account the features of Prospect Theory. This type of welfare analysis becomes poverty measurement if, for all i , the equivalent income level is below the poverty line, $y_i^* < z$, where z is the poverty line. The notion of equivalent income y^* allows the calculation of different types of poverty indices, including the simple headcount index or the poverty gap index.

One can ask why past income is included in static poverty measures. Multi-period poverty indices could be calculated as well, but the key point is that even these multi-period indices would depend on one additional past income level, which would be the reference income for the first period that is included in the poverty measure. If, for example, poverty were to be measured from period y_t to y_{t+n} , this n period poverty index would also depend on income at period y_{t-1} . While working with static poverty/inequality measures is therefore mainly a simplification that delivers the same basic insights about the impact of reference dependence as do multi-period indices, in the empirical part we also contrast our results to multi-period poverty indices.

Inequality measurement can also be based on social-welfare based measures, as was shown in an influential paper by Atkinson (1970). He proposed an inequality index of the type $I_A = 1 - \frac{\xi}{\mu}$, where μ is the mean income and ξ depicts equally distributed equivalent income—i.e., the income level that, if received equally by all individuals, would generate the same level of welfare as does the actual income distribution. With a CRRA type of social welfare function, it is defined so that $\sum \frac{y^{1-\eta}}{1-\eta} = n \frac{\xi^{1-\eta}}{1-\eta}$, where n refers to the number of individuals in the economy. With the definition of y^* , one can calculate the equally distributed equivalent income ξ^* as

$$(8) \quad \sum \frac{(y^*)^{1-\eta}}{1-\eta} = n \frac{(\xi^*)^{1-\eta}}{1-\eta}.$$

The discussion above can be summarized as follows:

Proposition 2. *Welfare-based measurement of inequality and poverty that takes into account loss aversion can be conducted based on standard poverty and inequality indices using the notion of equivalent income, defined in equation (5), as the argument.*

2.3. Changes in Social Welfare

The discussion so far provides measures for inequality and poverty at a given point in time. The difference in social welfare over time using the hybrid measure of utility is given by

$$(9) \quad \Delta SVF_t = \sum_i [h(y_{i,t}) - h(y_{i,t-1})] = \sum_i [u(y_{i,t}) - u(y_{i,t-1}) + v(y_{i,t} - \bar{y}_{i,t}) - v(y_{i,t-1} - \bar{y}_{i,t-1})].$$

The difference to conventional measurement is, of course, that the functional forms inherent in u and v are different, and the reference income is taken into account.

Determining what happens to the reference income becomes complicated when there are multiple time periods. To illustrate this, consider a three-period example, starting from period 0. For the change from period 1 to period 2, the reference income of the individual can either remain fixed at the period 0 level (this would be the case of no adaptation) or it can follow current consumption, i.e. income at period 1 (full adaptation), or it can be a combination of the two. In the empirical illustration below, we concentrate on the two polar cases and calculate the fast adaptation case $\sum_i [u(y_{i,2}) - u(y_{i,1}) + v(y_{i,2} - y_{i,1}) - v(y_{i,1} - y_{i,0})]$ and the no adaptation case $\sum_i [u(y_{i,2}) - u(y_{i,1}) + v(y_{i,2} - y_{i,0}) - v(y_{i,1} - y_{i,0})]$. Extension to cases with more than three periods would remain logically the same, but the reference income can in principle be a function of the entire income history.

2.4. Relation to Axioms on Poverty Measurement

The purpose of this section is to discuss to what extent the Prospect Theory based poverty measures that are calculated for equivalent income in (5) fulfill the desirable criteria for poverty measures proposed by Sen (1976) and also discussed by, for example, Sen and Foster (1997). These axioms are:

- (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).
- (4) Symmetry (switching the income between any two persons leaves poverty unaltered).
- (5) Scale invariance (multiplying income and the poverty line with a positive constant leaves poverty unaltered).
- (6) Replication invariance (multiplying the number of persons at each income level leaves poverty unaltered).

Of course, these axioms would hold by construction in the space of equivalent income. The interesting question is whether measures based on equivalent income would continue to satisfy these axioms in the space of observed (or current) income. Whether the axioms hold with respect to reference income is not discussed.⁷ And naturally, as these axioms are requirements of poverty indices, the discussion focuses on poor persons.

Whether the focus axiom is satisfied or not depends on how we define those who are poor. If the poor should only include persons whose current income is below the poverty line, i.e. $y_{i,t} < z$, Prospect Theory based poverty measures do not necessarily satisfy the focus axiom. This stems from the possibility that even if $y_{i,t} > z$, the gain–loss part reduces equivalent income if the person has experienced a loss. Then the focus axiom would not be satisfied. However, if the analysis is confined to the case where the poor are directly defined by the condition $y_{i,t} < z$, then the focus axiom holds by definition.

