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Debt and Depression

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by

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Abstract

The paper examines the effect of household financial indebtedness on the psychological well-being of mothers, using a large household survey of families with children for Britain. Although some existing studies find a link between debt and depression, they tend to utilise small and often highly selective samples of people and only self-reported measures of financial stress, responses to which are likely to correlate with other subjective measures of health. Our study constructs a variety of quantitative measures of financial stress and debt difficulties in order to validate self-reported measures. It examines the potential simultaneity of financial and psychological health by appropriate statistical techniques. The results confirm both a direct link between indebtedness and psychological stress and an indirect link through the impact of poor health on economic status.

Key words

Financial indebtedness   psychological well-being   self-reported measures

JEL classification

C81   D14   I31

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Debt and depression

1. Introduction

Problems with financial indebtedness, and the impact of financial stress on family well-being, have loomed large in media coverage of the consumer credit market in recent years. This paper investigates the impact of difficulties associated with financial indebtedness on the psychological well-being of a large random sample of women with children, some in couples and some of whom are lone parents. Existing empirical studies on the relationship between financial stress and psychological well-being are summarised in Section 2 below. The present paper, we argue, makes two substantial contributions to the existing literature.

First, existing studies on the association between financial difficulties and the psychological well-being of individuals or families typically utilise questions that invite respondents to provide rather general subjective perceptions of the household's financial insecurity or distress. These responses are treated as proxies for actual indebtedness and for underlying household budgetary problems. However, it is likely that respondents who are depressed or anxious may perceive a given set of financial circumstances as more difficult than respondents who are not depressed or anxious.

Ideally, therefore, if we are fully to understand the wider consequences of household indebtedness, subjective perceptions of financial insecurity should be confirmed, or augmented, by more 'objective' (albeit still likely to be self-reported) measures of the household's indebtedness such as the value of outstanding arrears, total loans outstanding etc. Moreover, with quantitative measures of indebtedness, it is possible to be more precise as to the link between the degree of financial difficulties and psychological well-being – for example, as to whether any impact of the total value of debts on self-reported stress is non-linear. Our data set provides this additional information. The paper follows in the recent trend in empirical economics of using a combination of indicators of subjective well-being (SWB) and 'objective' measures of family circumstances to understand household economic behaviour (see, *inter alia*, Bound *et al,* 1999; Charles, 2001; Baker, Stabile and Deri, 2004; Disney, Emmerson and Wakefield, 2005).

Our second contribution relates to a well established argument in the literature on the relation between individual economic activity (such as spells of employment

and unemployment) and health indicators – that there may be two-way causation between psychological and physical well-being on the one hand and economic status on the other (although this simultaneity is not always tested). For example, individuals with a history of mental illness, stress, depression and so on may have erratic employment and earnings histories. Therefore persistent poor health generates financial difficulties, including indebtedness. Past psychological problems may also cause them to cope less well with adverse financial shocks. We test this proposition by estimating a simultaneous model of psychological and financial well-being, augmenting the cross-section information with some details on past employment and family histories.

In the light of this, the structure of the paper is as follows. After a brief literature survey in Section 2 and a description of our data set in Section 3, our modelling strategy and empirical results are described in Section 4. These results can be summarised as follows. First, in common with the existing literature, we examine the covariates of self-reported psychological well-being among individuals in the data set using a range of demographics, health characteristics and family economic circumstances. We utilise self-reported general measures of financial stress and debt troubles and confirm that there is a statistically significant link between self-reported indebtedness and psychological well-being. In interpreting these results, we believe that respondents are responding to quite different issues, and not simply responding to different dimensions of personal 'stress', given the structuring of the questionnaire. Moreover we show that the link is statistically stronger when there is greater precision in the definition of financial stress, but that 'objective' measures of financial indebtedness, when *substituted* for subjective general measures of financial stress, have little explanatory power.

Our next stage departs from the existing literature in two respects. First, we predict self-reported financial difficulties from an auxiliary equation, using a range of characteristics including specific details concerning the nature and magnitude of indebtedness. We show how different quantitative measures of indebtedness impact on self-reported financial stress. Predictions from this auxiliary equation are used instead of categorical measures of self-reported financial difficulties as a latent variable in the model of psychological well-being. We confirm that predicted

financial difficulties based on these specific indicators are indeed positively associated with measures of a lack of psychological well-being.

Second, we handle the endogeneity issue. We estimate simultaneous equations in latent variables in which predicted financial well-being affects psychological well-being, and *vice versa*. We identify off the augmented set of financial variables that are contained in the debt equation and additional health indicators in the depression equation. We show that there is indeed simultaneity, in the sense that the predicted measures of well-being are significant in both equations. We test, and reject, the proposition that unmeasured person effects are biasing these results. We conclude that there is a strong direct, as well as indirect, link from indicators of financial stress to psychological well-being. Finally, Section 5 concludes the paper.

2. Previous literature

The relationship between financial well-being and psychological well-being has been investigated in a number of studies in a variety of settings. Reading and Reynolds (2001) investigated maternal depression among women with young children. Using self-reported worries about debt on a categorical scale to proxy the financial position of the household, they obtained a positive link between the extent of self-reported debt concerns and the scaled depression score in a multivariate analysis. Hatcher (1994), studying patients from hospital records who had deliberately poisoned themselves, found that 37% had reported problems with financial debts. Maciejewski *et al* (2000) showed that self-reported financial stress was a significant factor undermining self-efficacy (i.e. behavioural responses) of individuals with a prior history of depression. Ferrie *et al* (2003) examined gradients of morbidity, including measures of depression, across socio-economic groups (SEGs). They found that differences in self-reported financial insecurity across SEGs were a major determinant of differences in the incidence of depression. More generally, Wildman (2003), using the British Household Panel Survey, has shown that scaled self-reported financial status, and year-on-year past and expected changes in financial status, are associated with differences in self-reported health, incidence of long-standing illness and depression among survey respondents.

Leaving aside the very specific circumstances of some of the sampled individuals used in these analyses, there are two potential problems that arise in these studies. First, problems with financial debt in these studies are wholly self-reported and are not verified by detailed information concerning the financial circumstances of the household. It is possible that some individuals with symptoms of depression and anxiety may have a greater tendency to interpret given financial circumstances as stressful and difficult, whereas other households might, for example, regard the holding of a given level of debt as not being a source of particular concern. Such responses are understandable where media coverage of debt problems is pervasive and where, moreover, respondents might consider 'debt problems' as an appropriate response to questions concerning the environmental circumstances of perceived symptoms of depression (much the same point on 'response bias' has been made by Bound (1991) in the context of the widespread association of retirement from the labour force with events of ill-health).

