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DISTRIBUTIONAL CHARACTERISTICS OF INCOME INSECURITY IN THE U.S., GERMANY, AND BRITAIN

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This paper studies income volatility using recent data from the Cross National Equivalence File (CNEF). Measures of downward instability are applied to household income streams and the results are interpreted as indicators of income insecurity. Using this method we examine (i) cross national differences in average insecurity levels, (ii) the effects of taxes and transfers, and (iii) relationships between the insecurity index and household income. Insecurity estimates based on pre-government incomes are highest in Britain and lowest in Germany, however results for post-government incomes are highest in the U.S. It is also shown that insecurity estimates based upon pre-government incomes are heavily concentrated at the lower end of the distribution; although governments are effective at smoothing the income streams of these households. We also search for determinants of our measure and find that gender, household size, health status, and industry affiliations of the household head are the most significant covariates.

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1. Introduction

There is an emerging interest amongst academic researchers in the topic of economic insecurity. Although there are a number of working definitions, the concept broadly refers to a state of stress or anxiety felt by individuals when contemplating their financial futures. This idea has been consolidated by Bossert and D'Ambrosio (2013), Hacker (2006), and a number of works by Osberg (1998, 1999, 2009, 2010), Osberg and Sharpe (2002, 2008), and Sharpe and Osberg (2009) who have characterized insecurity in terms of perceptions of threats to future income or wealth. These threats include unemployment, illness, unexpected expenses, retirement, widowhood, crime, and a range of other factors.

Concern for economic insecurity relies upon the assumption that it is the cause of significant social costs. If such costs exist (as argued by the above authors) these should be included in an understanding of how personal or household finances translate into economic welfare. Thus for the formation of economic

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policy, and in particular the construction of social safety nets, there is a need to measure the strength of this phenomenon and identify households that are most at risk. This task is complicated as insecurity is a subjective experience, however it may be simplified by separating the welfare effects into two distinct components: (i) direct disutility from uninsured risk, and (ii) additional psychological afflictions stemming from that risk. The first point is straightforward; households that are constrained in their ability to smooth consumption through time have lower lifetime utility as shocks to income or wealth can lead to over consumption in some periods and under consumption in others. The psychological distresses associated with income risk however are more difficult to study given that they are highly dependent on personal characteristics. Nevertheless there is substantial evidence of their importance. For example, Kahneman and Tversky (1979) and Tversky and Kahneman (1991) highlight a cognitive bias for individuals to view losses and gains asymmetrically, with a greater emphasis placed on losses than gains. Similarly Akerlof and Kranton's (2000) work on economics and identity suggests that there are likely to be significant social and psychological costs for an individual who is unable to meet certain social norms concerning employment and consumption. Furthermore, a survey based study by Luechinger *et al.* (2009) shows that individuals with more secure employment exhibit higher subjective wellbeing scores, while links between various other stresses and perceptions of economic risk are studied by Scheve and Slaughter (2004) and Dominitz and Manski (1997). Other empirical evidence comes from Offer *et al.* (2010) and Smith *et al.* (2009) who highlight links between insecurity and obesity.

In this paper we set out to measure economic insecurity in three developed countries but confine ourselves to only one aspect—income volatility, and ignore other sources of risk and the associated psychological costs. Reflecting this limited scope we refer to our results as measurements of "income volatility" or "income insecurity" to indicate the specific nature of the work. Our method is thus related to other areas of income dynamics such as transitory variation and income mobility. Transitory volatility in income or earnings (Moffitt and Gottschalk, 2002) is conceptually similar to income insecurity, however the concepts are not identical as insecurity can be the consequence of both short and long run prospects. The similarities between insecurity and mobility (Jarvis and Jenkins, 1998) also suggest that mobility indices could capture certain aspects of insecurity, however there are enough differences between the concepts to warrant altogether independent approaches.[1] Unlike typical mobility indices such as the Shorrocks R coefficient (Shorrocks, 1978),[2] a measure of insecurity should ideally be focused mostly on the threat of downward drops rather than non-directional or inequality reducing movements.[3]

[1]See Jenkins and Van Kerm (2006), Burkhauser and Poupore (1997), and Canto (2000) for examples of this literature. In particular note the various conceptualizations of mobility and their decompositions discussed by Van Kerm (2004) and Gottschalk and Spolaore (2002). The directional mobility discussed by Fields (2005) is also applicable.

[2]This measures the extent to which inequality declines over an extending accounting period, thus decomposing it into permanent and transitory components.

[3]See Bénabou and Ok (2001) for a discussion of directional mobility within the context of the Shorrocks index.

Given these guidelines a number of authors have produced individual level insecurity measures, including Hacker (2006) and Hacker *et al*. (2010) who focus on the proportion of households exposed to large drops in income (a 25 percent reduction from one period to the next coupled with a lack of liquid assets), and Barnes and Smith (2011) and Smith *et al*. (2009) who construct indices based upon the predicted probabilities of events such as unemployment or falling below a particular poverty line. Other work comes from Nicholls and Rehm (2012) who consider decomposition methods for measuring volatility. The methods employed in these works focus on downside risk and are by necessity somewhat *ad hoc*, given that there is a great deal of uncertainty as to how insecurity manifests itself, in particular the way that trends and fluctuations in income translate into anxiety about the future.[4]

In this paper we take a similar approach to these works (and related pieces such as Dynan *et al*. (2007) and Shin and Solon (2008)) by studying income dynamics using simple descriptive statistics. This appears to be an effective way to generate certain types of proxy measures that model downward instability in household income streams. As instability can be both a cause and a symptom of insecurity at the household level, we would expect that such indices would capture a substantial component of insecurity as a whole. While this approach is simple and intuitive, there are a few imperfections worth addressing. First, an insecurity measure should ideally be *forward looking* as it deals with future perceptions, however as we only measure realized volatility, this approach is *backward looking* and ignores income risks that did not eventuate. Second, it is unclear what the relationship between income fluctuations and insecurity actually is. For example, a decline in income due to voluntarily taking time off work may not cause insecurity, while involuntary absences such as from retrenchment are likely to have strong negative effects.