The monotonicity axiom holds for $y_{i,t}$, even in a strengthened sense, since income losses are heavily weighted because of the presence of loss aversion.

The weak transfer axiom is not always satisfied, however. Consider a shift of income from a person who is very poor and whose income (y_l) is already well below the reference point, to another person who is closer to a poverty line but whose income (y_h) is also below the reference point. Then the change in sum of their welfare is $[u'(y_h) - u'(y_l)] + [v'(y_h - \bar{y}) - v'(y_l - \bar{y})]$. With concave u the first bracket is negative, whereas with convex v at the area below the reference point the second bracket is positive, and the sign of the overall effect on welfare (which also enters a poverty measure such as that of equation (6)), is ambiguous. Therefore, reference dependence can lead to situations where the weak transfer axiom does not hold.⁸ A similar situation arises if income is transferred from a poor person whose income

⁷In many cases increasing the reference income would actually have the opposite consequences as increasing current income, since the gain/loss part depends on $y_{i,t} - \bar{y}_{i,t}$.

⁸Of course, this requires that real-world preferences exhibit diminishing sensitivity in the loss area, which may or may not happen.

is above his reference point to a less poor person whose current income is below his reference point. Then poverty is reduced if the income transfer leaves the poorer person's income above the reference point but moves the less poor person above his reference point, as the latter person gets rid of the extra utility loss due to loss aversion.⁹

The symmetry argument does not necessarily hold either, because of the same type of argument as above. If there are two persons with the same income level but different reference points, and income is reshuffled between the two of them, the v function is evaluated at different points, so the overall effect need not add up to zero.

The scale invariance axioms hold if the reference income is changed in the same proportion as incomes. Likewise, the replication axiom holds if the replicated individuals' reference income remains the same.

These remarks are collected in the result below.

Proposition 3. *A suitably defined Prospect Theory based poverty measure satisfies the focus axiom, scale and replication invariance and the monotonicity axioms, but not the weak transfer axiom and symmetry axiom in the space of observed income.*

We also briefly discuss axioms related to inequality measurement if inequality is measured on the basis of equivalent income, for example as in (9).¹⁰ The mean independence axiom (that inequality should remain the same if everyone's income is multiplied by the same factor) holds if reference income is also multiplied. Likewise, the replication axiom holds if the replicated persons have the same reference income as the original ones. The weak transfer principle and symmetry requirements do not necessarily hold if income changes are made among people who are in the loss area (see the discussion above in the context of poverty measurement). Decomposability does not hold for many original inequality measures, such as the original Atkinson index without a corrective term (Sen and Foster, 1997, p. 155), and if the equivalent income formulation enters these as an argument, decomposability does not, clearly, follow.

The failure to satisfy the weak transfer axiom is understandable because of two features in Prospect Theory, loss aversion and the claim that individuals are risk loving in the loss area. Clearly, the latter phenomenon is not necessarily, or should not be, ethically accepted by society. If the reference income is not the individual's own income, but rather an income level across other members of society, then one also needs to decide if relative income concerns should be allowed to enter social welfare. When analyzing transition and developing economies this may not be such an important issue; Clark *et al.* (2008) argue that relative concerns increase as one moves from poorer to rich countries. This claim, however, rests on a quite limited literature from poor economies. Yet, Senik (2004)¹¹ and Carlsson *et al.* (2007) indicate that relative income comparisons do not pose significant negative concerns in post-soviet Russia or rural Vietnam. Another problematic

⁹We are grateful to a referee for noticing this possibility.

¹⁰For a treatment of these axioms, see Cowell (2011).

¹¹Senik finds that relative income has even a positive impact on life satisfaction in Russia. This finding is in line with the "tunnel" effect hypothesis, where reference income is seen as a source of information for forming expectations about future economic prospects.

feature, from a normative perspective, is the role of adaptation: if the impact of changes in income on well-being is relatively more important than the income level itself, then the low absolute income level of the poor would not count much in poverty measurement, and such analysis of deprivation is not necessarily ethically desirable. However, evidence in Clark *et al.* (2008), Layard and Nickell (2009), and Bartolini *et al.* (2011) suggests that while much adaptation clearly occurs, adaptation is not at all complete. This implies that both the level and the changes of income matter for well-being. Using the German SOEP data, Di Tella *et al.* (2010) indicate that strong adaptation takes place among the richer half of the German population in four years from an income shock. However, the poorer half of the population does not adapt as quickly to income changes. Moreover, Germans earning income below the median are clearly still much richer than most of the sample populations studied in our paper.

