

Miserly Developments*

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Abstract

We propose a simple index, the miser index, to measure the extent to which societies have poverty in the midst of affluence. It can be seen as a measure of polarization between the rich and the poor. We calculate the index for a number of developing and emerging economies and rank them according to their revealed miserliness. We also describe important correlates of the miser index: Countries that score high on the index tend to be socially fractionalized, bureaucratically inefficient, and politically corrupt. They provide their citizens with a low level of health care and education. Democracy and high growth rates do not moderate miserliness. Finally, considering the world as a single entity, we find a dramatic rise in global miserliness over the last 30 years.

Keywords: Miser index, poverty, affluence, inequality, development

JEL codes: D31, D63, F35, I32, O15

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For one very rich man, there must be at least five hundred poor, and the affluence of the few supposes the indigence of the many.

Adam Smith (1776: Book V, ch 1. p 232)

1 Introduction

Does underdevelopment imply a “tendency to keep down the mass of the people by poverty, in order to make them better beast of burden for the few,” as the economic historian Eli Heckscher (1955: 166) once phrased it. During the industrial revolution it was rather common to emphasize how “advantages and evils always balance one another” and how “the great richness of a small number are always accompanied by the absolute privatization of the first necessities of life for many others”.¹

To see to what extent such rich–poor polarization is the rule in developing countries today and in the recent development of the world as a whole, we propose a simple index that we denote the *miser index*. While a miser, according to the dictionary, is a person who hoards wealth and lives miserably, a miserly society is one where the rich hoard wealth and let the rest live miserably. To capture this the miser index measures the extent to which there is poverty in the midst of affluence, and the index can be interpreted as the institutionalized willingness to accept such inequalities.

Applying the index we focus on the extremely poor—those who live below two dollars a day (all dollar-measures are PPP-adjusted). With a poverty line of two dollars a day we calculate the index for a number of developing and emerging economies. The huge variation in the distribution of affluence and poverty even within the developing world is striking.

Tanzania, for instance, has 90 per cent of its population below two dollars a day which is not surprising since annual GNI is 555 dollars per capita. Nicaragua, however, has almost the same level of poverty (80 percent), but is more than five times as rich per capita. Jamaica,

¹Giammaria Ortes (1774, 24f), cited from Marx (1867, p.709) who also had his own version of the same story: “Accumulation of wealth at one pole is...at the same time accumulation of misery, agony of toil, slavery, ignorance, brutality, mental degradation, at the opposite pole...”.

with an income level at par with Nicaragua (3500 vs 3210 dollar), has only 13 percent of its population below two dollars a day. In their practice the three countries cannot be equally generous. Of the three only Nicaragua is among the 20 most miserly countries in the world according to our index. The top 20 list is dominated by large middle income countries such as South Africa, Argentina, Mexico, China and the Philippines.

The miser index highlights the disparities between those above and those below the poverty line. The concept of the poverty line indicates that these disparities in general should be considered more important than other differences in the income distribution that we ignore here. To capture the extent of ‘poverty in the midst of affluence’ we need a measure that relates poverty to the absolute amount of resources available. The index therefore highlights absolute rather than relative inequalities. Miserliness as absolute inequality implies that a poor country cannot become as miserly as a rich one at its worst. The index can be expressed as the head count measure of absolute poverty multiplied by the income disparity between society and the poor, i.e. by the difference between the average income in society and the average income of the poor. Thus the index is simple, transparent and easy to apply with readily available data.

To see what characteristics miserliness is associated with, we look at how the index is associated with institutional indicators, showing that miserliness goes together with low health care, bad governance and high corruption. We also show how miserliness is associated with high fertility, low life expectancy, and low education. A higher level of rich–poor polarization as measured by the miser index does not seem to generate higher growth. On the contrary, higher growth seems to lead to more polarization. Considering the world as one single unit we show that miserliness has increased as the world has grown richer over the last thirty years.

Conceptually the miser index is close to measures of polarization (Esteban and Ray 1994, Duclos, Esteban, and Ray 2004). It can be viewed as a measure of polarization between those below and those above the poverty line. It can also be interpreted as a measure of public policy failures—just as a miser can live better by reallocating some of his wealth for

consumption, a miserly society can improve by redistributions from the rich to the poor. In this respect, the miser index complements the recent paper by Kanbur and Mukherjee (2007) who develop an index of poverty reduction failures with a different axiomatic foundation and a somewhat different structure to ours.

Like the measures established by Esteban and Ray and Kanbur and Mukherjee our index builds on the huge literature on the evaluation of opulence, poverty and inequality (see e.g. Cowell 2000, Dutta 2002, and Bojer 2003 for surveys). It is closest to the works that derive their measures axiomatically from welfare concerns starting with Atkinson (1970), Kolm (1969), Sen (1976a), Foster et al. (1984), and Thon (1982). The miser index can be seen as a measure of group wise absolute inequality, so the paper is also related to the literature on absolute inequality. This literature is small: the theoretical foundations are given by Kolm (1976), and Atkinson and Brandolini (2008) are among the strongest proponents of this approach to measurement. See also Ravallion (2004) and Svedberg (2004). As poverty can be seen as an important form of deprivation, our approach complements Yitzhaki's (1979) study of the relationship between deprivation and the Gini coefficient, but we focus on poverty and a strict dichotomy between the poor and the non-poor.²

Below, we first discuss our miser index and provide some interpretations. We then use the measure to rank countries and to identify important correlates of the measure. We conclude by a discussion of whether the world as a whole in fact has become more or less miserly over the recent thirty years when slogans of ending poverty have flourished.

2 The miser index

An income distribution is characterized by a vector $\mathbf{Y} = (y_1, \dots, y_n)$. The poverty line is given by z . It separates the poor below the line from the rich above the line. Assume that

²Our index should not be confused with the misery index initially proposed by Arthur Okun and later popularized by Robert Barro. Their index is simply equal to the inflation rate plus the unemployment rate of a country and is meant to be a proxy for economic and social costs of bad macroeconomic policies.

agents are ranked according to income so

$$y_1 \leq y_2 \leq \dots \leq y_q < z \leq y_{q+1} \leq \dots \leq y_n$$

and hence that q is the number of people below the poverty line z and $h = q/n$ is the head count measure of poverty. We call h the *poverty rate*. When comparing different societies, the poverty line z is assumed constant. For any income distribution \mathbf{Y} , let \bar{Y} denote the mean $\sum_{i=1}^n y_i/n$, \bar{Y}_p denote the mean $\sum_{i=1}^q y_i/q$ among the poor, and \bar{Y}_R denote the mean $\sum_{i=q+1}^n y_i/(n - q)$ among the non-poor.

The simple expression

Our basic idea is that a society should be considered miserly if it is both rich and economically polarized between the rich and the poor. How rich society is can be measured by its average income \bar{Y} . How polarized society is depends on the economic distance between the rich and the poor $\bar{Y}_R - \bar{Y}_p$, and on the size of each group, $(1 - h)$ and h .

In both measures the absolute income differences are important. Being poor among the affluent means that one experiences an absolute shortfall between own incomes and the incomes of the rich. A doubling of all incomes (including the poverty line) would make this shortfall twice as large. The relative (proportional) distance between the rich and the poor would remain unchanged, however, implying that measured miserliness would not change if the index were based on relative disparities. We claim that a doubling of all incomes that leave the relative number of poor people unchanged, would make miserliness higher as the resources available for poverty reductions go up.

In accordance with these intuitions we impose three major axioms: *Focus*, whereby only transfers between rich and poor matter for miserliness, not transfers within groups; *Independence of Origin* whereby an increase of all incomes and of the poverty line by the same amount keeps miserliness unchanged;³ and *Homogeneity* whereby a scaling of all incomes

³This axiom corresponds to Kolm's (1976) translation invariance which distinguishes absolute measures from the scale invariance of relative measures.

including the poverty line, scales the miser index by the same scale. Together with some regularity assumptions, these axioms pin down the structure of the miser index to the following simple expression:

$$M = h(1 - h)(\bar{Y}_R - \bar{Y}_P) = h(\bar{Y} - \bar{Y}_P) \quad (1)$$

The details are provided in Appendix A. Here it should be observed that the second equality of (1) follows since average income is equal to $\bar{Y} = h\bar{Y}_P + (1 - h)\bar{Y}_R$, implying that $\bar{Y} - \bar{Y}_P = (1 - h)(\bar{Y}_R - \bar{Y}_P)$.