While these problems reveal a disconnection between theory and practice, they need not be too severe. Realized income volatility is likely to make a good proxy for future income insecurity if agents form their expectations based on past experience, so a backward looking measure can have some forward looking relevance. Moreover, while it is difficult to determine the extent to which a single income fluctuation drives insecurity of a household, it is reasonable to apply a "law of large numbers" argument to income fluctuations across households. Therefore insecurity comparisons over large samples of similar households should be informative although comparisons between individual households will be less so, as the latter are sensitive to various idiosyncratic factors.

In the paper we develop two measures of risk applicable to household income streams. The first index measures volatility in a raw sense and treats all fluctuations equivalently, while the second considers volatility associated only with declining incomes. It is argued that the first measure is useful as an aggregate insecurity index while the second may be employed at the household level. Once established the methods are applied to households from the U.S., Germany, and Britain. Estimates are produced based on incomes taken before and after the effects of

[4]An exception is the recent work of Bossert and D'Ambrosio (2013) which builds an index from axiomatic foundations.

government and hence allow us to assess the overall influence of policy on results. Given that these three countries are considered good examples of alternative economic models, our results are intended to shed light on broader questions associated with the role of government. We then examine the relationships that our insecurity indices have with income to determine whether insecurity is concentrated at one end of the income distribution. If insecurity is higher for low income households, this is of considerable interest as low income households are also less likely to have significant savings and less access to credit markets which would otherwise be useful in managing unexpected shocks. Lastly we search for various correlates of the index with the goal of identifying households that are most exposed to income risk such that they can be appropriately targeted by policy.

2. Income Volatility and Insecurity

To produce a proxy measure of insecurity we take a vector of realized incomes for each household and summarize the risk inherent in the observed stream. While a number of techniques are available, a method that has some appeal is the use of Social Welfare Function (SWF) measures studied by Atkinson (1970), Blackorby and Donaldson (1978), and Ebert (1987) amongst others. This approach has the benefit of tying income volatility to lost welfare and has been applied to income streams before by Osberg *et al*. (1998), Makdissi and Wodon (2003), Cruces (2005a, 2005b, 2006), and Allanson (2008).[5]

Consider the income stream $x_i = (x_{i1},\ x_{i2} \ldots x_{iT})$. If there are insufficient mechanisms in place to smooth through time, it is likely that the household may prefer to accept some slightly lower average income if the new level could be free from fluctuations. As this implies that a volatile income stream is less desirable than a steady one, we proceed by adjusting income streams of each household to account for this. The function $u_{it}(x_{it}) = x_{it}^{1-\alpha}/(1-\alpha)$ is used where u_{it} is the welfare of household i in period t and α specifies an attitude to risk. Choosing a value of zero for α implies no aversion toward income volatility while positive values introduce a degree of risk aversion.

Once a choice for α has been made, a constant income level is determined for each household that yields the same welfare as x_i. This income represents an alternative to the original income stream and is fixed throughout time such that an individual at this income level is free from the negative effects of volatility. This income level may be calculated as

$$x_i^{CE}(\alpha) = \left[\left(\frac{1}{T}\sum_{t=1}^{T} u_{it}\right)(1-\alpha)\right]^{\frac{1}{1-\alpha}} \tag{1}$$

where x_i^{CE} is referred to as the Certainty Equivalent (CE) income that provides the same welfare as the original stream. We also define a long-run income level x_i^* which is the arithmetic average of household incomes over the time period. The CE

[5]Osberg (1998) has also employed this technique in the context of insecurity, however he expresses some reservations about confusing the cost of "risk" with the cost of uncertainty with the method.

income will match the long-run household income when incomes are constant through time (i.e. $x_i^{CE} = x_i^*$ if $x_{it} = x^* \ \forall t \in T$). 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. $x_i^{CE} < x_i^*$), reflecting the reduction in utility due to risk.

From the CE income a "risk premium" exists for each household defined as $r_i = x_i^* - x_i^{CE}$. This provides a measure of the burden of risk borne by the individual in monetary units. The greater the risk premium, the greater the volatility of the income stream. If r_i is expressed as a proportion of the household long-run income we arrive at a definition $I_i = r_i \Big/ x_i^*$ which forms the basis of the two indices used throughout the paper.[6]

A potential issue is the sensitivity of the approach to macroeconomic movements such as economic growth or inflation, which will add to nominal household income volatility. However if all household incomes move proportionately it is not clear that these movements should contribute strongly to insecurity. To filter out these effects we rescale incomes in each year such that the mean income of all subsequent years is set equal to that of the first. The implication of this rescaling is that the measurement only considers income volatility relative to the mean of the income distribution. Thus a business cycle that affects all households exactly proportionally will have no influence on the measure; however a recession that affects the relative positions within the distribution (e.g. a large decline in incomes for some individuals, and little to no change experienced by others) will still drive the index. As a result of this rescaling the "long-run" income level x^* does not have the convenient interpretation of a permanent income. This "long-run" income level is slightly less than but approximately proportional to the permanent income level.

A second difficulty is that I ignores the order in which incomes arrive. If a steady increase is observed over multiple time periods this will appear as a volatile income stream even though it may be the product of a process of advancement that has little to do with insecurity. Our method for handling this is to censor I such that we only consider volatility for incomes that have lost ground relative to the overall trend. A time series regression of the form $x_{it} = \phi_0 + \phi_1 t + e_{it}$ is estimated for each household and the main measure we employ is $I^* = I$ if $\hat{\phi}_1 < 0$ and $I^* = 0$ for $\hat{\phi}_1 \geq 0$ meaning that households that increased their relative income share over time were judged to be free of income insecurity. Such estimates thus measure a sense of downward instability that is driven by both (i) variability in income and (ii) a negative slope coefficient. The first component (intertemporal variation) is valuable as an indicator of insecurity in the near term as a highly volatile income will *ceteris paribus* highlight changeable income streams. Such instability will likely impact negatively on the sense of economic safety of the household due to uncertainty in forecasting future values. The second component (a negative trend) requires that this changeability results in an erosion of the household's financial position over time and corresponds with a more long term conceptualization of insecurity. At the household level I^* is therefore our cleanest indicator of income insecurity and is the main measure used throughout the paper. As such the truncated version will be employed when examining distributional characteristics that

[6] I is therefore an alternative formulation of Atkinson's inequality index.

depend on household level estimates. Conversely the non-truncated estimates I are only used for an initial analysis of estimates averaged over the entire sample (where all income trends will average out) where its average is interpreted as a summary measure of bottom heavy, economy-wide volatility.

