Preliminary Draft

Vulnerability, Unemployment and Poverty: A New Class of Measures, Its Axiomatic Properties and Applications.

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Abstract

Measures of unemployment and poverty have tended to focus solely on those currently unemployed or below the poverty line. This approach has ignored the members of society that are *vulnerable* to becoming unemployed or falling into poverty. Current literature in this area has implicitly assumed that someone who is vulnerable experiences pain from the chance of becoming unemployed or falling into poverty and thus our standard measures of unemployment and poverty do not accurately account for this pain. People then asset that vulnerability is a 'bad' and policies should aim to reduce the numbers of people who are vulnerable in a society. In this paper we argue that, at the macro level, vulnerability can be viewed as a 'good' because, with unemployment remaining constant, the presence of vulnerable people imply that there must also exist currently unemployed people who expect to find work in the near future. And a society where unemployment is more equitably shared is better than a society where the burden of unemployment is carried by only a few. Given this view of vulnerability we then suggest

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a class of measures that, unlike the standard unemployment rate, account for the amount of vulnerability that exists in a society. Finally, we show some attractive axioms that our measure satisfies and apply it to data from both the U.S. and South Africa.

1 Introduction

Traditional measures of unemployment or poverty were concerned with the total number of people unemployed or living in poverty. In recent years such measures have come under criticism for ignoring those who may not currently be poor or unemployed but are vulnerable, that is, they live under the risk of *becoming* unemployed or poor (see Glewwe and Hall, 1998; Cunningham and Maloney, 2000; Thorbecke, 2003). And alongside this criticism a small but rapidly growing literature is emerging that looks at various aspects of vulnerability and tries to measure it (Ligon and Schechter, 2003; Prichett, Suryahadi and Sumarto, 2000; Chaudhuri, Jalan and Suryahadi, 2001; Kamanou and Morduch, 2001).

There is a presumption in much of this literature and the policy statements of international organizations and governments that vulnerability is bad; that we should craft policy to rescue people from being vulnerable. We argue in this paper that such a prescription is wrong, or, at best, misleading. Under a variety of 'normal' situations, having some people vulnerable to unemployment or to poverty make the aggregate problem of unemployment or poverty less severe (and more bearable).

The aim of this paper is to explain this normative stance of ours, to develop measures of unemployment and poverty that take account of this stance and then to apply it to U.S. and South African data.

The explanation of our normative position is not complicated and the general point can be made even here in the introduction. Let us start by looking at the case of unemployment. Consider a society in which, currently, some people are unemployed and some people are vulnerable to unemployment (that is, there is a probability that they will become unemployed in the next period). The presumption in much of the literature and in many World Bank policy discussions (see for instance, World Bank, 2002) is that the standard measure of unemployment, which ignores the vulnerable, effectively underestimates the pain of unemployment (including the pain of its anticipation). We, on the other hand, will argue that the standard measure of unemployment underestimates, not the *pain*, but the *inequity of the pain* of unemployment. Our argument is this – if unemployment holds constant over time and there are, currently, some people vulnerable to unemployment, then there must be some currently unemployed people who have the *opportunity* (we are aware that is not quite the right worked and are engaged is search of something better) of becoming employed in the next period. If this is so, then an *aggregate* (that is, an economy-wide) measure of *effective* unemployment, while taking account of the pain of those who live under the risk of unemployment, must also take account of the hope of the currently unemployed who expect to find jobs soon. We will argue presently that there is reason to treat the latter as more than offsetting the former.

Before that, consider the point some would make, that we are not right to assume that just because there are some people who are vulnerable to unemployment, there must be people currently unemployed but who have the probability of finding jobs in the next period. Our response to this is that if there were no such people, then having people who are vulnerable to unemployment is equivalent to saying that unemployment will rise tomorrow. If we then treat the situation as worse than what the standard measure captures, then this does not show our valuation of vulnerability but the fact that the absolute amount of unemployment is about to rise. To isolate our attitude to *vulnerability*, we must consider a case where the vulnerable population rises but the total number unemployed remains unchanged. But this compels us to assume that a vulnerable population will be matched by a population expecting a converse shift - *out* of unemployment.

To close the argument consider two societies, δ and α, in which unemployment is the same, say 10%, and this remains constant over time. However, in society δ no one is vulnerable to unemployment, while in α, 10% are vulnerable, that is they are currently employed but face a risk of unemployment. In other words, the total amount of the burden of unemployment to be shared in both societies is the same (10% of the people will have to be unemployed) but in α this burden is shared by 20% of the population, while in δ this is borne entirely by only 10% of the population. The same way that, *ceteris paribus* (to use a term rapidly going into extinction), greater equality in the distribution of income and wealth ('good things', that is) is valued in most societies, we feel that there is reason to prefer a society where the 'bads', such as unemployment and poverty, are more equally distributed. It follows that, starting with society δ, if vulnerability is increased and we reach society α, the we must consider this a change for the better. Therefore, the effective unemployment must be considered to be less in society α than in δ.

