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Measuring Income Insecurity: Analysis of Income Data from the United States, Britain and Germany

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Measuring Income Insecurity: Analysis of Income Data from the United States, Britain and Germany*

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Abstract

This paper seeks to measure and compare income insecurity in the United States, Great Britain and Germany using household income data from the Cross National Equivalence File (CNEF). As definitive techniques for measuring insecurity are yet to be established we present an explorative methodology based upon the volatility of incomes. Though imperfect, the method is well established in the fields of decision theory and inequality measurement and captures some important aspects of what may constitute income insecurity. Applying this technique we find that insecurity in the United States from 1990 to 2005 was substantially higher than in Great Britain and Germany, which were roughly comparable in several respects. We also measure the extent to which governmental taxes and transfers absorbed household insecurity and find that all three governments insulated households from similar levels in absolute terms. In relative terms however the German government absorbed around 80% of measured insecurity, the British government around 75% and the United States government less than 45%. Lastly we investigate the joint distribution of income insecurity and income and find that it was predominantly distributed amongst lower income earners for Britain and Germany, while in the United States it follows a distinct 'U' shape with very high insecurity levels for low and high income earners and lower insecurity levels for middle income earners. We argue that the distribution of insecurity has important implications for welfare and inequality.

1 Introduction

There has been a recent focus in the academic literature on the issue of economic insecurity. While the term is still new enough to lack a formal definition,

'insecurity' usually refers to a sense of anxiety associated with one's financial future. Works by Osberg (1998), Osberg and Sharpe (2002) and Hacker (2006) give a good background to the topic, categorizing insecurity in terms of threats to income or wealth from unemployment, illness, widowhood and a range of other factors. Though there is no great consensus within these studies on how it should be measured, the authors generally contend that economic insecurity has increased in recent years. Osberg and Sharpe (2002) for instance have found that economic *security* decreased in most OECD countries (including the United States) during the 1990s, while Hacker (2006) cites a number of examples from the United States showing that income volatility and bankruptcy rates have been rising since the start of this decade. While the issue of causality is difficult to establish, these changes have generally been attributed to policy making that has increasingly favored work incentives and labour market flexibility ahead of welfare and job security.

Concern for insecurity comes from the notion that there are significant welfare costs associated with risks and uncertainty. Although much has been written in the economic literature on financial market risk, it is probably true that for most people risk is more problematic at the household level. While most of the literature on insecurity argues that the risks that households are exposed to are a primary component of economic insecurity, work by Osberg (1998) suggests that insecurity is more than simply the aggregation of household risk. It is instructive therefore to divide insecurity into two separate components such that each may be considered in isolation. We refer to risk (as a result of volatility in income or wealth) as type 1 insecurity, while type 2 insecurity may be categorized as the additional psychological concerns stemming from that risk[1]. As economic insecurity can be seen as the sum of these two components it becomes a rather complex issue that is not easily studied in its entirety with standard economic tools.

While the welfare costs of insecurity as a whole are difficult to measure, the concern for economic risk (i.e. type 1 insecurity) is a reasonably well established concept. The costs arise when individuals have concave utility functions consistent with risk aversion, and credit and insurance markets are imperfect for managing risks. In this state of the world, shocks to income or wealth can introduce volatility to consumption that cannot be smoothed away, leading to diminished utility due to under consumption in some periods and over consumption in others. In addition to this concern, type 1 insecurity makes it difficult for households to determine an appropriate long run consumption level. It is generally thought that lifelong utility is maximized by consuming at one's permanent income (Friedman, 1957) which may be difficult for households or individuals to determine if they are exposed to noisy income or wealth streams.

As well as the negative effects of managing economic risk, households or individuals must deal with the associated psychological costs (type 2 insecurity). An important motivating factor for concern over type 2 insecurity comes from

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[1]Authors such as Dynan et al (2008) note that volatility does not necessarily translate directly into risk as some volatility may be voluntary or anticipated. As we do not have the data required to distinguish one from the other we regard these as equivalents.

the evidence of 'loss aversion' – the tendency to view losses and gains asymmetrically. Experimental evidence has found that individuals exhibit a strong bias against losses, where the disutility of a loss is greater than the utility of an equivalent gain (Tversky and Kahneman, 1991). Combined with the observed tendency for individuals to place disproportionate importance on objectively small probabilities (such as crime, ill health or unemployment within a specified time period) this finding lends support to the hypothesis that there are significant psychological costs to insecurity in addition to the standard cost of risk. Osberg (1998) adds to this argument, claiming that Akerlof and Kranton's (1998) work on economics and identity is also important for economic insecurity. This literature suggests that there is likely to be significant social and psychological costs for an individual who is unable to meet certain social norms with respect to employment and consumption.

As insecurity consists of both economic risk and these additional psychological factors, its measurement becomes a daunting task. Perhaps the only work that has attempted to fully measure both facets simultaneously has been the survey based measures by Dominitz and Mianzi (2002). While their questionnaire approach is attractive, survey based measures are limited in that they are difficult to apply retrospectively and as yet the data does not exist to allow cross national comparisons.