3. EMPIRICAL APPLICATIONS

3.1. *Russia*

This section uses household-level panel data from the Russia Longitudinal Monitoring Survey to illustrate the potential differences between conventional poverty and inequality measures and those based on Prospect Theory. The Russian panel provides an interesting setting for income and vulnerability analysis, as few countries in history have experienced such drastic political economic and social changes as Russia has over the past two decades. It is also one of the few transition and developing countries for which high-quality panel data (which is needed for Prospect Theory analysis) is available.

Economic Background

As we know by now, the transition to a market economy was accompanied by extreme macroeconomic turbulence. Russia continued the transformation from a centrally planned to a market economy during the period of the two different waves studied in this paper: the tumultuous years before the millennium (1995–98), including the downturn in 1998, as well as the years of rapid recovery (1999–2002).

In the first period, Russia was more or less on the verge of economic collapse. Russia's production declined and the early 1990s saw some extremely high inflation rates. Some stabilization efforts took place in 1996–97, but the results soon faded, as the country slipped into a financial crisis in August 1998. In the downturn, mean income fell dramatically, employee compensation and public transfers were paid irregularly, inflation rose to over 80 percent per annum, and the rouble devalued strongly. After the crisis, the economy rebounded strongly. Economic growth averaged over 6 percent annually in 1999–2003 and inflation stayed relatively low (from 10 to 20 percent). The political situation stabilized and Russia became one of the fastest growing economies in the world. Inflation was relatively low, the exchange rate of the rouble fully predictable, the state budget in surplus, and the currency reserves were bloating.

TABLE 1
INEQUALITY AND POVERTY IN RUSSIA 1995–2002

A. Annual Measures of Inequality and Poverty						
Year	Poverty		Atkinson		Gini	Average
	Head Count	Poverty Gap	eta = 1	eta = 2	g	m
1995	0.326	0.133	0.300	0.675	0.429	3732
1996	0.360	0.165	0.355	0.781	0.466	3815
1997	0.416	0.181	0.371	0.714	0.490	3625
1998	0.339	0.126	0.280	0.626	0.418	3627
1999	0.247	0.088	0.277	0.628	0.422	4330
2000	0.201	0.073	0.285	0.596	0.420	4755
2001	0.179	0.061	0.276	0.503	0.421	5335
2002	0.134	0.040	0.234	0.499	0.386	5464

B. Time-Averaged Measures of Inequality and Poverty							
Period	Poverty			Atkinson		Gini	Average
	Overall	Chronic	Transitory	eta = 1	eta = 2	g	m
1995–1998	0.216	0.117	0.099	0.213	0.410	0.371	3815
1999–2002	0.216	0.140	0.075	0.208	0.425	0.366	4986

Notes: Panel A refers to annual measures whereas Panel B contains the measurement of chronic and transitory poverty during two four-year periods. Total income per equivalent adult is used. The poverty line is fixed at 2004 roubles, which roughly corresponds to one half of median income in 2002.

Source: Authors' own estimations.

Sample and Variables

The Russia Longitudinal Monitoring survey (RLMS-HSE) is an annually collected panel dataset with detailed information on income, expenditures, household demographics, and poverty. The survey is conducted by the Higher School of Economics and ZAO “Demoscope” together with the Carolina Population Center, at the University of North Carolina at Chapel Hill and the Russian Institute of Sociology, RAS. Our panel includes data on eight waves during 1995–2002 and is further divided into two parts. Depending on the wave, there are 8342–10,636 individuals who answered the adult questionnaire and they are from 3750–4718 households. The RLMS-HSE sample is a multi-stage probability sample. The households are allocated in 38 different raions (similar to counties), of which 35 were drawn using the method of probability proportional to size and the remaining three were selected with certainty as they were already self-representing raions (Moscow city, Moscow oblast, St. Petersburg city). All statistics¹² reported in this paper are weighted using the RLMS-HSE sample weights that adjust for the sample design factors and for the deviations caused by panel attrition from the census characteristics.

Table 1 depicts some standard measures on poverty and inequality in Russia using the RLMS-HSE data. These are in line with earlier findings (e.g., in Gorodnichenko *et al.*, 2010). Poverty went up until the 1998 turnaround in the economy. Inequality first rose and then declined. Table 1 also contains the breakdown of poverty rates to chronic and transitory poverty during two four-year

¹²Excluding the regression results using individual level data that are reported in Table 2.

periods. We follow Jalan and Ravallion (1998) and define chronic poverty to be the fraction of the population whose mean income is below the poverty line. The remaining part of the overall poverty is considered as transitory. The results indicate that the relative importance of chronic poverty is greater in the later time period.