2 A New Measure of Effective Unemployment

Consider a society with n persons. Let r_i be the fraction of a year during which person i is unemployed. Hence, by the measure of the "standard unemployment rate" this society's unemployment is

(1) $$U \equiv \frac{r_1 + r_2 + ... \ + r_n}{n}$$

The standard unemployment measure that one encounters in newspapers is usually the above measure multiplied by 100, since the measure is usually stated in percentage terms.

From the above discussion it should be evident that we are looking for a measure of unemployment (MOU) which is distribution sensitive. That is, if the same aggregate unemployment is unevenly shared, we shall consider the effective unemployment to be greater in the more unequal society. We codify this later as the "equity axiom"

Let us define an unemployment profile of a society to be a vector $(r_1, r_2, ..., r_n)$ such that, for all i, $r_i \in [0,1]$. Let Δ be the collection of all unemployment profiles. Hence, $\Delta = \{(r_1, r_2, ..., r_n) \mid n \in Z_{++} \ \& \ r_i \in [0,1], \forall i\}$ where Z_{++} is the set of strictly positive integers.

Formally, a measure of unemployment (here after referred to as MOU) is a function, $M : \Delta \to R_+$, where R_+ is the set of non-negative real numbers. The MOU that we propose in this paper, takes the following form:

(2) $$M^{\beta}(r_1, ... , r_n) \equiv \frac{1}{\beta} - \prod_{i=1}^{n} (\frac{1}{\beta} - r_i)^{\frac{1}{n}} \text{ where } \beta \in (0,1)$$

Since for every $\beta \in (0,1)$ we have a distinct measure M^{β}, what we have just proposed is a *class* of new measures of unemployment. We shall show that these measures have appealing properties and then demonstrate, with some actual empirical examples how using these new measures makes a difference. Let us from now on call an MOU defined by (2) above an effective unemployment rate.

One property of every member of the family of effective unemployment rates worth observing at the outset is that if $R = (r_1, r_2, ... , r_n)$ is such that $r_i = r \ \ \forall i$, the $M^{\beta}(R) = r$. In other words, if the burden of unemployment is perfectly equitably shared by everybody then the effective unemployment rate is independent of $\beta \in (0,1)$ and equal to the standard unemployment rate defined in (1).

It is worth checking what the limits or boundaries of our class of measures look like. First consider the case where $\beta = 1$. This measure (which is not a part of the class we are recommending) is represented by: $M^1(r_1, r_2, ..., r_n) = 1 - \prod_{i=1}^{n} (1 - r_i)^{\frac{1}{n}}$. Note that if for some i, $r_i = 1$, i.e. one person is fully unemployed, then $M^1 = 1$. Hence, this measure makes no difference between the case where 1 person is fully unemployed and 10 persons are fully unemployed. It amounts to Rawlsian-type evaluation where a tragedy for one is a tragedy for all.

Now, what about the other limit, that is as β goes to 0? It can be shown that as $\beta \to 0$, $M^\beta \to U$. That is as β goes to 0, our measure converges to the standard unemployment rate as defined by (1). The first lemma establishes this result. Since the standard measure is one in which individual unemployments are aggregated by simply adding up, this could be thought of as a kind of utilitarian representation of unemployment. Hence the class of measures that we are proposing is bounded at one end by a Rawlsian-type representation and at the other end by a utilitarian one.

Lemma 1 *For all* $R = (r_1, r_2, ... , r_n) \in \Delta$, *and for all* $\beta \in (0, 1)$, $\lim_{\beta \to 0} M^\beta(R) = \frac{\sum_{i=1}^{n} r_i}{n}$

Proof.

$$\begin{aligned}
\lim_{\beta \to 0} M^\beta (R) &= \lim_{\beta \to 0} \{\frac{1}{\beta} - \prod_{i=1}^{n} (\frac{1}{\beta} - r_i)^{\frac{1}{n}}\} \\
&= \lim_{\beta \to 0} \{\frac{1}{\beta}[1 - \prod_{i=1}^{n} (\beta)^{\frac{1}{n}} (\frac{1}{\beta} - r_i)^{\frac{1}{n}}]\} \\
&= \lim_{\beta \to 0} \{\frac{1}{\beta}[1 - \prod_{i=1}^{n} (1 - \beta r_i)^{\frac{1}{n}}]\} \\
&= \lim_{\beta \to 0} \{\frac{[1 - \prod_{i=1}^{n} (1 - \beta r_i)^{\frac{1}{n}}]}{\beta}\} = \frac{0}{0}
\end{aligned}$$