Most other methods for measuring insecurity have involved designing some type of statistical method applicable to observational data. Due however to the complexity of the phenomena there is a need for some serious introspection over how such statistical indices should be designed. Osberg (1998, 1999) and Osberg and Sharpe (2002) for instance are particularly interested in developing insecurity measures that are 'forward looking'. These measures are concerned with quantifying personal future perceptions about various 'known risks' rather than focussing on past volatilities. The methodology they propose involves (1) measuring the risk of significant loss, (2) assigning a value to safety and (3) rescaling objective probabilities of such a loss so that they match the perceived probabilities of individuals. By aggregating these risks across the population Osberg and Sharp (2002) were able to provide estimates of security for a number of OECD countries.

Other work on measuring insecurity comes from Bossert and d'Ambrosio (2010) who follow Osberg and Sharpe (2002) by viewing insecurity as a forward looking concept. These authors design their index as an increasing function of the volatility of an individual's past wealth stream. This approach is less vivid than the Osberg and Sharpe (2002) method in that it does not explicitly quantify and exaggerate various risks in accordance with human perception. However it does possess a very appealing statistical neatness that involves outlining various axioms and designing statistical techniques which satisfy them. The measures produced by these authors are also attractive as they are dynamic, taking a wealth stream and giving a measurement of insecurity for the individual in each time period based only upon information available up to that point. It is this characteristic that is consistent with Osberg (1998, 1999) and Osberg and Sharpe's (2002) 'forward looking' property.

In this paper we diverge a little from these authors by dealing with the complexities of insecurity measurement by making some broad simplifying assumptions. Our primary simplification is that we only consider type 1 insecurity, and we restrict this to threats to income such as unemployment or inability to work due to illness or injury. Insecurity of this type is highly visible as it translates directly into unwanted volatility in an individual's income stream, making the problem fairly amenable to statistical analysis. As well as ignoring psychological issues this approach also ignores insecurity as a result of threats to wealth. Thus unexpected expenses stemming from medical payments, crime, damage to property as well as other factors such as drops in asset prices do not appear in our analysis. We are therefore thinking about economic insecurity purely in terms of income volatility and hence are only capturing one facet of economic insecurity as a whole. It is our belief however that income insecurity is an important enough component of economic insecurity to warrant study in isolation[2].

To model our conceptualisation of income insecurity we employ a measure of income volatility explored by Atkinson (1970), Allanson (2008), Osberg and Sharpe (2002) and others. However rather than taking the dynamic perspective used by Bossert and d'Ambrosio (2010) we measure insecurity ex post, and give a single measurement of the insecurity associated with an income stream after we have observed it. There are several criticisms that may be made of this approach: firstly it lacks the 'forward looking' property valued by the above authors as it summarizes the insecurity the household was exposed to, rather than the perceptions about the insecurity the household will be exposed to. Secondly, as we are only capturing type 1 insecurity (in terms of volatility) we may be ignoring a significant and defining aspect of the problem. While undoubtedly valid, it is unclear exactly how serious these weaknesses are. For example historical household income volatility is likely to be a respectable predictor of future volatility and hence the ex-post insecurity measurements we take should (on average) approximately reflect future perceptions of income risk. Furthermore while insecurity may be thought of as the combination of risk and its associated psychological afflictions, it seems reasonable to assume that insecurity is, (again on average) approximately proportional to risk[3]. This renders the scale of an

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[2]As we are considering income dynamics there are a number of related works that measure something akin to insecurity, though these methods are not appropriate for measuring insecurity directly. For instance there is a large literature on income mobility including works by Burkhauser and Pupore (1997), Canto, (2002), Aaberge et al. (2002), Chen (2009) and Jarvis and Jenkins (2002). Similarly there is considerable work on transitory earnings variance as typified by Moffitt and Gottschalk (1994, 2002), Gustavsson (2008) and Drewianka (2010). Works on transitory variance have involved dividing earnings into permanent and transitory components using an earnings function and examining the behaviour of the transitory component through time. There is also closely related work on volatility (see Shin and Solon (2008) and Dynan et al. (2007) that avoid earnings functions by employing simple descriptive statistics to analyse income or earnings fluctuations. The study presented in this paper may be considered to be in a similar vein.

[3]If type 1 security is measured as A, and type 2 insecurity is measured as B we are assuming a constant ratio for A/B. This assumption may be quite restrictive as it is possible that the relationship changes with income. For instance high income earners may have less

4

insecurity measure unimportant though the proportional relationship between two or more insecurity estimates remains intact. This allows the measure to be used for comparative purposes.

Despite its drawbacks we feel that there is enough merit in this approach to use it to examine two aspects of insecurity that (to our knowledge) have been unexplored in the literature. The first objective of the paper is to examine the relationship between our measure of insecurity and permanent income, as this may affect our concern for the issue. If insecurity rises with income it may be considered to be the acceptable price of affluence, especially as high income earners are likely to have access to greater savings and other facilities to insulate themselves from risks. Alternatively if insecurity falls with income it may be that lower income earners face more disadvantages than previously thought and that studies of inequality, particularly permanent income inequality may understate the true disparity between high and low income earners.

