Household Labour Supply in Great Britain:

Can policy-makers rely on neoclassical models?

Marie-Christine Tabet

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Department of Economics

University of Sussex

I hereby declare that this thesis has not been and will not be, submitted in whole or in part to another University for the award of any other degree.

Marie-Christine Tabet, 15th of January 2010.

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UNIVERSITY OF SUSSEX

MARIE-CHRISTINE TABET

DEGREE OF DOCTOR OF PHILOSOPHY

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SUMMARY

This thesis empirically examines whether the neoclassical economic model provides an adequate framework to analyse a couple's labour supply behaviour in Britain using recent data from the British Household Panel Survey. The thesis comprises three empirical chapters. The first chapter uses the instrumental variable (IV) estimation procedure to model the hours of work of married couples. This approach allows us to test whether some of the assumptions of the neoclassical model (e.g., income pooling and Slutsky properties) are satisfied by the data. In addition, further variables that have been identified as distribution factors in the literature are introduced to the empirical model to assess whether they play a role in explaining a couple's hours of work. The first chapter only considers couples in which both spouses work. In the second chapter, the sample is amended to include all couples (i.e., those that work and those that do not) and the analysis conducted models a couple's labour market participation decisions rather than their hours of work. After testing for income pooling and the impact of distribution factors, a further variable, the wife's mother-in-law work status when the male spouse was aged 14, is introduced into the model. This is done to determine the effect of "cultural" variables on labour market decisions. In the last chapter, this issue is explored further by explicitly modelling attitudes to a woman's role in the labour market. This approach uses a bivariate ordered probit model given the ordinal nature of responses to the attitudinal questions and again restricts the analysis to couples only. Finally, gender-role attitudes are introduced to the labour supply framework used in the second chapter in order to evaluate whether beliefs regarding women's role impact on a couple's labour market decisions.

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Abbreviations

BHPS: British Household Panel Survey

BSAS: British Social Attitudes Survey

GMM: Generalized Method of Moments

IV: Instrumental Variables

OLS: Ordinary Least Squares

UK: United Kingdom

US: United States of America

Introduction

What was once the basis of dozens of Victorian novels may form the basis for new economic models of household behaviour!
(Mark R. Killingsworth, Labor Supply, 1983)

At first glance, this thesis title suggests it constitutes an additional contribution to the vast economic literature on labour supply analysis in Great Britain. On the one hand, it does indeed, as it tackles the common theme of male and female labour market behaviour. However, on the other, it endeavours to exploit relatively novel concepts that have not been widely used in previous studies of labour supply. The study of labour supply decisions is important for understanding behaviour and thus policymaking. It can help in analysing the dramatic changes in employment trends over the past years as well as help predict future patterns. It also allows the study of the consequences of taxation and welfare programs on an individual's decision to work and the number of hours of work. Blundell and MaCurdy (1999) state that "understanding labour supply behaviour is vital in formulating proposals that build in work incentives while providing income support" (p.1561).

For a long time, low-income families in industrialised countries have relied on the welfare system for financial assistance and in-kind transfers. However, this type of benefits often decreased the incentive to work of its recipients. Nowadays, many governments, including

the UK government, attempt to design policies that promote work, known as "welfare to work" programs (Blundell, 2000). Policymakers can impact on two important components of labour supply. They can affect wages, and therefore work incentives, through taxation. They can also influence non-labour income through policies on benefits and pensions. Wage and non-labour income responses can be analysed through the computation of wage and income elasticities. Indeed, as stated in Pencavel (1986), the aim of most empirical research in labour supply has been to estimate the magnitude of the impact of a number of variables such as wages and income on measures of labour supply. However, Pencavel (1986) adds:

> Such quantification is naturally an important ingredient
>
> of any science, but in many laboratory sciences refined attempts at calibration
>
> represent a stage of research that usually follows, not precedes, the testing of
>
> hypotheses (p.5).

In other words, it is important to evaluate the suitability of the framework used to estimate labour supply responses. Testing some of the hypotheses of the early neoclassical model is precisely the aim of this thesis. If the assumptions on which the neoclassical model relies are not verified empirically, wage and income responses estimated within this framework may be suspect for use in policy analysis.

In the last thirty years, economists have attempted to elaborate new models of economic behaviour, which have addressed issues that were deemed to be outside the realm of the discipline during most of the twentieth century. In particular, labour economics has changed from being solely concerned with analyzing labour supply, to elaborating frameworks for the analysis of household production and intrahousehold resource allocation (Manski, 2000).

For a long time, the individual decision-maker was the sole object of study of neoclassical labour supply analysis. This implied that the researcher could avoid tackling the issue of

interactions between the "economic man" and others around him. However, the increased participation of women in the labour market was one of the factors that prompted researchers to re-evaluate the assumptions of the popular earlier neoclassical model, known as the unitary model, as it was acknowledged that the latter might not be suitable to analyse married women and men's labour market behaviour (Dex, 1985).

According to Katz (1997), "the extent to which intra-household analysis represents a true paradigm shift within microeconomics is unresolved" (p.26). The author believes there are mainly two approaches that have challenged the unitary model of household behaviour. One approach has used tools from neoclassical economics to explore intra-household relations. The other, developed by feminist economists, has called for a review of the assumptions of the neoclassical model and a more interdisciplinary attitude towards gender issues in the household. As mentioned by Katz (1997), both strands of the literature are not necessarily incompatible. This thesis attempts to provide an assessment of the suitability of the neoclassical approach to the analysis of household labour supply in Great Britain. However, as will become clear, its aim is not to fit in one particular school of thought, nor to cover all the criticisms that have targeted the neoclassical framework. Rather, it consists of a series of empirical papers that test various concepts in order to distinguish some of the elements that need to be accounted for in policymaking and some of those that can be ignored.

In the UK, an unprecedented increase in the labour force participation of married women, and more specifically women with pre-school children occurred throughout the second half of the twentieth century, while opposite trends have been found regarding male participation. In 2002, the female employment rate was 72% compared to a male employment rate of 82% (Robinson, 2003). A number of other changes that have affected British households in the last fifty years have exacerbated the need to explore in more

detail household behaviour in general, and labour supply more specifically. Indeed, studies from different social sciences have all highlighted the demographic changes that have occurred in post-war Britain. McRae (1999) reveals that the mean age at first marriage and first birth have increased while total fertility has decreased. Furthermore, in the same period, the divorce rate has increased six fold and cohabitation before marriage has become increasingly popular. Finally, the number of lone-parent families has trebled. Despite all these changes, Summerfield and Babb (2003) state that in 2000, 54% of British men and 52% of British women were married and a quarter of non-married adults aged between 16 and 59 were cohabitating. In this thesis, a choice is made to focus the analysis on the labour supply of couples as they represent a majority of households in Great Britain, albeit a slightly decreasing one. As stated in Dex (1985), the terms "household" and "individual" have often been used interchangeably in the economic literature, with the former constituting a "smokescreen", the use of which "has helped to hide the neglect of genuine households for generations of economic analysis" (p.74). It is precisely this neglect that is addressed in this thesis.

The present analysis is divided into three empirical chapters and uses data from wave 13 of the British Household Panel Survey. Each chapter incorporates its own data section, theoretical and empirical literature review and econometric methodology. In chapter one, following parts of the work of Clark *et al* (2002, 2004), a working couple's supply of hours to the labour market is investigated in order to explore whether the unitary model of household behaviour, which has been used in earlier studies of household labour supply, provides a satisfactory framework for the analysis of the latter. The unitary model stipulates that the household acts as one entity. It imposes a series of testable restrictions, among which symmetry of wage effects and income pooling, which are empirically tested in chapter one. The condition of symmetry stipulates that an income-compensated change in

the wage of the husband has an impact on his wife's hours of work that is equal to the impact of an income-compensated change in the wife's wage on his supply of hours (Ashenfelter and Heckman, 1974). The restriction of income pooling is equivalent to assuming that each spouse's individual non-labour income does not affect labour supply decisions: only the sum of a couple's unearned labour income does (Blundell and MaCurdy, 1999). Another feature of the unitary model is that by assuming a single household utility function, it does not provide an appropriate framework to analyse intra-household decision-making. A number of models have been developed in the economics literature to address this issue. The latter allow for the fact that spouses may be able to affect decision-making to suit their own preferences. In other words, they acknowledge the existence of a spouse's bargaining power. Therefore, a further test of the unitary model, described as an indirect test by Hoddinott *et al* (1997), is to investigate the impact of measures representing a spouse's bargaining power on their own labour supply and their partner's. Two types of measures that can proxy for bargaining are used in the analysis. One measure, the sex-ratio, is external to the household. Two other measures, the age difference between spouses and whether the wife is older, are measures that are internal to the household. Regarding the estimation procedure, male and female labour supply equations are estimated using Ordinary Least Squares (OLS) and the Instrumental Variables procedure (IV) respectively. Results reveal that income pooling is not satisfied by data on the hours worked of couples in Great Britain while Slutsky symmetry is (provided non-labour income is assumed to be pooled). The sex ratio is found not to impact on a couple's labour supply. Regarding age differences, only the binary variable indicating whether the wife is older influences her labour supply but it is unclear whether this effect constitutes a bargaining one.

In chapter two, the analysis conducted in chapter one is replicated on a sample of all working-age couples, but focusing on participation rather than hours worked, as done in

Del Boca (1997). A bivariate probit model is used in order to analyse a couple's labour market decisions. The income-pooling test, conducted on working couples in the first chapter, is now replicated for all couples. Pooling seems to describe male behaviour but not female. Next, the measures of a spouse's bargaining power used in the hours-of-work framework are introduced into the participation model. Unlike in the first chapter, the sex ratio is found to impact on labour market participation but not in the direction anticipated. Age difference only affects male participation casting doubt on its suitability as a distribution factor.

Bargaining is not the only concept that has surfaced recently in the labour supply literature. Fernandez *et al* (2004) argue that the work status of a husband's mother when a teenager might influence his wife's labour supply behaviour. The second part of the analysis investigates the consequences of introducing this measure into the model of a couple's labour market participation. This has not been previously done using British data. Results reveal that the working status of a wife's mother-in-law influences her work behaviour. This suggests that "cultural" factors, which are not normally accounted for in neoclassical models, play a role in the determination of labour supply behaviour.

In chapter three, data on gender-role attitudes which are available in the BHPS, are used to further explore the link between preferences/culture and labour market behaviour. The sociological literature provides a background for a better understanding of the determinants of gender-role attitudes. A bivariate ordered probit framework is used to model the joint determination of gender-role attitudes among couples. The impact of childhood variables, human capital indicators and demographic factors on the formation of attitudes is analysed. To the author's knowledge, this methodology has not been applied in this context before. Measures of attitudes towards the role of women in the labour market are derived and introduced into the model of labour market participation developed in

chapter two. While attitudes do seem to affect labour supply decisions, they have a mixed

impact on key policy related labour supply variables.

Chapter 1

A study of the supply of working hours of British couples

1 Introduction

In a number of areas in economics, particularly in early welfare applications, traditional economic models have postulated the family as a single decision and consumption unit. More specifically, in the analysis of labour market behaviour, the principles of the simple neoclassical model of labour supply, originally developed to describe individual decisions, were applied to the study of households. These models, referred to as the "unitary" approach in the literature, impose two types of restrictions on behaviour: income pooling and Slutsky properties, which have often been tested empirically. In recent decades, different models of household behaviour have challenged the unitary model by looking more closely at interactions between family members and using concepts such as a spouse's bargaining power, to improve the modelling of intra-household resource allocation. Today, it is widely acknowledged that the household is not a 'black box' and that interactions

among members might impact on consumption, labour supply and other behavioural decisions, and hence on welfare.

