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An Analysis of Mental Stress in Ireland, 1994-2000

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Abstract: The General Health Questionnaire (GHQ) is frequently used as a measure of mental well-being with those people with values below a certain threshold regarded as suffering from mental stress. Comparison of mental stress levels across populations may then be sensitive to the chosen threshold. This paper uses stochastic dominance techniques to regardless of the threshold chosen. Decomposition techniques suggest that changes in the proportion unemployed and in the protective effect of income, education and marital status upon mental health were the principal factors underlying this fall.

Keywords: GHQ, mental stress, dominance, decomposition.

JEL Codes: I12, I31, I32.

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1. Introduction

The General Health Questionnaire (GHQ) first introduced by Goldberg (1972) is one of the most commonly employed measures of mental health. The original development of the measure involved a 60 item version (GHQ-60) with the "best" 30, 20 and 12 of these items being identified for use when the respondent's time was at a premium (giving rise to the GHQ-30, GHQ-20 and GHQ-12 measures respectively). Items in the GHQ consist of questions asking whether the respondent has recently experienced a particular symptom or item of behaviour rated on a four-point scale. For example a respondent might be asked the question: have you recently been feeling reasonably happy, all things considered? The respondent then answers from one of the following four categories: more so than usual, same as usual, less than usual, or much less than usual.

The GHQ score can be used as a predictor of an individual being a psychiatric case. The score is highly correlated with standardised clinical interviews and in a review of six validity studies of the GHQ-12, Goldberg and Williams (1988) reported sensitivity rates (proportion of cases correctly identified) of between 71% and 91%, as well as specificity rates (proportions of normals correctly identified) of between 71% and 91%. The variance weighted mean of sensitivity and specificity rates were 89% and 80% respectively.

Two main scoring systems are then used to summarise the GHQ score. The first, the GHQ method, assigns a score of 0 if the individual answers in either of the first two categories or 1 if answering either of the latter two categories. The alternative scoring method is the Likert method where responses are given scores of 0,1,2, and 3. In this case, the “best” GHQ score in terms of mental well-being is a score of 0, while the worst is a score of 36. In some cases, the Likert ordering may be reversed, so that weights of 3, 2, 1, and 0 are given, in which case the best score is 36 and the worst is 0. For reasons that will become clear later on, this is the scoring system employed in the analysis here.

In terms of the choice between GHQ and Likert scoring systems, Banks et al (1980) suggest that the Likert method is to be preferred to the GHQ method in studies using parametric multivariate techniques, since its distribution more closely approximates the normal.

Given the general acceptance of the GHQ as a measure of mental health, it is worth asking whether there is any key threshold value, above (or below) which an individual may be considered to be experiencing mental stress. In the case of the GHQ scoring method, Goldberg et al (1998) show how the threshold may vary from place to place and suggest the mean score as a rough guide to the best threshold. In the case of the Likert scoring method, the choice of threshold is not as clearcut, partly because, as indicated above, the greater range of potential scores for each item implies that the distribution more closely approximates the normal. The choice of the mean score as a threshold in that case would imply that close to 50% of the population would be measured as experiencing mental stress, which does not seem plausible.

Thus when using the Likert scoring method, there is scope for varying threshold levels. For example, Piccinelli et al (1993) suggest a cut-off of 22/23 for the GHQ-12 scale while Goldberg et al suggest a cut-off of 24/25.[1] Clearly, there is room for some disagreement on the appropriate cut-off point to identify mental stress. This implies that comparison of mental stress levels across populations at a single point in time or for the same population across time can be sensitive to the cut-off point chosen.

This is an issue which is also encountered in the literature on poverty, where poverty comparisons can be sensitive to the particular poverty line chosen. To overcome this problem Atkinson (1987) suggested the use of *poverty dominance*. Poverty dominance is a situation where one distribution of, say income, can be identified as having a higher rate of poverty than another distribution, for a wide range of poverty lines and for a wide range of poverty indices. If poverty dominance is found then it is possible to make reasonably strong statements regarding poverty levels in two different distributions. If poverty dominance is not found, then it may be necessary to restrict the range of poverty lines and/or the class of poverty indices over which we search for dominance.

The approach of poverty dominance has clear potential to be applied to any situation where measurement of a phenomenon is sensitive to the choice of a critical threshold. In this paper we apply the concept of poverty dominance to compare the degree of mental stress in Ireland over the period 1994-2000, where mental health is measured by the Likert scoring method applied to the GHQ-12. As we are applying the insights of the poverty literature where more income is considered to be "better" than less income, it seems natural that we use the version of the Likert scale where higher scores are "better" than lower scores.