The second objective of this paper is to examine the influence of government upon income volatility. As Osberg (1998) argues, the government is thought to play a substantial role in insulating households from insecurity by taxing periods of high income and providing welfare in leaner periods, though the strength of ths effect may vary from country to country. To examine this we compare the income insecurity in both market incomes and post-governmental incomes across the United States, Britain and Germany. The results are of interest as these countries represent different perceptions on the appropriate role for government in terms of labour market regulation and social safety nets.

The paper is organized as follows. In section 2 we introduce the dataset and section 3 discusses the technique for measurement. Section 4 presents results illustrating the relationship between income insecurity and income and discusses some possible reasons for the observed differences between our countries. Section 5 provides some concluding comments.

2   Measuring Insecurity

To measure insecurity we take a vector of realized incomes for each household and attempt to summarize the risk inherent in the observed stream. Before deciding on the exact specification of the summary measure however, it is desirable to establish a set of properties that an ex-post measure of insecurity should exhibit. We argue that axioms of inequality measurement are also useful in establishing properties for an ex-post insecurity index and review these axioms in the context of income insecurity below. Consider an income stream for individual i $x_i = (x_{i1}, x_{i2}, ... x_{it})$ over t time periods where x_{is} refers to the income in time period s and the insecurity index $I(x) \rightarrow \Re_+$. Some desirable properties for an insecurity measure are:

1. Scale invariance. The measure should be insensitive to changes in the scale of the dependent variable. This property makes the insecurity mea-

(proportional) anxiety about (proportional) income risks than low income earners.

sure a purely proportional index, measuring the volatility of an income stream relative to the average of that stream and ensuring that, ceteris paribus, a proportional change in income (such as a 10% rise across all households) will not affect the measure. This property is consistent with arguments made by Hacker (2006) that insecurity can be independent of average income and distinguishes insecurity from the concept of 'vulnerability' (Bandyopadhyay and Cowell, 2007) which relates to the probability of an individual falling below a certain poverty line in the future. Furthermore as it is the intention of this paper to examine the relationship between insecurity and permanent income it is necessary to use an insecurity measure that is unaffected by scale.

2. Intertemporal replication. The measure should not be affected by adjoining an exact replication of the individual's income stream. That is, the income stream $(x_1, x_2, ...x_t)$ should yield the same insecurity as the income stream $(x_1, x_2, ...x_t, x_1, x_2, ...x_t)$ where the latter stream is equal to an intertemporal replicate of the former stream. This property allows for comparisons to be made between two income streams of different lengths and is therefore necessary when using an unbalanced panel with missing observations. An implication of this property that may be seen as undesirable is that it implies that rearrangements in the order of incomes will not affect the measure. While it is certainly possible that the order in which incomes arrive would have an impact upon insecurity, it is difficult to define precisely what the effect would be, or judge its importance. For instance it would be tempting to describe an income stream where the incomes have been ordered in a declining fashion as more insecure than incomes ordered in an increasing fashion. Such a judgment however appears to be based upon extrapolating these trends into the future, where it is expected that an income that trends up will have a higher average value in the future than an income that trends downwards. As however we are considering insecurity only over a fixed time period and as a scale invariant concept these factors should not be important. Analogously it is unclear to us whether a period of high income followed by a period of lower income is necessarily better or worse than the converse for a given income level over a specified time interval.

3. Intertemporal transfers. As insecurity is generally considered an increasing function of income volatility, any transfer of income from a higher period to a lower period should decrease the measure, while the converse transfer should increase the measure. In addition the intertemporal transfer must be sufficiently small such that the incomes are not reversed. More formally if we consider two income streams $x = (x_1, x_2, x_3)$ and $y = (x_1, x_2 + \varepsilon, x_3 - \varepsilon)$ then $I(x) < I(y)$ if $x_2 < x_3$ and $\varepsilon < x_3 - x_2$ where ε is the intertemporal transfer. This ensures that I is an increasing function of the volatility of x. It is also useful to require that $I = 0$ when all incomes are equal and hence the insecurity index is strictly positive when there is a degree of volatility within the income stream.

6

4. Diminishing intertemporal transfers. Given the asymmetry between losses and gains highlighted by Tversky and Kahneman (1991) a measure should place an increasing sensitivity on sharp reductions in income. For this reason a transfer of income from a period of middling income to a period of very low income will have a larger reduction in insecurity than a transfer from a period of high income to a period of middling income, and that the effect will diminish when the considered incomes increase.