As can be seen directly from the formula any rise in incomes that does not benefit the poor indicates higher miserliness; any redistribution from the rich to the poor indicates lower miserliness. For a given total income miserliness is maximized when one person gets everything and the others live in poverty. When total income depends on the poverty rate, things are a bit more complicated as we illustrate below.

Interpretations

The miser index can be interpreted in several ways. The expression $M = h(1 - h)(\bar{Y}_R - \bar{Y}_P)$ can be interpreted as the expected economic cleavage between the rich and poor in random encounters: When a rich and a poor person meet both experience a social divide. The average economic cleavage between the two in such encounters is $(\bar{Y}_R - \bar{Y}_P)$. Whenever either two rich or two poor persons meet they feel no divide as they belong to the same group. With random matches the probability that a rich and a poor person meet is $2h(1 - h)$ and the unconditional expected disparity is just proportional to $h(1 - h)(\bar{Y}_R - \bar{Y}_P) = M$. Thus the miser index can be interpreted as the expected cleavage with random matches. This interpretation is closely related to the literature on polarization and fractionalization, particularly the part focusing on the social distance between groups (see Esteban and Ray 1994 and Lind 2007).

Consider next the form $M = h(\bar{Y} - \bar{Y}_P)$. This way of writing the miser index expresses the total income shortfall of the poor from the average income. Hence, miserliness is high

when there are many poor whose incomes deviate heavily from the average income in society. M expresses the cost of bringing all the poor persons up to the average income of society. Miserliness, however, would vanish long before everybody gets \bar{Y} . As soon as all poor persons pass the poverty line, the poverty rate h becomes zero and so does the miser index. Yet, miserliness can be seen as the cost of the poor of deviating from the mean.

Finally, when we write the miser index as $M = h(1 - h) (\bar{Y}_R - \bar{Y}_P)$, it can be thought of as the poverty rate h multiplied by the total affluence of the rich $(1 - h) (\bar{Y}_R - \bar{Y}_P)$. Thus miserliness can be considered a specific evaluation of poverty where the poverty rate is enhanced by total affluence of the rich.

Graphical representation

Here we illustrate how the miser index (i) depends on the poverty rate for given average incomes to the rich \bar{Y}_R and average income of the poor \bar{Y}_P in Figure 1, and (ii) the average income in society for given poverty rate h and average income of the poor \bar{Y}_P in Figure 2.

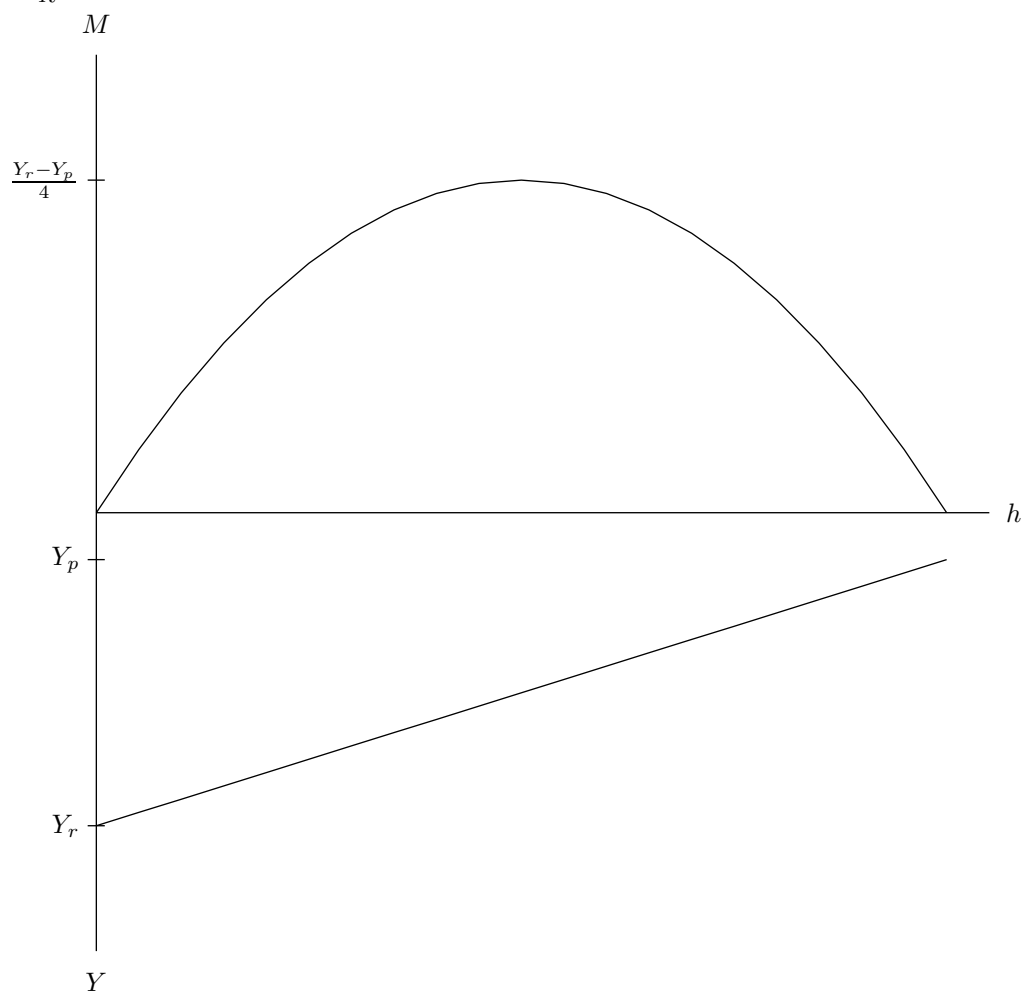
Consider first Figure 1. As the poverty rate increases from zero to one (for given values of \bar{Y}_P and \bar{Y}_R), average income in society declines from \bar{Y}_R to \bar{Y}_P . Clearly, in both ends miserliness is zero. At intermediate levels of the poverty rate the level of miserliness depends on the severity of poverty relative to the burden of poverty relief on each potential contributors. The maximum level of miserliness is reached when $h = 1/2$ and polarization is at its maximum as well. Here there are both a large number of poor and a large number of non-poor who could contribute in alleviating poverty. Miserliness is lower either when poverty is less severe, or when poverty is more severe but with fewer potential contributors to each poor.