[1] In the original papers the suggested cut-offs were actually 13/14 and 11/12 as the authors were

The results below will show quite a considerable change in the GHQ-12 among those at risk of mental stress over the period in question. This begs the question of whether any factor or set of factors can be identified as lying behind this change. We carry out standard regression analysis to attempt to identify the characteristics lying behind the probability of falling below the GHQ-12 threshold. We then apply decomposition techniques to identify changes in characteristics and in the "returns" to characteristics (returns in the sense of their effect upon the probability of being below the GHQ-12 threshold) which may lie behind the change in GHQ-12.

The remainder of the paper is as follows: in the next section we provide more formal definitions of dominance and in section 3 we describe our data and present results concerning dominance. In section 4 we carry out the regression and decomposition analysis to explore the factors lying behind the change in GHQ-12 over time. Section 5 offers concluding comments.

2. Dominance: a more formal definition

In this section we provide a more formal definition of dominance**.** Dominance analysis as presented here is an application of stochastic dominance to distributions of the GHQ-12. Until recently probably the main application of stochastic dominance in economics was in relation to assets with monetary payoffs where it is used to rank the payoff distributions of assets in terms of their level of return and the dispersion of the return i.e. the level of risk attached to the asset. It has also been used in poverty and

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regarding 0 as the best Likert score. We have rescaled them for the case where 36 is the best score.

income distribution analysis and it can be extremely useful when making non-parametric comparisons between distributions.

Suppose we have two distributions with cumulative density functions (CDF) $F(x)$ and $G(x)$ respectively. Then CDF $F(x)$ first-order stochastically dominates $G(x)$ if and only if, for all monotone non-decreasing functions $\alpha(x)$:

$$\int \alpha(x) dF(x) \geq \int \alpha(x) dG(x)$$

where the integral is taken over the whole range of *x*. Thus the average value of α is at least as large in distribution *F* as it is in distribution *G*, as long as the valuation function is such that more is better i.e. it is monotone non-decreasing.[2] In this sense distribution *F* stochastically dominates distribution *G*. An equivalent way of expressing this is to say that for all *x*,

$$G(x) \geq F(x)$$

so that the CDF of distribution *G* is always at least as large as that of distribution *F* i.e. distribution *G* always has more mass in the lower part of the distribution.

In terms of a diagram, in figure 1, the cumulative distribution points *H(y)*, on the vertical axis, are proportional to the area under the curves and to the left of *x*. As we can see from figure 1, distribution *G(x)* is everywhere above distribution *F(x)* and so the probability of getting at least *x* is higher under *F(x)* than *G(x)*, thus *F(x)* first-order stochastically dominates *G(x)*

[2] In the case of mental health we can regard the α function as being similar to a utility function which is increasing in the index of mental health, *x*.

So how is this related to analysis of mental stress? Suppose we decide upon a threshold level of the GHQ indicating mental stress and denote it as z. If there are n individuals in total and if q individuals have a GHQ score at or below z, then what we term the headcount ratio is $G_0 = q/n$. In this case we may regard the CDFs as Stress Incidence Curves and each point on the graph gives the proportion of the population with GHQ score less than or equal to the GHQ score on the horizontal axis. The cumulative distribution points correspond to head-count ratios in the sense that they represent the proportion of the population at and below a particular GHQ level.

Suppose there is some disagreement over the precise value of the GHQ threshold, but there is reasonable agreement that it is not greater than z^{max}. In this case, mental stress will fall between two dates if the stress incidence curve for the latter date lies nowhere above that for the former date, up to z^{max}. This is called the First Order Dominance Condition (FOD). In other words if, for GHQ thresholds up to z^{max}

$$G(x) \geq F(x)$$

then the incidence of mental stress will always be higher for distribution G than for distribution F. Thus the stress ranking of two distributions according to the headcount ratio is robust to all choices of the threshold up to z^{max} if, and only if, one distribution stochastically dominates the other.

In terms of our diagrams in Figure 2 the distribution $G(x)$ is everywhere above that of distribution $F(x)$ and so mental stress is greater for *G(x)* than *F(x)*, no matter where the threshold is drawn. This reflects the fact that the proportion of people with GHQ score less than the minimum threshold of z^{max} is always greater with distribution *G(x)* than with distribution *F(x)*.

If the curves intersect, as in Figure 3 below, then the ranking is ambiguous. For example, if the threshold was set at z_b, as in Figure 3, then distribution $G(x)$ will lie above distribution $F(x)$. If the threshold however, is set at z_a then distribution $F(x)$ will lie above distribution $G(x)$. Thus mental stress at z_b is higher with distribution $G(x)$, but at z_a mental stress is higher with distribution $F(x)$. We cannot therefore unambiguously state that one distribution exhibits dominance over the other as their ranking in terms of mental stress changes depends on where the threshold is drawn.