The first of these properties is analogous to the relativity axiom of inequality measurement discussed by Foster (1983), Sen (1973) and Cowell and Kuga (1981) amongst others, while the second is the series equivalent of Dalton's (1920) population replication axiom which is normally applied to incomes in parallel. The property of intertemporal transfers is equivalent to the Pigou-Dalton transfer principle, stating that inequality is reduced if a small quantity of income is transferred from a higher to a lower income earner. Lastly the increased sensitivity of the measure to lower incomes comes from Kolm's (1976) diminishing transfer principle, which requires the same extra sensitivity at the lower end of an income distribution of a cross sectional inequality metric.

If the given properties are considered reasonable the relative inequality between the longitudinal series of incomes will make an appropriate index. An inequality metric that has a certain appeal is Atkinson's (1970) measure[4] which is well known to satisfy properties 1-4 (Cowell and Kuga, 1981). To place Atkinson's index in the context of an insecurity measure suppose an individual receives the income stream $x_i = (x_{i1}, x_{i2}, ...x_{it})$ over t time periods. If there are insufficient mechanisms in place to smooth the incomes stream through time, it is likely that this individual may prefer to accept a slightly lower average income if the new income level could be fixed without fluctuations. As this implies that volatile long run incomes are less desirable than steady incomes, we proceed by adjusting estimates of the permanent income of each individual to account for this disutility. To capture this aversion to volatility we use the following utility function

$$U(x) = \frac{x^{1-\gamma}}{1-\gamma} \tag{1}$$

where γ is a measure of risk. Choosing a value of zero for γ implies no aversion towards income volatility for the individual such that he or she would be indifferent between any two income streams of the same average monetary amount, while positive values for γ introduce an element of concavity to the utility function and a corresponding degree of aversion to income volatility. In this paper we make a fairly arbitrary selection of $\gamma = 0.3$, though the results presented are fairly robust to changes in this value. Once a choice for γ has been

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[4]Osberg (1998b) discusses this technique as a measure of insecurity though he expresses some reservations about conflating the cost of 'risk' with the cost of uncertainty with this method. While this author notes that 'risk' may be an imperfect proxy for insecurity, Dynan et al. take the point further, explaining that income volatility is also an imperfect proxy for income risk.

made, an immobile, 'risk free' income level for each individual that yields the same utility as income stream $(x_{i1}, x_{i2}, ... x_{it})$ may be determined. This income represents an alternative to the original income stream and is fixed throughout time such that an individual earning this income level is free of the economic insecurity from income volatility. This income level may be calculated as

$$x_i^{CE}(\gamma) = \left[\frac{1}{t} \sum_{s=1}^{t} U(x_{is})(1-\gamma) \right]^{\frac{1}{1-\gamma}} \tag{2}$$

where x_i^{CE} is referred to as a 'Certainty Equivalent' (CE) income that provides the same utility as the original income stream. The CE income will match the risk free permanent income when incomes are constant through time (i.e. $x_i^{CE} = x_i^*$ if $x_{i1} = x_{i2} = ... x_{it}$) where x^* is the arithmetic series average or 'permanent' income. If there is a degree of volatility through time however (e.g. $x_{i1} \neq x_{i2}$) then the CE income will be less than the average level (i.e. $x_i^{CE} < x^*$), reflecting the reduction utility due to the risky nature of the income stream.

From the CE income we also define a 'risk premium' for individual i as $r_i = x^* - x^{CE}$. This provides a measure of the burden of the risk borne by the individual in dollar terms and may be interpreted as the maximum amount the person is willing to pay per year to make his or her income stable over time period $1...t$. The greater the risk premium r_i, the greater the volatility of the income stream $(x_{i1}, ... x_{i2}, ... x_{it})$ and the greater the income insecurity faced by the individual. If the risk premium r_i is expressed as a proportion of the household permanent income we arrive at our definition for Atkinson's inequality index $A_i = r_i / x_i^*$ which is used as our insecurity metric throughout the rest of the paper.

As we are employing simple descriptive statistics to examine income volatility our approach is similar to that advocated by Shin and Solon (2008) who avoid the use of dynamic income functions. A disadvantage of this method is that it leaves our measure sensitive to volatility from economy-wide factors such as GDP growth and inflation. As a primary source of this volatility is income growth we feel that the approach we have outlined is only permissible if we filter out these effects. This is done by rescaling of the incomes in each wave such that the incomes are equalized at the mean of the first wave. The implication of this rescaling is that measurement of insecurity only considers income volatility relative to the mean of the distribution. Thus a business cycle that affects all households proportionally will have no influence on the measure, however any movement that affects relative positions within the distribution will be detected. Although proportional movements in the entire economy will contribute to the insecurity faced by the individual, economy wide volatility is generally much smaller than the volatility faced by any specific individual and we feel it is reasonable to simplify the problem by ignoring this issue.

8

3   Data

The data for our study comes from the Cross National Equivalence File compiled at Cornell University. Known as the CNEF, this file consists of panel surveys including the Panel Study of Income Dynamics (or PSID) from the United States, the British Household Panel Survey (BHPS), the German Socio-Economic Panel (GSOEP) and similar datasets from other countries such as Australia, Switzerland and Canada. Each survey is designed to be approximately representative of the population of the country from which it was drawn. The CNEF is valuable in that it unites comparable variables from these surveys across countries and gives constructed variables that are not directly available from the original sources. These features greatly simplify the process of making cross national comparisons. Burkhauser et al. (2001) provides a thorough explanation of this dataset.