Consider next Figure 2. Here we utilize that the miser index is closely related to the Gini coefficient of between group inequality (social cleavage)

$$\mathcal{G}_B = h(1 - h) \frac{\bar{Y}_R - \bar{Y}_P}{\bar{Y}}$$

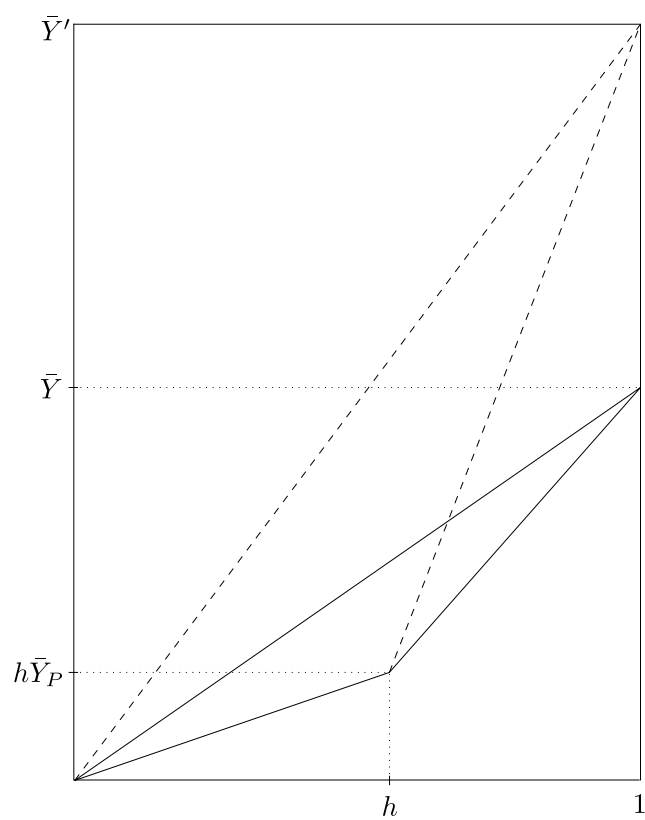
The miser index is $M = \mathcal{G}_B \bar{Y}$, the absolute rich-poor Gini coefficient. As incomes have to

Figure 1: Miser index M and income per capita \bar{Y} as functions of the poverty rate h , given \bar{Y}_P and \bar{Y}_R



be taken relative to the poverty line z , however, it does not have the usual independence of scale property. The figure illustrates how the miser index is constructed from a generalized Lorenz curve (Shorrocks 1983). The figure shows two cases, where the poverty rate h and the average income of the poor, \bar{Y}_P , are the same in both cases. In the first case, average income is \bar{Y} and the miser index is given by the area of the fully drawn triangle. This area is easily calculated as equal to $h(1-h)(\bar{Y}_R - \bar{Y}_P)$ (where $\bar{Y}_R = (\bar{Y} - h\bar{Y}_P) / (1-h)$). In the second case, the average income of the non-poor is higher so average income is \bar{Y}' and the miser index is given by the area of the stipulated triangle equal to $h(1-h)(\bar{Y}'_R - \bar{Y}_P)$ (where $\bar{Y}'_R = (\bar{Y}' - h\bar{Y}_P) / (1-h)$). As seen, this increases the area and thus the miser index goes up.

Figure 2: Relationships between the miser index and generalized Lorenz curves.



Relationship to other measures

First, the miser index is related to Amartya Sen's (1976b) welfare index $S = \bar{Y}(1 - \mathcal{G}_I)$. In Sen's measure, \mathcal{G}_I is the ordinary Gini coefficient using individual incomes instead of the group incomes used to calculate the miser index. As the income distributions of the poor and non-poor by definition do not overlap, we can decompose the individual Gini coefficient as $\mathcal{G}_I = \mathcal{G}_B + \mathcal{G}_W$, i.e. as between group and within group inequalities. We now see that the Sen measure satisfies

$$S = Y - \mathcal{G}_W Y - M$$

This could imply that conditional on income, ranking by the two indices might yield almost similar conclusions. Empirically, however, we show below that this is not the case. As the Sen measure is mostly concerned with inequality and the miser index focuses on the disparity between the poor and the non-poor, this finding is not surprising and shows that the miser index captures a different aspect of the distribution of income.

As stated, our miser index M is also close to Esteban and Ray's (1994) measure of how polarized the income distribution is between groups:

$$P_\alpha = \sum_i \sum_j p_i^{1+\alpha} p_j d_{ij}$$

where d_{ij} is the social distance between group i and group j with sizes p_i and p_j , and where α is a positive parameter. Their index becomes equal to the miser index if we consider the two groups situation with poor and rich people, where $d_{ij} = \bar{Y}_R - \bar{Y}_P$, and where $\alpha = 0$.

The miser index is also close to Kanbur and Mukherjee's (2007) index of poverty reduction failure (the PRF-index)⁴⁵ Their index is more flexible than ours, in that three functions

⁴The two indexes seem to have been developed independently – we first reported preliminary results from the Miser index in the business paper Dagens Næringsliv, April 2006.

⁵The general expression is

$$PRF = f \left(\left\{ \frac{1}{q} \sum_{i=1}^q \phi \left(\frac{z - y_i}{z} \right) \right\} \cdot \left\{ \frac{1}{n - q} \sum_{i=q+1}^n \psi \left(\frac{y_i - z}{z} \right) \right\}^\delta \right)$$

can be chosen almost freely. Ours has the virtue of simplicity, and also the convenience of providing a single expression. While their axiomatization provides a whole class of measures, our axioms pin down a single index. One way to compare the two is to use the functional forms that make their index as close to ours as possible. In one case, the PRF-index can be written

$$h(1-h) \left(\frac{\bar{Y}_R - z}{\bar{Y}} \right) \left(\frac{z - \bar{Y}_P}{\bar{Y}} \right)$$

indicating that it is multiplicative and relative whereas ours is additive and absolute. This implies that the miser index tends to give higher values than the PRF-index for richer societies and for societies where the poor are close to the poverty line.⁶

Both indexes associate policy failures and miserliness with a high level of poverty. This is in contrast to those who would emphasize that a *low* level of poverty reveals society's implicit tolerance of a completely unnecessary residual of poor people. A low residual is almost by definition inexpensive to *eliminate*. Thus when it persists, it can be interpreted as a sign of miserliness or grave policy failures since it does not cost much to get rid of it altogether.

A *high* level of poverty, however, reveals society's implicit tolerance of mass suffering. Such a high level of poverty can be more expensive to eliminate, but its persistence is a sign of miserly attitudes if it is associated with high inequality between the poor and the non-poor implying that poverty is inexpensive to *reduce*.

The two intuitions seem to be almost opposite; the first associates policy failures and miserliness with low poverty and the second with high poverty. Both aspects are relevant and therefore we report numbers on each of them. It should be noted, though, that the differences in intuitions may be due to framing. To *eliminate* sounds more drastic and complete than to *reduce*, even though in both cases the same amount of suffering may be eradicated. Suffering should count. With a given ability to fight poverty, a tolerance of mass

for some increasing functions f , ϕ , and ψ and a positive parameter δ

⁶Take for instance the case where the incomes of the poor converge to z and the rich have incomes well beyond z . In this case, the index of poverty reduction failure goes to zero whereas the miser index remains strictly positive. For many practical purposes, however, the two indices are quite similar. In the data set studied in this paper, the correlation between the two is 0.93.

poverty may therefore reveal stronger miserliness than a tolerance of an unnecessary residual of poor people, hence our focus on the miser index.

Implicit taxes

Before we move to the applications we define some conservative measures of the costs of fighting poverty expressed as hypothetical implicit tax rates. These rates are used below. Consider therefore the poverty gap⁷

$$g = \frac{1}{q} \sum_{i=1}^q \frac{z - y_i}{z} = \frac{z - \bar{Y}_P}{z}$$

implying that the total shortfall from the poverty line is hgz (a conservative estimate of the amount of resources needed to bring the poor out of poverty). It can be expressed as a share t_x of the total income per capita \bar{Y} analogous to a *production tax*, or as a share t_I of the total income of the non-poor $(1 - h)\bar{Y}_R$ analogous to an *income tax*:

$$t_x = \frac{hgz}{\bar{Y}} \quad \text{and} \quad t_I = \frac{hgz}{(1 - h)\bar{Y}_R} \quad (2)$$

It should be noticed that these rates are not necessarily feasible taxes in any sense, as they ignore e.g. deadweight losses from taxation and issues of targeting the poor. However, they still give indications of the magnitude of poverty relative to the countries' ability to transfer resources to the poor; if t_I is tiny it does indicate that poverty alleviation is not a severe financial burden.

3 Country rankings and correlates

To calculate the miser index it is sufficient to know some numbers that are readily available. The World Bank (2007)'s World Development Indicators, for instance, reports the average income (GNI) per capita \bar{Y} , the head count ratio of poverty h for the relevant poverty line

⁷Some scholars prefer to use hg as the poverty gap. This has no consequences for the further analysis.

z , and the poverty gap ratio g , which are sufficient to calculate the miser index M .⁸ Poverty data are available for most poor countries. In the rich countries, where very few people live below 2 PPP\$ a day, there are no reported poverty data so we exclude these from our analyses. There is also a group of middle income countries where the World Bank reports “less than 2% poor”, which we code as 2% poor.