The RLMS also contains questions about subjective well-being. Graham *et al.* (2004) explain changes in individual happiness by changes in log income, and confirm that income changes are associated with increased happiness over the period 1995–2000. On the other hand, when the dependent variable is self-rated economic welfare (a kind of perceived “welfare ladder,” from poorest to most well off), Ravallion and Lokshin (2002) find that lagged income has a positive impact on welfare; a finding not consistent with loss aversion. It can be the case that in a transition country context, people have especially positive expectations about future income levels, and those at rising income trajectories are less likely to regard themselves as poor.

Inequality and Poverty Analysis Based on Prospect Theory

Table 2 provides first comparisons between standard measures of poverty and poverty measures, drawing on Prospect Theory based equivalent income

TABLE 2
COMPARISON OF WINNERS AND LOSERS IN
RUSSIA—PROPORTIONS, MEAN INCOME CHANGE, AND POVERTY

A. Winners and Losers				
	1998		2002	
Distribution (%)				
Loser	48.8		27.2	
Gainer	53.6		71.5	
Average income in year 0				
Loser	4928.8		6114.7	
Gainer	2277.2		3086.2	
Average income in year 1				
Loser	2338.3		3365.1	
Gainer	4854.4		6300.1	
Average income change (%)				
Loser	-73.7		-58.7	
Gainer	81.7		73.0	
Panel B. Poverty among Winners and Losers				
	Head Count		Poverty Gap	
	1998	2002	1998	2002
Ln(income)				
All	0.339	0.134	0.027	0.008
Gainer	0.186	0.075	0.010	0.003
Loser	0.500	0.280	0.046	0.022
Pt eq. income				
All	0.470	0.243	0.108	0.043
Gainer	0.040	0.008	0.002	0.000
Loser	0.921	0.833	0.219	0.149

Source: Authors' own estimations.

in Russia. Equivalent income in 1998 is calculated based on the functional form in (6) and it is given by $\ln(y_{98}) - 2 \cdot [\ln(y_{95}) - \ln(y_{98})]^\beta$ for those who have experienced an income loss and as $\ln(y_{98}) + [\ln(y_{98}) - \ln(y_{95})]^\beta$ for the gainers, with β set to 0.5, and in a similar way for 2002. In other words, these are calculated for a CRRA utility with η set to unity and the loss aversion parameter to 2. Kahneman and Tversky (1979) estimated loss aversion to be 2.25 based on experimental data, and recent work based on field data by Engström *et al.* (2011) estimates the loss aversion parameter to be very close to the same figure. We set the parameter to 2 for simplicity. We also carry out sensitivity checks with respect to all these parameter values. The lag length in the illustrations is chosen from the relatively recent past. Using a reference income in the fairly recent past ensures that complete adaptation has not taken place and income change still plays a role in utility, and so that the first period coincides with a recession and the latter period with a boom to highlight possible differences between conventional and reference-dependent measurement in different times.

For comparison purposes, conventional poverty measures are for the log of income¹³ instead of for the level of income directly; these measures are therefore on the utility scale. In one of the examples below, the conventional measures are based on levels of income directly, and to compare Prospect Theory utility at the same scale, we take the exponent of the Prospect Theory utility.

The results in the upper panel of Table 2 show that, even during the growth period (from 1998 to 2002), there is a sizable minority (27 percent) who experienced an income loss, and the losses were really large on average. According to the lower panel, Prospect Theory based poverty is at a higher level in 1998 and 2002 than the conventional measures would suggest. In particular, the poverty rates are extremely high for those who have experienced income losses. Figure 1 also demonstrates how there is more mass in the income distribution at low income levels in Prospect Theory equivalent income than for the log of income directly.

Prospect Theory based poverty rates are also much higher than the chronic poverty rates, reported in the lower panel of Table 1. The two ways of measurement underscore different features of poverty: the chronically poor have *constantly* low mean income, whereas reference-dependent measurement stresses the importance of negative *changes* in income.

These results are consistent with the theoretical discussion above: poverty rates go up because of the presence of losers and loss aversion. This can happen to those who would be classified as poor according to conventional measures, but also some people can become poor if their experienced income loss is big enough. The latter phenomenon would be a case where the focus axiom does not hold. From the normative perspective, the differences between results from conventional measures and reference dependent measurement call for value judgment regarding the weight society wants to place on those who have lost income during a period of average growth. Even if these people would not be poor in a conventional way, their well-being can still be lowered and the need for a compensation can arise.