So we may now use L'Hôpital's Rule:

$$\frac{\partial}{\partial \beta} \beta = 1,$$

and

$$\frac{\partial}{\partial \beta}[1 - \prod_{i=1}^{n} (1 - \beta r_i)^{\frac{1}{n}}] = -\sum_{k=1}^{n} \left(\frac{1}{n}\right) (1 - \beta r_k)^{\frac{1-n}{n}} (-r_k) (\prod_{i \neq k} (1 - \beta r_i)^{\frac{1}{n}})$$

Taking the limit of this numerator we get

$$\begin{aligned}\lim_{\beta\to 0}\{-\sum_{k=1}^{n}\left(\frac{1}{n}\right)(1-\beta r_k)^{\frac{1-n}{n}}(-r_k)(\prod_{i\neq k}(1-\beta r_i)^{\frac{1}{n}})\} &= -\sum_{k=1}^{n}\left(\frac{1}{n}\right)(-r_k) \\ &= \frac{1}{n}\sum_{k=1}^{n} r_k\end{aligned}$$

Thus by L'Hôpital's Rule

$$\lim_{\beta\to 0}\{\frac{[1-\prod_{i=1}^{n}(1-\beta r_i)^{\frac{1}{n}}]}{\beta}\} = \frac{1}{n}\sum_{k=1}^{n} r_k$$

Which implies that

$$\lim_{\beta\to 0} M^{\beta}(R) = \frac{1}{n}\sum_{k=1}^{n} r_k$$

■

We shall now demonstrate how the effective unemployment rate, as characterized by (2), satisfies some attractive axioms. Consider first two routine axioms.

Monotonicity Axiom: *An MOU, M, is said to satisfy the monotonicity axiom if for any* $R = (r_1, r_2, \dots, r_n) \in \Delta$ *and* $R' = (r'_1, r'_2, \dots, r_n) \in \Delta$ *such that* $\forall i,\ r_i \geq r'_i$ *and* $\exists\ j,\ r_j > r'_i$*, then* $M(R) > M(R')$.

Population Replication Axiom: *An MOU, M, is said to satisfy the population replication axiom if for any* $R = (r_1, r_2, \dots, r_n) \in \Delta$ *and* $R^k = (r'_1, r'_2, \dots, r'_{kn}) \in \Delta$*, where* R^k *a k-replica of R such that* $r'_{(j-1)+1} = r'_{(j-1)+2} = \dots = r'_{jk} = r_j \quad \forall j \in \{1, 2, \dots, n\}$ *and k is a positive integer, then* $M^{\beta}(R) = M^{\beta}(R^k)$.

These two axioms are standard and we would expect a good measure to satisfy them. Fortunately – as is easy to see – the effective unemployment rate satisfies both of these axioms. Observe that, given the Monotonicity axiom, coupled with the fact that $M^{\beta}(1, 1, \dots, 1) = 1$, we now know that our measure ranges from 0 to 1. That is, $M^{\beta}(\Delta) \subset [0, 1]$.

Our measure, and the need to break away from the standard unemployment concept, was motivated by using an equity argument, namely, that it is superior to have a society where the burden of a certain amount of aggregate unemployment is more widely shared. So it is important to check that the effective unemployment rate satisfies equity. The simplest idea of equity may be formalized as follows.

Equity Axiom: *An MOU, M, is said to satisfy the equity axiom if for* $R = (r_1, r_2, \ldots., r_n) \in \Delta$ *and* $R^* = (r^*, r^*, \ldots., r^*) \in \Delta$ *such that* $\sum_{i=1}^{n} r_i = nr^*$ *and* $R \neq R^*$*, then* $M^\beta(R) > M^\beta(R^*)$.

It can be shown that M^β satisfies the equity axiom for every $\beta \in (0,1)$. But instead of showing this directly, we will show that M^β satisfies another axiom and then show that the latter implies the equity axiom. This other axiom is the 'transfer axiom' widely used in the literature on poverty and inequality measurement (for example Sen 1976). This, in the context of unemployment, says the following. Suppose there are two people, one who is unemployed more than the other. Now if the more unemployed person becomes even more unemployed – say by ε amount of time – and the less unemployed person finds more work – again by ε amount of time – then the effective unemployment is higher. Formally,

Transfer Axiom: *An MOU, M, is said to satisfy the transfer axiom if for any* $R = (r_1, r_2, \ldots., r_n) \in \Delta$ *and* $R' = (r'_1, r'_2, \ldots., r'_n) \in \Delta$ *such that* $r_k = r'_k \ \ \forall k \neq i, j$ *where for* i *and* j*,* $r_i \geq r_j$ *we have* $r'_i = r_i + \epsilon \leq 1$ *and* $r'_j = r_j - \epsilon \geq 0$ *(for some* $\epsilon > 0$*), then* $M^\beta(R') > M^\beta(R)$.