3. Data

Data come from the Cross National Equivalence File (CNEF) compiled by researchers at Cornell University. The CNEF is valuable for cross national comparisons as it draws comparable variables from these surveys across countries and provides constructed variables that are not directly available from the original sources (Burkhauser *et al*., 2001). For the paper we take data on household incomes for the U.S.,[7] Britain, and Germany. Our time span is 1991–2007 for German data while British data covers 1991–2006. This is the longest available time period for British data and we limit German data to the same period. Data taken from the U.S. started in 1991 and continues until 1997 without interruption, however the PSID changed from being an annual survey in 1997 to being bi-annual and every second wave is missing from this year onwards. The final wave of the PSID data used was in 2007 and hence there are five waves missing relative to German data and four relative to Britain.

Cross sectional surveys from each country are merged into panels by matching household heads through time. We also follow Burkhauser and Poupore (1997) by requiring that an income is recorded for each household in every wave of our sample. All other observations are dropped and the data are then weighted by employing longitudinal weights. We also weight each household by the number of occupants and each income is standardized by dividing by the square root of the household size. The waves are then rescaled to the mean of the first wave. Negative incomes are also dropped although these only constitute a tiny fraction of the sample, while zero incomes are included. Lastly we exclude households with heads aged less than 30 years or greater than 55 years averaged over the sample to avoid volatility associated with entering and leaving the labor force.

As well as incomes, various explanatory variables are employed. These include the age, race, gender, self-reported health, years of formal education, marital status, industry of employment, and annual work hours of the household heads. As self-reported health is recorded as an ordinal variable (five scores ranging from "poor" to "excellent"); this is simplified by assigning linear numerical values ranging from 1 (least healthy) to 5 (healthiest).

4. Results

Initially I and I^* are applied to both pre-government and post-government income streams and the results are given in Tables 1 and 2. For Table 1 the number

[7]Post-government incomes for the U.S. are not recorded and hence we use the simulated TAXSIM series (Feenberg and Coutts, 1993). For all three countries the pre-government income series captures the combined total income of household members before tax, and the post-government income series measures the sum of incomes accruing to household members after taxes and transfers for all household members.

TABLE 1

Averaged Estimates for the United States, Germany, and Britain

		United States		Germany		Britain	
		Pre-govt	Post-govt	Pre-govt	Post-govt	Pre-govt	Post-govt
1.	No. of households (n)	1,172	1,172	850	850	620	620
2.	Long run income ($\bar{x}^*$)	30,275	22,775	22,514	15,812	12,421	9,671
3.	Ave insecurity $\bar{I}$ (0.1)	0.0106	0.0061	0.0086	0.0030	0.0163	0.0049
4.	Ave insecurity $\bar{I}$ (0.3)	0.0323	0.0183	0.0269	0.0090	0.0499	0.0148
5.	Ave insecurity $\bar{I}$ (0.5)	0.0549	0.0307	0.0472	0.0151	0.0852	0.0241
6.	$\bar{I}$ (0.5) Omitted years	0.0514	0.0279	0.0410	0.0138	0.0846	0.0224
7.	$\bar{I}$ (0.5) Trimmed	0.0523	0.0289	0.0472	0.0148	0.0791	0.0221
8.	$\bar{I}$ (0.5) Unweighted	0.0682	0.0345	0.0531	0.0156	0.0831	0.0217
9.	$\bar{I}$ (0.5) Constant HH size	0.0635	0.0363	0.0363	0.0117	0.0782	0.0218
10.	$\bar{I}$ (0.5) All ages	0.0712	0.0333	0.0956	0.0157	0.0795	0.0242
11.	Gini (x^*)	0.3586	0.3069	0.2756	0.2171	0.3081	0.2372
12.	Gini (x^{CE}; 0.5)	0.3545	0.3001	0.2829	0.2166	0.3221	0.2391

Note: The leftmost of the paired columns gives results obtained using pre-government incomes while the right hand column gives equivalent results for post-government incomes.

Source: Authors' own calculations from CNEF dataset.

of households in each sample is given in row 1 and average long-run equivalized household incomes (benchmarked at 1991 levels in the respective currencies) are provided in row 2. Estimates averaged across each sample appear in rows 3–10. To check for robustness several sets of results are obtained using slightly different methods. These include using a range of values for α (rows 3, 4, and 5), excluding years 1998, 2000, 2002, 2004, 2006, and 2007 for all three countries as these years are not present in the U.S. or British data at the time of calculation[8] (row 6), trimming the top and bottom 1 percent of households as ordered by income (row 7), and omitting sample weights (row 8). Further checks involve estimates based on households with unchanged size (row 9) and without the age restrictions (row 10). Estimates for trimmed data, unweighted data and for consistent time periods are determined using $\alpha = 0.5$. Gini coefficients calculated from long run and certainty equivalent incomes are reported in rows 11 and 12.