¹³The poverty line used in the illustration is set for simplicity so that we use in all periods the same poverty line (2004 roubles) which roughly corresponds to the relative poverty line (one half of median income) that applied in 2002. We thus anchor poverty to a specific year, a not unusual approach that compromises between the fully relative and absolute views of poverty.

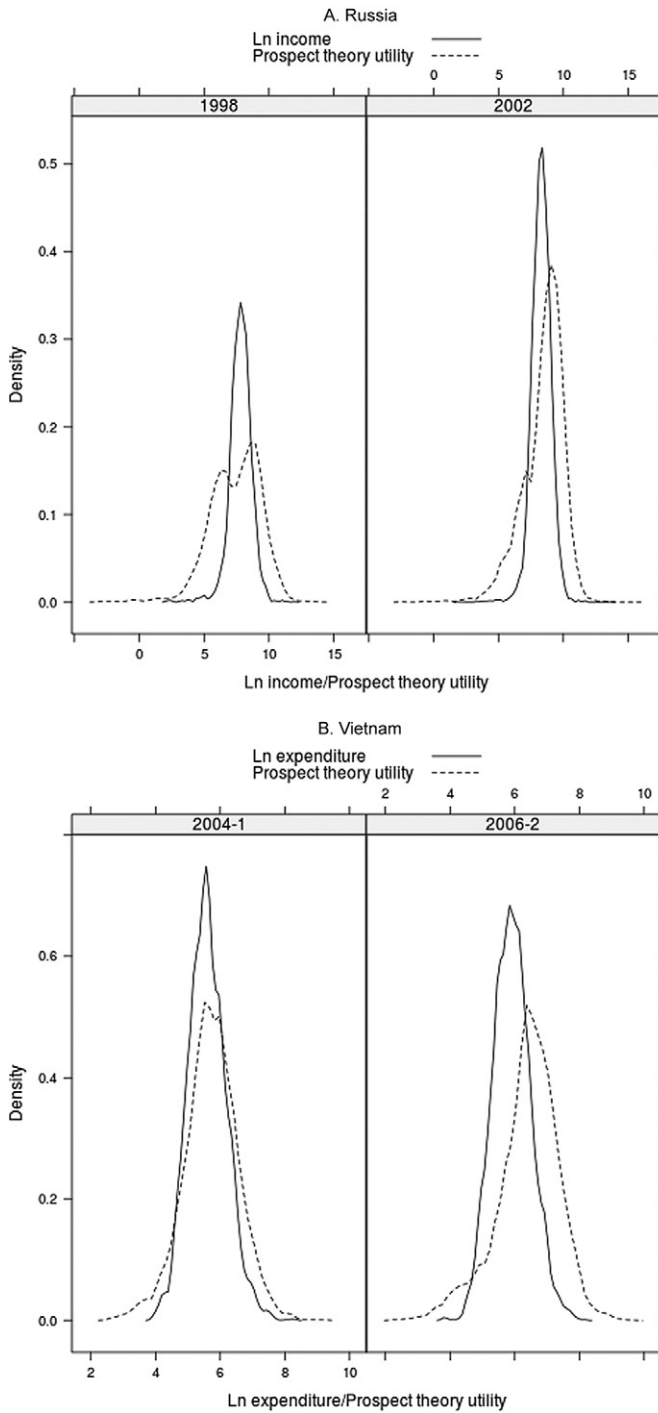


Figure 1. Density of Income/Expenditure and Prospect Theory Utility in Russia and Vietnam—Prospect Theory Utility as Defined in Equation (6), Income/Expenditure in Logs
 Source: Authors' own estimations.

TABLE 3
INEQUALITY AND POVERTY IN RUSSIA 1998 AND 2002 USING
INCOME AND PROSPECT THEORY INCOME

A. Income Scale				
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
B. Utility Scale				
Index	Equivalent Income		Income	
	1998	2002	1998	2002
Inequality				
Gini coefficient	0.143	0.100	0.058	0.048
Atkinson ($\eta = 1$)	0.037	0.022	0.007	0.004
Atkinson ($\eta = 2$)	0.093	0.072	0.015	0.009
Poverty				
Head count poverty	0.470	0.243	0.339	0.134
Poverty gap	0.108	0.043	0.027	0.008

Notes: Prospect Theory income (log exponent) measured on the income scale (exp of pt utility compared to income in levels) in Panel A and utility scale in Panel B; $\beta = 0.5$, $\alpha = -2$.

Source: Authors' own estimations.