This chapter follows the work of Clark *et al* (2002; 2004) who analysed household labour supply using British data from 1997. Elements of their research are replicated here with more recent data. Two research questions are investigated in the present analysis. First, tests are conducted in order to verify whether the data satisfy the assumptions of income pooling and Slutsky symmetry imposed by the unitary model. Second, an analysis of the consequences of introducing measures of bargaining power in the household labour supply framework is done.

2   Theoretical framework

Before providing an overview of the various models that have been used to describe household behaviour, one important point needs to be clarified. Blau *et al* (2006) state that: "a household consists of one or more persons living in one dwelling unit and sharing living expenses" (p.6). The authors emphasize that not all households are families as a family consists of "two or more persons, related by blood, marriage, or adoption, living in the same household" (p.6). In this thesis, the terms household and family are used interchangeably to mean a nuclear family constituted of a couple and their dependent children, if they have any.[1] As will be shown later, the unitary model of household behaviour, and more specifically labour supply, which is examined in this chapter, uses a framework that is similar to the one used to describe individual labour supply. The following section provides a brief overview of the latter.

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[1] Ferber (2003) is critical of the fact that economists have not attempted to reach a universally accepted definition of the "family" and that the neoclassical framework has taken the nuclear family as the basis of analysis thus ignoring other types of families such as extended families or families constituted of homosexual couples.

2.1 Individual Labour Supply

In his review of the literature on male labour supply, Pencavel (1986) states that the derivation of individual labour supply equations is a direct application of standard consumer theory as shown by Hicks (1946); and formulates the framework to analyse an individual's supply of working hours as follows:

Assume T is the total time available to an individual and equal to the sum of this individual's hours of work in the labour market h and their hours of leisure l; in other words $T = h + l$. Let A represent the individual's personal attributes and x their level of consumption; the individual's quasi-concave utility function is then defined as:

$$U = U(x, h, A, \varepsilon) \tag{1.1.1}$$

where ε represents an individual's tastes, which are unobservable to the researcher. The individual must reach the highest attainable utility given the budget constraint:

$$px = wh + y \tag{1.1.2}$$

where w is the wage per hour; p is the price per unit of x and y is non-labour income. Note that the budget constraint is homogeneous of degree zero in p, w and y.

This chapter only considers the case where the individual works. As established by standard consumer theory, they choose their hours of work so that the negative of the marginal rate of substitution of working hours for commodities equals their real wage rate.

The first-order conditions of the constrained maximization problem are (provided $h > 0$):

$$x = x(p, w, y; A, \varepsilon) \qquad\qquad h = h(p, w, y; A, \varepsilon) \tag{1.1.3}$$

The labour supply function $h = h(p, w, y; A, \varepsilon)$ satisfies a number of properties. First, it is also homogeneous of degree zero in p, w and y. Second, it satisfies the properties of

symmetry and negativity.[2] In this framework, a small increase in the wage results in an income effect $h\dfrac{\partial h}{\partial y}$ and a substitution effect s. Conventional consumer theory requires that the latter be positive (or non-negative). It represents the effect of an income-compensated rise in the wage and stipulates that more hours of work will be consumed (less leisure) when the wage increases (assuming utility is constant). The income effect on the other hand, implies that as the individual's wealth increases (due to the wage increase), their consumption of leisure will increase if the latter is a normal good, which means less hours of work will be supplied. The overall effect of a wage increase depends on the magnitude of these two separate effects. The Slutsky equation is expressed as follows:

$$\frac{\partial h}{\partial w} = s + h\frac{\partial h}{\partial y} \qquad\qquad [1.1.4]$$

The expression above can be re-written as:

$$E_u = E_c + w\frac{\partial h}{\partial y} \qquad\qquad [1.1.5]$$

where E_u is the uncompensated wage elasticity of hours, which can be obtained by taking the derivative of an individual's log labour supply function with respect to their log wage. Two other types of elasticities are usually reported in the literature: the income compensated-elasticity (denoted by E_c in equation 1.1.5 and computed from that equation) and the non-labour income elasticity, which is a measure of the magnitude of the change in hours worked when non-labour income changes. Let E_y designate the latter, then:

$$E_y = \frac{\partial \ln h}{\partial y} y \qquad\qquad [1.1.6]$$

This simple labour supply model has been referred to as the "neoclassical" model by Deaton and Muellbauer (1980): "a name (they) use to label the assumption of linear budget

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[2] Deaton and Muellbauer (1980) show that symmetry and negativity derive from the existence of consistent preferences.

constraints with fixed, known prices" (p.86). It has been extended to account for non-linear budget constraints (taxation and social security), and restrictions in hours worked (see Deaton and Muellbauer (1980)). However, accounting for these extensions is beyond the scope of this thesis.

The framework above is appropriate to study individual behaviour. In households, labour supply cannot be investigated in isolation for individuals, as the decision to work of one individual is bound to be determined, in part, by the behaviour of other household members as well as interactions among members. Indeed, as stated by Deaton and Muellbauer (1980): "one of the dangers of not recognizing interdependencies between consumers, is that we can mistake highly constrained behaviour for free choice" (p.13). The next section describes the different models that have been used to explore the economic behaviour of individuals in households and more particularly their labour supply.

2.2 Family labour supply

In her review of the different models of intra-household resources allocation, Doss (1996) highlights many of the issues that economists have to tackle in modelling household behaviour. Can the various utilities of household members be represented by a single aggregate household utility function or should one take these into account separately? Similarly, is there a single budget constraint at the level of the household representing the household's pooled income or are there different constraints? In addition, do individuals make separate or joint production (and consumption) decisions?

In the simplest framework of family labour supply, which is also the earliest one found in the literature, the husband does not take his wife's labour supply into account when making his own labour supply decision. However, the husband's earnings are considered as non-labour income in his wife's labour supply model. This approach is called the 'male

chauvinist' model. It is consistent with the individual's labour supply framework described above except for the fact that for the wife y includes her husband's labour income in addition to her own non-labour income (Killingsworth, 1983).[3] As mentioned in Davies *et al* (2000), the treatment of male and female labour supply is asymmetric. Moreover, there are no cross-equation restrictions and both husband and wife maximize utility independently (Lundberg, 1988). In this framework, economists bypass the issue of utility aggregation. However, the model relies on strong restrictions regarding the interdependence of a couple's labour supply behaviour. A different model, which also seeks to be consistent with standard consumer theory, assumes the existence of a joint utility function. It is known as the "unitary" model of household behaviour. Both its theoretical underpinnings and empirical implications are discussed in the next section.

2.2.1 The unitary approach

Samuelson (1956) analyses the problem of family utility in the more general discussion on community indifference curves. After demonstrating by proof that the latter do not exist, he asks: "if community indifference curves are impossible, how can we expect family demand functions observed in the market place to obey the consistency axiom of revealed preference or any other regularity condition?"(p.9). He argues that one could claim that one person has total control of the household and thus that the family demands express his/her consistent indifference curves but says that this is highly improbable particularly in Western societies. He thus suggests that assuming "family consensus" or a mutual agreement over consumption decisions is probably less far-fetched. According to the author, when analyzing families, there is a need to acknowledge that one member's tastes and marginal rate of substitution will be affected by other members' consumptions. He assumes a family

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[3] See Chapter 2 (footnote 2) of Killingsworth (1983) for applications of this model.

in which each member has their own consumption of goods and indifference curves ordering those goods. Furthermore, preferences among own goods do not depend on the behaviour of other members, but preferences of all members remain interrelated by a "social welfare function" that takes into account the ethical worth of each member's consumption. The family then acts to maximize this joint welfare function. The joint decisions only have to determine the distribution of the household's pooled income among family members. Moreover, income must be distributed in a way that ensures keeping the "marginal social significance of every dollar" equal. The author then establishes inferences on family demand by stating the theorem of revealed group preferences which stipulates that if the indifference curves of all members of the group have the conventional regular convexity, and that this also holds for the social welfare function, and if optimal lump sum transfers always occur inside the group, then there exists observable demand totals that will only depend on prices and total income, furthermore, the demands will have the revealed preferences or "Slutsky-Hicks" properties of any regular single demand (these are described below) and a set of indifference contours can be defined with all the properties of individual contours and which one can consider is being maximized by one agent. A number of researchers have questioned Samuelson's view. Lundberg and Pollak (1997) say: "Samuelson was concerned not with explaining distribution within the family but with identifying the conditions under which consumer demand analysis could proceed without doing so" (p.77). Becker (1991) criticized some aspects of this theory by stating that the "deservingness of the consumption levels" of different members could be, as in his own model that will be reviewed below, included in the members' preferences representation instead of just being interrelated through a common agreement among individuals. The author's altruist model seeks to explain family behaviour by positing the existence of an altruist in households, who is defined as a person whose utility depends on the welfare of

their spouse. In a household with one altruist and one beneficiary, the consumption of either member will not be affected by income redistribution. Furthermore, a family utility function is maximized irrespective of how income is distributed in the family as the other members' utilities decrease or increase in conjunction with the altruist's utility.[4] The author recognizes the importance of marriage markets in reinforcing the notion of altruism, as these markets will match altruists to beneficiaries. He also states that efficient marriage markets often result in positive assortative mating whereby high quality males form unions with high quality females and the reverse.[5] According to Lundberg and Pollak (1996), both the models of Samuelson and Becker outlined above constitute the theoretical basis of what has been labelled the "unitary" approach. As stated in Alderman *et al* (1995), it is labelled as such because the household (or in other words all of the household members) are assumed to act as one. It has also been called the "common preference model" for reasons that will become clearer below. Economists that believe in the unitary approach have used different explanations to justify that the household may act as one entity. Consensus, altruism and dictatorship are among the possible scenarios that lead to a unitary model framework.

In the labour supply literature, the 'family utility-family budget constraint' is an application of the unitary model. It was developed by Kosters (1966), cited in Killingsworth (1983), and stipulates that total family utility (which depends on the leisure times of all members and total consumption) is maximized subject to a family budget constraint. In this context, family members pool their earnings so that utility is maximized subject to a family budget constraint. Killingsworth (1983) refers to Hicks' composite theorem to show that in this approach, family consumption and leisure can be treated as composite commodities and

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[4] Becker (1991) has also extended his "altruist" model to families with children through the Rotten Kid Theorem.
[5] For a more detailed discussion on marriage markets see Ermisch (2003) chapter 7 and Becker (1991) chapter 4.

the analysis of the change in wages becomes similar to the one in the standard individual model (as shown below). Assuming leisure is a normal good, a rise in non-labour income will result in an increase in leisure, which is equivalent to a fall in earnings. The author shows that in this model, as mentioned by Ashenfelter and Heckman (1974) and Kosters (1966) among others, each household member's behaviour represents two substitution effects; the own-substitution effect being the substitution effect of a member's own wage on their labour supply, and the cross-substitution effect being the effect on an individual's labour supply of a income-compensated rise in the wage of another household member. The sign of the cross-substitution effect depends on whether the leisure times of family members are complements or substitutes. However, the model stipulates that they will always be equal. It is important to note that the earlier empirical literature has tended to assume that cross-substitution is zero thus treating the rise of one member's wage as a pure income effect on the labour supply of the other member.[6] Based on Fortin and Lacroix (1997), the unitary model is specified in what follows.