In this case there are essentially two courses we can pursue if we wish to establish dominance. First, we could restrict the range of the threshold over which we search for dominance i.e. look for dominance in an interval $z_{\min} \leq z \leq z_{\max}$. Alternatively we could impose greater structure on the way in which we summarise GHQ scores for any given distribution, which in turn may enable us to make comparisons across distributions in cases where dominance cannot be found. Effectively, this involves putting greater structure on the function $\alpha(x)$. In particular, as well as requiring $\alpha(x)$ to be increasing in x, we may also require it to be concave. Clearly, the greater degree of structure or restrictions imposed upon the α function, the greater the scope for disagreement between analysts as to the reasonableness of such restrictions. The imposition of greater structure (in the form of concavity etc) is clearly more plausible in poverty analysis when the underlying variable is cardinal than when it is ordinal, as with the GHQ measure. In the next section we search for dominance using Irish data on GHQ scores.

3. Data and Results

In this section we apply the approach outlined above to Irish data. The data comes from two waves of the Living in Ireland Survey (LII), 1994 and 2000.[3] The LII survey is a nationally representative survey which was collected annually between 1994 and 2001 and which formed the Irish part of the European Community Household Panel Survey. It has been used extensively in a variety of studies on (amongst other issues) poverty, deprivation and education.

One issue which inevitably arises with the use of panel data is attrition. Attrition is the process whereby households who were interviewed in the first year of the study are unavailable (for a variety of reasons) for interview in subsequent waves. Since attrition can occur on a year-by-year basis it is possible that a substantial proportion of the original sample may have been lost after a period of say, five or six years. There are two principal problems associated with attrition. The first is that if attrition happens on a non-random basis then the sample may gradually become unrepresentative. Secondly, as the sample shrinks in size it may lose precision.

There is a detailed discussion of attrition in the LII survey in Nolan et al (2002). They conclude that there is some evidence that as well as giving rise to a loss of precision, attrition in the LII survey may have been non-random. In particular, there may have been relatively higher attrition amongst households which changed address

[3] For an overview of the Living in Ireland Survey, see Watson (2004).

and which consisted primarily of young single adults. In response to this a booster sample, with just over 1500 new households, was introduced in 2000 with a view to alleviating the problems arising from attrition (see Watson, 2004). On this basis, it seems best to use as our two years of comparison 1994 and 2000, as these are the years least prone to any problems with attrition.

Figure 4 presents first order dominance curves for 1994 and 2000. The results are presented for values of the Likert scale from 6 to 25. The upper bound of 25 is chosen as a reasonable upper value for the stress threshold and 6 is chosen as the lower threshold as there are simply very few observations with Likert values below 6.

For Likert values below around 12, the curves are quite close together and it can be difficult to establish dominance merely via visual inspection. Accordingly, in figures 5, we “magnify” the CDF curves to look at the narrower interval of values between 6 and 12.

Bear in mind that because the Likert scale is a discrete, rather than a continuous variable, there is likely to be a range of values of the CDF for each value of the Likert scale. Hence there may be overlap between the values of the CDF for the two distributions for each value of the Likert scale. This can lead to curves where visual comparison is difficult. Hence the dominance curves we present show the highest values of the range of CDF values for each value of the Likert scale.

Figures 4 and 5 present a very consistent picture. In all cases the CDF for the Likert score is higher for 1994 than for 2000, suggesting that no matter where the threshold is drawn, 2000 shows dominance over 1994 i.e. mental stress was lower in 2000 than in 1994.

Of course, while it is one thing to observe that the CDF values for one distribution lie above that for another, it still has to be established that such dominance is statistically significant. To test for statistical significance we adopt the procedure of Kakwani (1990) in calculating statistical significance for poverty measures. Since the (higher) values of the CDF for each GHQ score can essentially be regarded as equivalent to poverty headcount ratios (i.e. the proportion of the population with GHQ scores on or below a given threshold) we calculate the standard errors of these headcount ratios for each year for each GHQ score. We can then test the null hypothesis that the difference between these headcount ratios is statistically significant.

More formally if we denote the values of the CDF for the GHQ scores for years 1 and 2 as $\hat{G}_1$ and $\hat{G}_2$ respectively, then the standard error of $(\hat{G}_1 - \hat{G}_2)$ will be

$$SE(\hat{G}_1 - \hat{G}_2) = \sqrt{\frac{\hat{\sigma}_1^2}{n_1} + \frac{\hat{\sigma}_2^2}{n_2}}$$

where $\hat{\sigma}_i^2 = \hat{G}_i(1 - \hat{G}_i)$ and n_i refers to the sample size for year i. Then the statistic $\eta = \frac{\hat{G}_1 - \hat{G}_2}{SE(\hat{G}_1 - \hat{G}_2)}$ has an asymptotic normal distribution with zero mean and unit variance.