The results in Table 3 convey the same message in two ways; the difference is that the upper panel is on the income scale (the exponent of Prospect Theory equivalent income is taken and compared to income-based measures directly), and the lower panel is on the utility scale, and income is in logs in conventional measures.

The main point here is the following. Suppose we measure inequality using the Atkinson index with η set to one. Then inequality decreased from 1998 to 2002 using conventional measures—the Atkinson index decreased from 0.280 to 0.234 (see Table 3, upper panel). However, if we compare the Prospect Theory based measure in 2002 (0.592), it is higher than the conventional measure in 1998. Therefore, one can reach different conclusions regarding the direction of inequality changes, but this argument requires that the comparison of a more recent Prospect Theory based measure is made with an earlier conventional measure. The same does not happen for poverty, since at the same time as standard poverty measures declined from 1998 to 2002, Prospect Theory based poverty headcount (although higher than conventional measures in 2002) is still lower than conventional measures in 1998.

Table 4 collects results from different types of robustness checks. With a higher value of the loss aversion parameter (3 instead of 2), poverty and inequality tend to increase, as expected from the theoretical analysis. Small changes in the β parameter (0.2 or 0.8 instead of 0.5) leave all qualitative results unchanged.

TABLE 4
ROBUSTNESS CHECK OF INEQUALITY AND POVERTY IN RUSSIA 1998 AND 2002

A. Higher Loss Aversion, $\alpha = -3$					
Inequality			Poverty		
	1998	2002		1998	2002
Gini coefficient	0.184	0.120	Head count poverty	0.492	0.262
Atkinson (eta = 1)	0.061	0.034	Poverty gap	0.156	0.067
Atkinson (eta = 2)	0.165	0.100			
B. Lower β , $\beta = 0.2$					
Inequality			Poverty		
	1998	2002		1998	2002
Gini coefficient	0.145	0.105	Head count poverty	0.497	0.271
Atkinson (eta = 1)	0.039	0.023	Poverty gap	0.119	0.051
Atkinson (eta = 2)	0.096	0.055			
C. Higher β , $\beta = 0.8$.					
Inequality			Poverty		
	1998	2002		1998	2002
Gini coefficient	0.149	0.101	Head count poverty	0.457	0.223
Atkinson (eta = 1)	0.042	0.023	Poverty gap	0.106	0.040
Atkinson (eta = 2)	0.139	0.080			
D. Lower Risk Aversion, $\eta = 0.5$					
Inequality			Poverty		
	1998	2002		1998	2002
Gini coefficient	0.251	0.212	Head count poverty	0.381	0.157
Atkinson (eta = 0.5)	0.052	0.038	Poverty gap	0.111	0.036

Notes: Prospect Theory income measured on the utility scale (pt. utility vs. ln income).

Source: Authors' own estimations.

Finally, changes in η , the risk aversion parameter, lead to small changes in different directions; the reason for this probably being that this parameter affects valuation in both the conventional utility, u , and the gain–loss part, v .

In our last illustration of realized Prospect Theory measures of well-being for Russia, we examine the change in poverty from 1995 to 1998 and further from 1995 to 2002—that is, two periods. For Prospect Theory measures, there are two options (again with η set to unity):

Option (1). Poverty in 2002 calculated as $\ln(y_{02}) - 2 \cdot [\ln(y_{99}) - \ln(y_{02})]^\beta$ for losers (immediate adaptation).

Option (2). Poverty in 2002 calculated as $\ln(y_{02}) - 2 \cdot [\ln(y_{95}) - \ln(y_{02})]^\beta$ for losers (no adaptation).

The results on applying these two approaches are presented in Table 5. Since conventionally measured poverty in 1999 was at a somewhat smaller level than in

TABLE 5
 POVERTY AMONG WINNERS AND LOSERS IN RUSSIA IN 1998 AND 2002 USING 1995 AND 1999 TO
 MEASURE INCOME CHANGE FOR PROSPECT THEORY

	Head Count		Poverty Gap	
	2002–1999	2002–1995	2002–1999	2002–1995
Ln(income)				
All	0.139	0.139	0.009	0.009
Gainer	0.084	0.054	0.003	0.002
Loser	0.280	0.390	0.023	0.027
Pt eq. income				
All	0.240	0.228	0.043	0.042
Gainer	0.009	0.007	0.000	0.000
Loser	0.835	0.879	0.151	0.164

Source: Authors' own estimations.

1995, there is more scope for downwards income movement during the period from 1999 to 2002 than from 1995 to 2002. That is why poverty measured using the longer time span (no adjustment to the interim income level) is also lower than poverty based on the shorter comparison for the population as a whole.