Affluence

Our data includes an unbalanced panel of 100 countries and 373 observations. Figure 3 shows a scatter plot of the calculated miser index against affluence measured by GNI per capita. As we see there is a considerable variation among miserly countries. Many of them have reasonably high incomes, and could therefore easily afford to alleviate extreme poverty at a quite low cost. Both quite poor countries and quite rich countries are among the countries with high levels on the miser index. This confirms that the index measures something beyond income.

Let us return to Sen’s (1976b) measure again. Using the calculations of the miser index, we can study how closely related it is to Sen’s welfare measure. The relationship is very weak; the correlation between the two is only 0.02. Hence, it is clear that the miser index captures something else than Sen’s measure.⁹ Consider for instance a situation where inequality and poverty go up for a given \bar{Y} . While Sen offers a simple formula to assess how welfare declines in this case, we offer a simple formula to assess how rich poor polarization has risen under these circumstances. In fact, a measure that is increasing in inequality – as $\bar{Y}\mathcal{G}_I$ – would be more in line with our reasoning. But again, the correlation between our miser index and $\bar{Y}\mathcal{G}_I$ is only 0.43.

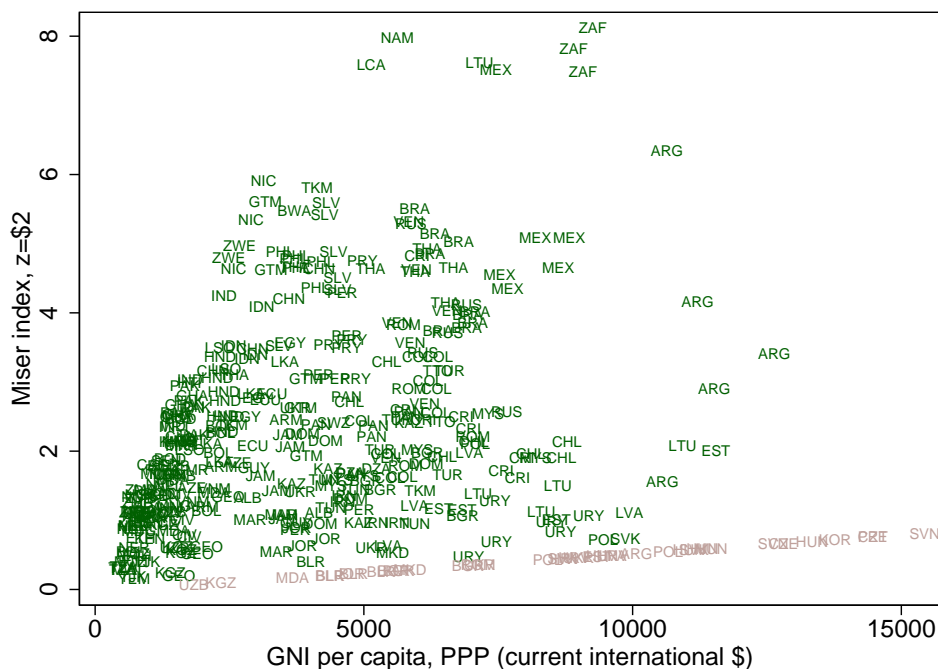
⁸In World Bank publications the poverty gap \hat{g} is defined as $\hat{g} = h(z - \bar{Y}_P)/z$, implying that $\bar{Y}_P = z(1 - \hat{g}/h)$. The average non-poor excess income $(\bar{Y}_R - \bar{Y}_P)$ becomes

$$\bar{Y}_R - \bar{Y}_P = \frac{\bar{Y} - h\bar{Y}_P}{1 - h} = \frac{\bar{Y} - z(h - \hat{g})}{1 - h},$$

When \bar{Y}_R , \bar{Y}_P , and h are known we can easily calculate the miser index $m = h(1 - h)(\bar{Y}_R - \bar{Y}_P) = h[\bar{Y} - z(h - \hat{g})]$.

⁹There is some tendency for a hump-shaped relationship between the two variables though. A regression of the miser index on the Sen measure and the square of the Sen measure yields a R^2 of 0.10.

Figure 3: The relationship between the miser index and national income



Countries with head count rates below 2% are depicted in grey

Ranking developing countries

Table 1 shows the twenty most miserly countries.¹⁰ In an online Appendix¹¹ we report the full ranking of all developing (and emerging) countries. As seen from Table 1, South Africa turns out to be the most miserly country according to our data. South Africa is rich by African standards, but has nevertheless a very high poverty rate of more than 34 per cent in year 2000. The total poverty gap is less than one per cent (the production tax) of GNI. The huge inequalities of the country is inherited from apartheid. But since ANC took over in the early 1990s South Africa could have ‘eliminated’ all its extreme poverty by a rather small tax on the non-poor of just above 1 per cent in year 2000. Having not done so can be interpreted as a sign that the process of social and political conciliation after the war has lead to continued miserly behavior towards the poor – as our index indicates.

Moving down the list there is an interesting contrast between Argentina - the fourth

¹⁰For each country, the most recent data are used.

¹¹Available at <http://folk.uio.no/jlind/papers/Miser.htm>

Table 1: The 20 most miserly countries

Country	Survey year	Production tax (%)	Income tax (%)	Head count ratio (%)	GNI/cap	Miser index
South Africa	2000	1.21	1.32	34	9260	8.12
Namibia	1993	4.82	5.42	56	5623	7.97
St. Lucia	1995	4.52	5.19	60	5136	7.59
Argentina	2003	0.71	0.77	23	10638	6.34
Nicaragua	2001	11.70	14.06	80	3134	5.91
Botswana	1986	7.38	8.86	61	3707	5.48
Zimbabwe	1995	17.29	21.24	83	2487	4.8
Philippines	2000	3.78	4.58	47	4200	4.74
Mexico	2002	0.70	0.77	21	8618	4.65
China	2001	3.94	4.78	47	4170	4.64
El Salvador	2002	3.93	4.67	41	4511	4.5
India	2000	13.43	17.61	81	2400	4.24
Thailand	2002	0.86	0.98	26	6526	4.14
Venezuela	2000	1.64	1.91	28	5620	3.85
Brazil	2003	1.05	1.19	22	7026	3.85
Peru	2002	2.58	3.09	32	4683	3.67
Egypt	2000	2.78	3.56	44	3630	3.57
Paraguay	2002	3.33	4.02	33	4347	3.54
Indonesia	2002	4.70	6.28	52	2985	3.39
Sri Lanka	2002	3.05	3.92	41	3532	3.29

most miserly country - and Nicaragua - the fifth most miserly country on our list. While Argentina is almost four times as rich as Nicaragua (measured by GNI per capita) and could have eliminated its poverty of 23 per cent of the population by an income tax on the non-poor of 0.77 per cent (or a production tax of a little more than 0.7 per cent only), Nicaragua would need an income tax of 14 per cent (or a production tax of about 11 per cent) to eliminate its poverty rate of close to 80 per cent of the population. In spite of these huge differences the two countries end up as almost equally miserly according to our index. The basic reason for this is that the average income of the non-poor in Nicaragua is at the same level as the average income of the non-poor in Argentina. This can actually be read from the table as a poverty rate h around 20 per cent (in Argentina) and around 80 per cent (in Nicaragua) yielding the same value of the product $h(1-h)$. Thus the two countries must have similar average incomes per non-poor member as they end up with an almost equal index score of $M = h(1-h)(\bar{Y}_R - \bar{Y}_P)$. In fact, while the higher affluence $(1-h)(\bar{Y}_R - \bar{Y}_P)$ in Argentina is mitigated in the miser index by a lower poverty rate, the four times higher poverty rate

in Nicaragua is mitigated in the miser index by a lower affluence.