Moreover the relationship between debt and psychological well-being might be non-linear, with greater anxiety being attached to relatively small amounts of debt, whereas large debts may lead individuals to engage in very different behaviour and response to psychological questioning (or indeed *vice versa*). Ideally, therefore, evidence of household and personal debt and financial difficulties should be validated by a more detailed analysis of family economic circumstances.

Second, there is the possibility of two-way causation in the relationship between financial and psychological well-being. Particular individuals may have a tendency to report both health problems and financial problems, irrespective of environmental and other socio-economic circumstances. More fundamentally, a personal or family history of ill-health, including episodes of depression, is likely to induce adverse economic outcomes and episodes such as job loss, loss of earnings capacity and unemployment, that may in turn induce financial problems. It is worthy of note that one of the first contributions by economists to the field of economic and psychological well-being drew the link wholly from mental illness to economic circumstances, and not the other way round (Bartel and Taubman, 1986). Although some studies (such as Theodossiou, 1998) continue to presume a unidirectional link from economic events to psychological events, other studies have attempted to explore the simultaneous link between economic and psychological circumstances,

either by assuming that individual responses to economic shocks are mediated through unmeasured individual characteristics (Björklund, 1985) or by estimation of an explicit simultaneous model of the relationship between the two, as in the study of (un)employment and mental health by Hamilton *et al* (1997). To our knowledge, however, these considerations have not been applied to the issue of financial debt and its relation to psychological well-being.

3. The data

This paper uses data from a relatively new UK household data set, the Families and Children Survey (FACS). The FACS was first established in 1999 as the Survey of Low Income Families (SOLIF). This data set was originally designed to elicit information on household characteristics, health status and the economic and financial position of a sample of low-income families with children. The financial status of households in this first wave is analysed in Bridges and Disney (2004). The same sample of families was then re-interviewed in 2000. In 2001 the sample was increased to encompass a representative sample of *all* families with children, and has continued thereafter in this format. We focus on the 2002 survey although we exploit the panel aspect of the data to construct variables relating to relationship and work history. The data used in this paper comprises of 7,882 families: 5,531 couples and 2,351 lone parents[1] from the survey.

The main aim of the FACS was to examine the effectiveness of new government work incentive measures (particularly Family Credit and its replacement, Working Families Tax Credit), and in doing so it asked the standard questions on household demographics, health, and income sources. However, it also asks both qualitative and quantitative questions on financial hardship in each wave, together with questions on the extent of credit and borrowing arrangements that are not available in other surveys[2]. The respondent for most of the survey is either the lone parent, or the female partner within couples (i.e., is normally the woman)[3].

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[1] This is the status in 2002. Over the panel, families move from lone parent to couple status, and *vice versa.*
[2] The British Household Panel Survey asks questions about aggregate household debt, ownership of specific assets and the use of particular credit instruments in Waves 5 and 10.
[3] The respondent's partner is also interviewed separately in places, and where this is not possible proxy questions are asked of the main respondent. However, this information is not always complete and so is not included.

The key variables in the FACS for our analysis are asked in separate parts of the questionnaire. In the section on respondent's health, the interviewee is asked whether s/he has any longstanding illness, disability, or infirmity of any kind. If the answer is 'yes', s/he is asked: 'What kind of illness or disability do you have?' Among a list of 13 potential positive responses identified are 'Depression and bad nerves' and 'Mental illness or suffer[ing] from phobia, panics or other nervous disorders'. Of the sample, 4.14% (n=326) respond positively to these two possible responses. Respondents are also asked, 'Has a doctor ever told you that you were suffering from depression or severe anxiety?'[4] We find that 3.88% (n=306) of the sample responds positively to this second question. Not surprisingly, the overlap between these responses is high – all those who reported the doctor's positive diagnosis also responded positively to the question on self-reported longstanding illness, although there are 20 respondents who are 'self-diagnosed' as having depression, nerves, mental illness and/or phobias. Given the strong overlap in responses to these questions, we work with the self-reported responses to the illness or disability question in what follows, rather than the reported medical diagnosis.

In the section on the financial circumstances of the household, respondents are asked: 'Taking everything together, which of these phrases… best describes how you and your family are managing financially these days?' There then follows a spectrum of potential responses from 'manage very well' through to 'are in deep financial trouble'. We identify the 10.48% of the sample (n=826) who report that they 'don't manage very well', or 'have some financial difficulties' or 'are in deep financial trouble' as respondents who are suffering from financial stress. A more specific question asks: 'Thinking back over the past 12 months, how often would you say you have had trouble with debts that you found hard to repay?' Again there is an array of possible answers, but 13.31% of respondents (n=1,049) report trouble 'almost all the time' or 'quite often' and we identify these as being families with persistent debt problems. This section of the questionnaire also contains detailed questions on the nature of credit arrangements and on the value of arrears.

A full list of the variables used in this paper, together with their summary statistics are presented in Appendix A.

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[4] The interviewer is asked to mention that this should include postnatal depression.

4. Modelling Strategy and Results

4.1 Single equation estimates of impact of indebtedness on psychological well-being

Our first model is designed to replicate existing studies, but using the FACS data set. Table 1 therefore provides results from a probit maximum likelihood of the probability that an individual in the survey reports being depressed, mentally ill, nervous or phobic. For each model, the table provides coefficients, standard errors (levels of significance) and marginal effects.

<< Table 1 here >>

The explanatory variables are separated into the two measures of self-reported financial stress or indebtedness (in columns 1 and 2 of Table 1 respectively), demographics, economic circumstances of the family, and additional self-reported health variables. Of the demographic variables, only respondents reporting their ethnicity as being British/'white' background[5] has a positive and significant effect on the probability of reporting depression. The marginal effect suggests that this factor explains less than a percentage point change in the likelihood of reported depression or mental illness. Working more than 16 hours a week reduces the incidence of reported depression or mental illness by around a percentage point, but the past employment status of the respondent/partner and benefit receipt seem to have little effect on the incidence of depression.