Table 1 summarises the result of the test of the null hypothesis of no difference between the CDF values. We see that we can reject the null hypothesis for comparisons between 1994 and 2000.

This section has provided evidence that mental stress as measured by the proportion of the population with GHQ-12 scores below a key threshold has diminished over the period 1994 to 2000. The strength of this conclusion is reinforced by the fact that this result holds regardless of where the threshold is drawn. We now turn to the question of whether we can identify any factor or set of factors as lying behind this reduction in mental stress.

4. Decomposition of Change in Mental Stress

This section attempts to identify the factors lying behind the change in mental stress in Ireland over the period 1994-2000. To do this requires some “model” of mental stress. We will not provide any structural model of mental stress. Instead we estimate a reduced form model of mental stress which attempts to identify those factors lying behind mental stress without specifying the pathway whereby they cause mental stress. Thus the estimating equations (and consequent decompositions which we carry out) are very much in the spirit of Clark and Oswald (1994, 2002).

Before presenting a reduced form model of mental stress we first of all have to return to the definition of mental stress. The discussion in section 1 outlined how there was some disagreement over the choice of appropriate threshold and indeed the purpose of the analysis so far has been to arrive at conclusions which are not sensitive to choice of threshold. For the analysis in this section, however, it is necessary that some choice be made, so we will adopt the Goldberg threshold of 24/25 and check the sensitivity of our results to the choice of an alternative threshold.

We therefore adopt a binary threshold of mental stress whereby all individuals with GHQ-12 scores below 25 are deemed to be suffering from mental stress and those with GHQ-12 scores of 25 or above are not. We then estimate a probit model to identify the factors associated with being mentally stressed i.e. GHQ-12 below 25. Before presenting our regression results we first present a simple table of our summary statistics by year and gender. Table 2 simply reproduces in table form what can be observed in figure 4. The proportion of the population suffering from mental stress fell from over 30% to just below 27% for males and from about 37% to 32.4% for females. [4]

Thus the reduced form model for mental stress is given by the probit model

$$\Pr(S_{it} = 1 | X_{it}) = \Phi(X_{it}\beta)$$

where X_{it} is a vector of characteristics describing individual *i* in period *t*, $S_{it} = 1$ indicates the individual is stressed i.e. their GHQ-12 lies below the threshold, β is a vector of parameters and Φ is the standard normal cumulative density function.

Estimates of β are obtained for the two time periods, 1994 and 2000 and then an unbiased predictor of the fraction of the population suffering mental stress in time period *t* is given by

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[4] Women consistently appear to register higher levels of mental stress when measured by GHQ scores (see Emslie et al.,2002).

$$\hat{P}_t = \left(\frac{1}{n_t}\right)\sum_{i=1}^{n_t} \Phi(X_{it}\hat{\beta}_t)$$

where n_t is the sample size in period t. Then the change in mental stress between 1994 and 2000 is decomposed into two parts, explained and unexplained. The explained part refers to the change in mental stress that can be accounted for by changes in the characteristics vector X_i, such as employment status, health status etc. The unexplained part arises from changes in the vector of parameters, β. The vector β can be regarded as describing the "returns" to the characteristics in X_i , in the sense that it reflects the impact of a marginal change in one of the characteristics on the probability of being below the mental threshold.

The breakdown of the change in mental stress between 1994 and 2000 is given by

$$\hat{P}_{00} - \hat{P}_{94} = EXP + UNEXP\,.$$

The explained part of the change is the change in the proportion suffering from mental stress which would occur if the returns to characteristics were to remain unchanged but the characteristics of the population changed from those of 1994 to those of 2000.[5]

This is given by:

$$EXP = [\left(\frac{1}{n_{00}}\right)\sum_{i=1}^{n_{00}} \Phi(X_{i,00}\hat{\beta}_{94})] - [\left(\frac{1}{n_{94}}\right)\sum_{i=1}^{n_{94}} \Phi(X_{i,94}\hat{\beta}_{94})]$$

while the unexplained portion is that which is unexplained by characteristics, but is due to differences in returns i.e. $\hat{\beta}_{94}$ changes to $\hat{\beta}_{00}$:

[5] Essentially we are adapting the well-known Blinder-Oaxaca decomposition, originally developed for linear regression, to a probit.

$$UNEXP = [\left(\frac{1}{n_{00}}\right)\sum_{i=1}^{n_{00}} \Phi(X_{i,00}\hat{\beta}_{00})] - [\left(\frac{1}{n_{00}}\right)\sum_{i=1}^{n_{94}} \Phi(X_{i,00}\hat{\beta}_{94})]$$