3.2. Vietnam

This section presents some of the same analysis for Vietnam in 2002–06. Vietnam has taken considerable steps in poverty reduction during the 2000s, and thus provides us with an interesting setting for poverty and vulnerability analysis.¹⁴

Economic Background

Vietnam is a country where economic growth has been able to reduce income poverty with a particular strength relative to many other rapidly growing economies. It has a beneficial economic composition and structure for generating broad-based growth (Arndt *et al.*, 2012). Moreover, it has been cited as an example of successful economic liberalization and trade opening, which has improved household welfare. As a result of its good growth performance, Vietnam gained lower middle income country status in 2009. However, the remarkable aggregate poverty reduction hides significant variation in progress in poverty reduction across different segments of the society. Moreover, vulnerability has become an increasingly important issue in Vietnam (Nguyen *et al.*, 2006).

Sample and Variables

We use data from the Vietnam Household Living Standards Survey (VHLSS). The VHLSS is a rotating household survey that is conducted nationwide every two years, covering a rich set of questions. For our analysis three datasets were merged together to form one panel 2002–2004–2006. The final

¹⁴Because the data is more limited (it has three waves) and the gist of the results resembles the message from the analysis on Russia, some of the sensitivity analyses have been skipped and the results are discussed quite briefly.

TABLE 6
INEQUALITY AND POVERTY IN VIETNAM

Year	Poverty			Atkinson		Gini	Average
	HC (VN pov.line)	Head Count	Poverty Gap	eta = 1	eta = 2	g	m
2002	0.319	0.319	0.074	0.191	0.309	0.361	273
2004	0.204	0.170	0.037	0.174	0.300	0.342	338
2006	0.162	0.069	0.013	0.169	0.299	0.337	452

Notes: Average expenditure in longitudinal sample (monthly per capita expenditure in VND/Vietnamese Dong). Poverty lines for the first column (VN pov.line) are 159.788, 172.5, and 213.3 in 2002, 2004, and 2006, respectively, and the next two use 159.788 in all years.

Source: Authors' own estimations.

sample size for our illustration consists of a total of 7,048 individuals. In this analysis, expenditure¹⁵ data has been used in the place of income for two reasons. First, according to checks done by several users of VHLSS data, the expenditure data is of better quality than income data. This is often the case with yearly income questions in survey data, especially in poor or rural areas. Second, as expenditures are often more stable than income, they measure changes in welfare in poor contexts well. All statistics reported in this paper are weighted using the sample weights that adjust for the sample design factors and for the deviations caused by panel attrition from the census characteristics.

The inequality and poverty in Table 6 reveal the Vietnamese success in reducing poverty and also to some extent inequality during the period we study when poverty and inequality are measured using conventional tools.

Results

Panel B in Figure 1 depicts the distribution of income and equivalent income (the basic parameterization behind equivalent income calculations is the same as above: η is set to unity, β to 0.5, and a , the loss aversion parameter, to 2). As in the Russian case, the mass of the equivalent income is more concentrated to the lower end of the distribution, in comparison to the distribution of ordinary income. The upper panel of Table 7 reveals the reason for this: although the great majority of the population has benefitted from economic growth, the average losses among those who have experienced a drop in income are sizable. Panel B of Table 7 also confirms how poverty rates are clearly higher among those who have seen their income decline.

The main results of the comparison between conventional and Prospect Theory based measurement of poverty and inequality for the Vietnamese case are presented in Table 8. The results suggest, first, that according to all measures that are calculated on the basis of equivalent income, poverty and inequality are at a higher level than standard measurement would indicate, again because of the presence of losers and loss aversion. Second, inequality, measured by the Gini index, has risen from 2004 to 2006 if calculated on the basis of equivalent

¹⁵The expenditure survey was conducted for a far more limited number of households, which further narrowed down the sample size.

TABLE 7
COMPARISON OF WINNERS AND LOSERS—PROPORTIONS, MEAN
EXPENDITURE CHANGE, AND POVERTY

A. Winners and Losers				
	2004		2006	
Distribution (%)				
Loser	12.1		14.7	
Gainer	83.1		86.1	
Average expenditure in year 0				
Loser	339.1		462.4	
Gainer	298.2		275.8	
Average expenditure in year 1				
Loser	263.9		348.5	
Gainer	348.1		469.0	
Average expenditure change (%)				
Loser	-22.0		-24.8	
Gainer	16.3		52.7	
Panel B. Poverty among Winners and Losers				
	Head Count		Poverty Gap	
	1998	2002	1998	2002
Ln(expenditure)				
All	0.170	0.069	0.009	0.003
Gainer	0.147	0.054	0.007	0.002
Loser	0.337	0.166	0.022	0.009
Pt eq. expenditure				
All	0.188	0.096	0.020	0.013
Gainer	0.107	0.005	0.006	0.000
Loser	0.784	0.656	0.127	0.094

Source: Authors' own estimations.