Lemma 2 *For all* $R = (r_1, r_2, \ldots., r_n) \in \Delta$*, and for all* $\beta \in (0,1)$ *every effective unemployment rate,* M^β*, satisfies the transfer axiom.*

Proof.

$$\begin{aligned}
M^{\beta}\left(R'\right) &= \frac{1}{\beta}-\prod_{k=1}^{n}(\frac{1}{\beta}-r'_k)^{\frac{1}{n}} \\
&= \frac{1}{\beta}-(\frac{1}{\beta}-r'_i)^{\frac{1}{n}}(\frac{1}{\beta}-r'_j)^{\frac{1}{n}}\prod_{k\neq i,j}^{n}(\frac{1}{\beta}-r'_k)^{\frac{1}{n}} \\
&= \frac{1}{\beta}-[(\frac{1}{\beta}-r_i-\epsilon)(\frac{1}{\beta}-r_j+\epsilon)]^{\frac{1}{n}}\prod_{k\neq i,j}^{n}(\frac{1}{\beta}-r_k)^{\frac{1}{n}} \\
&= \frac{1}{\beta}-[\left(\frac{1}{\beta}-r_i\right)\left(\frac{1}{\beta}-r_j\right)-(r_i-r_j)\epsilon-\epsilon^2]^{\frac{1}{n}}\prod_{k\neq i,j}^{n}(\frac{1}{\beta}-r_k)^{\frac{1}{n}} \\
&> \frac{1}{\beta}-[\left(\frac{1}{\beta}-r_i\right)\left(\frac{1}{\beta}-r_j\right)]\prod_{k\neq i,j}^{n}(\frac{1}{\beta}-r_k)^{\frac{1}{n}} \\
&= \frac{1}{\beta}-\prod_{i=1}^{n}(\frac{1}{\beta}-r_i)^{\frac{1}{n}}=M^{\beta}\left(R\right)
\end{aligned}$$

■

The fact that M^{β} satisfies the equity axiom follows from Lemma 2 and the following axiom.

Lemma 3 *If an MOU satisfies the transfer axiom, it must satisfy the equity axiom.*

Proof. Suppose M is an MOU that satisfies the transfer axiom.

Consider, $\widetilde{R}=(r_1,r_2,....\ ,r_n)$ and $R^*=(r^*,r^*,....\ ,r^*)$ which satisfy the hypotheses of the equity axiom. That is $\widetilde{R},R^*\in\Delta$, $\widetilde{R}\neq R^*$ and $\sum_{i=1}^{n}r_i=nr^*$

Define $S\subset\Delta$ such that $S\equiv\{R=(r_1,r_2,....\ ,r_n)\in\Delta\mid\sum_{i=1}^{n}r_i=nr^*\}$.

Note that for any $R\neq R^*$, $R=(r_1,r_2,...\ ,r_n)\in S\backslash\{R^*\}$

So we can define $\overline{r}(R)\equiv\max_i r_i$ and $\underline{r}\left(R\right)\equiv\min_i r_i$.

Let $\varepsilon=\min\{\overline{r}(R)-r^*,r^*-\overline{r}(R)\}$

Now define a mapping $\Psi:S\rightarrow S$, as follows:

$\Psi\left(R^*\right)=R^*$or, if $R=(r_1,r_2,....,r_n)\neq R^*$, then $\Psi(R)=R'$

where $R'=(r'_1,r'_2,...\ ,r'_n)$ such that $r'_k=r_k\ \forall r_k\neq\overline{r}(R),\underline{r}\left(R\right)$

and $r_i=\underline{r}\left(R\right)+\varepsilon$ for $r_i=\arg\min_i r_i$

and $r_j=\overline{r}(R)-\varepsilon$ for $r_j=\arg\min_i r_i$.

By the transfer axiom we know that $M(R)>M(\Psi(R))$.

Now look at the infinite sequence $\{R^1, R^2, ... \}$

such that $R^1 = \widetilde{R}$ and $R^{t+1} = \Psi(R^t) \; \forall t > 1$.

There must exist some $\overline{t}$ such that $\forall t \geq \overline{t}$, $R^t = R^*$.

Thus $M\left(R^1\right) > M\left(R^t\right) \; \forall t > 1$ and therefore $M(\widetilde{R}) > M\left(R^*\right)$ ■

In light of this result, the next lemma is obvious and stated only for completeness.