In turn, following Even and Macpherson (1990) the contribution of the explained gap due to the *j*th explanatory variable is defined as:

$$EXP_j = EXP\left[\frac{(\overline{X}_{00,j} - \overline{X}_{94,j})\hat{\beta}_{94,j}}{(\overline{X}_{00} - \overline{X}_{94})\hat{\beta}_{94}}\right].$$

While the contribution of the return of the *j*th explanatory variable to the unexplained gap is given by:

$$UNEXP_j = UNEXP\left[\frac{(\hat{\beta}_{00,j} - \hat{\beta}_{94,j})\overline{X}_{00,j}}{(\hat{\beta}_{00} - \hat{\beta}_{94})\overline{X}_{00}}\right].$$

We model the probability of suffering from mental stress as depending upon the following variables: age, gender, marital status, education, health, labour force status, and two social capital variables, membership of a club or society and religious attendance. Table 3 gives the characteristics of the population in terms of the explanatory variables used in the regression. Compared to 1994, the sample in 2000 was older, had higher educational qualifications, a higher proportion at work (and hence fewer unemployed or on home duties), fewer with health problems and lower religious attendance.

Note that many of the variables which enter the reduced form model for mental stress are categorical variables, such as education or marital status. Oaxaca and

Ransom (1999) point out an identification problem which can arise with decompositions when one or more of the right-hand variables is categorical. The separate contributions of sets of dummy variables to the unexplained portion of the decomposition are not invariant to the choice of reference group for categorical variables (i.e. the omitted category). A solution to this issue is suggested by Gardeazabal and Ugidos (2004) who point out that identification can be obtained via a normalisation restriction on the coefficients of each set of dummy variables. The restriction is that for a categorical variable X_j with G groups, the sum of the coefficients on the G groups must be zero i.e. $\sum_{g=1}^{G} \hat{\beta}_{gj} = 0$. Thus essentially, in the case of the categorical variable, rather than estimating the coefficient $\hat{\beta}_{gj}$ i.e. the coefficient for X_{gj} the gth group of categorical variable j, we estimate the coefficient on $(X_{gj}-X_{1j})$ where group 1 is the reference category.

Table 4 gives the estimated marginal effects for 1994 and 2000. Bearing in mind that we are trying to model the probability of stress a positive coefficient is associated with an increased likelihood of stress. It is interesting to observe not just the signs of the coefficients but also how they changed over the period. Amongst the more notable changes is that the protective effect of income and education have increased, substantially so in the case of income.[6] In terms of labour force/economic status, compared to working, the impact on mental stress of being unemployed has decreased, while that of being in full-time education has increased. Within the categories of marital status the relative protective effect of being married or single falls while the impact of the categories of widowed or separated/divorced on the probability of mental stress is reduced.[7] The increased probability of mental stress associated with unemployment also falls over the period. For some covariates a note of caution should be entered regarding the direction of causality. Thus being a member of a club or society may act to reduce the probability of mental stress, but it is arguably just as likely that causality is in the other direction i.e. suffering from mental stress decreases the probability that one would join a club.

Ferrer-i-Carbonell and Frijters (2004) discuss methodological issues in estimating the determinants of the returns to happiness. While we are not estimating happiness as such their recommendations have clear relevance to this exercise. They suggest that the inclusion of individual fixed effects may be of greater importance than the question of the ordinality/cardinality of the dependent variable (virtually all studies in this area employ an ordinal dependent variable). Unfortunately since we are examining the role of changes in both characteristics and their estimated effects between two periods we have to estimate two separate regressions. Since we have only two waves of a panel which we believe are not adversely affected by attrition, we are unable to incorporate individual fixed effects into our analysis.

The observed proportion of the population of those suffering from stress falls between 1994 and 2000 by about 4%. Of that fall, about one quarter is "explained" in the sense that it can be accounted for by changes in population characteristics, while the remaining three quarters is unexplained and accounted for by changes in the "returns" to characteristics. Table 5 gives the proportional contribution of each

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[6] We use the log of non-equivalised income, in line with the suggestion of Ferrer-i-Carbonell and Fritjers (2004).

[7] Bear in mind that given the normalisation adopted above the *sum* of the impact of these variables must be zero.

variable to the explained and unexplained part of the change. In terms of interpreting the coefficients a positive coefficient indicates that a change in this variable (or the returns to this variable) contributed to the fall in mental stress. The major contribution to the explained part of the fall is in the area of labour market status. In particular the fall the proportion unemployed and the increase in the proportion at work on their own can account for nearly 70% of the explained fall. It is tempting to view these two effects as equivalent, but it should be borne in mind that part of the increased proportion at work may be accounted for by people previously in the "home duties" category, a category which may contain a degree of disguised unemployment. The increase in income also makes a substantial input to the fall in mental stress, with a contribution of 42%. The reduction in the fraction of the population suffering from health problems also comprises a significant part of the explained fall. On the other hand changes in marital status and the reduction in those with regular religious attendance tended to work against the fall in mental stress.