Cross national comparisons can be made by examining the estimates across various rows of the tables. Taking the estimates in row 5 from Table 1 as a baseline shows that Britain has the highest scores in terms of pre-government income, with the U.S. second and Germany last. On this basis we conclude that British pre-government incomes were more volatile relative to trend than for the other two countries. The relative magnitudes of this result are reasonably insensitive to robustness checks, although they do not hold when age restrictions are not applied. For post-government incomes the U.S. has the highest scores followed by Britain and Germany. Again this ordering is insensitive to changes in approach and in this case it holds over all households. The high estimates for U.S. post-government incomes are a little surprising as the literature on dynamics has generally shown incomes in Germany, as being more mobile than in the United

[8]All years are available in the SOEP-CNEF data file, thus eliminating these years leaves a consistent set of waves for all three countries. This is required as the Atkinson inequality index has a degree of small sample bias (Breunig and Hutchinson, 2008) and therefore it is important to express measurements across consistent sample sizes when longitudinal observations are limited.

States (Burkhauser and Poupore, 1997; Maasoumi and Trede, 2001). Recent data however suggest that this difference has been closing or even slightly reversed in later years (Gangl, 2005; Chen, 2009; Bayaz-Ozturk *et al*., 2012), a finding partially attributed to the reunification of Germany beginning in 1990. Other factors that could be contributing to this difference are (i) our measure is a summary over the entire 15 years of data while the aforementioned mobility studies consist of a series of year-to-year comparisons, and (ii) our measures are *bottom-heavy* in that they place an increasing emphasis on low income years relative to high income years. If the German social welfare system is more effective than the corresponding system in the U.S. at protecting households from sharp reductions in income (as is commonly perceived) this may explain our results as such movements are intended to be strong drivers of the index.

The aggregate effect of governmental taxation and transfers on smoothing household incomes can be compared by examining the differences in the index between pre-government and post-government incomes. Taking the ratios of post-government to pre-government estimates for each country (from rows 3–10 in Table 1) shows U.S. estimates based on post-government incomes are 50–58 percent as high as for pre-government incomes, indicating that the U.S. government insulates households from 42–50 percent of measured volatility in pre-government incomes. Similarly post-government German levels are 20–34 percent as high as pre-government levels, and for Britain the corresponding figures are 26–30 percent. Again the results appear consistent to changes in the method and weighting parameters. The finding that the U.S. government does the least in terms of income smoothing while the British and German governments do more is consistent with general expectations about the differences in social welfare systems and the varying roles of governments between the countries.

Results based on the second set of estimates appear in Table 2 and are subject to the same battery of robustness checks as Table 1. Here row 1 reports the

TABLE 2

Averaged Truncated Estimates for the United States, Germany, and Britain

		United States		Germany		Britain	
		Pre-govt	Post-govt	Pre-govt	Post-govt	Pre-govt	Post-govt
1.	No. of households ($n(\phi > 0)/n$)	0.45	0.48	0.33	0.43	0.44	0.47
2.	Ave insecurity $\bar{I}^*$ (0.1)	0.0043	0.0026	0.0044	0.0013	0.0075	0.0021
3.	Ave insecurity $\bar{I}^*$ (0.3)	0.0133	0.0079	0.0141	0.0038	0.0225	0.0063
4.	Ave insecurity $\bar{I}^*$ (0.5)	0.0230	0.0134	0.0245	0.0063	0.0377	0.0107
5.	$\bar{I}^*$ (0.5) Omitted years	0.0297	0.0220	0.0199	0.0058	0.0330	0.0096
6.	$\bar{I}^*$ (0.5) Trimmed	0.0231	0.0130	0.0254	0.0061	0.0378	0.0106
7.	$\bar{I}^*$ (0.5) Unweighted	0.0325	0.0317	0.0215	0.0073	0.0418	0.0122
8.	$\bar{I}^*$ (0.5) Constant HH size	0.0338	0.0224	0.0189	0.0034	0.0346	0.0084
9.	$\bar{I}^*$ (0.5) All ages	0.0415	0.0181	0.0722	0.0071	0.0404	0.0116
10.	Gini (x^{CE}*; 0.5)	0.3541	0.3001	0.2762	0.2156	0.3173	0.2337
11.	Correlation $\rho(I^*(0.5); x^*)$	–0.0938	0.1958	–0.1047	0.1322	–0.2744	–0.0299

Note: The leftmost of the paired columns gives results obtained using pre-government incomes while the right hand column gives equivalent results for post-government incomes.

Source: Authors' own calculations from CNEF dataset.

proportion of observations in each sample that have a non-zero (i.e. uncensored) insecurity value. As expected, the values are lower than in Table 1 due to the censoring of estimates associated with non-negative income trends. For pre-government incomes we again see British figures being mostly the highest, with Germany and the U.S. lower. For post-government incomes we get a clearer ranking with the U.S. having the highest averaged scores and Germany the lowest. These results hold over almost all specifications and are consistent with those presented in Table 1. The ratios of pre-government to post-government estimates are less consistent than for the non-truncated index, ranging from 44–97 percent for the U.S., 18–34 percent in Germany, and 24–29 percent in Britain. While there is a greater degree of variation in these estimates, on average they are similar to the non-truncated case. To preface our results in the next section we also include estimates of the Gini coefficient of inequality for long-run and CE incomes, and correlation coefficients between I^* and the long-run income level (rows 10–11).[9] The results from row 11 imply mostly negative relationships between volatility and income which raises the question of how the two variables are jointly distributed.

5. Relationships Between Income and Volatility

In the following sections we take the truncated household level index I^* and examine its distribution with income and its relationships with various demographic and labor market variables. Initially it is observed that the correlations reported in Table 2 suggest that in most instances, I^* is relatively high amongst low income households. This conclusion is supported by the evidence presented here. We examine the relationship between the estimates used to produce row 4 of Table 2 and the household's long-run income level using 40 unit moving averages across the distribution of income.

Results are graphed for the three countries in panels 1–3 of Figure 1. Although the plots depict only one set of estimates, qualitatively similar results can be obtained using other sets of filters and weights. In each case the dashed lines correspond to averaged estimates from pre-government incomes and the solid lines correspond to estimates from post-government incomes. The plots are constructed such that the units of measurement on the x-axis depend on the curve being examined. The horizontal axis refers to pre-government incomes when interpreting pre-government insecurity and the converse also applies for post-government incomes. Due to the combining of the axes it should be noted that a household represented at a given pre-government income level will not correspond to a household represented at the same post-government income.