Since the China versus India comparison is often emphasized (see for instance Drèze and Sen 1989, Ch. 11) it should be noted that Table 1 ranks China way above India in miserliness (6th place versus 12th place). The head count measure of poverty in India is almost twice as high as the Chinese level. The reason why China is considered more miserly than India is basically that China is more affluent and has more potential contributors to alleviate poverty than potential receivers of poverty support. This is in contrast to the poorer India that has more than 80 per cent potential receivers of poverty relief and only 20 per cent contributors.

It is also interesting to see from Table 1 that Botswana, the African growth success par excellence, actually ends up among the top twenty miserly countries (on 18th place on our list). Although the country since independence has experienced the highest economic growth in the world, it has been much less successful in eliminating poverty. In 1986 (the most recent observation of poverty levels in the country) the poverty rate was still more than 60 per cent. Sri Lanka on the 20th place is also considered a success story according to some social indicators. For instance, the population of Sri Lanka has a life expectancy at birth of almost 73 years, which is way beyond what other countries at this income level have. Yet Sri Lanka has not been equally successful in eliminating income poverty.

Let us then move to the other end of the list. Table 2 ranks the least miserly countries according to our measure. As seen on the top of this list the least miserly country is Yemen. It is evident from the table that most of the least miserly countries should be classified as extremely poor - half of them have a GNI per capita less than 1000 USD per year. The richer countries included, like the Slovak Republic, typically have rather low poverty rates, and hence do not reveal strong miser attitudes.

Poverty and hypothetical tax rates

Table 3 shows what the hypothetical tax rate is like for countries of different levels of poverty as measured by the head count ratio. We concentrate on the income tax rate t_I – the tax rate that measures the magnitude of the poverty problem relative to total affluence.

Table 2: The 20 least miserly countries

Country	Survey year	Production tax (%)	Income tax (%)	Head count ratio (%)	GNI/cap	Miser index
Yemen	1998	18.42	-407.75	45	726	0.16
Malawi	1998	58.85	1134.17	76	580	0.29
Tanzania	2001	82.05	514.05	90	537	0.33
Tajikistan	2003	11.78	59.77	42	969	0.4
Ethiopia	2000	33.87	173.57	78	780	0.49
Mozambique	1997	46.00	220.72	78	713	0.51
Burundi	1998	70.08	262.9	88	622	0.55
Kyrgyz Republic	2003	2.50	5.31	23	1608	0.57
Ukraine	2003	0.15	0.18	5	5135	0.6
Jordan	2003	0.26	0.33	7	4298	0.73
Slovak Republic	1996	0.08	0.08	3	9867	0.73
Kenya	1997	19.35	61.21	56	1017	0.73
Mali	1994	81.21	172.64	91	665	0.92
Niger	1995	67.97	156.22	86	717	0.92
Tunisia	2000	0.20	0.23	7	5950	0.95
Iran	1998	0.23	0.27	7	5618	0.96
Benin	2003	28.54	74.68	73	988	0.96
Guyana	1998	0.90	1.17	11	3742	0.96
Jamaica	2000	0.70	0.93	13	3500	1.02
Bulgaria	2003	0.13	0.15	6	6838	1.07

The table only reports countries with a head count ratio above 2% as the World Development Indicators does not distinguish between 2% and below.

As the table demonstrates, there are 11 country observations with poverty in the range between zero and five per cent, nine of which could eliminate their poverty with a tax rate of less than 0.1 per cent. Of the 17 observations of poverty rates in the range between 20 to 40 per cent, 18 per cent could eliminate their poverty by a tax rate of less than 1 per cent, and all of them by a tax rate less than 10 per cent. Similarly, of the 17 observations of poverty rates between 40 and 60 per cent, more than half of them could eliminate their poverty by a tax rate in the range between 1 and 10 per cent. Finally, only 11 observations of the 99 could not eliminate their poverty by a tax rate of less than 100 per cent.

Table 3: Income tax by level of poverty

	Tax rate							Total
	0-0.1%	0.1%-1%	1%-10%	10%-20%	20%-50%	50%-100%	Above 100%	
0-5%	9	2	0	0	0	0	0	11
5%-10%	0	11	0	0	0	0	0	11
10%-20%	0	8	4	0	0	0	0	12
20%-40%	0	3	14	0	0	0	0	17
40%-60%	0	0	9	4	2	2	0	17
60%-80%	0	0	1	2	10	2	4	19
80%-100%	0	0	0	1	2	2	7	12
Total	9	24	28	7	14	6	11	99

The table shows the number of countries within each interval of the head count measure which fall into the interval of the tax rate on excess income, i.e. income above the poverty line z . For each country, the most recent data are used.

The correlates

To see some of the characteristics of miserly countries, Table 4 shows the results from regressions of a number of indicators of policies and social outcomes on the miser index, controlling for log of income per capita. For countries with more than one observation of the miser index, all observations are included. However, standard error are clustered to account for the possible dependency between these observations. There is no clear direction of causality in these estimates, so they should be seen more as descriptive correlations than structural relationships.

Size, trade, health and education

The first thing to notice from table 4 is that larger countries in terms of population size tends to be more miserly. This could be because larger countries are more heterogeneous, but also because social cohesion may be lower and hence that redistributive schemes may be more difficult to implement.

Secondly, the association between miserliness and openness to trade seems to indicate that more open countries, measured by both the export share of GDP and the import share, tend to be less miserly. This fits the general pattern that open economies normally have better social insurance than less open economies. In our data, however, the negative correlation between openness and miserliness is to some extent driven by the positive correlation between country size and miserliness as smaller countries are more open.

Thirdly, table 4 shows that more miserly countries tend to have lower public expenditures on health. This is what we should expect. A general provision of health care is a pro-poor policy, and since miserly countries can be considered to reveal little care for the poor one should expect that they do not spend much on general health care. As Table 4 demonstrates, there is also a tendency that fertility rates are higher in more miserly countries. This may be interpreted as a side effect of a low level of health care, low education, and most likely the absence of social insurance.

Finally, table 4 demonstrates that primary education is positively associated with miserliness, while secondary and tertiary education are negatively associated with miser attitudes.

In sum the descriptive correlations demonstrate that miserly countries educate their populations to a limited extent, and do neither provide them with health care nor with higher education. As Table 4 also demonstrates, we find no relationship, however, between military expenditures and miserliness and between international aid and miserliness. Thus there is no support for our initial speculations that miserliness goes together with “canons for butter” policies. Similarly, miserly countries neither tend to be favored nor disfavored by the international aid community. One could argue that miserly countries should be able to reduce their own poverty by their own means more easily than other countries and that

Table 4: The correlation of the miser index with some outcome measures

	Miser index		Observations	R^2
	Coefficient	t-value		
Log population	0.259	2.78***	373	0.08
Exports of goods and services (share of GDP)	-0.021	2.37**	345	0.10
Import of goods and services (share of GDP)	-0.025	2.40**	345	0.04
Health expenditure, public (% of GDP)	-0.251	2.46**	146	0.39
Military expenditure (% of GDP)	0.197	0.64	283	0.00
Fertility rate, total (births per woman)	0.129	2.28**	225	0.54
Life expectancy at birth, total (years)	-0.340	0.73	220	0.59
Literacy rate, adult total (% of people ages 15 and above)	3.290	0.91	10	0.26
Aid (% of GNI)	-0.066	0.27	360	0.44
Labor force with primary education (% of total)	4.185	2.45**	63	0.14
Labor force with secondary education (% of total)	-4.568	3.14***	61	0.29
Labor force with tertiary education (% of total)	0.028	0.02	62	0.00
School enrollment, primary (% gross)	2.322	2.72***	120	0.22
School enrollment, secondary (% gross)	-3.558	2.98***	114	0.49
School enrollment, tertiary (% gross)	-3.620	3.06***	109	0.46

*The table shows the estimates from a regression of the outcome on the miser index and log GNI per capita. Numbers in parentheses are t-values clustered at the country level. * significant at 10%; ** significant at 5%; *** significant at 1%*

miserly countries therefore should be in less need of foreign assistance. If this is right, we should expect that foreign aid tend to be lower in more misery countries. As seen, it is not.