For this paper we take the harmonized data on pre-government and post-government household incomes for our three countries. Our time span is 1990-2005 for German data while British data covers 1991-2004. This is the longest available time period for British data and it was considered undesirable to use German data that extended significantly beyond this range. We take data from the United States starting in 1990 and ending in 2005 however the PSID changed from being an annual survey in 1997 to being semi-annual and hence every second wave is missing from this year onwards. The effect of missing waves upon our analysis was discussed in the previous section.

In all cases we use the pre-government household income variable I11101XX and for Britain and Germany we use the post-government household income variable I11102XX. Data on United States post government income was not recorded in the PSID after 1992 and hence we use the simulated series created using the TAXSIM algorithm written by David Feenberg (Feenberg and Coutt, 1993) in its place. This program is designed to approximate the effect of taxes on United States incomes and is recommended for this purpose in the PSID handbook. For all three countries the pre-government income series' capture the combined income of household members before tax, though there are a few technical differences in recording which can be found by consulting the relevant codebooks. The post-government income series measures the sum of incomes accruing to household members after taxes and transfers for all household members. Again there are some small technical differences that can be found between the countries.

In preparing the data, each household income (both before and after tax) is equivelised by dividing through by the square root of the household size to give an approximation of the income accruing to each individual, and the households were weighted by the number of members in each time period. In addition to this weighting, we employ the longitudinal weights provided in the CNEF file to account for biases caused by attrition between the surveys. As we are interested in studying income volatility and such volatility may be caused by uniform economic growth or inflation, we mean-equivelize our data by rescaling each wave such that the average income in every wave is set equal to the mean income

in the first year. Also in order to study the income dynamics of households we require that each household report non-zero incomes for at least two years. This is rather undemanding on our data as most households have few missing values and we have upwards of 9,000 households included in the sample for each country. Lastly we drop negative incomes from all periods, though these only constitute a tiny fraction of sample. Zero incomes are included.

4 Income Insecurity in the United States, Britain and Germany

To measure insecurity in our three countries we apply Atkinson's inequality metric to longitudinal income data from the CNEF file, generating an estimate of the insecurity faced by each household over the time period. The average value of this index for United States households for pre-governmental incomes is 0.091 and the value falls to 0.051 after taxes, transfers and other forms of government smoothing. This implies that on average, United States households bear an income risk equivalent to about 9% of their pre-government permanent incomes and 5% of their post-government incomes. We note however that these value are sensitive to our arbitarily chosen value for γ.

Applying the same techniques gives the average value for the index of 0.063 for Britain for pre-government incomes and 0.015 for post government incomes, while for Germany the corresponding figures are 0.052 and 0.011. The results show a high level of insecurity in the United States relative to Britain and Germany for both pre and post tax incomes. It is interesting to note that the magnitudes of the reductions in insecurity attributable to the governments are approximately the same (.04 on average in the United States, .042 in Germany and .047 in Britain) indicating that all three governments absorb approximately the same level of household income insecurity in absolute terms. This suggests that the higher insecurity level of post-government income in the United States is primarily down to a greater volatility in pre-government incomes than an insufficient degree of government smoothing. If we consider the effect of government smoothing in relative terms however we find that the United States government absorbs less than 45% of measured insecurity, which is much lower than the 75% in Britain and the 80% of German insecurity.

An issue of particular interest is how this insecurity is distributed with income within each of our countries. As we have an estimate of the insecurity faced by each household we can investigate the relationship between the distribution of insecurity and the distribution of permanent incomes amongst households. To do this, a concentration curve for Atkinson's index is generated by ordering household incomes from lowest to highest, and plotting the cumulative proportion of the population share against the cumulative proportion of aggregate insecurity. If household i has weighting w_i the cumulative population share and cumulative insecurity share can be given as

$$p_j = \frac{\sum_{i=1}^{j} w_i}{\sum_{i=1}^{n} w_i} \qquad\qquad q_j = \frac{\sum_{i=1}^{j} A_i}{\sum_{i=1}^{n} A_i}$$

The horizontal axis of Figures 1, 2 and 3 gives the cumulative population share and the vertical axis gives the proportion of the total economy wide insecurity borne by the lowest earning proportion p. It is straightforward to verify that a plot of q against p must pass through the origin (as the lowest earning 0% of income earners will receive 0% of the total economy wide insecurity) and termination point [1,1] (as the lowest earning 100% will receive 100% of all aggregate insecurity). In all cases the red line gives the cumulative insecurity share of A determined from pre-government incomes and the blue line gives the corresponding share for post-government incomes. In all figures (1-6) the horizontal axis is formed by splicing together both pre and post-governmental income variables. For this reason the household referred to at the pth percentile of the pre-government cumulative insecurity share curve will not necessarily be the same household referred to at the same percentile on the corresponding post-government cumulative insecurity curve. This is a result of the ordering of households from lowest to highest in terms of equalized permanent incomes being slightly different after government taxes and transfers.