TABLE 8
INEQUALITY AND POVERTY IN VIETNAM USING EXPENDITURE AND PROSPECT THEORY EXPENDITURE

Index	Equivalent Expenditure		Expenditure	
	2004	2006	2004	2006
Inequality				
Gini coefficient	0.441	0.446	0.342	0.337
Atkinson (eta = 1)	0.294	0.326	0.174	0.169
Atkinson (eta = 2)	0.520	0.624	0.300	0.299
Poverty				
Head count poverty	0.188	0.096	0.170	0.069
Poverty gap	0.067	0.042	0.037	0.013

Notes: Prospect Theory expenditure (log exponent) measured on the expenditure scale (exp of pt utility compared to expenditure in levels); $\beta = -0.5$, $\alpha = -2$.

Source: Authors' own calculations.

income—and here, unlike in Russia, this Prospect Theory measure is compared with its own earlier value—although the conventionally measured Gini has declined during the same period. This further underscores the point that even in a growing economy, well-being measured based on reference-dependent preferences does not necessarily increase. This raises the question on whether losses are compensated to a sufficient degree.¹⁶ Many citizens, even in a growing economy, would surely value social policy that would provide cushions against heavy income losses.

4. CONCLUSION

Lessons from the rapidly expanding field of behavioral economics have become increasingly important. On the other hand, there is a strong tradition of poverty and welfare measurement that is also of key importance to countries rich and poor alike. The purpose of this paper is to provide a contribution to the literature that aims to combine behavioral economics viewpoints and poverty or inequality measurement. The paper focused, in particular, on taking into account features that are key ingredients in Prospect Theory for poverty and inequality measurement. Prospect Theory is relevant for poverty measurement, as individuals' perceived poverty can depend on a reference point (which can be income in the previous period) and individuals can also perceive losses as more severe than gains of equal size (this is the phenomenon of loss aversion).

Since Prospect Theory only concerns changes in income, whereas traditional poverty and inequality measures build on the levels of income, we suggest a new notion of equivalent income, the income level with which the individual would be equally well off, evaluated using a standard concave utility function, as he actually is, evaluated with a reference-dependent utility function. In this paper, the reference level is determined by an individual's own past income level.¹⁷ All the standard measures of poverty and inequality can then be defined in the domain of this equivalent income. One of the key results of such extensions is that a reshuffling of income among households holding the overall income level fixed, such that conventional poverty measures remain unchanged, raise Prospect Theory based poverty measures. In addition, the principle of transfers (requiring that a regressive transfer among the poor should raise poverty) does not necessarily hold for Prospect Theory based poverty measures because of the idea of diminishing sensitivity.

We also examined the differences between standard poverty and inequality measures and measures that are calculated based on the notion of equivalent income for realized income using household-level panel data, first, from the Russian transition period, during which people experienced large gains and losses in income, and second, from Vietnam during a period of rapid income growth. With a large amount of losers in the Russian case and because of the presence of loss aversion, Prospect Theory based poverty and inequality measures tend to take higher values than conventional measures. In Vietnam especially, the

¹⁶According to the sensitivity checks, the rise in equivalent income based inequality is greater if the loss aversion parameter increases, but with a sufficiently small weight on the gain–loss part (small β), inequality drops between 2004 and 2006 even if it is measured based on equivalent income.

¹⁷Examining the case where the reference income would depend on other people's income in society is left for future research.

measures examined in this paper and conventional inequality indices can give conflicting views on the direction of inequality changes. All conventional poverty and inequality measures indicate an increase in the well-being of the poor, whereas reference-dependent inequality measures, which give a high weight to those who have experienced an income loss, suggest an increase in inequality.

We believe that the Prospect Theory type of measurement can help us understand many real-world phenomena—for example, the political economy difficulties of carrying out economic reforms that on average bring gains to the economy, but create a large number of losers—and it can thereby offer a way to also understand the disagreements between economists and representatives outside of the discipline. However, while we believe that reference dependence and loss aversion are also valid concerns from the social welfare point of view, it can also be the case that society wants to overrule some features of Prospect Theory, such as diminishing sensitivity, and adopt in this sense a non-welfarist stance (see the discussion in Kanbur *et al.*, 2006). A worry that the poor could adapt to their circumstances would also speak against accepting perceived poverty at face value in welfare measurement. But even in these cases, it will be helpful to the policymaker to understand the sources of different valuations of societal well-being.

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