The unexplained part of the fall is perhaps a little more difficult to interpret. The change in the constant in the regression is included in this part and we label this part "other unexplained". Perhaps this is best regarded as that part of the change which can be regarded as arising from unobservables (both in terms of characteristics and returns to characteristics) and this change contributed significantly to the fall in mental stress. Changes in returns to education had a broadly neutral effect but net changes in the return to marital status worked against the fall in mental stress, owing to the change in the impact of being married or single. However the greatest contribution to the fall is the increased protective effect of income. The size of the coefficient in the regression nearly doubles and accounts for over 300% of the unexplained fall. On the other side changes in the returns to age, religious attendance and being in full-time education all worked against the reduction in mental stress. [8]

We repeated the exercise for a lower GHQ threshold (where mental stress is defined as a value of GHQ-12 of 22 or lower) and the results (which are available on request) were qualitatively very similar. The proportion of the change in mental stress accounted for by explained factors was around 27% with about 73% accounted for by unexplained factors. Once again labour market status (falls in the proportion unemployed and an increase in the proportion at work) and changes in the proportion suffering from health problems and a higher age profile accounted for the bulk of the fall arising from explained factors, with the decline in the proportions regularly attending religious services working in the opposite direction. For unexplained factors changes in the protective effect of income and in the returns to age continued to exercise a strong influence on the fall in mental stress, as did labour market status. Changes in the return to religious observance, and being married or single and being at work were the principal forces working in the opposite direction.

5. Conclusions

This paper has investigated the change in mental stress in Ireland over the period 1994 to 2000. We have used applied stochastic dominance techniques, previously used in poverty analysis, to show that, regardless of where the threshold for mental stress (in terms of the GHQ-12 measure) is set, levels of mental stress in Ireland were lower in 2000 compared to 1994. We also applied a version of the well-known Blinder-Oaxaca decomposition technique to analyse the factors lying behind the

[8] The result that the probability of mental stress essentially follows an inverse U shape with respect to

change. We find that in terms of changes in observable characteristics of the population the greatest contribution to the fall in mental stress came from higher income and employment levels. We also find that a substantial part of the change is unexplained in the sense that it arises from changes in the returns to characteristics (in the sense of their impact upon mental stress). In this regard the most important changes were with respect to income, education and marital status.

age is consistent with recent results by Blanchflower and Oswald (2007).

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Table 1: Significance Tests for GHQ Thresholds

GHQ Threshold	Test Statistic 2000/1994 Total	Test Statistic 2000/1994 Males	Test Statistic 2000/1994 Females
6	2.59	1.72	1.99
7	2.76	1.78	2.18
8	3.00	2.05	2.28
9	4.15	3.47	2.68
10	3.72	2.89	2.56
11	3.62	3.19	2.22
12	3.69	2.84	2.53
13	4.83	3.34	3.59
14	5.52	4.29	3.75
15	5.77	4.41	3.98
16	5.79	4.36	4.05
17	5.91	3.90	4.57
18	7.45	4.93	5.74
19	8.11	5.23	6.38
20	8.38	5.92	6.17
21	8.51	6.07	6.26
22	8.85	6.09	6.70
23	9.26	6.16	7.16
24	5.24	3.20	4.37
25	15.39	3.53	4.60

Table 2: % Populations with Mental Stress by Year and Gender (threshold=24/25)

	1994	2000
Male	0.380	0.344
Female	0.449	0.403

Table 3: Characteristics of Population, 1994 and 2000

Characteristic	1994	2000
Age	43.010	45.516
Gender (% female)	0.521	0.537
Income (log)	5.920	6.201
Single	0.332	0.321
Married	0.591	0.584
Sep/Divorced	0.019	0.028
Widowed	0.059	0.067
No Quals	0.355	0.304
Inter Cert	0.228	0.229
Leaving Cert	0.288	0.296
3rd level	0.128	0.171
Bad health problem	0.033	0.029
Mild health problem	0.134	0.111
Working	0.476	0.537
In full-time education	0.074	0.068
Unemployed	0.073	0.032
Retired	0.088	0.111
On home duties	0.272	0.229
Other	0.017	0.023
Club member	0.426	0.434
Religious	0.817	0.755