Not surprisingly, the incidence of self-reported depression or mental illness is strongly associated with other general self-reported indicators of long-term illness or disability, such as health problems/disabilities that are expected to last for more than a year, and health problems that limit daily activities. Depression is also associated with chronic health problems among one or more children in the family, although the relationship is only significant at the 10% level. There are also associations with other indicators of long term ill-health or disability, although the associations with depression and mental illness are not always positive: there is a positive association

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[5] Respondents are asked to define their ethnicity only once, in their first interview. However, the question on ethnicity has changed over the 4 waves. In 1999 and 2000 the question was of the form: To which of these groups do you consider you belong? ("1=White, 2=Black-Caribbean, ... 10=None of these"). In later waves the question became: To which of these groups do you consider you belong? ("1=British, 2=Any other white background, ...16=None of these"). These two questions are not directly comparable. Thus, we define our ethnic dummy as equal to 1 if the respondent reports either being white, British, or any other white background.

with allergies, but negative coefficients on almost all other significant disabilities and chronic conditions. Smoking is positively associated with poor psychological well-being, although it may well be endogenous.

Of most significance in the present context is the association between self-reported depression and mental illness on the one hand and indicators of financial difficulties on the other. Such links have been found in the existing literature and column 1 (Table 1) confirms a positive association between the rather general indicator of financial difficulties and the indicator of depression/mental illness, whilst column 2 confirms the link with a more specific question on personal indebtedness (the exact wording of the questions were described in Section 3). Although the marginal effects are similar, column 2 is to be preferred since the question focuses on debt and because the equation is slightly better specified (in terms of the likelihood ratio and the significance of the financial term). Our subsequent analyses thus focus on the indebtedness form of the question.

We argued in previous sections that we should err on the side of caution in making inferences from general questions on financial indebtedness since people with a tendency to anxiety, stress or depression might perceive given financial circumstances (or adverse financial shocks) in a different light to individuals with higher levels of psychological well-being. One way of handling this is to augment general questions with specific questions on financial circumstances. The FACS questionnaire is unusually detailed in asking households about the range of credit instruments used – such as the number of saving accounts, credit and store cards, personal loans etc; about assets such as owner occupation (although not, unfortunately, self-reported values of housing wealth), and about indebtedness and bill-paying. On the latter, for example, the questionnaire itemises individual bills (not just for loans and other credit arrangements but also utility bills and council tax payments) and asks respondents to detail their arrears, if any, on each of these items and the magnitude of these arrears. These arrears are not summed by the respondent or interviewer, but total reported arrears can be calculated by the researcher.

Our first alternative to the 'traditional' specification that relies on self-reported indebtedness is to replace the subjective question used in Table 1 column 2 by all the 'objective' measures of credit market involvement and financial indebtedness, the argument being that this additional information gives external validation (or

otherwise) of the 'debt problem' reported by the respondent and therefore supersedes any information from the response to the subjective question. This is done in Table 2, which contains the additional covariates on financial circumstances and indebtedness but omits the subjective general questions on financial difficulties and indebtedness. Since the coefficients on the other co-regressors are pretty similar to Table 1 (although more demographics are now significant), our discussion focuses on the impact of the measures of credit market involvement and financial indebtedness.

<< Table 2 here >>

At first sight, the results from Table 2 are rather disappointing – true, the likelihood is improved, but few of the individual measures of the financial position of the household are significant. The total number of outstanding loans is strongly significant – every additional loan raises the probability of self-reported depression or mental illness by one half a percentage point (the maximum number of loans in a household observed in the sample is five – see Appendix Table A1). The total number of credit and store cards is also significant but with the 'wrong' sign – since we control for household income and home ownership, this is probably not arising from a positive association between access to credit markets and underlying wealth.[6] Moreover, this last variable, along with all other financial variables apart from 'total loans' can, statistically, be excluded from the equation by a standard likelihood ratio test (using a likelihood ratio test, $\chi^2_6 = 7.96$, Prob > $\chi^2 = 0.241$). On the other hand, adding self-reported overall debt problems to Table 2, even with all the other financial controls *cannot* be rejected by a standard likelihood ratio test (using a likelihood ratio test, $\chi^2_1 = 3.95$, Prob > $\chi^2 = 0.047$).

Clearly, in this context, additional financial information is not providing much extra explanatory power. This is surprising, particularly as we might expect the variable 'total arrears' to be an important predictor of anxiety, stress or depression. We draw two conclusions from this. First, it is the interaction of the individual's perception of indebtedness with 'objective' measures of indebtedness that lies at the

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[6] Of course asking about the number of credit and store cards is not a good indicator of indebtedness *per se* since it is inability to pay minimum amounts or exceeding credit limits that triggers financial difficulties.

heart of the relationship between debt and psychological well-being.[7]   Second, to explore this interaction, we need an alternative estimation strategy.

4.2 Modelling financial indebtedness

This section explores the determinants of the probability that an individual reports general 'debt troubles'.   Although Table 2 suggests that objective financial circumstances do not fully explain the relationship between indebtedness and psychological well-being, we might believe that there is a more direct relationship between self-reported 'debt problems' and these financial circumstances. We also want to investigate whether poor health in turn impinges on perceived debt problems. Table 3 provides the results from a reduced form maximum likelihood probit of the probability that an individual reports debt troubles (see Section 3) using all the financial variables and measures of indebtedness, demographics, economic circumstances and health measures.

<< Table 3 here >>

Table 3 shows a strong relationship between self-reported debt problems and specific financial circumstances. In general, individuals with significant assets (such as home ownership and saving accounts) are much less likely to report debt problems – for example, having a mortgage on a property, rather than renting, reduces the probability of self-reported debt problems by 2.5 percentage points. Interestingly, having credit cards and financial loans have significant but opposite effects: each credit or store card owned *reduces* the probability of debt problems by a percentage point; each financial loan *raises* the probability of debt problems by 5 percentage points.   The possibility that this reflects a 'hierarchy' of debt arrangements is discussed further in Bridges and Disney (2004). Most strikingly, total arrears have a highly significant impact on the probability of reported debt troubles: the arrears specification is non-linear but in fact, as we show in the next sub-section, the turning point is at a very high percentile of the debt distribution.