Consider a household with two working-age individuals denoted by the subscripts m (male) and f (female). Let h^m and h^f denote male and female hours of work respectively, x^m and x^f denote their respective consumption of a private composite good, the price of which is set to 1; w_m and w_f denote male and female wages and y_m and y_f represent male and female non-labour income respectively. The household's utility is defined as:

$$U = \tilde{U}(x^m, x^f, h^m, h^f) \qquad\qquad [1.2.1]$$

Its budget constraint is expressed as follows:

$$w_m h^m + w_f h^f + y^m + y^f \geq x^m + x^f \qquad\qquad [1.2.2]$$

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[6] See for example Cohen, Rea and Lerman (1970) cited in Killingsworth (1983).

The utility function $\tilde{U}$ is strictly concave, twice differentiable in its arguments, increasing in x^m and x^f, and decreasing in h^m and h^f. Since individual consumptions of the composite good (x^m and x^f) are rarely observed and given that the price of x^m and x^f is set to one, Hicks composite commodity theorem allows us to obtain a utility function which in turn can be used in the constrained maximization problem:

$$\max_{(x,h^m,h^f)} U = \hat{U}(x,h^m,h^f) \qquad [1.2.3]$$

Subject to: $w_m h^m + w_f h^f + y^m + y^f \geq x$

Among the solutions to the programme above is a pair of unrestricted supply functions:

$$h^m(w_m,w_f,y_m,y_f) = H^m(w_m,w_f,y_m + y_f)$$

$$\qquad\qquad [1.2.4]$$

$$h^f(w_m,w_f,y_m,y_f) = H^f(w_m,w_f,y_m + y_f)$$

Fortin and Lacroix (1997) state, as implied by expression [1.2.4], that one of the restrictions of the unitary model is that the distribution of non-labour income among members does not determine individual labour supply. This restriction is expressed by the following two expressions:

$$\frac{\partial h^m}{\partial y_m} = \frac{\partial h^m}{\partial y_f} \quad \text{and} \quad \frac{\partial h^f}{\partial y_m} = \frac{\partial h^f}{\partial y_f} \qquad [1.2.5]$$

Equation [1.2.5] denotes what is commonly referred to as the income pooling restriction. Let $y = y_m + y_f$, the income pooling proposition implies that only the level of y impacts on the labour supply of each individual. The labour supply equations are then:

$$h^m(w_m,w_f,y_m,y_f) = H^m(w_m,w_f,y)$$

$$\qquad\qquad [1.2.6]$$

$$h^f(w_m,w_f,y_m,y_f) = H^f(w_m,w_f,y)$$

Income pooling is equivalent to assuming all sources of income are pooled in a household, which means that the household's demand for goods and leisure will not be affected by

who receives income in the family except through the wage effect on the substitution of leisure and commodities (Hoddinott *et al*, 1997).

A second set of restrictions implied by the unitary model concerns the usual Slutsky properties and in particular own and cross-substitution wage effects as well as income effects. In order to derive the latter, the income pooling restriction is assumed to hold. Following Fortin and Lacroix (1997), let S_{ij} be the compensated (own or cross) wage effect, which is equal to $\dfrac{\partial h^i}{\partial w_j} - h^j \dfrac{\partial h^i}{\partial y}$ for $i = m, f$ and $j = m, f$. The properties of the labour supply functions in the unitary framework are summarized by the following three equations:

$$S_{mf} = S_{fm} \qquad\qquad\qquad [1.2.7]$$

$$S_{ii} \geq 0, \ i = m, f \qquad\qquad\qquad [1.2.8]$$

$$S_{mm}S_{ff} - S^2_{mf} \geq 0 \qquad\qquad\qquad [1.2.9]$$

Equation [1.2.7] represents symmetry of compensated cross wage effects and implies that the marginal compensated wage effects of the two spouses have the same impact on each other's labour supply (Ashenfelter and Heckman, 1974). It can be re-written as:

$$\frac{\partial h^f}{\partial w^m} - h^m \frac{\partial h^f}{\partial y} = \frac{\partial h^m}{\partial w^f} - h^f \frac{\partial h^m}{\partial y} \qquad\qquad [1.2.10]$$

The second restriction, represented by equation [1.2.8], concerns the non-negativity of compensated own wage effects, which means that an income compensated increase in an individual's wage will result in an increase in their hours of work; and finally, equation [1.2.9] represents non- negativity of the determinant of the Slutsky matrix (Ashenfelter and Heckman, 1974).

As in the individual labour supply framework, the model described above can be extended to include exogenous factors A without any effect on its implications:[7]

$$h^m(w_m, w_f, y_m, y_f, A) = H^m(w_m, w_f, y_m + y_f, A)$$

$$h^f(w_m, w_f, y_m, y_f, A) = H^f(w_m, w_f, y_m + y_f, A)$$

[1.2.11]

Before looking at the various criticisms that have been directed at this framework, it is important to mention that in a piece of research published at the time of writing, Browning *et al* (2006) argue that the term "unitary" has been used inappropriately in the literature and should only be used to describe models in which Slutsky conditions are satisfied. The authors claim that the rejection of income pooling does not mean that the "unitary" model should be rejected as income pooling is neither a necessary nor sufficient condition for the unitary model to hold. While this chapter acknowledges the contribution of the article mentioned above, as in most pieces of research to date, it uses the term "unitary" to refer to a model that satisfies both income pooling and Slutsky properties.

Lundberg and Pollak (1996) state that both the theoretical assumptions and empirical implications of the unitary model have been subjected to mounting criticism. On the empirical front, restrictions imposed on labour supply equations, particularly regarding income pooling, have often been rejected by the data as will be shown in the empirical review. On the theoretical side, Chiappori (1992) states: "such models simply fall short of meeting the basic rules of neoclassical microeconomic analysis. Micro approaches are grounded on methodological individualism and the latter basically requires individuals to be characterized by their own preferences rather than be aggregated within the ad hoc fiction of a collective decision unit. Modelling a group (even reduced to two participants) as though it were a single individual can be seen only as a mere holistic deviation" (page 440).

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[7] This type of model stipulates continuity in the income, hours and wage variables, which is not strictly correct in most empirical applications. This point is ignored here as it is the case in most of the literature.

One further criticism of the unitary approach, related to the first two, is that it fails to address bargaining between spouses and the issue of power. This issue is discussed in Pollak (1994), who reviews the various types of criticism that traditional economic models have encountered, primarily but not exclusively by Marxists and feminists. The next section provides an overview of the various frameworks that have challenged the unitary model of household behaviour.

2.2.2 Non-unitary models of the household

Non-unitary models of the household are based on the theoretical premise that every individual in a household has their own set of preferences. However, they differ in the assumptions they make regarding interactions between household members. There are mainly two types of models of household behaviour in mainstream economics today: non-cooperative models and co-operative ones.

Non-cooperative models of household behaviour

The "non-cooperative approaches" assume that individuals act like separate units within the household and are not necessarily bound by contracts. The only link between the partners is through transfers of income. In their decision-making, individuals choose their exclusive consumption of goods considering the level of net transfers and maximize their utility subject to the constraint that purchases are lower than the sum of own-income and net transfer. The difference between this type of model and a representation of two rational individuals with independent behaviours lies in the presence of joint consumption of public goods (Lundberg and Pollak, 1997). Non-cooperative behaviour could be equivalent to an "internal divorce" where the couple is linked through the household's public goods but where transfers of money and time coordination are no longer in place (Lommerud, 1997).

Leuthold (1968) in what is, according to Chiappori and Donni (2006), probably the first non-unitary approach to household labour supply, uses a model in which she specifies an individual's utility that is maximized subject to a family budget constraint. As stated by Killingsworth (1983), the implications of this model are different to those of the unitary one, as they do not incorporate cross-substitution effects. However, because earnings are pooled, individuals are subject to non-direct income effects. When the wage of an individual rises, the usual substitution and income effect occur, however, there is an additional effect due to the fact that they work more thus raising family income. Their spouse, on the other hand, will reduce their work hours if they consider leisure to be a normal good. Ashworth and Ulph (1981), cited in Killingsworth (1983) and Kooreman and Kapteyn (1990) are other applications of this model.[8] Another set of models that provide a different framework of analysis of household behaviour is the co-operative approach.

<u>Co-operative models of household behaviour</u>

As in the unitary model, co-operative models stipulate that individuals will marry or cohabitate if the utility of doing so is higher than that of remaining single. The divergence between the two models occurs when one looks at how resources are allocated in the household (Alderman *et al*, 1995). Co-operative models assume a certain structure in the decision-making and household allocations are considered to reflect the outcome of a certain bargaining process. There are different types of co-operative models found in the literature. One set of models implies a divorce threat point such as in the Nash co-operative bargaining models introduced separately by Manser and Brown (1980) and McElroy and Horney (1981).[9] In this framework, the solution to the intra-household resource allocation problem is obtained by maximizing the product of the gains to

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[8] For a detailed review of non-cooperative approaches of household labour supply see Donni (2006).
[9] For a criticism of this model see Chiappori (1988).

cooperation subject to the constraint of expenditure equalling household income. Threat points, which are the maximal levels of utility that can be obtained by individuals outside marriage, depend on the prices of goods, non-wage and wage income and some external factors. Only credible threats are considered in this model as they guarantee the existence of a solution. A stronger threat point guarantees that the individual's preferences will have a higher weight in household demands. In this setting, changes in demand equations within the household do not only occur due to shifts (or twists) of budget constraints, as changes in the objective function determined by changes in outside opportunities also affect demand. The bargaining framework introduces new factors into the analysis of household behaviour. In McElroy (1990) the notion of EEPs (extra household environmental parameters) is developed. The latter are threat-point shifters that do not impact on prices or non-wage income. They include among others, the size of marriage/remarriage market, wealth or permanent income or measures of employability (McElroy, 1997). They represent a spouse's bargaining power and will be discussed further below. Another set of co-operative models is where the threat point is a state of non-cooperation within marriage such as the separate-sphere bargaining model developed by Lundberg and Pollak (1997). The authors mention that there are two main differences between the divorce-threat bargaining model and the model they propose. First, in this setting, a new threat point is defined as a state of non-cooperative equilibrium within marriage in which each spouse considers their partner's strategy as fixed, the latter depending on gender roles. Second, even if the non-cooperative outcome is not Pareto optimal, it might represent the final outcome due to high transaction costs. The two models imply different distributional effects. In a divorce threat model, policies that improve control of incomes by wives while married without any effect on incomes upon divorce will not be effective at redistributing income while it is stipulated in the separate-spheres bargaining that those policies will have

the required impact. In a series of papers, Chiappori (1988) and McElroy (1990), debate of the empirical tractability of the Nash-bargaining approach. In the context of labour supply analysis, the latter has been used as a theoretical basis for the empirical research of Del Boca (1997) and has been the subject of further modelling in Barmby (1996).