Table 4: Probit Estimates for Mental Stress (marginal effects), Threshold 25

Variable	1994 (N=8731)	2000 (N=6608)
Age	0.010	0.008
	*(0.002)****	*(0.003)****
Age squared	-0.000	-0.000
	*(0.000)****	*(0.000)****
Gender	0.044	0.028
	*(0.014)****	*(0.015)**
Income (log)	-0.018	-0.032
	*(0.010)**	*(0.010)****
Married	-0.054	-0.038
	*(0.014)****	*(0.014)****
Sep/div	0.070	0.052
	*(0.032)***	*(0.029)**
Widow	0.086	0.023
	*(0.022)****	*(0.023)*
Inter Cert	-0.016	0.003
	(0.010)	*(0.011)*
Leaving Cert	-0.012	-0.029
	(0.010)	*(0.011)****
3rd level	0.009	-0.012
	(0.013)	*(0.013)*
Bad health problem	0.365	0.441
	*(0.028)****	*(0.034)****
Mild health problem	0.216	0.193
	*(0.017)****	*(0.021)****
In full-time education	-0.051	0.007
	*(0.023)***	*(0.027)*
Unemployed	0.140	0.062
	*(0.020)****	*(0.030)***
Retired	-0.074	-0.080
	*(0.022)****	*(0.023)****
On home duties	-0.036	-0.020
	*(0.016)***	*(0.018)*
Other	0.114	0.124
	*(0.040)****	*(0.040)****
Club member	-0.064	-0.057
	*(0.012)****	*(0.013)****
Religious	-0.070	-0.041
	*(0.015)****	*(0.015)****

Default category is male, single, with no formal educational qualifications, no health problem and working. Standard errors in brackets. *, ** and *** indicate significant at 1%, 5% and 10% respectively.

Table 5: Proportional Contribution of Characteristics to Explained and Unexplained Change in Mental Stress, 1994-2000

Characteristic	Explained	Unexplained
Age	-0.044	-0.226
Gender (% female)	-0.042	0.308
Income	0.424	3.565
Single	-0.067	-0.784
Married	-0.021	-0.333
Sep/Divorced	-0.041	0.017
Widowed	-0.041	0.161
No Quals	0.060	-0.232
Inter Cert	0.001	-0.162
Leaving Cert	0.006	0.201
3rd level	-0.024	0.139
Bad health problem	0.091	-0.097
Mild health problem	0.290	0.095
Working	0.344	0.061
In full-time education	-0.019	-0.153
Unemployed	0.347	0.092
Retired	0.099	0.037
On home duties	-0.091	-0.131
Other	-0.038	-0.013
Club member	0.030	-0.076
Religious	-0.261	-0.806
Other unexplained		-0.660
% of total change	**0.249**	**0.751**