Institutions

To identify some institutional arrangements that are associated with miserliness we have utilized indexes of governance and institutional quality. Table 5 shows the results from regressions of the miser index on measures of democracy from the Polity IV database (Marshall and Jaggers 2000). It seems reasonable that democratic regimes generally would pay more attention to the needs of the poor as they also have the right to vote, although also autocratic regimes may need support from parts of the population (see e.g. Acemoglu and Robinson (2005) for an extended discussion of these points).

The first thing we notice is that, controlling for log income, democratic regimes do not seem to be less miserly than autocratic regimes. From Columns (1) to (3), there seems to be no significant relationship when using the measure of democracy, the measure of autocracy, and the composite of the two. This finding is in line with views emphasizing that democracy in developing countries is more efficient in fighting temporary poverty related to famines

Table 5: The relationship between the miser index and measures of democracy

Log GNI	0.670*** (3.13)	0.603*** (2.95)	0.630*** (2.99)
Institutionalized democracy score	0.000654 (0.02)		
Institutionalized autocracy score		-0.0519 (-1.25)	
Democracy-Autocracy			0.0117 (0.58)
Constant	-2.968* (-1.92)	-2.318 (-1.46)	-2.677* (-1.70)
R^2	0.115	0.123	0.117
Observations	281	281	281

*Dependent variable is the miser index with poverty line $z = 2\$$. T-values clustered at the country level in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%*

and catastrophes than they are in fighting chronic poverty, which shows up as a high level of persistent extreme poverty (see for instance Drèze and Sen, 1989, and Sen, 2000). Building on this, one possible assertion is that the chronic poor can be more of a threat to autocratic regimes than to democratic. If this is right, democracy in developing countries is no direct guarantee against miserly behavior towards the worst off.

Regressions reported in Table 6 focus on different proxies for institutional quality. From the table we notice that good institutional quality seems to reduce the level of miser attitudes. In Column (1), the index used is an average of five indexes that capture the rule of law, bureaucratic quality, corruption in government, risk of expropriation and government repudiation of contracts, taken from Sachs and Warner (1997). One reading of this finding is that miserly countries tend to have more rule bending and to be more venal and bureaucratically inefficient. Columns (2) to (8) corroborate these findings using the six dimensions of Kaufmann et al.'s (2006) governance indicators.¹²

The two findings that democracy and bad institutions both are correlated with miserliness also hold when we control for them simultaneously (results not reported here, but available

¹²We use the 2005 observations of the indicators to maximize the size of the sample. As institutions are not changing quickly, this should be an innocent approach.

upon request). It may therefore be tempting to assert that many miserly countries tend to be imperfect democracies with bad institutions.

A final variable we include in these regressions is the measure of ethno-linguistic fractionalization (ELF) derived from Bruk and Apenchenko (1964), and popularized by e.g. Easterly and Levine (1997) who find that ELF has a detrimental effect on growth as well as most factors known to boost growth. Controlling for per capita income, we find that more fractionalized countries tend to be more miserly. This suggests that miserly behavior is associated with low social cohesion.

Growth

A final point that we consider is the relationship between miserliness and growth. On the one hand, one could imagine that miserly countries, by hoarding wealth among the rich, would boost investments and hence grow faster, potentially generating a trickle down effect to the poor at some stage of development. If this were true we may have misclassified countries as miserly while they instead may follow a strategy of growth-mediated poverty alleviation. The high levels of poverty that they presently have may be due to some non-monotonicity between growth and extreme poverty (à la Kuznets 1955). On the other hand, miserly countries may simply be very unequal countries with a high level of social exclusion that can be viewed as obstacles to growth and development. Or, they may have experienced high growth in the past that has led to social exclusion and high inequality.

Table 7 show the results from some growth regressions. We look at growth during three periods, 1960-2000, 1975-2000, and 1990-2000. In columns (1) to (3), we use the earliest measure of the miser index available in an attempt to capture the causal effect of miser attitudes on growth. There seems to be essentially no impact from the miser index to the subsequent growth.

In Columns (4) to (6) in Table 7, we instead use the most recent measure of the miser index available. Now there seems to be a positive relationship between miserliness and growth, albeit not a strongly significant one. In addition we have to admit that it is not

Table 6: The relationship between the miser index and measures of institutional quality and ethnolinguistic fractionalization

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GNI	0.890*** (4.91)	0.545*** (3.22)	0.694*** (4.35)	0.706*** (3.70)	0.664*** (3.46)	0.752*** (4.43)	0.799*** (4.58)	1.137*** (4.23)
Quality of institutions	-0.242* (-1.80)							
Voice and accountability		-0.0397 (-0.20)						
Political stability and absence of violence			-0.363** (-2.23)					
Government effectiveness				-0.346 (-1.21)				
Regulatory quality					-0.260 (-1.02)			
Rule of law						-0.550** (-2.28)		
Control of corruption							-0.630** (-2.25)	
Ethno-linguistic fractionalization								0.0125* (1.69)
Constant	-3.553** (-2.39)	-2.237* (-1.71)	-3.602*** (-2.92)	-3.628** (-2.38)	-3.244** (-2.15)	-4.134*** (-3.07)	-4.546*** (-3.23)	-7.125*** (-3.10)
R^2	0.177	0.066	0.094	0.078	0.075	0.098	0.102	0.236
Observations	242	373	373	373	373	373	373	236

Dependent variable is the miser index with poverty line $z = 2\$$. T -values clustered at the country level in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%

easy to interpret the causality of this relationship. Given the results in columns (1) to (3), the most reasonable assertion may be that growth increases the affluence of the country without reducing poverty very much. Thus miserly countries might be seen as countries with inequitable growth that makes the non-poor richer and leave the worst off further behind.

Consider the miser index M in a case where the income of the poor is negligible low ($\bar{Y}_P = 0$). In a society where the income of the rich grows with a certain rate, how fast does poverty have to decline in order to have non-increasing miserliness? From $M = h(1 - h)\bar{Y}_R$ we obtain

$$\frac{\dot{M}}{M} = \frac{\dot{\bar{Y}}_R}{\bar{Y}_R} + \left(\frac{1 - 2h}{1 - h} \right) \frac{\dot{h}}{h}$$

implying that

$$\dot{M} \geq 0 \Rightarrow \frac{\dot{h}}{h} \geq -\frac{1 - h}{1 - 2h} \frac{\dot{\bar{Y}}_R}{\bar{Y}_R} \text{ for } h \neq 1/2$$

Miserly countries may have a growth of the average income of the non-poor \bar{Y}_R that is higher than $(1 - 2h)/(1 - h)$ times the reduction in poverty. Growing incomes to the rich with a yearly rate of say k per cent is consistent with a constant miser index if it is met by (i) a yearly reduction in the number of poor people that is higher than k per cent when $h < 1/2$, and (ii) a growth in poverty that is less than k per cent when $h > 1/2$.

The growth performance of miserly countries reminds us of what Jagdish Bhagwati (1958) denoted immiserizing growth. In Bhagwati's case, economic growth could make the majority worse off as the country, because of high growth, could experience a fall in the terms of trade and thus a fall in real incomes. In our case the growth is real enough but a large fraction can nevertheless be excluded from its gains due to vanishing empathy or socially bad institutions.