Collective model of household behaviour

One last set of models to be reviewed is the collective approach of household behaviour. According to Clark *et al* (2004), the latter is becoming an increasingly popular framework in which to analyse household labour supply. The general collective framework imposes less structure than co-operative models of household behaviour. Its main assumption is Pareto efficiency of household allocations. In other words, one family member cannot be made better off without another family member being made worse off. According to Browning and Chiappori (1998) this assumption "has a good deal of intuitive appeal" (p. 1243) as individuals in couples are likely to know their partners' preferences well and thus the decision process can be viewed as a repeated game. In this framework, it is assumed that each of the spouses has their own preferences. Furthermore, efficiency can be considered as "the most natural generalization" (p.1243) of the standard welfare analysis to multiple agents. In the collective model, efficiency leads to the derivation of a function called the sharing rule as long as the preferences of spouses are not interdependent (egoistic preferences or caring preferences separable into private or public goods). Its intuitive meaning is as follows: in a household, individuals allocate non-labour income according to the sharing rule, the latter being dependent on prices and non-labour income. After that, each member maximizes his or her utility subject to the established budget constraint. In the context of labour supply analysis, under specific assumptions, testable restrictions of the collective model can be derived and the sharing rule, as well as the parameters for each member's utility function, can all be recovered up to an additive constant (Bourguignon

and Chiappori, 1992). The original collective model as developed by Chiappori (1988, 1992) relies on the assumption that goods consumed are private. This can be rather restrictive in some applications particularly in the context of "targeting". Indeed, children can be considered as public goods as both parents probably derive utility from their presence. Blundell, Chiappori and Meghir (2005) expand the original model to allow the inclusion of public goods (namely children). Identification of the decision process is possible in two cases: first, if expenditures on public goods are separable from the individuals' preferences over leisure and private consumption or alternatively, if a distribution factor is used in the analysis. Browning and Chiappori (1998) define 'distribution factors' as variables that impact on household decisions but do not affect the household's consumption set or individual preferences. They are similar to the EEPs mentioned earlier in the context of cooperative models. In the collective model, if a distribution factor is favourable to the wife, the "balance of power" will be shifted in her favour and a reduction in her labour supply will be observed (actually an increase in her non-market time) through an increase in her share of income as well as an increase in her spouse's labour supply. In the original model, household work was not accounted for which means that a low level of labour supply was interpreted as a high amount of leisure. However, this might not be the case as a low level of hours of market work might mean a high level of household work. This distinction is crucial when it comes to welfare issues, which is why the original collective model was criticised for failing to include household production. Apps and Rees (1997) and Chiappori (1997) discuss the importance of taking into account domestic production in a collective model of household labour supply however empirical applications of collective models with domestic production are rare. Finally, the original collective model was developed to analyse labour supply behaviour of working couples. It did not account for labour market participation, which is rather

restrictive. However, recent work on labour market participation in the collective model has been published (see Blundell *et al* (2007)).

All the models reviewed above are described by Woolley (1993) as "neoclassical models with rational, visible, women" (p.495). However, it is important to mention the existence of alternative views of household behaviour such as the transaction cost approach developed by Pollak (1985), the Marxist approach to the family or feminist views of the family.[10]

In the light of the discussion above, one can address a further criticism of the unitary model, already mentioned earlier, which is its neglect of bargaining power. Since EEP (or distribution factors), which attempt to capture the woman's bargaining power, feature explicitly in prominent models of household behaviour that challenge the unitary model, testing for the significance of the impact of these variables on the labour supply of couples provides an indirect test of the unitary model. It is important to highlight that it is beyond the scope of this thesis to explore each of the various models of household behaviour available. In this sense, this chapter investigates whether the early (and most popular) neoclassical approach (or unitary model) remains a valid tool for analysis today. The next section addresses the issue of measurement of bargaining power.

2.3 Bargaining in households

"Bargaining power is anything that allows a particular individual to influence household decisions. It is the relative amount of influence that one individual has compared to other individuals in the household" (Doss, 2003: p.44). Variables that can proxy bargaining power can be either quantifiable or intangible (Agarval, 1997).

Before exploring the various dimensions of bargaining, it is important to mention that some of the earlier models of household behaviour did acknowledge its existence. Becker

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[10] See Blau *et al* (2006) for a summary of these alternative approaches.

(1991) rejects criticism that his model of the family has failed to sufficiently address the issue of bargaining within households and has exaggerated the importance of marriage markets. His main argument is that it is crucial to recognize that bargaining between spouses occurs within the wider context of marriage markets and that competition within these markets will contribute to reducing power imbalances in marriages. Furthermore, Becker's work emphasizes the importance of marriage markets in determining the well being of individuals in families. According to the author, a person enters the marriage market if they expect their income in partnership to exceed their income as a single person. As will be discussed in the empirical section, the introduction of sex ratios to labour supply analysis attempts to capture these effects. Regarding individual quantitative variables, one expects income to affect a person's influence in the decision process. One interpretation would be that the more income the person has, the bigger their say in the allocation of resources in the household (the main breadwinner for example). Another interpretation would be that if a person has sacrificed their potential income (a wife that gives up on her career to care for the children) they would have greater bargaining power. However, income has limitations as a proxy for bargaining power as it could affect household outcomes (expenditures or leisure) without necessarily revealing anything about bargaining strength. Another related measure of bargaining is wealth, measured as the value of assets or income from these assets. However, this measure also could pose problems, as individuals with more power will tend to be able to acquire more assets. There are also non-monetary quantitative measures of bargaining. These include, for example, education, as more human capital results in more opportunities in the labour market and more social status within society and the household more specifically. Regarding influences that are not individual or household specific, laws and social norms can also affect bargaining power. Laws regarding property rights, the labour market or marriage can contribute to improving

women's choices thus giving them more power in the household. However, there is no spatial variation in legislation in the UK which thus limits the empirical use of such factors to analyse bargaining. Changing regulation might be not sufficient as social norms can also affect women's status. Some jobs can be considered inappropriate for women even though there is no law preventing them from working in these positions. Social norms, could also affect women's ability to acquire assets (Doss, 2003). These can be difficult to measure. As stated by Argaval (1997), norms can affect gender relations in the household in a number of ways. Norms delimit what can be bargained about as what is regarded as tradition might be indisputable. Furthermore, they determine the nature of the bargaining process (explicit or implicit, gentle or forceful). In most economic applications, social norms are considered exogenous but in reality, they are themselves subject to bargaining and can change. A change in social norms will have an impact not only on current marriages but potentially affect future marriage market equilibriums (Lundberg and Pollak, 1997). There are additional factors that determine bargaining power in households among which are: ownership of resources, an individual's social capital and personal values and attitudes. Given the multitude of potential bargaining measures, Agarval (1997) pinpoints the importance of prioritizing the latter particularly for the purpose of policymaking. However, this can be quite difficult to implement in practice.

One important caveat to the discussion above is that a spouse's bargaining power might change during marriage. This is seldom addressed in studies of intrahousehold decisions, which are often set in a static context (Thomas *et al*, 1997). Indeed, the economic literature has been concerned with the effect of bargaining power on intrahousehold allocation and decision-making in the household but has not addressed the potential reverse causation of household dynamics influencing bargaining power. Indeed, acquiring bargaining power is a

long process and even changes in circumstances are unlikely to result in immediate results (Basu, 2006).

As mentioned earlier, the notion of a spouse's bargaining power is prominent in Nash bargaining models and the collective framework. In the former, McElroy (1997) emphasizes the role played by distribution factors (or EEPs) but states that "interpreting the coefficients associated with EEPs is often a delicate business" (p.58). The author does not, for example, conjecture on the direction of the impact of a distribution factor on labour supply. In the collective framework, predictions are more specific. Chiappori *et al* (2002) argue that if a distribution factor favours one spouse (the wife), she has greater bargaining strength and standard income effects predict she will enjoy more leisure (or in other words reduce her supply of hours in the labour market).

2.4   Relevance of household models for policymaking

Regarding the policy implications of the discussion above, Alderman *et al* (1995) ask whether distinguishing between different models is just important at the theoretical level or whether it has more practical consequences. In terms of policymaking, relying on the unitary model of household behaviour can have serious consequences. As stated by Alderman *et al* (1997), in many instances, the government assumes that in addressing the problem of household poverty, individual poverty will be alleviated or that the latter can be tackled without taking into account other household members. The authors identify certain aspects of policymaking that require careful scrutiny. First, the choice of the economic model on which a policy relies is a key determinant of the policy's consequences. In collective models, the household's consumption behaviour will be altered according to whom receives public transfers. In contrast, the unitary model predicts that the impact of public transfers does not depend on its recipient. Second, the reaction of other household

members to the transfer is also important, as it might be that resources will be diverted from them to compensate for the income receipt. Finally, some policies, which will not be considered in a unitary framework on the basis that they do not affect household preferences or production technology, might greatly impact on intra household allocations in other frameworks. One study by Lundberg *et al* (1997) used a policy change in the UK as a natural experiment to test whether the identity of the benefit's recipient affects the household's consumption's patterns and showed that transferring children's allowance from fathers to mothers increased spending on women and children clothing relative to men's. As stated by Lundberg and Pollak (1997) the question remains of whether the individual receiving the benefits does determine how the money is to be spent.

Although some have been critical of the types of policies mentioned above on the basis that they interfere in private matters within households, it must be recognized that even doing nothing will affect intrahousehold distribution (Doss, 2003). The objective of this chapter is to analyse the extent to which the unitary model represents an adequate framework to study household behaviour. As stated by Alderman *et al* (1995): "the guide to policymaking implied in the unitary model is simpler if it is correct, inefficient if it is not" (p.2).

3   Empirical Review of the Literature

As shown in the theoretical section, this chapter relies on both the labour supply literature and the one that addresses intra-household resource allocation. It is beyond the scope of this chapter to analyse both literatures in their entirety, therefore, the review conducted below starts with a brief overview of labour supply estimates of British married men and women before analysing the various studies that have tested the unitary framework in the context of labour supply analysis.

3.1 Married women and men labour supply

As stated in Pencavel (1986), there is a vast and old literature on the determinants of labour supply behaviour, and until recently the latter was mainly analysed in the context of a traditional neoclassical framework. A wide range of studies have analysed individual labour supply of men and women mostly in industrialized countries. "First generation models" that date from the 1960s and the beginning of the 1970s used very simple methodologies but were considered to have pinpointed more problems than they solved. They estimated ad hoc labour supply functions and generally ignored the participation decision (corner solution). The range of elasticities found in these studies is very wide. In general, even though there is no real consensus regarding the magnitudes of elasticities for both genders, the findings were that female labour supply behaviour is more sensitive to changes in wages and income than men. Male uncompensated elasticities' estimates ranged between 0.00 and -0.4 with some studies finding positive elasticities for men. Regarding women, most gross wage elasticities were found to be positive and rather large with a variation in values even larger than that of men. "Second generation models" differ in that they have used labour supply equations derived from specified utility functions and budget constraints. There are few studies of male labour supply but the literature reports it less elastic with respect to wage and income than female labour supply, as suggested by earlier studies. Male gross wage elasticities estimates found in these studies range from -0.2 to 0.14 while female ones are normally higher than 0.60 (Killingsworth, 1983). In Great Britain in particular, Pencavel (1986) reveals that most of the studies of male labour supply have been conducted in the context of taxation (i,e.; non-linear budget constraint). The following table provides a summary of the main results of studies of married male and female labour supply in the United Kingdom. Some of the estimates cited are based on non-linear budget constraints, others correct for selection bias. Studies of participation decisions are not reviewed, as they

are the subject of the next chapter. It is important to note that studies that model

simultaneously household labour supply and commodity demands are not included in the

table.[11]

Table 1.1: A selection of British Studies of married males and females labour supply

Study	Sample and procedure	Own wage elasticity	Spouse's wage elasticity	Non-labour income elasticity
Female labour supply				
Layard *et al* (1980)	Working wives only/ OLS/LBC	0.08	-0.10	-0.003
Greenhalgh (1980)	Working wives only/ OLS/LBC	0.717	*f*	-0.08 [a]
Ashworth and Ulph (1981) †	Family utility-family budget constraint model/working couples	-1.18	1.73	-0.04 [a]
	Individual utility-family budget constraint model/working couples	-4.46	5.05	0.56 [a]
Arrufat and Zabalza (1986)	Sample of married women/ML/NLBC	0.62	-0.34	-0.06
Main and Reilly (1994)	Sample of married women/ Tobit/LBC	1.39	-0.142	0.043
Davies *et al* (2000)	Sample of working couples/SR/LBC	-0.053	*f*	0.001
Clark *et al* (2002)	Sample of couples/IV/LBC	0.326	-0.136	-0.053
Male labour supply				
Ashworth and Ulph (1981) †	Family utility-family budget constraint model/working couples	-0.03	-0.16	-2.21 [a]
	Individual utility-family budget constraint model/working couples	-1	0.87	1.47 [a]
Davies *et al* (2000)	Sample of working couples/SR/LBC	-0.122	*f*	-0.005
Clark *et al* (2002)	Sample of couples/IV/LBC	NS	-0.036	-0.007

Notes: (†) reference taken from Killingsworth (1983) and (*f*) not available
(a) denotes total income elasticity

As is clear from table 1.1, studies of individual and household labour supply behaviour vary

in the samples they use, the frameworks they are based on and the estimation procedures.