The concentration curve for Britain in Figure 1 below shows that insecurity is heavily distributed on lower income earning households. The lowest earning 10% of Britons can be seen to accrue approximately 40% of all national income insecurity in pre government incomes and around 18% of insecurity in post-govt incomes. Both figures are disproportionately large. That the red line denoting pre-govt insecurity lies at all times above the proportional 45° line indicates that the lowest earning proportion p always bears a disproportionately high level of market insecurity. Similarly the red line also lies above the blue for the entire distribution (except the trivial instances of the origin and termination point) indicating that the government lessens the proportional insecurity share of the lowest earning proportion p for all $0 < p < 1$. Another notable feature of the plot is the intersection of the blue post-govt insecurity share curve with the 45° line around the 90th percentile. This indicates that households receiving the top 10% of incomes bear a slightly greater than proportional share of insecurity in post-govt income.

Despite insecurity levels in Germany being slightly lower than in Britain, the distribution of insecurity is more concentrated amongst low income earners. Figure 2 reveals that the lowest earning deciles bear around 43% of all pre-govt insecurity and 24% of post government insecurity, while similar results persist for higher decile shares. As for Britain, insecurity in market incomes is always disproportionately higher than population share, though for post-govt incomes there is evidence that the highest earning 6% also accrue a slightly greater than average insecurity share.

While the results for Germany and Britain are reasonably similar, there are some notable differences for United States data as illustrated in Figure 3.

Figure 1: Pre-government and post-government income concentration of insecurity for lowest earning proportion p in Britain
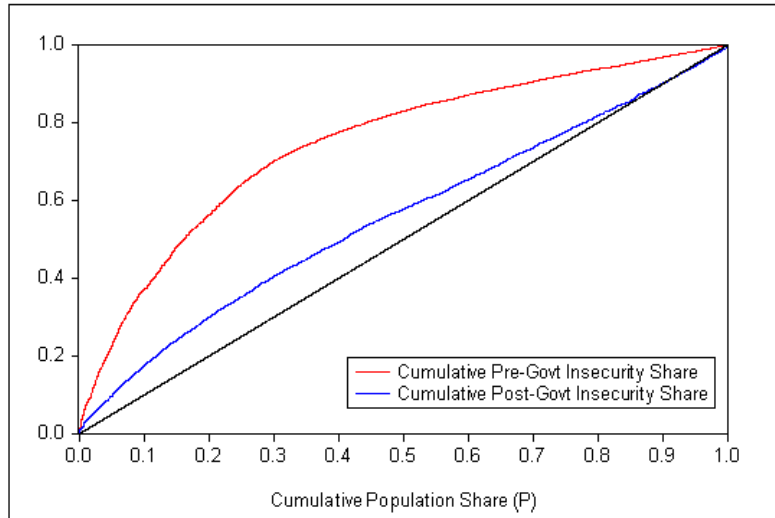

Figure 2: Pre-government and post-government income concentration of insecurity for lowest earning proportion p in Germany
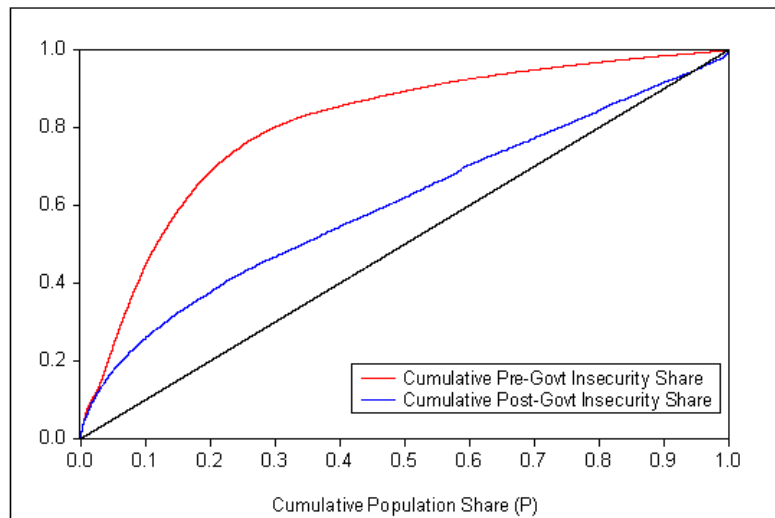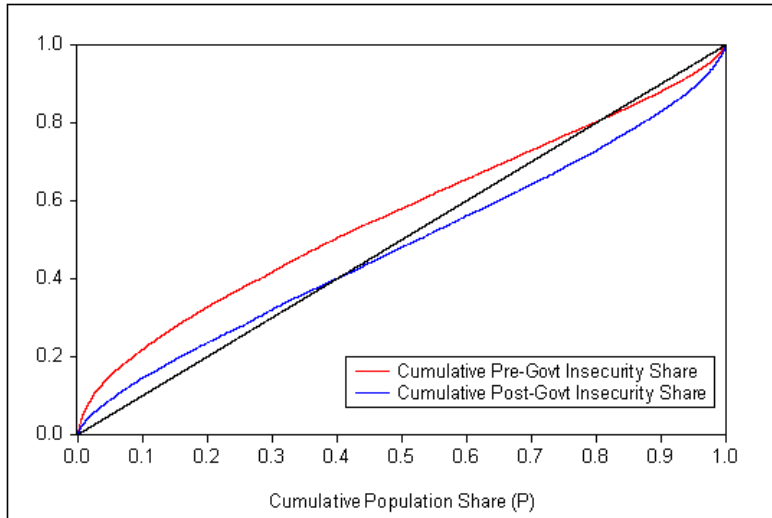
Figure 3: Pre-government and post-government income concentration of insecurity for lowest earning proportion p in the United States