Lemma 4 *Every effective unemployment rate, M^β, satisfies the Equity Axiom.*

While the measure being suggested here has attractive axiomatic properties, should one use this measure? One possibility is to study the sensitivity of ranking societies with respect to changes in β. The other is to pick on some salient values of β from the interval $(0,1)$ and use those specific measures. This is the strategy that is often used vis-a-vis the Foster-Greer-Thorbecke family of poverty measures (Foster, Greer and Thorbecke, 1984).

For such salient β's a natural one is the half-way mark, that is, $\beta = \frac{1}{2}$. There is another one, $\beta = \frac{8}{9}$, which appears unnatural, but emerges in quite a natural way.

Consider a society of size n and let x be the fraction of society that has to be unemployed. In other words the total amount of jobs available is $(1-x)n$. Let us fix x and consider different distributions of the total amount of unemployment nx, and their corresponding effective unemployment. By using the equity axiom it is clear that effective unemployment is minimized if nx is distributed equitably, that is, if each person is unemployed a fraction x of her time.

Let $m(x)$ be the minimum effective unemployment rate for a society with a total burden of unemployment nx. It is easy to see this is independent of $\beta \in (0,1)$. Hence, writing this as $m(x)$, with no mention of β, is fine. It is obvious that $m(x)$, will be a 45^o–line as shown in figure one. Thus if half the society has to be unemployed (i.e. $x = \frac{1}{2}$), the lowest value M^β takes is when every person is half-time unemployed. In that case, for all $\beta \in (0,1)$, $M^\beta(x) = \frac{1}{2}$.

Here is an interesting question. Let us pick any $x \in [0,1]$ and think of the worst distribution of this total burden of x unemployment (in the sense of the distribution that makes effective unemployment the maximum). By the Transfer Axiom, we know that this happens when some people are fully unemployed and the rest are fully employed. Hence, fix $\beta \in (0,1)$, consider this worst-distribution for every x and define $\overline{M}^\beta(x)$ as the value of M^β for a $(r_1, r_2, ... , r_n)$ which is the worst way to share the burden of nx. Clearly $\overline{M}^\beta(x) \in (x, 1), \forall x$. It is not hard to see that

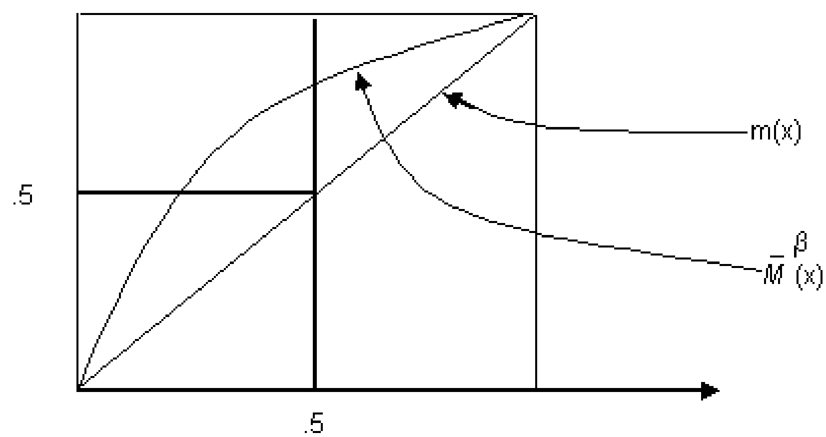

Figure 1:

for a given β, $\overline{M}^{\beta}(x)$ will look something like the curve shown in Figure one. The higher values of β, the higher the curve will be. And as β goes to 0, the line will converge to the $m(x)$ curve.

There are two ways of choosing β. One is to elicit this from individual choice. This involves asking individuals questions like: If you face a choice of two lotteries, one in which you will be unemployed all year with the probability $\frac{1}{4}$ or employed for the full year with probability $\frac{3}{4}$; and the other in which you will be employed for a fraction t of the year with certainty and unemployed for the remainder of the year, what value of t would you choose?

The other way to approach β is as a moral judgement of the policy maker. In the absence of data on individual risk-aversion, let us explore that moral approach here. Just to fix our thinking consider the case of $x = \frac{1}{2}$. We know that if every person's unemployed $\frac{1}{2}$ of the year then $M^{\beta}(R) = \frac{1}{2}, \forall\beta$. Now consider the worst distribution of this total burden. Clearly this is one where $\frac{n}{2}$ persons are fully employed and $\frac{n}{2}$ persons are fully unemployed. Let $R = (r_1, r_2, ... , r_n)$ signify such a distribution. We know that $M^{\beta}(R) \in (\frac{1}{2}, 1)$ as β varies from 0 to 1. We need to ask ourselves: what score we would like to give to $M^{\beta}(R)$? One simple strategy is to set this half-way in this interval. That is $M^{\beta}(R) = \frac{3}{4}$. In other words we are making the judgement that a society where half the people are fully employed and half are fully unemployed is equivalent to one where everybody is certainly employed one quarter of their time. What would β have to be to yield this mid-way result?