Debt problems are also related to family circumstances. Working more than 16 hours a week reduces the probability of reporting debt trouble by 2 percentage

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[7]   This is very similar to the finding that the relationship between ill health and transitions in and out of economic activity cannot be understood simply by focusing on *either* self-reported health 'states' or on 'objective' measures of disability and longstanding illness. See Bound (1999) and the subsequent literature cited in the references.

points. Higher earnings also reduce the likelihood of debt problems. Having more children significantly raises the probability of reported debt problems but the marginal effect is not large. Other demographics seem to have little impact.

Turning to the health problems, not surprisingly reporting poor health over the last 12 months tends to raise the probability of perceived debt problems but, interestingly, other specific disabilities or chronic conditions have little effect (epilepsy is weakly associated with reduced debt problems). Of some interest is the coefficient on 'depression/mental illness'. This has the 'right' sign but is only significant at 17%. However, while the exclusion restriction of removing *all* specific health problems *except* depression is accepted ($\chi_{11}^2 = 12.73$, Prob $> \chi^2 = 0.312$), the sequential removal of depression from the equation is then rejected ($\chi_1^2 = 5.43$, Prob $> \chi^2 = 0.020$). Specifically, if we remove all personal health variables except 'health not good' and 'depression', the latter is now significant at the 5% level (coefficient = 0.210 (s.e=0.090)). Of course, we might by further experimentation find that some other health conditions, in isolation, affect perceived debt problems significantly, but this result concerning depression is of particular interest in the present context. Note too that a reported chronic health condition in a child in the family seems to have a stronger and more robust effect on the likelihood of a perceived debt problem than on psychological well-being (comparing Tables 1 and 2).

From this analysis of self-reported 'debt troubles' we draw two conclusions. First self-reported debt problems are indeed related to objective financial circumstances and measures of indebtedness and arrears, although the impact of these factors on psychological well-being is mediated through the individual's propensity to perceive such factors as potentially constituting a 'debt problem'. Second, there is some evidence of a 'feedback' effect of psychological well-being on the circumstances that lead an individual to perceive a debt problem. Taken together, these conclusions suggest that we should adopt a simultaneous approach to the problem, and this is done in the next section.

4.3 Simultaneous methods

This sub-section augments the modelling strategy in two significant respects. First, we assume that categorical responses to questions concerning self-reported states such as depression/mental illness/financial stress/debt problems can be

interpreted as indicators of individual latent probabilities of being in these states that differ by characteristics. Note for example that we could calculate from Table 1 the predicted latent probability of reported depression for each individual in the data set depending on his or her characteristics. By analogy, therefore, we envisage that each respondent has a latent probability of financial difficulties and/or debt problems that depends on a variety of household characteristics, including types of debt and magnitudes of arrears.

Second, for reasons described in Section 2, we explore the intrinsic simultaneity between the likelihood of facing financial and debt problems, on the one hand, and reported depression or mental illness on the other. It is likely that both depend on both the current and past trajectory of health and economic circumstances, which are strongly interlinked.

To examine a model of latent probabilities in a simultaneous equation structure, we utilise the method discussed by Mallar (1977) and Maddala (1983). Here our two equation structural model is of the form:

$$y_1^* = \gamma_1 y_2^* + \beta_1' X_1 + \mu_1 \tag{1}$$

$$y_2^* = \gamma_2 y_1^* + \beta_2' X_2 + \mu_2 \tag{2}$$

where y_1^* is the latent (unobserved) propensity of reporting debt problems and y_2^* is the latent (unobserved) propensity of reporting depression/mental illness. X_1 and X_2 are the set of exogenous regressors thought to affect y_1^* and y_2^*, and μ_1 and μ_2 are random errors that are distributed standard normally. Note the simultaneous nature of the model; y_1^* and y_2^* simultaneously determine each other.

Here y_1^* and y_2^* are unobserved. Instead what we observe are the binary outcomes:

$$y_1 = \begin{cases} 1 \text{ if } y_1^* > 0 \\ 0 \text{ otherwise} \end{cases}$$

$$y_2 = \begin{cases} 1 \text{ if } y_2^* > 0 \\ 0 \text{ otherwise} \end{cases}$$

Following Mallar (1977), equations (1) and (2) are estimated using a two-stage estimation technique as follows. The first step is to estimate the following reduced form equations for (1) and (2) by probit maximum likelihood:

$$y_1^* = \Pi_1' X + v_1 \tag{3}$$

$$y_2^* = \Pi_2' X + v_2 \tag{4}$$

where X is the set of exogenous variables in X_1 and X_2, and Π_1 and Π_2 are the parameters to be estimated. From (3) and (4) we obtain the predicted values:

$$\hat{y}_1^* = \hat{\Pi}_1 X \tag{5}$$

$$\hat{y}_2^* = \hat{\Pi}_2 X \tag{6}$$

In the second step the predicted values ($\hat{y}_1^*$ and $\hat{y}_2^*$) are substituted for y_1^* and y_2^* in equations (1) and (2) and the structural equations are estimated by maximum likelihood probit. The resulting coefficient estimates from this final step are consistent, but the standard errors need to be corrected to account for the sampling variation in the predicted values of the variables. The correct variance-covariance matrix is provided in Maddala (1983: page 247), and outlined in Appendix B.

The results for the structural equations are illustrated in Table 4. The equation in column (1) reports the determinants of reported depression. The difference in the estimates from our previous results are twofold: the equations are derived from a simultaneous equation model in which, instead of the categorical variable concerning debt problems, we insert the predicted value of the latent propensity of reporting debt problems, and secondly, many of the financial variables are excluded from the equation following our discussion of Table 2.

<< Table 4 here >>

The coefficients on the regressors common to this equation and Table 1 are very similar. The coefficient on the value of predicted debt problems is highly significant. To obtain an interpretation of the impact of this variable on depression, we can calculate probabilities of reporting depression for the whole sample and examine how these vary for different predicted values of reported debt problems. For example, an individual with the average value (or mean probability) of characteristics (with, for example, a probability of having a health problem(s) that limits activities of

p=0.12, and a probability of having a health problem(s) that is expected to persist of p=0.20 – see Table A1), and the mean value of predicted debt problems from the simultaneously-estimated equation, has a 0.8% chance of reporting depression. If that person had the *lowest* value of the distribution of predicted debt problems, the probability of depression is 0%. With the *highest* value of the distribution of predicted debt problems, the probability of reporting depression rises to 4.8%.