While insecurity is far higher in the United States than the other countries it appears to be much more equally distributed, with both pre-govt and post-govt cumulative insecurity curves lying closer to the 45° line signifying proportional distribution. For the purposes of comparison we can see that the lowest earning 10% of Americans receive 22% of total American insecurity in pre-govt income, and only 14% of post government insecurity, considerably less than for Britain or Germany. Both curves can also be seen to intersect the 45° line, indicating the increased relative insecurity of higher income earners.

The slope of the lines at a specific point can also be used to make inferences about the insecurity of households earning at the relevant percentile. If the slope of the curve is greater than the 45° line at a given point, the household represented at that point faces a disproportionately high level of insecurity relative to the entire economy, while a slope less than the 45 degrees implies a lower level of proportional insecurity. Thus it can be seen that for British households both pre–govt and post-govt insecurity is disproportionately high for the lowest earning 25% while disproportionately low for the upper 75%. Similarly for Germany the lowest earning 25% bear disproportionate insecurity in pre-govt incomes and the lowest earning 15% bear disproportionate insecurity from post-govt incomes. For the United States both pre-govt and post-govt curves are steeper than the proportional line for the lowest and highest deciles, again indicating that insecurity is high at both ends of the United States permanent income distribution, a result consistent with recent research by Dynan et al (2007).

We can also examine the influence of government on insecurity for persons at a particular percentile by comparing the slope of the lines at this point. If the red, pre-govt line is steeper than the blue line then the government is distributing relative insecurity away from the household at that percentile, while if the blue line is steeper the government is distributing relative insecurity towards the household at that percentile. Both the German and British governments distribute relative insecurity away from lower income earners (although the German government does not achieve this for very low income earners, see Figure 2) and begin redistributing to income earners at around the 30-35% percentile (the gap between the pre-govt and post-govt plots is maximized at this point for both countries). In the case of the United States it can be seen that both cumulative insecurity curves are steep at the extremities of the distribution (very high and low income earners) while fairly flat for middle income earners, indicating that United States insecurity is reduced for the middle class.

These findings can be supported by examining the relationship between income and insecurity more directly. Figures 4, 5 and 6 give a weighted 101 unit spatial moving average of Atkinson's inequality index (denoted A) against our estimates of pre-government and post-government permanent incomes in 1990 units (1991 for Britain). The 101 unit moving average is obtained for each point by ordering households in terms of pre and post-government income and averaging each point with the 50 observations below it and the 50 observations above it. This technique gives a smoothed representation of the average insecurity level for a given permanent income level, though it involves a loss of data at the extremities of the income distribution. The moving average is useful as we know that our time span is far too short for a household to experience all the potential income risks that it was exposed to. Thus when the index is aggregated across individuals we are employing a "law of large numbers" approach to get a truer picture of the risks faced by a household rather than the risks that were actually realized. Again in the plots the red line gives the pre-govt moving average insecurity level while the blue line gives the post-govt moving average insecurity level. The units on the x axis depend on which curve is being examined. When refering to the red line the x axis gives the pre-goverment permanent income while the same axis gives the post-goverment permanent income when observing the blue line.

14

Figure 4: Smoothed Insecurity against Permanent Income – Britain 1991-2004
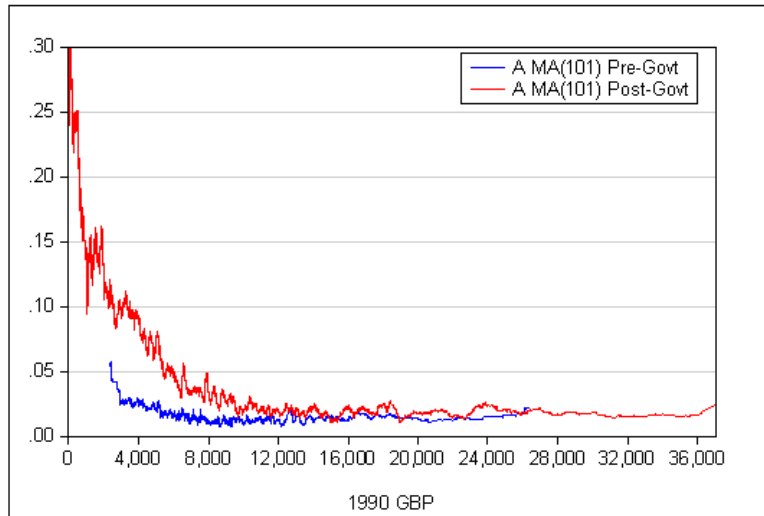