The answer turns out to be, interestingly, $\frac{8}{9}$. To see this note:

$$
\begin{aligned}
M^{\beta}(R) &= \tfrac{1}{\beta} - \left(\tfrac{1}{\beta} - 1\right)^{\frac{1}{n} * \frac{n}{2}} \left(\tfrac{1}{\beta} - 0\right)^{\frac{1}{n} * \frac{n}{2}} \\
&= \tfrac{1}{\beta} - \left(\tfrac{1}{\beta} - 1\right)^{\frac{1}{2}} \left(\tfrac{1}{\beta}\right)^{\frac{1}{2}} \\
&= \tfrac{1}{\beta} - \tfrac{(1-\beta)^{\frac{1}{2}}}{\beta}
\end{aligned}
$$

If $M^{\beta}(R) = \frac{3}{4}$, it follows that $\beta = \frac{8}{9}$. Hence, the $\frac{8}{9}$ rule, which we will use in the empirical section, as one of the salient values.

3 Simple Data Exercise

We now turn to an empirical exercise to illustrate how our measure of effective unemployment, as defined by (2), will relate to the standard unemployment measure, as defined by (1). To begin we examine the Current Population Surveys collected in March by the US Census Bureau for the years 1989 through 2003. These surveys give us data on the unemployment for the years 1988 through 2002. Figure 2 shows the unemployment rate over these years for the "usual" measure and our effective measure of unemployment for both $\beta = \frac{1}{2}$ and $\beta = \frac{8}{9}$. These unemployment rates are not for the whole population. They are for men and women between the ages of 25 and 54, the prime aged working force if you will. They were calculated by looking at the number of weeks that people we unemployed. Therefore the r_i from our effective unemployment rate was able to take on 53 values; zero if someone was employed the whole year, $\frac{1}{52}$ if someone was employed for only one week during a year and so on.

It is simple to see that as expected the effective unemployment measure is above the normal measure, meaning that unemployment is not equally shared among members of the labor force in the US. Also we see that as our value of equality with regards to unemployment gets closer to that of a Rawslian, then the level of effective unemployment gets larger. Now, though, lets look at the trend in unemployment over time. This is easiest done with a graph such as that in Figure 3.

Figure three shows that our measure of effective unemployment follows roughly the same pattern as the usual unemployment rate. This means that as unemployment is increasing or decreasing, the proportion of people sharing the unemployment burden is not changing. For example, if 20% of the population was sharing the unemployment burden in 1988, then roughly 20% of the population was sharing the unemployment burden in 2002. To get an idea of how much of the population

	Normal	Beta=.5	Beta=9/8
2002	0.048	0.063	0.081
2001	0.040	0.053	0.067
2000	0.033	0.044	0.055
1999	0.033	0.045	0.056
1998	0.044	0.058	0.074
1997	0.038	0.050	0.064
1996	0.047	0.062	0.079
1995	0.053	0.070	0.090
1994	0.056	0.073	0.094
1992	0.065	0.085	0.110
1991	0.064	0.083	0.106
1990	0.053	0.071	0.088
1989	0.046	0.062	0.077
1988	0.048	0.064	0.081

Figure 2:

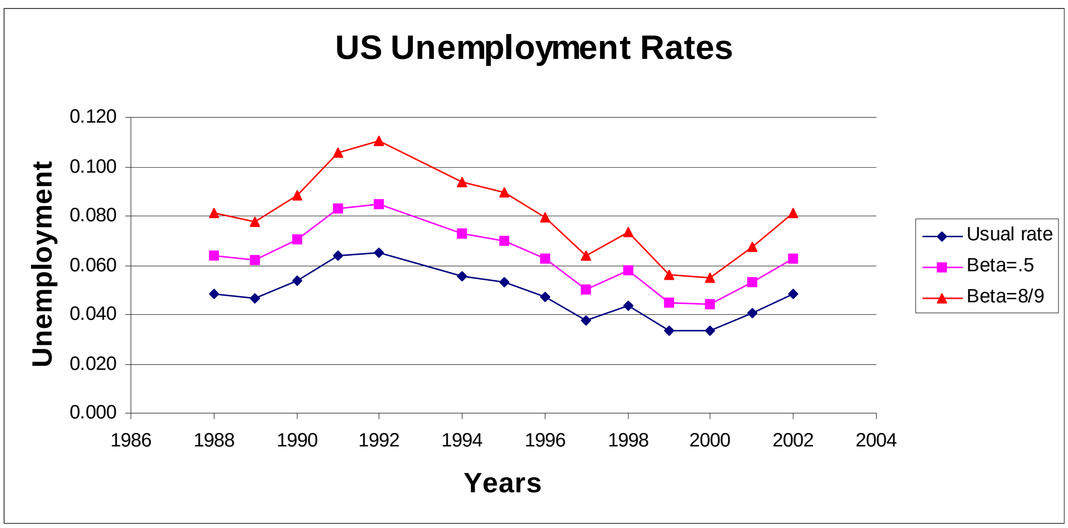

Figure 3:

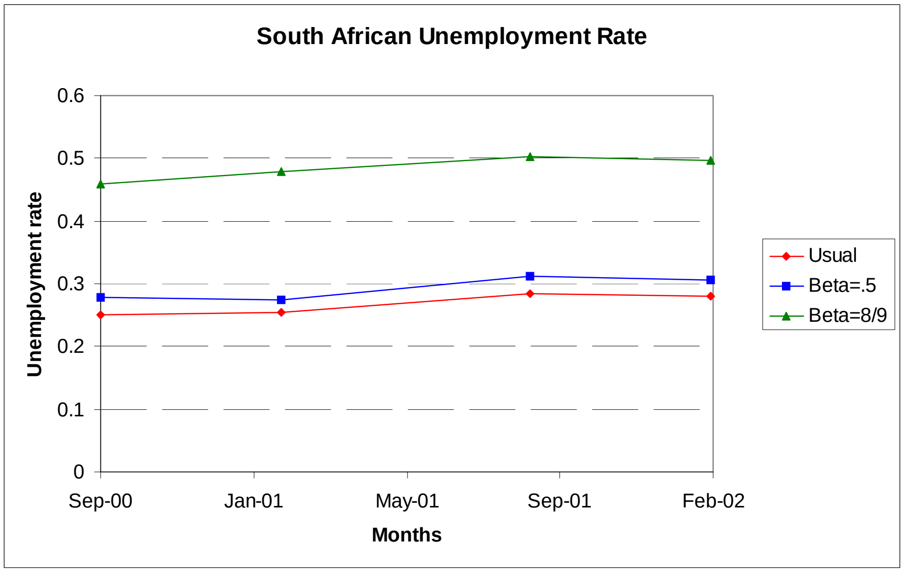

Figure 4:

is sharing the unemployment burden we may look at how the unemployment situation in the US differs from the unemployment situations in other countries. For this paper we will compare the US to South Africa.

We use the South African data that is available in the Labour Force Survey (LFS) for February 2002 and 2001 and September 2001 and 2000. We will again examine how the change in unemployment varies using the normal measure, and the effective measure with both $\beta = \frac{1}{2}$ and $\beta = \frac{8}{9}$. The graph of the national unemployment level is South Africa, from the period of September 2000 till February 2002 is in Figure 4.

The first contrast that one can see to the US graph is how large of a difference there is between the effective measures when $\beta = \frac{1}{2}$ and when $\beta = \frac{8}{9}$. This vast change in the effective unemployment rate shows that the burden of unemployment is much less equitably shared in South Africa than in the US. Given South Africa's past this is not a surprising result. Furthermore, we can see that unlike in the US the inequitable share of unemployment is getting worse at certain times in South Africa. From September 2000 till February 2001 the usual unemployment measure has unemployment decreasing, but the effective unemployment measure with parameter $\beta = \frac{8}{9}$ has unemployment *increasing*. This tells us that the unemployment is becoming less equitably shared.

That is, the burden of unemployment is falling on a smaller and smaller group of people.

From February 2001 onwards, the effective unemployment rate follows the trend of the usual unemployment rate. This suggests that the decrease in the amount of people sharing the unemployment burden has become permanent. The amount of people sharing the unemployment burden before September 2000 was larger than the amount of people sharing the unemployment burden after February 2001.

In order to generate the South African graphs some assumptions did have to be made. The LFS asks a person how long she may have been unemployed, but does not ask a person how long they have been employed. Therefore, we only have the duration of unemployment over a year for people who were currently unemployed at the time of the survey. Therefore, assuming that the number of jobs in the economy were constant over the year, we assumed that if someone had been unemployed for four weeks that there was an employed person who had been *employed* for only four weeks.

This section shows us how to read the changes in effective unemployment and what insights we can gain from comparing effective unemployment to the usual measure.

4 The Literature

Most of the literature on vulnerability has focused on poverty. The suggestions, as in (Ligon and Schechter 2002), have discussed vulnerability as a 'bad.' Ligon and Schechter, for example, use a concave utility function to show how a person could prefer to be below the poverty line then to face uncertainty over income. We too will soon discuss how our measure can shed light on the discussion of poverty and vulnerability. But, unlike poverty, the discussion of incorporating vulnerability into unemployment has not been as vastly researched. Borooah (2002) is an exception.