The first panel of Figure 1 gives the relationship between long-run income and I^* for the U.S. The most notable feature of the graph is that insecurity scores are

[9]The Gini estimates from Tables 1 and 2 provide a useful check and the results are generally in line with expectations. The U.S. is estimated as having the highest long-run inequality, followed by Britain, then Germany. This is consistent with many findings, the most recent of which is probably Leigh (2009). The inequality estimates are lower in all cases after the influence of government, and the difference between pre-government and post-government incomes is lowest in the U.S.

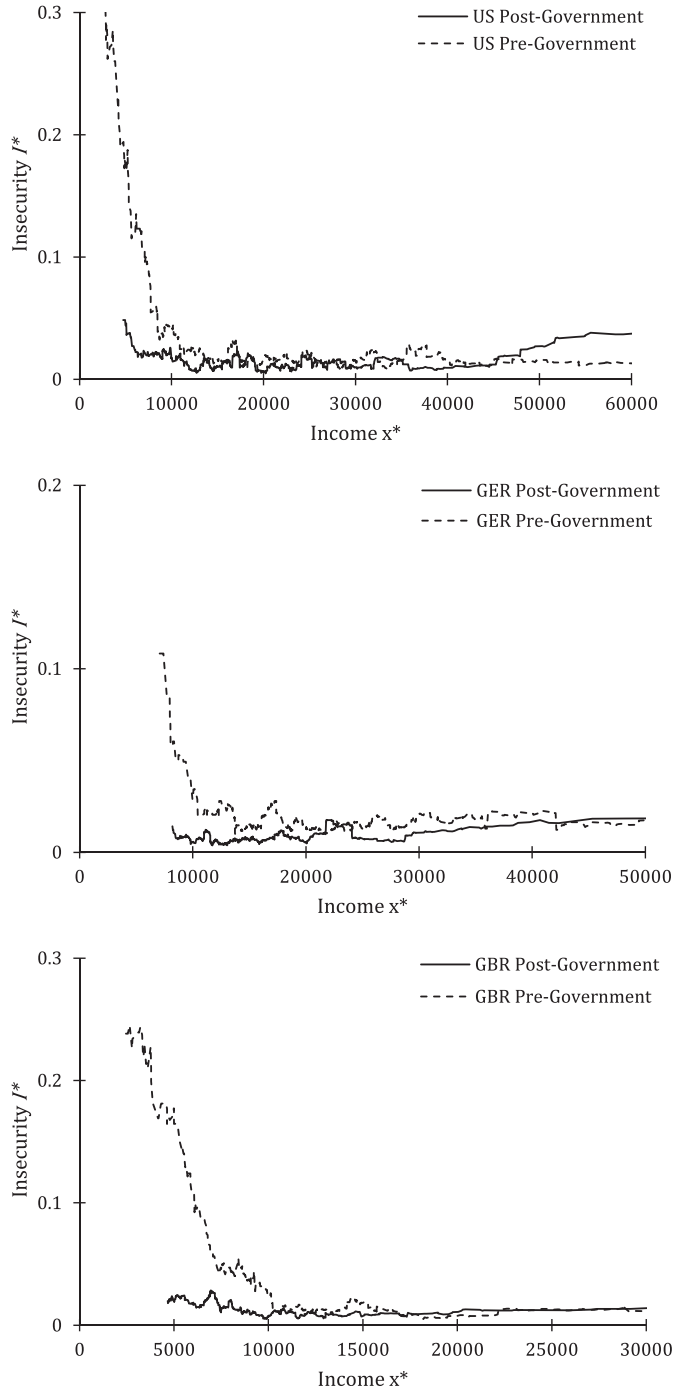

Figure 1. Truncated Insecurity Estimates Against Long Run Income

Note: The horizontal axis gives the long-run income level benchmarked at 1991 levels for both income variables and the vertical axis gives the average insecurity level. Results generated using $\alpha = 0.5$.

high for low income households, a result which is especially strong for pre-government incomes. In this case the dashed line exhibits an "L" shape, declining dramatically with income until a value of around 15,000 USD is reached, after which the curve is mostly flat. For post-government incomes we observe a much more modest decline in insecurity scores for households with under 15,000 USD per equivalized unit. After this point the curve is also low and flat, but rises again slightly for incomes beyond 45,000 USD, indicating a slight increase in insecurity scores for those at the top of the post-government income distribution. Note that the overall positive correlation between income and insecurity estimates for U.S. post-government incomes of 0.1958 given in Table 2 is not especially evident in this diagram. This correlation is primarily driven by a very small number of extremely high incomes which are not evident in the figure. Comparing the two curves it is evident that government taxes and transfers have the effect of smoothing the income streams at the low end of their distribution.

Comparable results for Germany are given in the second panel. Again there are high average scores for low income households and relatively low scores for households with middle and higher incomes. As with the U.S. there is a strong reduction in the magnitudes of the estimates after governmental smoothing. Pre-government insecurity scores decline strongly for incomes less than around 20,000 EUR, after which a small upward relationship is evident. Post-government insecurity scores decline slightly with income for households with less than 15,000 EUR, but the curve follows a slight upward trend thereafter. Once again the effect of government appears to reduce volatility markedly, particularly at the lower end of the distribution.

The representation for Britain in the bottom panel of Figure 1 is broadly similar to the U.S. and Germany, with a strong but diminishing negative relationship between x^* and I^* based upon pre-government incomes and a notable reduction in insecurity for post-government incomes. Both curves bottom out at around 10,000 GBP, however one qualitative difference between Britain and the other two cases is that there is no particular sign of increased insecurity in post-government incomes after a certain income level is attained.