In the context of the unitary model, different approaches have been used to model

household labour supply (Blundell and MaCurdy, 1999). The study by Wales and

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[11] See for example Blundell and Walker (1982).

Woodland (1976) is among the earlier ones to have analysed jointly the hours of work of household members. Kooreman and Kapteyn (1986) use the Almost Ideal Demand System to develop a model consistent with the unitary approach, which they use to analyse household labour supply in the Netherlands. Ransom (1987) develops a model of continuous hours with censoring to analyse the hours-of-work decisions of American families. Other studies investigate the impact of welfare programme participation on couples' labour market behaviour (see Hoynes (1996)). A survey of these studies is not needed for the purposes of this chapter as they often rely on specific utility functions or budget constraints that are suited to address the research questions they pose. Therefore, the only models of household labour supply surveyed in depth are those that have been used to test the implications of the unitary model. These studies are reviewed in the next section.

3.2   Testing the unitary model of household labour supply

Before providing a review of studies that have tested the unitary model of household labour supply, it is important to note that many studies have tested the unitary framework using consumer demand analysis both in developing and developed countries.[12] In the context of labour supply analysis, studies have tested each of the three aspects addressed in this chapter namely: income pooling, symmetry of Slutsky effects and the impact of distribution factors.

Ashenfelter and Heckman (1974) derive the unitary model's restrictions in a framework in which they can be easily tested. They use three-stage least squares to estimate a variant of husband and wife's labour supply functions where the substitution effects are among the coefficients being estimated. They then use these coefficients and their standard errors to

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[12] See Hoddinott *et al* (1997) for a review.

test for the equality of substitution effects (or in other words symmetry) and find that they cannot reject equality of effects. They impose this equality restriction on the data and argue that this improves the precision of the parameters estimated.

Lundberg (1988) investigates models of household behaviour using panel data from the financial control group of the Denver Income Maintenance Experiment, by estimating a dynamic simultaneous equations model of wife's and husband's hours of work. She starts with a general unrestrictive framework that nests within it a traditional model. The traditional model used is consistent with the unitary model and stipulates that the hours of work of men are independent of that of their wives and independent of her attributes as well, and for women, that their husband's behaviour is exogenous to theirs. The author finds that in couples with young children, there are interactions in family labour supplies. This rejects the traditional model in which individual leisure is an argument of a single household utility function whereas children seem to be an important commodity for couples in the sample.

Another paper that tests the 'neoclassical model' (as labelled by the author) is Schultz (1990). The author uses the 1981 socioeconomic Survey of Thailand and finds that family members do exhibit self-interest in distribution within the household. This is done in the context of estimating labour supply equations for men and women. Due to the fact that earnings are not an exogenous determinant of household demands, the author tests the effect of male and female unearned income on household behaviour. Two working assumptions are made, the first being that sources of unearned income of different members must be indistinguishable when it comes to what they can purchase in the market and produce in the household, and that unearned income is treated as exogenous. The estimation is done in multiple stages and different specifications are developed for robustness purposes. The first step is to estimate wage equations for males and females.

Only husbands and wives in couples where both earn a wage are analysed. After that, the author examines the impact of wife and husband transfers and non-property income on labour supply to test the equality restriction of the two effects implied by the neoclassical model. The results show that the different sources of non-labour income can be aggregated. Furthermore, there seems to be different effects on the woman's labour supply of spouse-specific non-earned income. Moreover, an individual's own non-labour income has a stronger negative impact on their labour supply than the income of their partner. This goes against the predictions of the unitary model of household behaviour.

Kawagushi (1994) tests various models of household labour supply using Australian data from 1986. The author estimates a system of simultaneous labour supply functions for husbands and wives using Maximum Likelihood. Results reveal that for both husband and wife, the own wage effect is positive when the wage level is low and becomes negative as the wage rate increases. Non-labour income has a positive effect on wives and negative effect on husbands. Regarding the implications of the "neoclassical model" (as labelled by the author), income pooling and Slutsky symmetry are investigated. Results show that the hypothesis of income pooling is rejected at the five percent significance level. In the case where income effects are not zero, the hypothesis that the Slutsky matrix is symmetric is rejected by the data. Kawagushi (1994) also investigates the impact of an EEP, the sex ratio, on the labour supply of husbands and wives but finds that the latter is not statistically significant.

Using Canadian data from 1986, in the context of the collective framework, Fortin and Lacroix (1997) estimate a general model, which embodies both unitary and collective approaches to test restrictions imposed by the former using maximum likelihood techniques. They find that the pooling hypothesis is rejected in most cases but that the collective model is rejected in the case of young couples with pre-school children. They

also estimate female and male elasticities and find that own wage elasticities for both women and men are in line with the range of estimates obtained in the literature. They are slightly larger for women than men. Cross-wage elasticities are much lower but not precisely estimated.

Winkler (1997) tests whether cohabiting individuals pool income and whether the type of income pooling depends on the kind of cohabitation, long term or short term and if the couple has children. The data used are from the 1993 Current Population Survey and the 1987 National Survey of Families and Households. A Heckman two-step model of hours worked consisting of a probit model of labour force participation is used. Subsequently, a linear hours worked equation, corrected for sample selection, is estimated. Results show that non-labour income has a negative effect on female labour supply. The hypothesis of income pooling is rejected.

Chiappori *et al* (2002) use a collective model augmented to include exogenous distribution factors. They use two types of measures. The first one is the sex ratio, computed by age, state of residence and race. The second is a Divorce Law Index. The latter is constructed based on four characteristics of divorce legislation and attempts to measure how favourable legislation is to women. Both are added to test the unitary framework where such variables are assumed not to affect labour supplies. The sample of 1618 households they use is drawn from wave 22 of the PSID (year 1988). They restrict the analysis to couples where both spouses work and do not take into account participation decisions. They find that both the sex-ratio and the Divorce Law Index have an effect on labour supply of husbands and wives and thus income transfers between spouses. A one percentage point increase in the sex ratio is found to decrease wives' annual labour supply by 17.9 hours and increase their husbands' by 45 hours. All the parameters of the sharing rule are found to be statistically significant.

Davies *et al* (2000) investigate the supply of both domestic and market hours of work using various models of household behaviour for a sample of British couples from the BHPS (year 1994). While the objectives of the study are different to those of this chapter, a brief overview of the latter is nevertheless informative. The analysis is restricted to couples with a working male. Three different types of households are identified depending on whether the wife is in full-time or part-time employment or not working. The authors use a switching regression approach to model hours of work, with a multinomial logit model for female labour force participation as a switching criterion. Both domestic and market hours are modelled for the three types of couples. Non-labour income is assumed to be non-pooled. The authors attempt to determine which type of approach, cooperative or non-cooperative, best describes their behaviour. The authors state that the data "suggest a much greater degree of autonomy of the two partners in marriage than any of the commonly used theoretical models would imply" (p.241). The estimates of the full model are found to be poorly determined, therefore, the authors estimate a hybrid model where no cross-effects are allowed in couples where the woman does not work or works part-time. For dual-earner couples, cross-income effects are allowed in the presence of dependent children. In the case where both partners are employed full-time, findings reveal that the hypothesis of zero correlation between the residuals of the four hours equations is not rejected at the 5% significance level. Regarding income and wage effects, the findings show significant but small own-wage effects for men and no own-wage effects for women. The authors attribute this result to the fact that the sample is split into full-time and part-time female workers and mention that if the equation is fitted to all women then female wages have a significant positive effect on their hours of work in the market.

Clark *et al* (2002, 2004) use British data from wave seven of the BHPS to estimate a collective model of labour supply 'a la Chiappori' to derive robust estimates for the effects

of wages, income and other variables on hours of work, and also to analyse intra-household bargaining by estimating a sharing rule. The sample they use consists of couples where both members work, but the issue of selection bias that results from this choice is not addressed. The authors model male and female labour supply simultaneously. The estimation procedure used is GMM. The authors test for the exogeneity of wages and non-labour income. A number of bargaining measures are incorporated in the analysis. Marital status, the woman's religious beliefs and the man's political involvement (measures available in the BHPS) are used as distribution factors. A woman is found to have greater bargaining power if she is less interested in religion and if she is married, but has lower bargaining power if her husband is involved in politics. Sex ratios are also used but do not seem to affect the supply of labour and therefore are not retained in the specification. Male elasticities are found to be insignificant and the estimated uncompensated wage elasticities indicate that the substitution effect dominates the income effect. The female labour supply elasticity with respect to her own wage is 0.326 for all couples and 0.249 for couples without pre-school children. The elasticity with respect to her husband's wage is found to be -0.136 for samples using all couples and not significant for couples without pre-school children. Moreover, both the income pooling hypothesis and the Slutsky symmetry hypothesis are rejected by the data.

The studies reviewed above show that in most cases, apart for samples with pre-school children, the hypothesis of income pooling is rejected by the data. For symmetry, conflicting results are found. Furthermore, it is important to note that pooling has been more often tested than symmetry in the context of labour supply analysis. With respect to distribution factors, sex ratios are found to be statistically significant in some studies but not in others. In this chapter, two types of measures of sex ratio will be investigated as discussed below.

Few studies have used distribution factors that are couple-specific, probably due to endogeneity concerns. For this reason, a decision is made not to use religious attendance and political involvement in this study (they were considered as distribution factors by Clark *et al* (2002)). Clark *et al* (2002, 2004) also explore the role of parental socio-economic background and introduce a measure of gender-role attitudes to their model. In this thesis, this will be done in chapters two and three. One distribution factor, which is couple-specific, and is not endogenous, the age difference between husband and wife, will be used in this study and is discussed below. The next section provides a detailed analysis of the data including a discussion of the variables to be employed in the present analysis.

4 Data

The aim of this thesis is to empirically test a number of propositions regarding a couple's labour market behaviour in Great Britain. There are various British surveys that collect information on household behaviour such as the Family Expenditure Survey and the General Household Survey among others. In this thesis, the data are drawn from the British Household Panel Survey that is described in the next section.