As an alternative simulation, consider the case where the individual has average values of all other characteristics but reports that their health limits activities (p=1) and have a health problem that is expected to persist (p=1). At the average value of the distribution of predicted debt problems, the probability of reporting depression is now 13.8%. At the lowest value of the distribution, the probability again falls to 0%. At the highest value of predicted debt, the probability of reporting depression is 37.1%. This shows how sensitive reported depression is to changes in predicted debt problems and health status.

The equation in column (2) of the simultaneous model in Table 4 estimates the probability of a respondent reporting a debt problem. It utilises responses to a variety of additional questions concerning financial status in the FACS. These questions include: whether the respondent is a homeowner (with a mortgage or owned outright), number of savings accounts held, the total value of arrears, and the total number of credit cards and loans held. Given the results in Table 3, we exclude most of the health variables from this equation.

The coefficient on the variable that indexes the probability of predicted depression is positive and strongly significant, confirming that adverse background health characteristics affect the probability of reporting debt problems. Higher numbers of children in the household and having a higher degree are also associated with a heightened probability of self-reported debt problems.

The equation also shows how the specific characteristics of the household's assets and liabilities affect the probability of reporting a debt problem. Being a mortgaged owner-occupier reduces the probability of debt problems. Having other proxies for wealth, such as higher earnings and saving accounts, also reduce the probability of reporting debt (although the former is entered as a non-linear function, the quadratic term is not significant). Owning credit cards is not a predictor of debt and seems to be associated with other characteristics (particularly home ownership)

that reduce the probability of debt.   On the other hand, having a higher number of outstanding loans *is* associated with a greater probability of reporting debt problems.

As mentioned, we used FACS data to calculate the accumulated sum of arrears reported by the respondent: that is, outstanding overdue balances, not just on financial debts such as loans, but also on utility and council tax bills. We can test the tentative hypothesis that the relationship between reported debt problems and arrears is non-linear – at high levels of indebtedness, the individual's probability of reporting debt problems actually falls – either because the individual probability has reached such a high probability that the predicted rise decelerates or because the individual no longer cares. This has implications for the relationship between outstanding arrears and depression. We test this by imposing a quadratic form on the arrears term. The results suggest that the relationship is indeed non-linear, and it is interesting to plot both the maximum probability of reporting debt problems as arrears increase across the sample, and where this turning point lies relative to the distribution of arrears.

The outcome is plotted in Figure 1 over those reporting positive arrears (around 19% of the sample). Mean arrears in the sample are around £135; among those with arrears, median arrears are £300 and mean arrears around £750.

<< Figure 1 here >>>

It will be noted from Figure 1 that the probability of reporting debt problems reaches a peak at around £5500, close to the 99th percentile of arrears. Thereafter the probability declines, although since we are in the extreme tail of the distribution of arrears, very few debtors are affected.[8]

To examine the impact of self-reported depression on debt problems, we conduct a similar exercise to that reported for the depression equation. For example, an individual with the average value (or mean probability) of characteristics (and therefore with mean arrears (£136) and mean outstanding loans (0.63)), and the mean value of predicted depression, has a 7.2% chance of reporting debt problems.   If that person had the *lowest* value of the distribution of predicted self-reported depression, the probability of debt problems is 0%. With the *highest* value of the distribution of predicted depression, the probability rises to 17%. In contrast, an individual with all

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[8]   There are very few observations above £5000 and we trimmed values of arrears at £20000. There must be a strong suspicion that some very high values of arrears (as opposed to debt) are measurement error rather than genuine arrears.

average characteristics except a high value of arrears (£2000) and 4 outstanding loans has a probability of reporting debt problems of 89.7%. With a low value of the distribution of predicted self-reported depression this probability is 47.8%, but with the highest value it is 96.2%. The simultaneous model shows not just that depression is affected by debt but that, especially among those with clearly and objectively delineated high levels of debt, the self-reported perception of 'debt problems' is strongly associated with self-reported depression.

A key assumption of the Mallar model is that $\text{cov}(\mu_1, \mu_2) = 0$. This assumption rules out correlated measurement error across individuals in the two equations. In general terms, we can argue that reporting bias may be strongest when dealing with general attitudinal questions, and that correlated measurement error should be lower where individuals are asked for details of specific health difficulties and financial questions (and in effect, the method applied here substitutes responses to these specific questions for responses to the more general attitudinal questions). However an indirect way of testing this proposition is to estimate a bivariate probit with our two dichotomous variables (debt trouble and depression) as dependent variables and the set of all exogenous variables as regressors, and test whether ρ, the correlation coefficient between u_1 and u_2 is significant. We do this and find that the correlation between the errors in the two equations is low (ρ = 0.096), but more importantly the likelihood ratio test that ρ is not significantly different from zero is accepted ($\chi_1^2 = 3.53$, Prob > χ^2 = 0.06), thus rejecting the hypothesis of correlated errors (at the 5% level).

5. Conclusions

The objective of this paper has been to explore the relationship between debt and depression among families, using a large representative sample of families with children, where the mother is the normal respondent. We delineated several problems with existing studies: small and selective samples, the use of rather general qualitative questions (especially on debt problems), and the lack of simultaneous modelling of debt problems and the probability of reporting depression. We utilised a simultaneous model of latent probabilities of debt and depression, and a range of auxiliary financial information to effectively instrument self-reported debt problems. We show that there is indeed a link from self-reported debt problems to depression, but also an indirect

effect since self-reported depression is itself likely to increase the likelihood of financial problems. We also showed that arrears on debts and outstanding loans are particularly associated with debt problems, whereas holding credit cards, as well as other household wealth, tended to reduce the probability of perceived debt problems.

The data suggest that an individual with 'average' characteristics has a very low probability of reporting depression, and indeed of reporting 'debt problems', so that the impact of the conjunction of these characteristics is relatively small. For people with chronic health conditions, however, the sensitivity of reported depression to the magnitude of financial problems is much greater than for people with good health. In similar vein, the perception of reported debt problems for respondents with 'objective' adverse financial circumstances is very sensitive to their reported mental health. This suggests that the debt-depression link arises from clustering with other characteristics – long term illness, particular forms of indebtedness, and so on. It is combinations of these specific health and financial characteristics that appear to behind the general association between depression and debt problems.