Figure 1: First-Order Stochastic Dominance

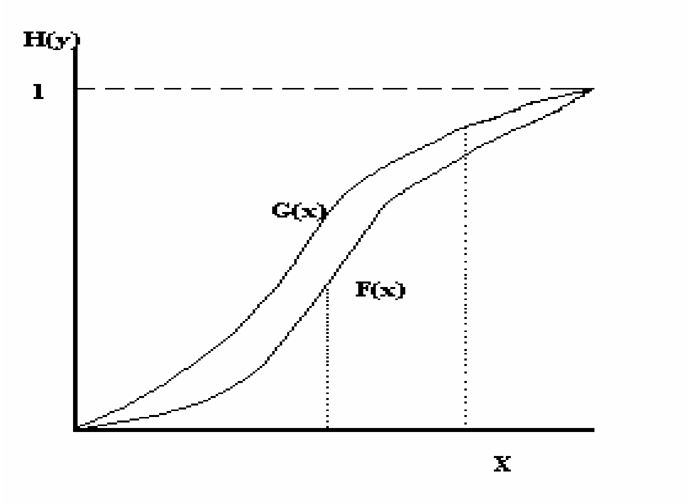

Figure 2: First Order Stress Dominance

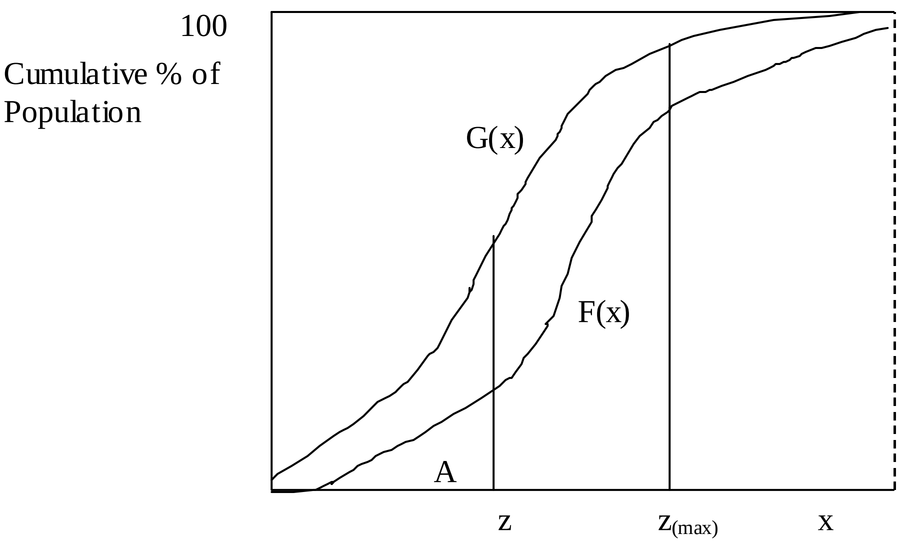

Figure 3: Crossing of Stress Incidence Curves

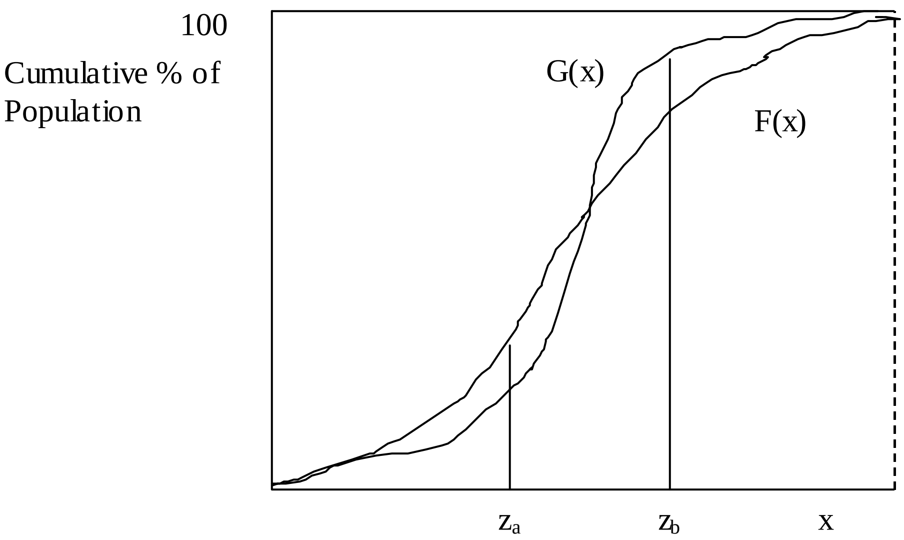

Figure 4: GHQ 1994 & 2000, Likert Scores, 6 to 25

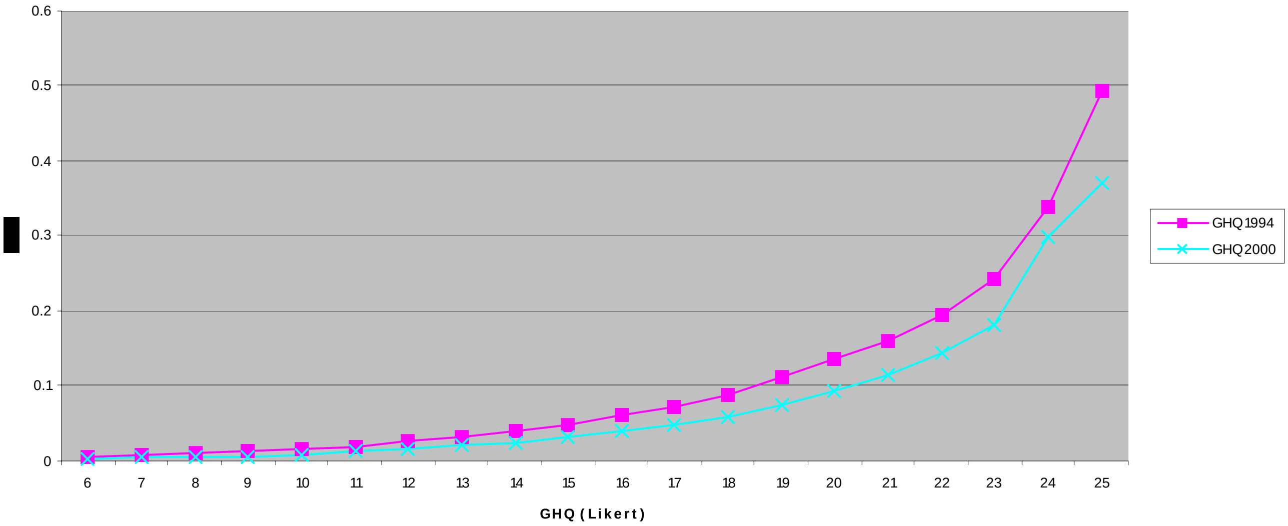

Fig 5: GHQ 1994 and 2000, CDF for Likert values between 6 and 12