4.1 The British Household Panel Survey

The British Household Panel Survey (BHPS) is an annual survey designed to facilitate the investigation of social and economic conditions both at the individual and household level in Britain, and has been extensively used by the academic community. It covers topics such as household organization, wealth, socio-economic values and the labour market. It started in 1991 and comprises annual waves to the current date. It is conducted by the ESRC UK Longitudinal Studies Centre, with the Institute for Social and Economic Research at the University of Essex. The fieldwork generally takes place from September 1st to the end of

April of the following year. Adults aged over 16 are interviewed totalling more than 5,000 households. It is a panel, which means that the same individuals are interviewed in consecutive years. If they leave their original household, they will still be interviewed as well as the members of the new household they integrate into. The survey has been regularly enhanced to better fit the needs of researchers. At wave nine, two additional samples in Scotland and Wales were added to increase the relatively small sample sizes of these two regions and to permit comparisons within the UK. The same was done for Northern Ireland in Wave 11 (Taylor *et al*, 2005).

There are a number of surveys that can be employed for labour supply analysis in the UK. The Family Expenditure Survey has been extensively used in studies of labour supply in the UK. Another survey that includes rich information on labour supply behaviour and that has been used to model labour market behaviour is the Labour Force Survey. The General Household Survey is a third survey of British households that has been employed to analyse labour market behaviour. All these surveys are cross-sectional. They include similar questions to the BHPS. However, the latter has two further elements that make it a better choice for the present study. First, it is a panel, which means that variables from previous waves can be used in modelling. Second, it includes questions on gender roles. These also feature in other surveys such as the British Social Attitudes Survey; however the latter would not be suited for the present purpose as it does not have detailed labour income information. It is important to note that the BHPS is likely to suffer from attrition problems.[13]

As stated in Clark *et al* (2004), the BHPS is distinctive as it includes information on various aspects of household behaviour and individual characteristics that can be used to unveil the complex mechanisms governing a couple's behaviour inside and outside the household.

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[13] See Uhrig (2008) for a discussion of attrition and non-response in the BHPS.

The survey is thus well suited for the analysis conducted in this thesis. The data come from Wave 13 of the BHPS and correspond to the years 2003 and 2004. The sample and variables used in this chapter are described in the next section.

4.2 Dataset construction

A number of adjustments have been made to the raw data in order to obtain the final dataset to be used in this chapter. Three types of variables are needed for the analysis. First, individual and household characteristics need to be defined.

Individual and household data

The analysis in this thesis is restricted to the working age population; therefore men aged more than 64 and women aged more than 59 are dropped from the sample as these correspond to the employees' retirement ages in the United Kingdom. A decision is made to restrict the analysis to Great Britain and exclude households in Northern Ireland, as the same specifications might not apply in that jurisdiction. As stated earlier, this chapter analyses the labour supply of couples. It is beyond the scope of this research to distinguish between married and cohabitating individuals.[14] Individual and household characteristics are needed for the analysis. The individual's age and education are key determinants of labour market behaviour. While the former is readily available, a choice has to be made regarding the most appropriate measure of an individual's education as the BHPS includes a number of variables that can proxy human capital. They are: age at which the person finishes school, highest academic qualification and highest educational qualification. The latter is used and the variable for education is constructed as five dummy variables corresponding to the following categories: one category includes people who have a higher degree; the second is composed of people who have a first degree, the third corresponds to

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[14] See Winkler (1997) for an analysis of income pooling among cohabitating couples.

people who have teaching or nursing qualifications, apprenticeships or any other higher qualification, the fourth includes individuals who have A levels, O levels, a commercial qualification or CSE grade 2-5 or equivalent, and the last category is the one comprising individuals without any formal qualification. Regarding household specific data, region of residence and the number and age of children are all available. There are two different variables regarding the number of children: number of own children in the household and number of children in the household. There does not seem to be a notable difference between the two in the sample used here. With respect to the age of children, variables indicating the number of children between 0 and 2, 3 and 4, 5 and 11, 12 and 15 and finally 16 and 18 are used to construct three dummy variables indicating the presence, in the household, of at least one child aged under 5, or between 6 and 11 or over 12. This distinction is important, as female employment rates are known to vary depending on the age of their children (this issue is discussed further in chapter two).[15]

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[15] Preliminary analysis revealed an expected high correlation between the number of children and the binary variables indicating the presence of children in the various age categories. Therefore, only the latter were retained in the analysis.

Table 1.2: Individual and household variables' description and summary statistics

Variable name	*Variable description*	*Males*	*Females*
educ0	Binary variable that equals 1 if the respondent has no qualification and 0 otherwise	0.07	0.07
educ1	Binary variable that equals 1 if the respondent has o levels, a levels, cse grade 2-5 or commercial qualification and 0 otherwise	0.34	0.39
educ2	Binary variable that equals 1 if the respondent has a nursing or teaching qualification, other higher qualification or apprenticeship 0 otherwise	0.40	0.35
educ3	Binary variable that equals 1 if the respondent has a first degree and 0 otherwise	0.14	0.16
educ4	Binary variable that equals 1 if the respondent has a higher degree and 0 otherwise	0.04	0.03
age	Continuous variable representing the individual's age in years	41	39
childlessthan5	Binary variable that is equal to 1 if there is at least one child aged between 0 and 4 in the household and 0 otherwise	0.16	0.16
child5to11	Binary variable that is equal to 1 if there is at least one child aged between 5 and 11 in the household and 0 otherwise	0.27	0.27
childolderthan 12	Binary variable that is equal to 1 if there is at least one child aged between 12 and 18 in the household and 0 otherwise	0.22	0.22
london	Binary variable that equals 1 if the household is in inner or outer London and 0 otherwise	0.04	0.04
eastanglia	Binary variable that equals 1 if the household is in East Anglia and 0 otherwise	0.03	0.03
north	Binary variable that equals 1 if the household is in and 0 otherwise	0.19	0.19
south	Binary variable that equals 1 if the household is in the South East or the South West of England and 0 otherwise	0.21	0.21
scotland	Binary variable that equals 1 if the household is in Scotland and 0 otherwise	0.22	0.22
wales	Binary variable that equals 1 if the household is in Wales and 0 otherwise	0.17	0.17
midland	Binary variable that equals 1 if the household is in the east midlands, the west midlands conurbation or the region of west midlands and 0 otherwise	0.13	0.13
	Sample size	1415	1415

Labour supply and income data

In this chapter, labour supply is taken to mean the total number of hours worked on all jobs in a month.[16] It is important to note a discrepancy in the hours' variable pertaining to the main job and the one relative to the secondary job. In the first case, the number of hours reported is the "usual number of hours worked per week" whereas in the case of the secondary job, it is the "number of hours worked last month". As stated in Borjas (1980), the "usual" number of hours is an appropriate measure, as it most likely does not take into account holidays and sick days. One cannot assume that the hours on the second job are constant throughout the year. However for the main job, one could assume that the usual hours were observed during the month before the interview. Therefore, the number of total monthly hours to be used in the analysis as the dependent variable is the sum of the usual weekly hours converted into a monthly figure by multiplying by the factor 4.33 to which are added hours on the second job last month. With respect to labour income, for the main job, the take home pay at the last payment as well as usual pay are reported. For the secondary job, only last month's gross pay is available. Labour income for the month before the interview date is also available and is reported in gross terms. This is the variable that is used to construct the hourly wage measure in order to ensure consistency with the second job information reported. The hourly wage is defined as last month's labour income divided by total number of hours worked last month. This measure can potentially be affected by what has been known in the literature as the "negative division bias", in case the hours variable is measured with error, as hours appear on both sides of the equation (Borjas, 1980).

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[16] Second job holders constitute 7% of the sample of working couples.

In the survey, itself, the non-labour income is derived from four sources: benefit income, transfer income, pension income and investment income. Benefit income is equal to all state benefits payment. Investment income is the sum of all income from savings and investment, as well as proceeds from rents or borders and lodgers. Pension income is equal to the sum of all amounts received from non-state pensions. Finally, transfer income is the sum of all other receipts such as educational grants, payment from absent family members and others. Two types of income measures are available in the survey: yearly non-labour income (during the year from September in the year before the interview until September of the interview year) and last month's non-labour income. A monthly income value is obtained by dividing the first measure by 12 as it is more likely to represent "permanent income" than the second. It is important to mention a potential problem with income variables. In some cases, the couple jointly receives payments. In order to obtain individual measures, joint receipt payments are divided by two. This poses a problem in the present study, as its aim is precisely to investigate how non-labour income is divided at the level of the household. However, the problem can be conveniently ignored as it concerns less than 5% of couples in the case of investment income and less than 1% with respect to all other types of income. In addition, income variables include imputed values. It is important to note a cluster of zeros for non-labour income. This might result in a lack of variation of the income variable in regression models and thus yield imprecise estimates. Individuals who have missing information for any of the variables of interest are omitted from the sample. Finally, one should also be aware of other potential problems that might arise regarding some of the variables. As mentioned previously, regarding wage measurement, any error in labour supply values (hours) will also affect the wage measure, as it is the ratio of monthly earnings over monthly hours. A few problems also arise in the construction of the income variable. A number of sources of non-labour income are effectively work related such as

certain types of transfers, in which case they can no longer be considered exogenous. In this chapter, potential endogeneity concerns will be addressed using the Instrumental Variables (IV) procedure, as will be discussed later. Finally, one last point concerning income measurement is whether the monetary value of the services from housing, durables and others needs to be incorporated in the income measure (Killingsworth, 1983)? The inclusion provides an estimate of non-labour income, which is more consistent with a life-cycle approach where approximating the value of durable assets is important.

Table 1.3: Labour market and income variables' description and summary statistics

Variable name	*Variable description*	*Males*	*Females*
hours	Ordinal variable. It is equal to the sum of hours on main and second jobs. (all jobs)	172 (32)	129 (45)
male_wage	Log of male hourly wage for all jobs (see main text for a detailed description)	2.4 (0.47)	-
female_wage	Log of female hourly wage for all jobs (see main text for description)	-	2.09 (0.47)
less6mths	Binary variable that equals 1 if the individual has been in their current job for a period of less than six months and 0 otherwise	0.15	0.16
7mths_1yr	Binary variable that equals 1 if the individual has been in their current job for a period of of seven months to one year and 0 otherwise	0.10	0.12
1yr_3yr	Binary variable that equals 1 if the individual has been in their current job for a period of one to three years and 0 otherwise	0.26	0.29
3yr_5yr	Binary variable that equals 1 if the individual has been in their current job for a period of three to five years and 0 otherwise	0.14	0.14
5yr_10yr	Binary variable that equals 1 if the individual has been in their current job for a period of five to ten years and 0 otherwise	0.18	0.15
10yr_more	Binary variable that equals 1 if the individual has been in their current job for more than ten years and 0 otherwise	0.17	0.14
male_income	Continuous measure. Monthly male non-labour income obtained by dividing non-labour income in the year before the interview by 12. It includes transfer, benefit, pension and investment income	81 (250)	-
female_ income	Continuous measure. Monthly female non-labour income obtained by dividing non-labour income in the year before the interview by 12. It includes transfer, benefit, pension and investment income	-	116 (186)
couple_ income	Continuous measure. Pooled monthly non-labour income that is equal to the sum of the male and female monthly non-labour incomes	197 (323)	197 (323)
	Sample Size	1415	1415

Distribution factors

As stated in Thomas *et al* (1997), even though there is an intuitive interpretation of power in the theoretical modelling of intra-household relations, it "has proven to be the Achilles heel of empirical work on household decision-making" (p.1). According to Quisumbing and Maluccio (1999), in addition to the fact that an appropriate distribution factor should be exogenous to bargaining between spouses, it is crucial that the latter also reflects cultural patterns that are likely to be relevant to within marriage bargaining. However, as stated by Phipps and Burton (1995), there is limited variation in social/institutional factors within one country, thus limiting the type of variables that can be used to proxy bargaining. Nevertheless, two broad types of distribution factors are used in this study and thus computed. These comprise internal and external factors to the household. The first distribution factor used in the analysis is the percentage age difference, which is constructed by subtracting the female age from the male age and dividing the result by the male's age. According to Smith *et al* (2003), this gives more importance to that factor in younger couples. A related distribution factor that is also used is a dummy variable indicating whether the wife is older than her husband. In developing countries, studies have shown that women's power was lower the older their husband (see Jejeebhoy, 1995). However, another interpretation is also possible. If the male is younger, his partner could feel that he has more options in the marriage/remarriage market than her. As stated by Becker (1991), separated or divorced women, even when young, tend to remarry slower than men as they often have custody of children which could discourage new partners.