Our results do not contradict Dollar and Kraay (2002) who in a sample of 92 countries find that "average incomes of the poorest fifth of a country rise and fall at the same rate as average incomes". To grow with the same rate as the average income (of the non-poor) is not enough, however. A stronger reduction in poverty rates would be achieved by redistributing from rich to poor, but this tool does not seem to be heavily used, as empirically observed poverty alleviation is more strongly driven by rises in average incomes than in changes in

Table 7: Growth and misery

	(1)	(2)	(3)	(4)	(5)	(6)
	Earliest measure of miser index			Latest measure of miser index		
	1960-2000	1975-2000	1990-2000	1960-2000	1975-2000	1990-2000
Miser index	0.000938 (0.74)	0.000377 (0.29)	0.000110 (0.08)	0.00251** (2.03)	0.00161 (1.26)	0.00176 (1.24)
Log initial GDP	-0.00359 (-1.30)	-0.000650 (-0.22)	0.00310 (1.02)	-0.00487* (-1.82)	-0.00156 (-0.55)	0.000553 (0.20)
Constant	0.0408** (2.07)	0.0163 (0.75)	-0.0121 (-0.52)	0.0462** (2.43)	0.0203 (0.97)	0.00360 (0.16)
R^2	0.030	0.001	0.015	0.086	0.022	0.021
Observations	60	74	81	60	75	86

*Dependent variable is average annual growth rates over the given period. The measure of the miser index employed is either the earliest available observation or the last available observation. T-values in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%*

the distribution (Kraay 2006). As discussed in Section 2, revealed miser attitudes can rise even when poverty rates are reduced with the same percentage as incomes grow.

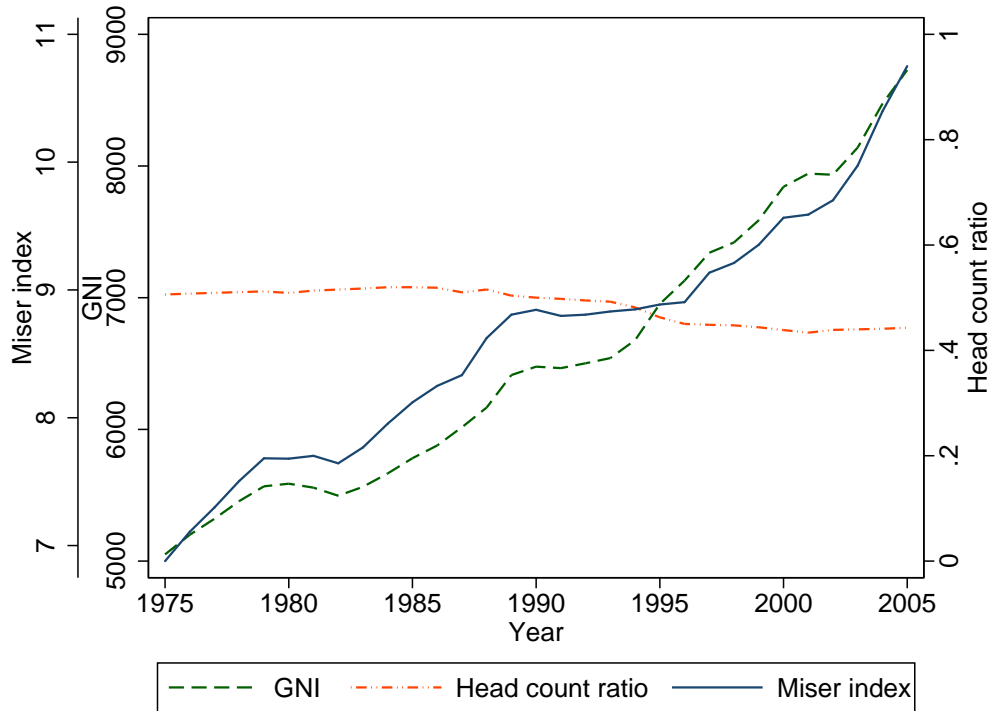
4 Is the world becoming more miserly?

Miserliness in a sum of income distributions can be either larger or smaller than the sum of the miserliness of each of these distributions.¹³ This is of some importance as we now treat the whole world as one society where the rich have a responsibility for helping the poor. By combining countries into one social unit (and extending the numbers of countries) a poor country with a high share of poor people can be integrated with richer countries with a lower share of poor people. Thus the miserliness of the new combined unit can become higher than the sum of the miserliness in each country viewed in isolation, which in fact must be the tendency in the data as we include rich countries with no extreme poverty.

We are not only interested in how miserly the world is in comparison with specific coun-

¹³One can show, however, that if two countries share the same \bar{Y}_P , merging the countries would lead to a combined miser index at least as high as the lowest of the miser indices of the two. (See Kolm 1976 for a general discussion of how different types of inequality measures account for the inequality in a sum of distributions.)

Figure 4: The evolution of the miser index globally



tries viewed in isolation. Our question concerns how miserliness evolves over time, and in particular we would like to know whether the world’s miserliness has increased or not over last thirty years when there has been so much discussion of fighting poverty. To answer this, we have made some fairly rough calculations of the global miser index from 1975 to 2005. The data sources are the same as above. We first calculate the head count ratio and poverty gap ratio for all available countries by linearly interpolating the available data. For countries without data on poverty, we treated poverty as zero if the country had a GNI above 10 000 PPP\$, otherwise as missing. Adding up, we get the results shown in Figure 4.

Related, but different, questions of global inequality (Milanovic 2005, Sala-i-Martin 2006) and global poverty (Chen and Ravallion 2001) have received a lot of attention recently. The debate on how to derive properties of the global income distribution is still not settled, and some of the suggested solutions are both computationally complicated and data demanding. We follow a cruder approach than most of this literature, but do also answer a different question. Our results are reasonable, although they portray a rather pessimistic picture.

Table 8: Global tax rates to alleviate poverty

Year	Production tax	Income tax
1975	3.34	4.91
1980	3.04	4.41
1985	2.98	4.21
1990	2.56	3.42
1995	2.09	2.67
2000	1.72	2.15
2005	1.56	1.86

All tax rates in percentages

Global miserliness has been rising almost monotonically over the whole period. The head count ratio has declined somewhat, from about 51 per cent to about 44 per cent, but this is out of proportion to the global GNI per capita, which has almost doubled over the same period. Only a very small fraction of global growth over the last twenty years has gone to alleviate poverty, hence the dramatic rise in global miserliness.

Table 8 shows the corresponding tax rates on production and income of the non-poor to alleviate poverty. Although a tax rate of about 5% on the excess income of the non-poor was necessary to alleviate poverty in 1975, this has been steadily decreasing due to the growth in global income per capita. In 2005 the tax rate reached 1.86%, or only 1.56% of global GNI.

5 Conclusion

Throughout the world poverty persists in the midst of affluence. To measure the extent to which this is capture some of this, we have developed a simple yet powerful measure of societies' revealed miserliness – the miser index. This index is not a passive reflection of how rich the various countries are. Countries with similar levels of national income per capita have in fact huge variations in miserliness.

The miser index allows us to rank countries according to their tendency to hoard wealth and let the poor live miserably. Almost half of the twenty most miserly countries in the world have a population of 40 million or more. Among them we find two, Argentina and Mexico, which the UN classifies as countries with high human development. Only one of

the top twenty, Zimbabwe, is classified as a country with low human development. The rest of the top twenty are countries with medium human development according to the UN's Human Development Report (UNDP 2006).

We also find that high poverty persists in countries with low financial costs of getting rid of it. About a third of our 99 country observations are cases where the government could have eliminated their substantial poverty by transferring resources to the poor that amount to less than 1 per cent of the total incomes of the non-poor. Such transfers are not necessarily the best way to fight poverty, but the numbers put the magnitude of the poverty problems in perspective.

Considering a large set of factors that may potentially be correlated with miser attitudes, we find, among other things, that miserly countries neither provide their populations with good health care nor do they offer their citizens higher education. It is also clear that democracy is no guarantee against miser attitudes, and that miserly countries tend to be socially fractionalized, bureaucratically inefficient and politically corrupt.

Indexes like ours may guide the implementation of the Millennium goals (UN Millennium Project 2005, Sachs 2005). As miserly countries could alleviate poverty fairly easily by redistributing domestic resources, one should perhaps concentrate foreign assistance on less miserly countries.