Borooah (2002) is a paper that is closely-related to the theoretical discussion above. He, as we have done, works from the premise that a more equitable sharing of the burden of unemployment is superior to the case where the burden of unemployment is borne solely by one group of society. However, unlike in our measure, where the equity aversion is direct, Borooah lays out a measure where each individual finds the pain of unemployment to be increasing at an increasing rate.

Furthermore, Borooah assumes that each person has the same pain function and treats the social pain as the simple addition of each person's pain. Hence, his measure is based on a utilitarian premise, which is not the case with our approach.

Let us take a look at our proposed MOU again. Recall, $M^{\beta}(R) = \frac{1}{\beta} - \prod_{i=1}^{n} \left(\frac{1}{\beta} - r_i\right)^{\frac{i}{n}}$ and lets examine society's view of one person's unemployment load, or pain - as referred to by Borooah. Using r_1 as an example we can see that $\frac{\partial M^{\beta}(R)}{\partial r_1} = \frac{1}{n\left(\frac{1}{\beta} - r_1\right)} \left[\frac{1}{\beta} - M^{\beta}(R)\right]$ depends on the total effective unemployment as measured by $M^{\beta}(R)$. Hence if total unemployment is higher then $\frac{\partial M^{\beta}(R)}{\partial r_1}$ is lower. Therefore "the level of pain" that society associates with person i's unemployment depends on the level of effective unemployment in society. This essential relativity is not there in Borooah's measure . Also, we feel a concern with poverty or unemployment is essentially non-welfarist. It is a concern that cannot be thought of as located entirely in the welfares of individuals and their aggregation.

5 Poverty

Sen (1976) showed us what insights could be gained by looking the depth of a person's poverty and not just wether a person is poor. This multidimensional approach is now being augmented by the work on vulnerability. With the concept of vulnerability research is now focused on both the poor people and those people who are likely to become poor. With this augmentation of vulnerability to our concept of poverty we again argue that vulnerability is again not necessarily a 'bad.' If the level of poverty, as measured by the headcount ratio, where to stay the same, then having people at risk of becoming poor means there exist people who are currently poor and are at *risk* of becoming non-poor. Therefore, under the headcount ratio, our measure would again provide some useful insights.

To begin, let poverty be measured using the headcount ratio, then define p_i is the proportion of a year that a person spends below the poverty line. Therefore if $p_i = 1$ then a person is poor for an entire year and if $p_i = 0$ the person is above the poverty line for an entire year. Now we have $(p_1, p_2, ..., p_n)$ defined as a poverty profile of a society where, for all i, $p_i \in [0, 1]$. Thus Δ is the collection of all poverty profiles – $\Delta = \{(p_1, p_2, ..., p_n) \mid n \in Z_{++} \ \& \ p_i \in [0, 1], \forall i\}$ where Z_{++} is the set of strictly positive integers. Then letting n be the number of people in a country we are able to define 'usual' headcount ratio of poverty as follows:

$$U \equiv \frac{p_1 + p_2 + \ldots.. \ + p_n}{n} \tag{3}$$

Now we may define a measure of poverty (MOP) as a function $P : \Delta \rightarrow R_+$. Using our measure from above we propose the following MOP

$$M^{\beta}\left(p_1, \ldots. , p_n\right) \equiv \frac{1}{\beta} - \prod_{i=1}^{n} \left(\frac{1}{\beta} - p_i\right)^{\frac{1}{n}} \text{ where } \beta \in (0,1) \tag{4}$$

Here β would be our parameter of poverty aversion. Our MOP will satisfy all of the properties that are discussed above. This measure of poverty is bounded on one side by the 'usual' headcount ratio and on the side by a Rawlsian-type measure of poverty.

6 Conclusion

We have offered an alternative way to look at vulnerability than what is currently being discussed in the literature and by policy makers. That is, vulnerability need not always be viewed as a 'bad.' Given this perspective we have provided a way of measuring 'effective' unemployment or poverty. This measure is bounded on one side by the utilitarian social measure and on the other side by the Rawslian social welfare measure. Furthermore our measure satisfies axioms that most people would agree are what one would want from a measure motivated by equity concerns. We have shown how the measure can be applied to data in both the US and in South Africa and what insights can be gained by comparing the 'usual' measure and the 'effective' measure.

This paper then serves two purposes. First, it suggests that the current debate on vulnerability needs to examine not only the effect of vulnerability on people currently not poor or unemployed, but also the *hope* that vulnerability provides to people who are currently unemployed or poor. Secondly this paper provides a way of taking account of these concerns and shows how to interpret the results.

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