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Table 1: Probit estimates of the determinants of self-reported depression or mental illness with self-reported financial and debt problems

Health problem = depression	(1)			(2)		
Variable	Coefficient	s.e.	Marginal Effect	Coefficient	s.e.	Marginal Effect
Constant	−2.815***	0.189	-	−2.797***	0.188	-
Financial stress (yes/no)	**0.240*****	**0.083**	**0.008**	-	-	-
Debt problems (yes/no)	-	-	-	**0.267*****	**0.077**	**0.008**
Demographics						
In couple 2002	−0.168	0.115	−0.005	−0.161	0.115	−0.004
In couple 1999-2001	0.203	0.127	0.006	0.210*	0.127	0.006
Changed family status	0.064	0.104	0.002	0.055	0.104	0.001
No. of children	−0.007	0.034	−0.0002	−0.015	0.034	−0.0004
Ethnicity (=1 if British/'white' background)	0.454***	0.150	0.007	0.438***	0.150	0.007
Education to GCSE (A-C)	0.006	0.077	0.0001	0.009	0.077	0.0002
Education to 'A' level	0.027	0.117	0.0007	0.033	0.117	0.0008
Education: degree & above	−0.168	0.121	−0.004	−0.166	0.121	−0.004
Economic status						
Working>16 hours	−0.291**	0.122	−0.009	−0.305**	0.122	−0.009
Partner/Respondent worked 1999-2001	−0.074	0.090	−0.002	−0.070	0.090	−0.002
Partner/Respondent work changed 1999-2001	−0.128	0.113	−0.003	−0.135	0.113	−0.003
No of benefits received	0.061	0.037	0.002	0.055	0.037	0.001
Total earnings	0.840	0.527	0.021	0.899*	0.532	0.022
Total earnings^2	−0.879*	0.534	−0.022	−0.916*	0.538	−0.022
Health status						
Health 'not good'	0.571***	0.078	0.025	0.578***	0.078	0.025
Problems with:						
Limbs	−0.549***	0.090	−0.008	−0.547***	0.090	−0.008
Hearing/Sight	0.228	0.161	0.007	0.229	0.160	0.007
Allergies	0.426***	0.151	0.017	0.445***	0.150	0.018
Chest	−0.193*	0.104	−0.004	−0.195*	0.103	−0.004
Heart	0.039	0.118	0.001	0.039	0.118	0.001
Stomach	−0.313**	0.135	−0.006	−0.322**	0.134	−0.006
Diabetes	−0.768***	0.226	−0.009	−0.751***	0.225	−0.008
Learning difficulties	−0.185	0.598	−0.004	−0.188	0.600	0.004
Epilepsy	−0.472*	0.249	−0.007	−0.450*	0.249	−0.007
Health limits activities?	0.915***	0.093	0.054	0.913***	0.093	0.052
Health problems persist?	0.710***	0.088	0.031	0.709***	0.088	0.030
Child(ren) have chronic health problem(s)	0.127*	0.072	0.003	0.124*	0.072	0.003
Smoker	0.153**	0.069	0.004	0.142**	0.069	0.004
Number of Observations	7882			7882		
Log likelihood	−888.37			−886.70		
LR χ^2 (29)	938.48			941.84		

Notes: For full definitions of variables, see text Appendix.
*** significant at 1%   ** significant at 5%   * significant at 10%.

Table 2: Probit estimates of the determinants of self-reported depression or mental illness with reported measures of credit instruments and indebtedness

Health problem = depression			
Variable	**Coefficient**	**s.e.**	**Marginal Effect**
Constant	−2.768***	0.192	-
Finances/debt			
Owns house outright	−0.041	0.150	−0.001
Mortgaged owner occupier	−0.001	0.093	−0.00004
No. of saving accounts	0.036	0.031	0.001
No. of credit cards	−0.083**	0.040	−0.002
No. of loans	0.208***	0.043	0.005
Total arrears of debt	0.130	0.088	0.003
Total arrears of debt^2	−0.019	0.014	−0.0004
Demographics			
In couple 2002	−0.193*	0.116	−0.005
In couple 1999-2001	0.258**	0.128	0.008
Changed family status	0.063	0.105	0.001
No. of children	−0.020	0.035	−0.0005
Ethnicity (=1 if British/'white' background)	0.448***	0.152	0.007
Education to GCSE (A-C)	−0.036	0.078	−0.001
Education to 'A' level	0.003	0.119	0.0001
Education: degree & above	−0.199	0.124	−0.004
Economic status			
Working>16 hours	−0.329***	0.124	−0.010
Partner/Respondent worked 1999-2001	−0.101	0.091	−0.002
Partner/Respondent work changed 1999-2001	−0.174	0.115	−0.003
No of benefits received	0.046	0.038	0.001
Total earnings	0.791	0.542	0.019
Total earnings^2	−0.805	0.543	−0.019
Health status			
Health 'not good'	0.586***	0.078	0.025
Problems with:			
Limbs	−0.541***	0.091	−0.008
Hearing/Sight	0.261	0.162	0.008
Allergies	0.414***	0.152	0.016
Chest	−0.205**	0.104	−0.004
Heart	0.040	0.120	0.001
Stomach	−0.324**	0.135	−0.005
Diabetes	−0.727***	0.226	−0.008
Learning difficulties	−0.089	0.592	−0.002
Epilepsy	−0.492*	0.252	−0.007
Health limits activities?	0.929***	0.094	0.053
Health problems persist?	0.711***	0.088	0.029
Child(ren) have chronic health problem(s)	0.131*	0.073	0.003
Smoker	0.124*	0.072	0.003
Number of Observations		7882	
Log likelihood		−877.05	
LR χ^2 (35)		961.13	