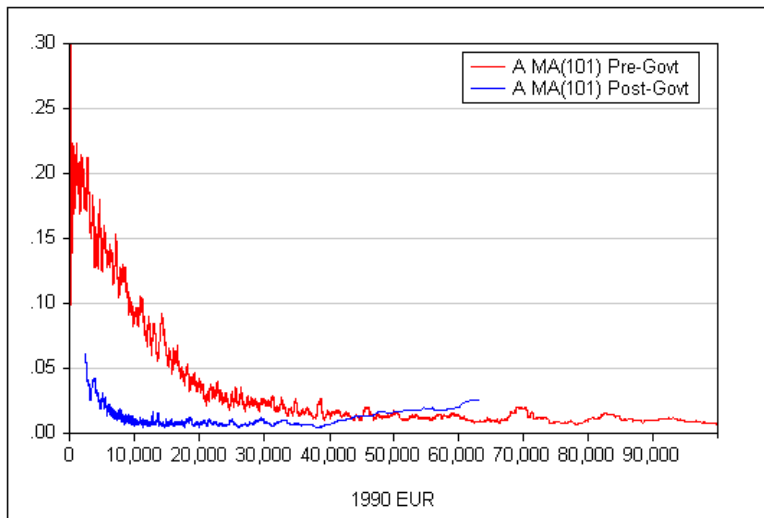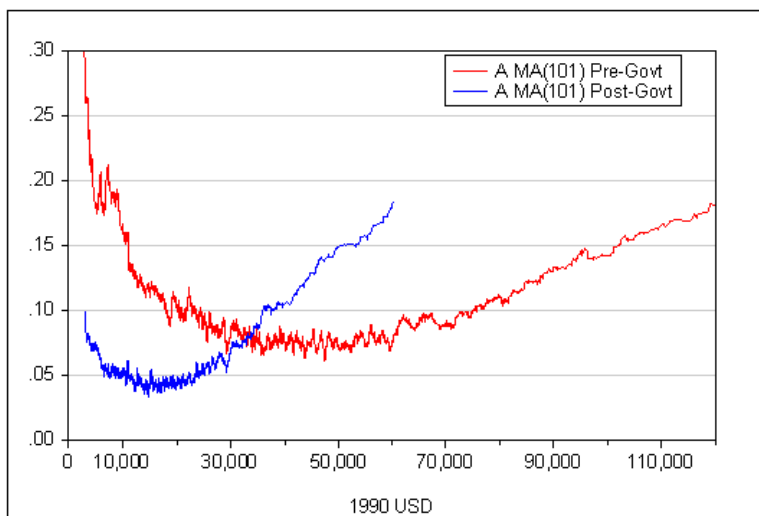Figure 5: Smoothed Insecurity against Permanent Income – Germany 1990-2005

Figure 6: Smoothed Insecurity against Permanent Income – United States 1990-2005

Again the results show the similarity between the joint distribution of insecurity with income in Britain and Germany and the smoothing role played by the respective governments. Insecurity is naturally higher amongst low income earners and both governments insulate lower income earners from this phenomenon, but without completely removing the bias. In the United States the pre-govt insecurity follows a remarkable 'U' shape, being very high for both low and high income earners and lower for middle income earners. The United States government is effective for absorbing insecurity for low income earners but does not do this for high income earners and thus the post-govt income insecurity index is more of a skewed 'U' shape with greater insecurity on high income earners.

5   Conclusion

This paper has sought to analyze income insecurity in the United States, Britain and Germany. While insecurity is a difficult phenomenon to quantify as it involves perceptions about one's future, we argue that a series application of Atkinson's inequality index to household equalized income makes a reasonable ex-post measure. We apply this technique to longitudinal CNEF data for the three countries from 1990-91 to 2004-5 and learn that insecurity as we measure it is much higher in the United States than in Britain or Germany. By taking both pre-govt and post-govt incomes we learn that the United States government absorbs only slightly less income volatility than the other governments, and

16

hence the higher insecurity in the United States may be attributed to highly uncertain market incomes rather than a low level of governmental insulation.

We also examine the distribution of insecurity with income and find that in Germany and Britain there is a strong tendency for low income earners to have high insecurity, and that insecurity generally decreases with income in these countries, except for very high income earners. This pattern persists before and after the influence of government, though it is less pronounced for incomes after taxation and transfers. In the United States the largely negative relationship between insecurity and income breaks down after a pre-govt equivalised household income of around $50,000USD and an equivalent post-govt income of around $18,000. After these points insecurity appears to rise with permanent income.

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