Quisumbing and Maluccio (1999) state the importance of social capital in determining a woman's bargaining power. In the survey, there are a number of variables pertaining to membership of individuals to organizations such as women's group, sports' club, and social or community groups. This information is not used as it could be a result of bargaining

strength as well as an indicator of it. For the same reason, attendance at religious services is also not employed despite the fact that it was used as a distribution factor in Clark *et al* (2002).

Regarding variables outside the household, a sex-ratio, defined as the number of men per woman in a population, is constructed. In this study, two different measures of sex-ratios are used. The first sex-ratio measure is defined as the ratio of the number of males whose age falls in the age category of the husband over the number of females whose age falls in the category of the wife in a particular county. The second sex-ratio measure is defined as the ratio of the number of males whose age falls in the age category of the husband over the number of females whose age falls in that same age category. The data are obtained from the Office of National Statistics. They describe population estimates by age group, gender and local authority in 2003.[17] The sex ratios are computed at the level of county. As the BHPS does not have this particular information, districts are used and assigned to relevant counties. There might be slight discrepancies in the geographical boundaries of the regions as a number of changes in districts occurred in 1996 and the survey do not take these into account. If there are more men than women in a region, then women are at an advantage as they have more "options" in case of divorce. The definitions of sex-ratio employed in this paper might seem ad-hoc. Indeed a number of questions can be raised regarding the measure likely to best reflect the marriage market. Should the measure reflect the state of the marriage or remarriage market? When an individual looks for a new partner, what is their "target" group?

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[17] See Office of National Statistics (2003).

It is important to note that a number of studies have analysed the impact of sex ratios on the behaviour of women in slightly different contexts to the current chapter. Angrist (2002) uses a migration episode in American history to study the effect of changing sex ratio on marital status, fertility and labour market outcomes. He finds that high sex ratios result in a positive effect on the likelihood of female marriage and a large negative effect on their labour force participation. Grossbard-Shetman and Neideffer (1997) use the 1990 census Public Use Microdata Sample to study the impact of marriage market on women's labour supply. The hypothesis to be tested is that high sex ratios, which signal the presence of an excess of males in the marriage market, lead to women working less in the labour market and getting more income from spousal labour. A few considerations need to be addressed regarding the use of the sex ratio as a distribution factor. In certain regions, due to the presence of a certain type of industry or occupations, there might be a high presence of males and therefore a high sex ratio which might lead to a spurious correlation with hours worked. In the particular case of regional variation, if the latter does exist, differences in habits or other factors specific to the community can be alternative explanations (Hoddinott *et al*, 1997). However, it is important to also note that that using factors outside the household helps avoiding potential endogeneity problems (Chiappori *et al*, 2002).

Another distribution factor that has been widely used in the literature is some measure of divorce legislation as the latter influences property rights in the event of a marriage breakdown. Gray (1998) uses changes in unilateral divorce laws, and more specifically their implications regarding property rights, in order to evaluate different models of household behaviour. The analysis is conducted using three samples: the Current Population Survey, the Census and PSID. Two years are used for each survey. One year prior divorce law changes and one year after half the states had adopted them. The results were the following: First, it was shown, as predicted by the Coase theorem, that a reassignment of

property rights did not increase the probability of divorce. Second, women that were positively affected by the legislation increased their labour supply while those that were disadvantaged reduced it. The author states that these findings are consistent with a bargaining model that usually predicts a reverse impact on labour supply due to a change in power only if non-market time is divided between leisure and non-market time and that they reject the standard unitary model. In Britain, there is no spatial variation in legislation as in the US. One could use the divorce rate to proxy divorce patterns in a certain district. However, the interpretation is not as clear as in the case of legislation. Indeed, if the divorce rate influences labour supply, this could have a bargaining interpretation but also a labour supply interpretation since higher divorce rates might mean more single women aiming to work and therefore impact aggregate labour supply/demand. The variable is therefore not included in the analysis.

As explained above, in the collective model, an increase in a distribution factor that is considered to favour the wife's bargaining power will lead to a reduction in her labour supply. In the case of sex ratios, it is expected that a greater number of men relative to women is equivalent to a greater female bargaining power and thus an increase in the sex ratio is expected to reduce female hours of work. The reverse should hold for men. With respect to age difference, most studies suggest that an increase in the age difference between a wife and her husband should reduce her bargaining power or in other words increase her labour supply. As mentioned previously, this interpretation does not take into account household production and should therefore be referred to cautiously. For this reason, it is important to note that other studies that have used distribution factors only look at the significance of distribution factors and not the direction of their impact. As mentioned by Phipps and Burton (1995): "whether an increase in bargaining power for

women will result in an increase or a decrease in labor-force participation presumably depends upon women's preferences with respect to paid employment."(p.159).

Table 1.4: Distribution factors description and summary statistics

	Variable description	*Variable name*	*Mean; standard deviation*	*Range*
Couple specific	Percentage age difference	age_difference	0.0386 (0.1145)	[-0.63;+0.54]
	Whether the wife is older	female_older	0.1618	Binary variable (0,1)
Regional	Sex ratio (definition 1)†	sex_ratio	1.14 (0.31)	[0.4;3]
	Sex ratio (definition 2) ††	sex_ratio2	0.99 (0.07)	[0.85;1.27]

Notes: (†) Sex ratio definition 1: ratio of the number of males whose age falls in the age category of the husband over the number of females whose age falls in the ages fall in the category of the wife in a particular county.

(††) Sex-ratio definition 2: ratio of the number of males whose age falls in the age category of the husband over the number of females whose age falls in that same age category.

4.3   Description of the sample

This chapter only considers dual-earner couples with a more in-depth analysis of all couples conducted in the next chapter. Descriptive statistics for the sample are reported in tables 1.2 and 1.3 above. Regarding the educational level, a Pearson chi-square test of independence of educational levels of spouses in dual-earner couples reveals that the two are correlated. There do not seem to be important differences between married male and female employees in lower and higher levels of education. At intermediate levels, there is a higher proportion of males in apprenticeship, nursing and other higher qualifications than females. The mean age difference between couples is two years. Regarding the presence of children, the lowest proportion of dual-earners is the one of couples with at least one pre-school aged child. This is expected as the presence of young children imposes important time constraints on parents as will be discussed in the next chapter. The regional sample statistics reveal a high proportion of dual-earner couples in Scotland and Wales. However, this is most likely due to the fact that the proportion of individuals in Scotland and Wales in the BHPS sample is higher than the national one as discussed earlier.

In the present sample, married employed men work on average 43 more hours per month than their female counterparts. They also earn on average 30% more per hour than women employees, which is consistent with the raw gender pay gap in Britain during this period. With respect to non-labour income, women earn more benefit income than men and the average benefit income is lower among couples who are duals earners (see tables A1.1 (appendix 1) and A2.3 (appendix 2)). This could be explained by the fact that these couples are probably less likely to get benefits than single parents, or couples where one spouse is unemployed or other similar cases. Men have higher pension income than women. As can be seen from table 1.4, the age difference in couples is equal to four percent on average and

the range of estimates is high. Finally, the sex ratio variables have similar means but the first definition has more variation and the cut off point of the range do seem to indicate the potential presence of outlier couples. The second sex ratio variable seems to have more plausible descriptive statistics although it suffers from a lower variation.

5 Econometric Methodology

As outlined in the theoretical section, labour supply equations represent solutions to a utility maximization problem. The researcher can choose to start with a utility function and then derive the corresponding labour supply equations or the reverse. However, as stated in Pencavel (1986): "Although there have been a number of instances to the contrary, the general procedure has not been to specify a particular expression for the direct or indirect utility function and then to estimate the implied hours of work function. More often, an hours of work function convenient for estimation has been specified *ab initio* and the popular choice has been one that is linear in parameters" (p.52). The functional form chosen (direct utility, indirect utility, expenditure, labour supply) should be tractable. In the case where one starts with labour supply, it implies one should be able to integrate back to the utility function. In the case where one starts with a utility function, tractability implies it is possible to find a solution to the maximization problem (Stern, 1986). Normally a simple labour supply equation means a more complicated utility and *vice versa*. In general, one starts with one or other of the two.

5.1 Issues in estimation

When estimating a labour supply equation, several factors have to be considered. First, the functional form should be relatively easy to estimate and satisfy conventional theoretical considerations as well as be sufficiently flexible to allow extensions to the empirical specifications. Second, it should be consistent with utility theory. It should also be practical in real problem solving and flexible in the behavioural responses it allows (Stern, 1986). As stated earlier, all these issues represent only part of the challenges facing researchers in the study of labour supply. Another important issue is that of sample selection in labour supply

analysis, which arises when the sample is chosen according to a criterion that could potentially affect or be affected by labour supply decisions as the disturbances may not be a zero mean random variable in this context. This makes the use of Ordinary Least Squares (OLS) techniques inappropriate as they assume that errors have an expected value of zero on average. The regression line fitted to data from a sample of working individuals only could lead to inconsistent and statistically biased estimates of the structural labour supply behaviour if sample selection is an issue. It is thus important to analyse whether sample selection arises in any particular application and whether the magnitude of the bias is large enough to justify changing estimation techniques in order to take it into account (Killingsworth, 1983).