A simultaneous comparison of all three plots suggests that governments in the three countries differ in the extent to which they smooth incomes at lower and higher levels. This can be evaluated by comparing the correlations between incomes and insecurity estimates before and after governmental smoothing. In Britain pre-government insecurity is negatively correlated with income ($\hat{\rho} = -0.2744$) but this is reduced for post-government incomes ($\hat{\rho} = -0.0299$). The difference between the two correlation coefficients provides a rough guide to the extent to which governments are "progressive" in the sense of insulating lower income households from risk more than higher income households. This difference is 0.2445 in Britain, 0.2369 in Germany and 0.2896 in the U.S., indicating that while the U.S. government does less to protect against volatility, it is more progressive in the way that it is carried out. The less negative (or more positive) relationships between income and insecurity for households in the U.S. can be seen as a somewhat egalitarian characteristic, as it implies that a greater level of risk falls upon high income households. This is also evident in the Gini coefficients of inequality from Tables 1 and 2 which compare inequality of long-run incomes (x^*)

with Certainty Equivalent incomes (x^{CE}). While U.S. Gini coefficients are relatively high, they are reduced when considering risk-adjusted income streams over their long-run counterparts, indicating that to some small extent, the distribution of risk serves as a counterbalance to inequality in the distribution of income. This is less so of German or British Gini coefficients, which are relatively low, but both increase or decrease less when this volatility is accounted for.

Concentration Curves

Further light can be shed on the distributional relationships between income, I^* and the effects of government with the use of concentration curves. The curves are generated by ordering household incomes from lowest to highest and plotting the cumulative proportion of aggregate scores against the cumulative population share. If household i has weighting w_i the cumulative population share P_j and cumulative insecurity share Q_j are given as:

$$P_j = \frac{\sum_{i=1}^{j} w_i}{\sum_{i=1}^{n} w_i} \qquad Q_j = \frac{\sum_{i=1}^{j} I_i^* w_i}{\sum_{i=1}^{n} I_i^* w_i}$$

where both P_j and Q_j are defined on the interval [0,1]. Results are again generated using truncated estimates based upon $\alpha = 0.5$ and are shown in Figure 2.

The concentration curve for the U.S. shows that pre-government insecurity scores are highly congregated around low income households, with the lowest 10 percent of the sample accruing approximately 50 percent of the aggregated index. However beyond this point insecurity can be seen as relatively low, indicated by the flatness of the dashed line over the rest of the population. This line crosses the diagonal 45° line (representing an equal share of insecurity over the income distribution) at around the 90th percentile, which implies that the richest few percent also have higher than their proportional share of the index. A similar but far less dramatic relationship is evident for post-government incomes (the solid line), with the lowest and highest 10 percent still exhibiting higher than average scores while the central 80 percent had lower scores.

The concentration of German scores in the second panel is markedly different to that of the United States. First, the curves are much closer to the diagonal equal distribution line and in both cases have much less low-end emphasis. Again looking at pre-government incomes we see a large share of insecurity scores going to the bottom 10 percent (however only around a 30 percent share rather than 50 percent in the previous case) and the curve being fairly flat from then on, indicating a moderately even distribution for all but the lowest households. For post-government incomes the concentration curve only briefly exceeds the equal distribution line before dropping below, suggesting that the lower 5 percent and top 20 percent had higher than average scores while the remainder of the distribution had less.

For Britain we observe a similar relationship between the insecurity index and income as was evident for the U.S. Insecurity in pre-government incomes is particularly high for the lowest 10 percent with around 50 percent of the aggregated

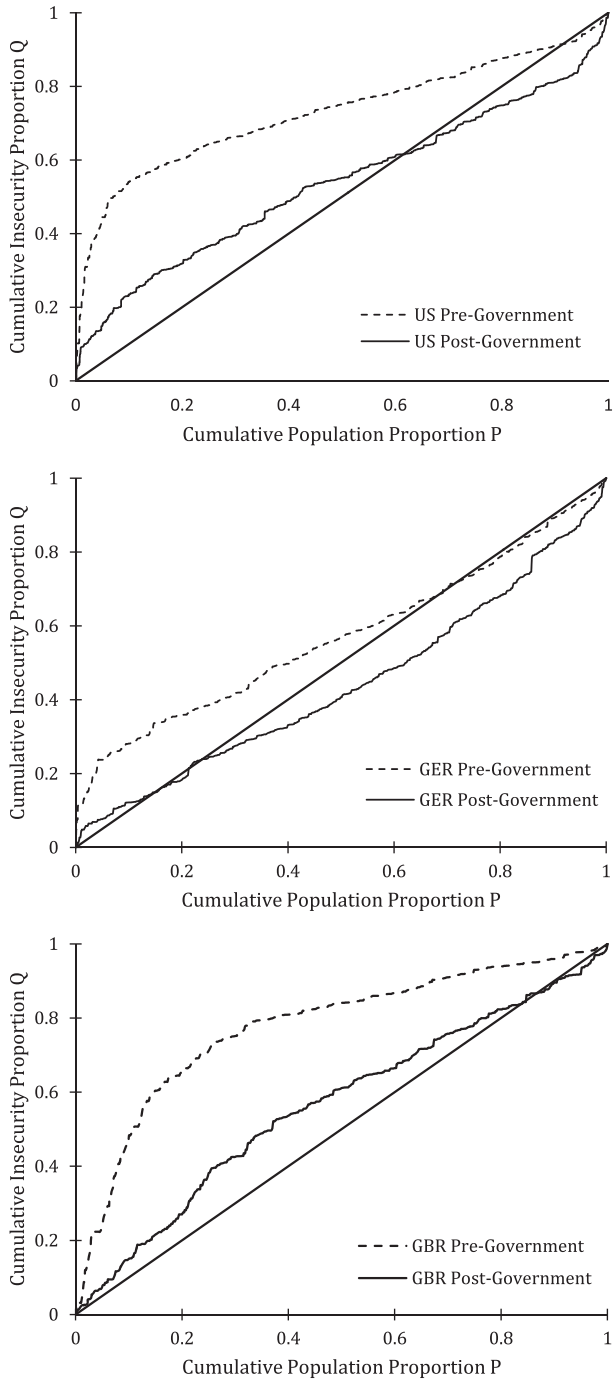

Figure 2. Concentration of Truncated Insecurity Estimates with Income

Note: The horizontal axis gives the cumulative population proportion and the vertical axis gives the cumulative I^* proportion where observations are ordered with respect to income. Results are generated with $\alpha = 0.05$.

scores coming from these households. The line however flattens out for the top 80 percent of households revealing a lower than proportional share for this end of the distribution. For post-government incomes the concentration curve lies mostly above but always fairly close to the 45° line, indicating only slightly higher scores for poorer households (and consequently slightly lower levels for richer households).