Finally, what we call miserly countries should not be mistaken as countries that follow growth-mediated poverty alleviation. There is no connection between initial miserliness and subsequent economic growth. On the contrary, many countries with high growth tend to have a miserly development. This can be viewed as a special form of immiserizing growth that makes the rich richer and leaves the poor further behind. This development is also true for the miser attitudes for the world as a whole. We find a dramatic rise in global miserliness over the recent 30 years.

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A An axiomatic characterization of the miser index

Now we want to derive an index of poverty related miserliness $M = M(\mathbf{Y}, z)$ from a set of axioms. The first property we want is that the poverty line has no other normative effects than separating the poor from the non-poor. This is captured by our first axiom:

- **Focus:** Keeping the number of poor persons constant, (i) a change in the poverty line z does not affect miserliness, i.e. if $h(\mathbf{Y}, z') = h(\mathbf{Y}, z)$ then $M(\mathbf{Y}, z') = M(\mathbf{Y}, z)$, (ii) a transfer from rich to less rich, or from poor to poorer leaves miserliness the same, i.e. if \mathbf{Y}' is obtained from \mathbf{Y} by a redistribution among the poor or a redistribution among the rich so that $h(\mathbf{Y}', z) = h(\mathbf{Y}, z)$, then $M(\mathbf{Y}', z) = M(\mathbf{Y}, z)$.

One reason why the poverty line ought not to have a separate influence on miserliness beyond its impact via the poverty rate is simply its somewhat arbitrary determination. Changing the poverty line z alters the position of both the rich and the poor relative to the poverty line - but does not alter the income gap between them. For a given poverty rate, experienced miserliness should be thought of as this income gap between the rich and the poor where the poverty line z plays no other role than separating the poor from the rich. Miserliness therefore characterizes the lack of warranted redistribution, and any redistribution in favor of the poor reduces miserliness:

- **Transfer:** A transfer from rich to poor decreases miserliness, implying that our index satisfies the Pigou-Dalton criterion. Formally, if \mathbf{Y}' is obtained from \mathbf{Y} by a transfer from rich to poor, then $M(\mathbf{Y}, z) > M(\mathbf{Y}', z)$.

The measures that satisfy Focus and Transfer constitute the class of measures of miserliness. To further structure the measure we need some additional restrictions. One reasonable restriction is that special needs that are fully compensated should not affect miserliness. For instance, two societies should be considered equally miserly if they are identical except that some needs are higher in one of them and all incomes and the poverty line are raised correspondingly to these special needs. This is the intuition behind the following axiom:

- **Independence of origin:** If the poverty line and all incomes are raised by an amount b , miserliness is unchanged. Formally, $M(\mathbf{Y} + b, z + b) = M(\mathbf{Y}, z)$ as the poverty rate h is unchanged and as the absolute cleavage between the poor and the rich is unchanged.

If all incomes and the poverty line are raised by the same percentage, however, the poverty rate would still remain constant, but now the absolute economic cleavages would increase by this percentage. Since the absolute inequality drives miserliness, our measure should go up with the same percentage as the absolute inequality. Hence, we assert:

- **Homogeneity:** If the poverty line z and all incomes are raised by the same percentage a , miserliness is also raised by the same percentage. Formally, $M(a\mathbf{Y}, az) = aM(\mathbf{Y}, z)$

as the rate of poverty h is unchanged and the absolute income gap between the poor and the rich has gone up.

If two societies have the same average income and if all poor persons in the two societies have equal incomes, we would think that miserliness in the two countries should be proportional to their poverty rates:

- **Proportionality:** If all the q poor have the same income y , and if a regressive transfer transforms a rich into a poor with income y , then $M(\mathbf{Y}', z) = ((q + 1)/q)M(\mathbf{Y}, z)$, i.e. the index is proportional to the number of poor in this context.

Finally, we would naturally think that miserliness does not depend on the size of the society, but that the maximum degree of miserliness does depend on how rich the society is. This intuition is made precise in the following axiom:

- **Population invariance:** Replication of the population leaves miserliness unchanged, i.e. whenever X is obtained by replicating Y any number of times, then $M(\mathbf{Y}, z) = M(\mathbf{X}, z)$.

Proposition 1. *If M satisfies the axioms above it is of the form*

$$M = Ah(1 - h)(\bar{Y}_R - \bar{Y}_P) = h(\bar{Y} - \bar{Y}_P) \quad (3)$$

for some positive constant A .

As the constant C can be chosen freely, we have throughout the paper focused on $A = 1$.

Proof: To prove the proposition, we first prove a result for a wider class of indices:

Lemma. *The class of indices satisfying Transfer, Focus, Population invariance, Homogeneity, and Proportionality is given by*

$$M(\mathbf{Y}, z) = \bar{Y} \Phi \left(\frac{\bar{Y}_P}{\bar{Y}} \right) h$$

for any decreasing function Φ .

Proof: Consider a series of transfers among the rich and among the poor where we replace $\mathbf{Y} = (y_1, \dots, y_q, y_{q+1}, \dots, y_n)$ by the “simplified distribution” $\mathbf{Y}' = (\underbrace{\bar{Y}_P, \dots, \bar{Y}_P}_q, \underbrace{\bar{Y}_R, \dots, \bar{Y}_R}_{n-q})$. By Focus, $M(\mathbf{Y}, z) = M(\mathbf{Y}', z)$. By Population invariance, the index doesn't depend on the size of the groups q and $n - q$, but only the proportion $h = q/n$. Hence, there is a function f so that $M(\mathbf{Y}, z) = f(\bar{Y}_P, \bar{Y}_R, h, z)$. Since \bar{Y}_R is a function of \bar{Y} and \bar{Y}_P one can as well write the function as $f(\bar{Y}_P, \bar{Y}, h, z)$ as well. It must be increasing in \bar{Y} .

Fix z . From Proportionality it follows that there is a function g such that $f(\bar{Y}_P, \bar{Y}, h) = hg(\bar{Y}_P, \bar{Y})$.

Note that for α close to 1, the number of poor in $\alpha(\bar{Y}_P, \bar{Y})$ is the same as the number of poor in (\bar{Y}_P, \bar{Y}) . Therefore Homogeneity and Focus imply that for some $\varepsilon > 0$ sufficiently small, we have for all $\alpha \in (1 - \varepsilon, 1 + \varepsilon)$ that $M(\alpha\mathbf{Y}, z) = \alpha M(\mathbf{Y}, z)$, hence that $g(\alpha\bar{Y}_P, \alpha\bar{Y}) = \alpha g(\bar{Y}_P, \bar{Y})$ implying that there is some function Φ such that $g(\bar{Y}_P, \bar{Y}) = \bar{Y}\Phi(\bar{Y}_P/\bar{Y})$. By Transfer we require Φ to be decreasing. **QED**

It is now relatively straightforward to prove the main proposition:

Proof of Proposition 1: For d close to 0, the number of poor in $\mathbf{Y} + d$ is the same as in \mathbf{Y} , so Independence of origin implies that there is some $\varepsilon > 0$ sufficiently small so that for all $d \in (-\varepsilon, \varepsilon)$, we have $M(\mathbf{Y} + d, z) = M(\mathbf{Y}, z)$, and hence $(\bar{Y} + \Delta)\Phi\left(\frac{\bar{Y}_P + \Delta}{\bar{Y} + \Delta}\right) = \bar{Y}\Phi\left(\frac{\bar{Y}_P}{\bar{Y}}\right)$. Differentiating with regard to Δ and setting $\Delta = 0$, we get $\Phi\left(\frac{\bar{Y}_P}{\bar{Y}}\right) + \bar{Y}\Phi'\left(\frac{\bar{Y}_P}{\bar{Y}}\right)\left[\frac{1}{\bar{Y}} - \frac{\bar{Y}_P}{\bar{Y}^2}\right] = 0$. Hence, Φ satisfies the differential equation $(x - 1)\Phi'(x) = \Phi(x)$ whose solution is $\Phi(x) = C(x - 1)$ for some constant C . Given the condition imposed on Φ from the Lemma, we require $C < 0$. **QED**