Table 3: Single equation model of self-reported debt problems

	Probability of debt problem		
	Coefficient	**s.e**	**Marginal Effect**
Constant	−0.987***	0.110	-
Finances/debt			
Owns house outright	−0.132	0.106	−0.016
Mortgaged owner occupier	−0.177***	0.057	−0.025
No of saving accounts	−0.225***	0.026	−0.031
No of credit cards	−0.072***	0.025	−0.010
No of loans	0.348***	0.027	0.048
Total arrears of debt	1.106***	0.060	0.151
Total arrears of debt^2	−0.106***	0.008	−0.015
Demographics			
In couple 2002	−0.098	0.073	−0.014
In couple 1999-2001	0.009	0.085	0.001
Changed family status	−0.010	0.067	−0.001
No. of children	0.060***	0.023	0.008
Ethnicity (=1 if British/'white' background)	−0.085	0.078	−0.012
Education to GCSE: A-C	−0.021	0.051	−0.003
Education to 'A' level	0.036	0.078	0.005
Education: degree & above	0.093	0.076	0.013
Economic status			
Working>16 hours	−0.137**	0.068	−0.020
Partner/Respondent worked 1999-2001	−0.144**	0.058	−0.020
Partner/Respondent work changed 1999-2001	−0.096	0.073	−0.012
No of benefits received	−0.016	0.029	−0.002
Total earnings	−0.485***	0.149	−0.066
Total earnings^2	0.012	0.023	0.002
Health status			
Health 'not good'	0.179***	0.069	0.027
Problems with:			
Depression/mental illness	0.132	0.097	0.020
Limbs	−0.021	0.089	−0.003
Hearing/Sight	0.113	0.158	0.017
Allergies	−0.011	0.163	−0.002
Chest	0.007	0.096	0.001
Heart	−0.090	0.121	−0.012
Stomach	0.096	0.127	0.014
Diabetes	−0.008	0.181	−0.001
Learning problems	0.419	0.578	0.076
Epilepsy	−0.452*	0.247	−0.044
Health limits activities?	0.114	0.090	0.017
Health problems persist	0.089	0.078	0.013
Child(ren) have chronic health problem(s)	0.134***	0.050	0.019
Smoker	0.128***	0.047	0.018
Number Observations	7882		
Log likelihood	−2165.31		
LR χ^2 (36)	1852.25		

Notes: For full definitions of variables, see text Appendix.

*** significant at 1%   ** significant at 5%   * significant at 10%.

Table 4: Structural model of self-reported debt problems and depression/mental illness

	(1) Probability of depression etc.			(2) Probability of debt problem		
	Coefficient	s.e	Marginal Effect	Coefficient	s.e	Marginal Effect
Constant	−2.567***	0.192	-	−0.565***	0.165	-
Finances/debt						
Predicted debt	**0.168***	**0.046**	**0.004**	**-**	**-**	
Owns house outright	**-**	**-**		−0.116	0.106	−0.015
Mortgaged owner occupier	**-**	**-**		−0.173***	0.058	−0.024
No of saving accounts	**-**	**-**		−0.231***	0.026	−0.032
No of credit cards	**-**	**-**		−0.061**	0.026	−0.008
No of loans	**-**	**-**		0.317***	0.030	0.043
Total arrears of debt	**-**	**-**		1.089***	0.066	0.149
Total arrears of debt^2	**-**	**-**		−0.104***	0.009	−0.014
Demographics						
In couple 2002	−0.152	0.116	−0.004	−0.072	0.075	−0.010
In couple 1999-2001	0.215*	0.129	0.006	−0.027	0.088	−0.004
Changed family status	0.071	0.105	0.002	−0.019	0.069	−0.003
No. of children	−0.027	0.034	−0.001	0.061***	0.023	0.008
Ethnicity (=1 if British/'white' background)	0.453***	0.150	0.007	−0.150*	0.084	−0.023
Education to GCSE: A-C	0.001	0.077	0.00004	−0.015	0.052	−0.002
Education to 'A' level	0.037	0.118	0.001	0.040	0.079	0.006
Education: degree & above	−0.162	0.122	−0.004	0.124	0.079	0.018
Economic status						
Working>16 hours	−0.289**	0.121	−0.009	−0.089	0.072	−0.013
Partner/Respondent worked 1999-2001	−0.046	0.091	−0.001	−0.131**	0.059	−0.018
Partner/Respondent work changed 1999-2001	−0.136	0.112	−0.003	−0.074	0.074	−0.010
No of benefits received	0.054	0.037	0.001	−0.020	0.029	−0.003
Total earnings	1.020*	0.528	0.025	−0.601***	0.170	−0.082
Total earnings^2	−0.902*	0.526	−0.022	0.136***	0.093	0.019
Health status						
Predicted depression	**-**	**-**		**0.153***	0.047	**0.021**
Health 'not good'	0.548***	0.079	0.023	0.113	0.081	0.017
Problems with:						
Limbs	−0.531***	0.092	−0.008	-	-	-
Hearing/Sight	0.212	0.162	0.007	-	-	-
Allergies	0.428***	0.158	0.017	-	-	-
Chest	−0.196*	0.108	−0.004	-	-	-
Heart	0.055	0.123	0.001	-	-	-
Stomach	−0.334**	0.141	−0.006	-	-	-
Diabetes	−0.726***	0.220	−0.008	-	-	-
Learning problems	−0.192	0.528	−0.004	-	-	-
Epilepsy	−0.397	0.253	−0.006	-	-	-
Health limits activities?	0.890***	0.099	0.050	-	-	-
Health problems persist	0.689***	0.096	0.029	-	-	-
Child(ren) have chronic health problem(s)	0.105	0.072	0.003	0.115**	0.051	0.016
Smoker	0.102	0.071	0.003	0.112**	0.048	0.016
Number Observations	7882			7882		
Log likelihood	−886.12			−2169.12		

LR χ^2 (29/25)	943.00	1844.64

Notes on Table 4

Notes: For full definitions of variables, see text Appendix. Standard errors corrected: see Appendix 2. Bold denotes predicted value. *dy/dx* = marginal effect of variable *x* on outcome *y*. ***significant at 1% **significant at 5% *significant at 10%.