Comparing the three curves simultaneously we see that the U.S. and Britain exhibited far more low end insecurity (especially in pre-government incomes) than Germany, however both Germany and the U.S. exhibited a tendency for very high income households to also experience volatile incomes, while this trait was almost entirely absent for Britain. Furthermore, in all cases the post-governmental curve lies below the pre-government curve, which indicates that all three governments reduce the proportional share borne by the lowest Pth percentile over the entire distribution. This difference in proportional share is in all cases large and generally peaks at around 20 percent of aggregate insecurity and occurs around the middle of the distribution. This corroborates our earlier observation about taxes and transfers strongly smoothing income streams at the low end with little effect higher up the income scale. It is also clear that in general the curves are steepest at the far tails of each distribution and flattest somewhere around the median of the distribution, indicating that middle income households had the lowest levels of volatility over both income definitions.

6. Cross Sectional Determinants

In addition to modeling the distributional properties of I^* and income we also look to identify demographic and labor market characteristics of insecure households. To do so we take results from row 4 of Table 2 and regress them upon the covariates outlined above.[10] To accommodate the large number of zeros the regressions are of the Tobit functional form and the model is fitted via maximum likelihood. We note that the model has the potential for endogeneity issues which may result in biased coefficients and hence should be regarded as descriptive rather than causal, although this is unimportant for the purpose of identifying insecure households. Results of the regressions based on both pre-government and post-government incomes for all three countries are given in Table 3.

Results from Table 3 show that the most consistent predictors of low scores on the index are health, industry affiliations, and gender of the household head, with all these variables generally exhibiting negative coefficients. In almost all cases households with heads that are employed in the specified industries had significantly lower insecurity scores than those in the base group (i.e. without affiliations), while families with female heads had lower scores relative to males. Unsurprisingly healthier heads presided over households with less volatility as

[10]Three racial stratifications are made, "white," "black," and "other race." While CNEF data have finer racial data, these broad definitions were used to ensure that each group had a reasonable number of observations. Longitudinally averaged variables are used as income volatility is summarized over the length of the panel. Variables such as race and gender are time invariant and hence are included as true dummy variables. Conversely variables such as the industry of employment may change and hence are expressed as proportions of time over the timespan.

TABLE 3

COEFFICIENT ESTIMATES OF INSECURITY BASED ON TOBIT MODELS FOR THE UNITED STATES, GERMANY, AND BRITAIN

	Insecurity Pre	Insecurity Post	Insecurity Pre	Insecurity Post	Insecurity Pre	Insecurity Post
Variable	United States		Germany		Britain	
(Constant)	2.42E-01***	7.39E-02***	4.20E-01***	3.55E-02**	5.06E-01**	6.73E-02***
	(5.19E-02)	*(2.37E-02)*	*(6.78E-2)*	*(1.52E-02)*	*(8.26E-02)*	*(2.29E-02)*
Income	−1.87E-08	−2.05E-07	−7.07E-06***	−6.72E-07	−5.57E-06**	2.88E-06
	(3.67E-07)	*(2.61E-07)*	*(1.16E-06)*	*(7.17E-07)*	*(1.81E-06)*	*(1.91E-06)*
Income^2	3.58E-13	9.53E-13	4.61E-11***	−1.35E-12	2.80E-11	−1.15E-10*
	(1.15E-12)	*(1.18E-12)*	*(1.21E-11)*	*(1.58E-11)*	*(2.06E-11)*	*(6.89E-11)*
Health	−1.89E-02***	−5.29E-03*	−3.19E-02***	−4.47E-03**	−1.71E-02	−2.62E-03
	(6.29E-03)	*(2.87E-03)*	*(9.67E-03)*	*(2.07E-03)*	*(1.26E-02)*	*(3.35E-03)*
H-hold size	−3.16E-02***	−1.45E-02***	−3.68E-02***	−7.05E-03***	−4.87E-02***	−1.31E-02***
	(4.56E-03)	*(2.07E-03)*	*(6.82E-03)*	*(1.46E-03)*	*(9.67E-03)*	*(2.54E-03)*
Education	4.22E-03*	1.26E-03	1.55E-03	9.18E-04*	–	–
	(2.33E-03)	*(1.06E-03)*	*(2.48E-03)*	*(5.19E-04)*	–	–
Hours	−1.79E-05	−3.95E-06	1.41E-05	5.79E-07	−6.54E-06	−8.41E-06
	(1.17E-05)	*(5.33E-06)*	*(1.71E-05)*	*(3.66E-06)*	*(1.89E-05)*	*(5.05E-06)*
Age	1.77E-03***	7.92E-04*	1.25E-03	3.46E-04*	−8.84E-04	−1.74E-04
	(6.76E-04)	*(3.10E-04)*	*(9.20E-04)*	*(2.02E-04)*	*(1.09E-03)*	*(2.90E-04)*
Divorced	−1.79E-02	−8.56E-03	6.27E-02**	8.39E-03	−3.38E-02	−9.41E-03
	(1.87E-02)	*(8.50E-03)*	*(2.55E-02)*	*(5.53E-03)*	*(3.59E-02)*	*(9.51E-03)*
Single	−5.01E-02***	−1.62E-02*	1.81E-02	−4.41E-03	−3.70E-03	−6.74E-03
	(1.82E-02)	*(8.32E-03)*	*(2.56E-02)*	*(5.53E-03)*	*(3.07E-02)*	*(8.14E-03)*
Widowed	8.24E-02*	2.94E-02	6.04E-02	−4.60E-03	−1.33E-03	7.19E-03
	(4.22E-02)	*(1.92E-02)*	*(4.12E-02)*	*(9.52E-03)*	*(6.19E-02)*	*(1.66E-02)*
Female	−3.14E-02**	−7.30E-03	−1.46E-02	5.73E-03	−3.73E-02*	−8.76E-03*
	(1.38E-02)	*(6.27E-03)*	*(1.69E-02)*	*(3.62E-03)*	*(1.95E-02)*	*(5.18E-03)*
Black	2.94E-02***	1.09E-02**	–	–	−2.41E-02	−5.50E-03
	(1.05E-02)	*(4.83E-03)*	–	–	*(7.34E-02)*	*(2.04E-02)*
Other race	−1.42E-02	−3.29E-03	–	–	−6.66E-02	−2.30E-02
	(2.26E-02)	*(1.05E-02)*	–	–	*(5.49E-02)*	*(1.45E-02)*
Agriculture	−1.67E-01***	−3.50E-02)	−2.74E-01***	−2.21E-02	−2.35E-01***	1.68E-02
	(4.83E-02)	*(2.20E-02)*	*(6.83E-02)*	*(1.47E-02)*	*(7.48E-02)*	*(1.93E-02)*
Energy	−2.41E-01***	−7.66E-02***	−4.18E-01***	−4.07E-02***	−2.42E-01***	−5.35E-03
	(4.32E-02)	*(2.00E-02)*	*(1.03E-01)*	*(1.53E-02)*	*(6.99E-02)*	*(1.76E-02)*
Mining	−2.69E-01***	−8.71E-02**	−2.20E-01**	−1.79E-02	−4.75E-01*	−8.73E-02
	(7.63E-02)	*(3.51E-02)*	*(9.81E-02)*	*(2.20E-02)*	*(2.80E-01)*	*(7.18E-02)*
Manufacturing	−2.26E-01***	−6.67E-02***	−2.64E-01***	−3.03E-02***	−2.57E-01***	−1.84E-02
	(3.13E-02)	*(1.43E-02)*	*(4.11E-02)*	*(8.97E-03)*	*(4.33E-02)*	*(1.17E-02)*
Construction	−2.06E-01***	−5.17E-02**	−3.10E-01***	−2.88E-02***	−2.48E-01***	−6.27E-03
	(3.32E-02)	*(1.52E-02)*	*(4.49E-02)*	*(9.52E-03)*	*(4.70E-02)*	*(1.24E-02)*
Trade	−1.84E-01***	−3.89E-02**	−3.01E-01***	−3.53E-02***	−2.54E-01***	−1.66E-02
	(3.34E-02)	*(1.53E-02)*	*(4.90E-02)*	*(1.06E-02)*	*(4.34E-02)*	*(1.17E-02)*
Transport	−2.37E-01***	−8.13E-02***	−2.75E-01***	−1.66E-02	−2.26E-01***	−5.58E-03
	(3.72E-02)	*(1.72E-02)*	*(5.23E-02)*	*(1.11E-02)*	*(4.81E-02)*	*(1.31E-02)*
Banking	−2.34E-01***	−6.85E-02***	−2.86E-01***	−3.35E-02***	−2.29E-01***	−1.63E-02
	(3.62E-02)	*(1.65E-02)*	*(5.30E-02)*	*(1.11E-02)*	*(4.99E-02)*	*(1.34E-02)*
Services	−2.58E-01***	−7.77E-02***	−3.16E-01***	−3.47E-02***	−2.62E-01***	−1.51E-02
	(2.95E-02)	*(1.35E-02)*	*(4.13E-02)*	*(8.74E-03)*	*(3.65E-02)*	*(9.91E-03)*
$\hat{\sigma}$	0.1169	0.0548	0.1283	0.0299	0.1495	0.0396

Note: Reference group for dummy variables is a white married male household head with no industry affiliation. Income variables refer to average household income from which insecurity estimate was calculated. *, ** and *** denote significance at 10%, 5%, and 1%, respectively. Results generated using $\alpha = 0.5$.

well, which is consistent with the idea that poor health may drive income insecurity through limiting paid work. Other factors such as race and marital status had mixed effects; in some cases these were positive and others negative, with variable levels of statistical significance.

A second result common to all three countries is the generally reduced coefficient sizes from pre-government to post-government incomes, which implies that governments cause a loss of association between our index and the explanatory variables. This is consistent with the notion that governments smooth in particular the income streams of households that exhibit determinants of high volatility. A third result of interest is that larger households had lower scores—an intuitive finding as it is consistent with risk pooling within the household. That is, the greater the household size, the less potential for fluctuations as variations in one member's income may be diluted or offset by changes in another's. Furthermore, we note that while the income variables mostly have the expected signs given the relationships plotted in Figure 1 (i.e. positive quadratic coefficients), they are not significant correlates of the index once other factors are included in the model.

7. Conclusion

This paper presents an empirical analysis of income insecurity at the household level. A truncated form of Atkinson's inequality metric is used to measure downward instability of household income streams, and the technique is applied to harmonized panel data from the U.S., Germany, and Britain. We observed that of the three countries, averaged insecurity scores based on pre-government incomes is highest in Britain and lowest in Germany, while our measure of volatility in post-government incomes are highest in the U.S. and lowest in Germany. Accordingly the U.S. government appears to reduce this component of insecurity less than the other governments. Examining the relationship between our insecurity index and income, we find that our measure based on pre-government incomes is mostly negatively related to income, but that this is reduced or even reversed for the post-government case. This implies that the effect of all three governments is a smoothing of the income streams at the lower end of the distribution. Lastly regressions of the index against demographic and labor market variables allowed us to identify highly insecure households. It was observed across all three countries that smaller households with less healthy male heads (who also lack jobs with specific industry affiliations) had higher scores on our insecurity index.

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