Figure 1

Arrears (£) and probability of reporting 'debt troubles'
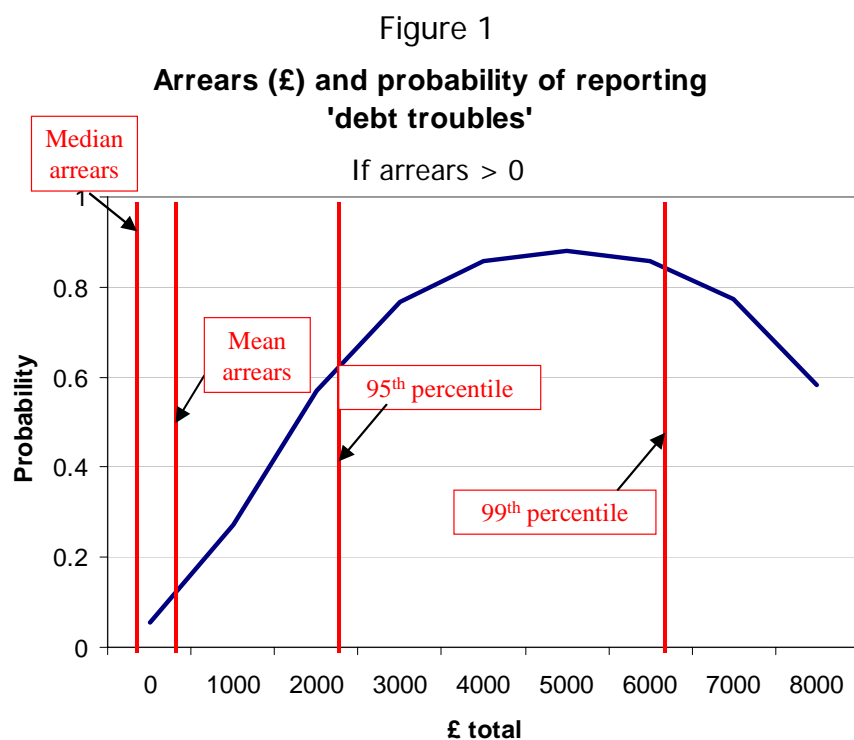
Appendix A

Table A1

Descriptive statistics

Variable	Mean	Std. Dev	Minimum	Maximum
Reported debt trouble	0.133	0.340	0	1
Reported depression	0.041	0.199	0	1
Reported financial stress	0.105	0.306	0	1
Predicted **debt**	−1.464	0.915	-24.122	3.065
Predicted **depression**	−2.378	10.488	-931.152	0.946
Respondent's age	37.506	8.440	17	73
In couple 2002	0.702	0.458	0	1
In couple 1999-2002	0.153	0.360	0	1
Changed couple status	0.535	0.499	0	1
No. of children	1.695	0.953	0	8
Ethnicity (=1 if British/'white' background)	0.927	0.260	0	1
Education to GCSE (A-C)	0.346	0.476	0	1
Education to 'A' level	0.125	0.331	0	1
Education: degree & above	0.208	0.406	0	1
Working≥16 hours	0.791	0.407	0	1
Partner/Respondent worked 1999-2002	0.515	0.500	0	1
Partner/Respondent work changed 1999-2001	0.076	0.266	0	1
Owner (mortgage)	0.590	0.492	0	1
Owner (owned outright)	0.077	0.267	0	1
No of benefits received	1.465	0.855	0	7
No of saving accounts	1.417	1.499	0	9
Total earnings (£ weekly/1000)	0.324	0.491	0	34.455
No of credit cards	1.297	1.008	0	4
No of loans	0.634	0.769	0	5
Total arrears (£/1000)	0.136	0.643	0	20.64
Health 'not good'	0.105	0.306	0	1
Health problems with:				
Limbs (arms/legs)	0.079	0.270	0	1
Hearing/sight	0.013	0.115	0	1
Allergies	0.014	0.119	0	1
Chest	0.048	0.213	0	1
Heart	0.029	0.167	0	1
Stomach	0.023	0.149	0	1
Diabetes	0.013	0.112	0	1
Learning difficulties	0.001	0.030	0	1
Epilepsy	0.007	0.084	0	1
Health limits activities?	0.120	0.325	0	1
Health problem to persist?	0.200	0.400	0	1
Child(ren) have chronic health problem(s)	0.230	0.421	0	1
Smoker	0.330	0.470	0	1

Appendix B: Calculation of the standard errors

As outlined in Section 4.3 our two equation structural model is of the form:

$$y_1^* = \gamma_1 y_2^* + \beta_1' X_1 + \mu_1 \tag{1}$$

$$y_2^* = \gamma_2 y_1^* + \beta_2' X_2 + \mu_2 \tag{2}$$

where $\gamma_1, \gamma_2, \beta_1$, and β_2 are the parameters to be estimated. Now let α_1 and α_2 be the vector of estimated structural parameters defined by:

$$\alpha_1' = [\gamma_1 \ \beta_1'], \ \alpha_2' = [\gamma_2 \ \beta_2']$$

And:

$$Z_1 = \begin{bmatrix} \hat{\pi}_1 X \\ X \end{bmatrix}, \ Z_2 = \begin{bmatrix} \hat{\pi}_2 X \\ X \end{bmatrix}$$

Let ϕ and Φ respectively refer to the probability density function and cumulative density function of the standard normal distribution. Then define the following:

$$\phi_1 = \phi(Z_1'\alpha_1); \phi_2 = \phi(Z_2'\alpha_2); \Phi_1 = \Phi(Z_1'\alpha_1); \Phi_2 = \Phi(Z_2'\alpha_2)$$

$$\mu_1 = y_1 - \phi_1; \mu_2 = y_2 - \phi_2; a_1 = \frac{\phi_1}{\Phi_1(1 - \Phi_1)}; a_2 = \frac{\phi_2}{\Phi_2(1 - \Phi_2)}; A_1 = \phi_1 a_1; A_2 = \phi_2 a_2$$

$$W_1 = \frac{1}{N}\sum_1^N A_1 Z_1 Z_1'; \ W_2 = \frac{1}{N}\sum_1^N A_2 XX'; \ W_3 = \frac{1}{N}\sum_1^N A_1(\gamma_1)Z_1 X'; \ W_4 = \frac{1}{N}\sum_1^N (a_1 a_2 \mu_1 \mu_2)XZ_1'$$

Then the covariance matrix of $N^{1/2}(\hat{\alpha}_1 - \alpha_{01})$, where α_{01} is the true value of α_1 and $\hat{\alpha}_1$ is the two-stage estimator, is:

$$W_1^{-1}[W_1 - W_3 W_2^{-1} W_4 - W_4' W_2^{-1} W_3' + W_3 W_2^{-1} W_3']W_1^{-1}$$

The covariance matrix of $\hat{\alpha}_2$ will be a similar expression, with the subscripts 1 and 2 interchanged in the definitions of W_1, W_2, W_3, and W_4.

Working Paper List 2005

Number	Author	Title
05/02	Simona Mateut and Alessandra Guariglia	Credit channel, trade credit channel, and inventory investment: evidence from a panel of UK firms
05/01	Simona Mateut, Spiros Bougheas and Paul Mizen	Trade Credit, Bank Lending and Monetary Policy Transmission