As stated in Blundell and MaCurdy (1999), the log-linear (or semi-log) model is useful in cases of potential endogeneity issues and measurement problems. It has often been used in first generation studies but also in papers with an objective similar to the current one (Chiappori *et al*, 2002). In order to investigate the income pooling proposition, the equality of male and female non-labour income effects in both the male and female regression models needs to be tested. The labour supply equations are taken to be log- linear functions specified as follows:

$$hours_i^f = \alpha^f + A_i^{f'}\beta^f + \gamma^f inc\_f_i^f + \partial^f inc\_m_i^f + \theta^f \ln w_i^f + \kappa_i^f \ln w_i^m + \varepsilon_i^f \qquad [1.4.1]$$

for $i = 1,....,n_f$

$$hours_j^m = \alpha^m + A_j^{m'}\beta^m + \gamma^m inc\_f_j^m + \partial^f inc\_m_j^m + \theta^m \ln w_j^f + \kappa_j^m \ln w_j^m + \varepsilon_j^m \qquad [1.4.2]$$

for $i = 1,....,n_m$

The superscripts m and f indicate the equations for males and females with n_f and n_m being the number of female and male sample observations respectively. Each female i and male j, belong to a couple in the sample. For each couple, $hours_i^f$ represents a wife's

supply of total monthly hours of work (denoted by h^f in the theoretical section) and $hours_j^m$ represents a husband's supply of total monthly hours of work (denoted by h^m in the theoretical section), $inc\_f_i^f$ and $inc\_m_i^f$ represent a wife's own non-labour income and her husband's one respectively while $inc\_m_j^m$ and $inc\_f_j^m$ represent a husband's own non-labour income and his wife's respectively (note that male and female non-labour incomes are represented by y^f and y^m respectively in the theoretical section). $\ln w_i^f$ and $\ln w_i^m$ represent the natural log of hourly wage for the ith female and her husband respectively (using both primary and secondary jobs) and $\ln w_j^m$ and $\ln w_j^f$ represent the natural log of hourly wage for the jth male and his wife respectively (using both primary and secondary jobs). A_j^m and A_i^f are $k \times 1$ vectors of male and female characteristics respectively and include age, region of residence and the presence of children aged less than 5, between 5 and 11 and older than 12 in the household. Finally, β^m and β^f are $k \times 1$ vectors of unknown parameters corresponding to these characteristics.

A variant of the model includes the couple's pooled income instead of male and female incomes being introduced separately. It is equivalent to imposing the following constraints:

$\gamma^f = \delta^f$ and $\gamma^m = \delta^m$

It is important to mention that this particular restriction represents the "income-pooling" test to be described later.

The male and female labour supply equations with pooled non-labour income are:

$$hours_i^f = \alpha^f + A_i^{f\prime}\beta^f + \psi^f(inc\_f_i^f + inc\_m_i^f) + \theta^f \ln w_i^f + \kappa_i^f \ln w_i^m + \eta_i^f \quad [1.4.3]$$

for $i = 1,....,n_f$

$$hours_i^f = \alpha^f + A_i^{f\prime}\beta^f + \psi^m(inc\_f_i^f + inc\_m_i^f) + \theta^f \ln w_i^f + \kappa_i^f \ln w_i^m + \eta_i^f \quad [1.4.4]$$

for $i = 1,....,n_m$

where $\psi^f = \gamma^f = \delta^f$ and $\psi^m = \gamma^m = \delta^m$

Let equations [1.4.1] and [1.4.2] constitute specification I (i.e., the specification that includes male and female non-labour income separately) and equations [1.4.3] and [1.4.4] constitute specification II (i.e., the specification that includes pooled non-labour income).

In the second part of the analysis, distribution factors are introduced into the regression model. As mentioned in the data section, there are two alternative definitions of sex ratios used in this chapter. They are introduced in turn. Then, two other variables, age difference and whether the wife is older are also included, first to the original regression model and then together with the sex ratios. If distribution factors are found to be significant, this indicates that bargaining models provide a more appropriate framework than the unitary model. According to the collective model, an increase in the sex ratio (higher female bargaining power) should lead to a reduction in female labour supply and an increase in male labour supply. Similarly, an increase in the age difference (lower female bargaining) should lead to an increase in female labour supply and a decrease in male labour supply, although a higher age difference can possibly favour the wife as discussed previously. Finally, it is expected that an older woman will have a stronger bargaining position and therefore reduce her labour supply (although a different interpretation is also possible as an older woman might feel less secure in her marriage).

Before estimating the various models mentioned above, a few issues need to be addressed.

The issue of potential endogeneity of the variables arises in most econometric applications. If one or more of the explanatory variables are correlated with the equation's error term, then the regressors are considered endogenous. There are three main sources of endogeneity in econometrics. First, omitted variables are often a cause of endogeneity. This is a case in which one would like to control for a particular variable but lack of data prevents this. If one of the explanatory variables is related to this unobservable factor, then the latter will be endogenous as the effect of the unobservable will be captured in the disturbance term. Second, endogeneity can arise because of measurement error. The latter occurs if one can only observe an imperfect measure of the independent variable of interest. In such a case, a measurement error is introduced in the disturbance term. Finally, simultaneity is a third cause of endogeneity and appears if one of the explanatory variables and the dependent variable are determined simultaneously. In practice, one cannot easily disentangle the different sources of endogeneity and they need not be mutually exclusive and may also co-exist (Wooldridge, 2002). In the present study the two latter causes of endogeneity are probably present as wages and hours are likely to be determined simultaneously. Furthermore, the hourly wage variable is obtained by dividing monthly hours by monthly pay and both variables are thus subject to a potential measurement error. In labour supply models, wages, non-labour income and the number of children are often treated as endogenous. The latter is treated as exogenous in this study as an explicit analysis of fertility is not the subject of study of this chapter. With respect to non-labour income, a decision is made to use a measure from the year before the interview. The latter is undoubtedly less endogenous than a current measure of non-labour income, however, due to high persistence in income, it might be potentially endogenous to labour market behaviour. Unfortunately, there do not seem to be enough instruments in the data to identify a model where both wage and non-labour income are treated as endogenous.

Therefore, in this chapter, a decision is made to treat the wage as the only potentially endogenous variable. There is then a need to find good instruments for the latter. The search for appropriate instruments for wages is conducted separately for men and women.

When there are potential endogenous variables in the model to be estimated, OLS will yield biased and inconsistent estimates (Bound *et al*, 1995). Methods to estimate in this case are the Instrumental Variables (IV) technique, the Generalized Method of Moments (GMM) and Full Information Maximum Likelihood Estimation (FIML). The latter does not seem appropriate as it is sensitive to distributional assumptions and does not perform well with the type of sample size available to us here. While many studies have used GMM for this type of analysis (see Chiappori *et al* (2002) and Clark *et al* (2002, 2004)), in this chapter the Instrumental Variables (IV) method is used. GMM is seen as a solution to heterescedasticity of unknown form but it can potentially have poor power in small samples as one could add more moments conditions without gaining more information. Furthermore, most statistical software packages allow for a correction for heteroscedasticity in the context of instrumental variables estimation, thus "additional gains from using GMM may be small" (Wooldridge, 2001, p.93) in cross section applications. In his paper, Wooldridge (2001) compares results from IV and GMM and shows that the results from both methods are very similar showing that heteroscedasticity is probably not a significant issue. There are two ways of considering the results of this experiment. On the one hand, one could consider that there are no benefits from using GMM compared to two-stage least squares. On the other hand, it could be argued that there is no loss in using GMM in any case. One should note that OLS and IV are both particular applications of the GMM estimator. Before providing a description of the IV procedure, two further issues need to be addressed.

First, one might expect husbands and wives to jointly determine their labour supply behaviour. In the latter case, a system of equations would have to be used. It is then necessary to test whether the "unobservables" affecting male and female labour supplies are correlated. The first step consists in estimating the female labour supply equation using the appropriate model (as identified by the IV procedure to be described below) and then estimate male labour supply equations. The final step is subsequently to test whether the correlation between male and female residuals obtained from the two equations is equal to zero using a Spearman rank order test.

Second, there is a need to describe the procedure used to test whether the two propositions of the unitary model hold. Income pooling is equivalent to considering that the distribution of non-labour income between the male and the female does not matter for individual labour supplies and that only the level of pooled household non-labour income does. This can be tested by investigating whether there is equality in the regression coefficients on female and male non-labour income (Fortin and Lacroix, 1997). Using equations [1.4.1] and [1.4.2] for females and males respectively, this is done using two Wald tests (one for each gender) with equality of income effect as the null hypothesis. These are expressed as follows:

Income pooling test for females:

$$H_0 : \gamma^f = \delta^f \quad \text{versus} \quad H_A : \gamma^f \neq \delta^f \tag{1.4.5}$$

Income pooling test for males:

$$H_0 : \gamma^m = \delta^m \quad \text{versus} \quad H_A : \gamma^m \neq \delta^m \tag{1.4.6}$$

Empirically, the implementation of this test presents a number of problems. First, the validity of the test is closely related to the precision of the estimated coefficients of non-labour income. In addition, measurement error, which is likely to be present in the case of income variables, can also hamper the test's reliability (Del Boca, 1997). Finally, as

mentioned by Hoddinott *et al* (1997), rejecting pooling does not say anything about other models of household behaviour and just provides evidence against the unitary model of household behaviour. Following this line of thought, this chapter's objectives are to investigate if the unitary model is an appropriate simplification of household behaviour and not to suggest potential alternatives.

Regarding the Slutsky symmetry test, assuming that the household pools non-labour income and using the expression derived in the theoretical section, the symmetry test amounts to a test of the null hypothesis:

$$H_0 : \left(\frac{\partial h^f}{\partial w^m} - h^m \frac{\partial h^f}{\partial y} \right) - \left(\frac{\partial h^m}{\partial w^f} - h^f \frac{\partial h^m}{\partial y} \right) = 0$$

In a log-linear model, this is equivalent to testing the following:

$$H_0 : \left(\frac{\partial h^f}{w^m \partial \ln w^m} - h^m \frac{\partial h^f}{\partial y} \right) - \left(\frac{\partial h^m}{w^f \partial \ln w^f} - h^f \frac{\partial h^m}{\delta y} \right) = 0$$

Using specification II (equations [1.4.3] and [1.4.4] above) this is re-expressed as:

$$H_0 : \left(\frac{\kappa^f}{\overline{w}^m} - \overline{h}^m \psi^f \right) - \left(\frac{\kappa^m}{\overline{w}^f} - \overline{h}^f \psi^m \right) = 0 \qquad\qquad [1.4.7]$$

Where $\overline{w^f}$, $\overline{w^m}$, correspond to female and male mean wage respectively and $\overline{h^f}$, $\overline{h^m}$ are female and male mean hours respectively.

The t statistic with the null proposition imposed is given by:

$$t = \frac{(\frac{\kappa^f}{\overline{w}^m} - \overline{h}^m \psi^f) - (\frac{\kappa^m}{\overline{w}^f} - \overline{h}^f \psi^m) - 0}{\sqrt{VAR\left[(\frac{\kappa^f}{\overline{w}^m} - \overline{h}^m \psi^f) - (\frac{\kappa^m}{\overline{w}^f} - \overline{h}^f \psi^m) \right]}}$$

where

$$VAR\left[(\frac{\kappa^f}{\overline{w}^m} - \overline{h}^m \psi^f) - (\frac{\kappa^m}{\overline{w}^f} - \overline{h}^f \psi^m) \right] =$$

$$VAR(\frac{\kappa^f}{\overline{w}^m} - \overline{h}^m\psi^f) + VAR\ (\frac{\kappa^m}{\overline{w}^f} - \overline{h}^f\psi^m) =$$

$$\left(\frac{1}{\overline{w}^m}\right)^2 VAR(\kappa^f) + \left(\overline{h}^m\right)^2 VAR(\psi^f)\ -\ 2\frac{\overline{h}^m}{\overline{w}^m}\ COV\ (\kappa^f, \psi^f)$$

$$+ \left(\frac{1}{\overline{w}^f}\right)^2 VAR(\kappa^m) + \left(\overline{h}^f\right)^2 VAR(\psi^m)\ -\ 2\frac{\overline{h}^f}{\overline{w}^f}\ COV\ (\kappa^m, \psi^m)$$

The covariance is zero given non-overlapping samples (i.e., separate samples by gender group).

According to Schultz (1990), this test is less robust to misspecification than the pooling test suggested above. Furthermore, the test becomes more complicated if it is found that male and female non-labour income do not have the same impact on the labour supply of each member.

5.2 Instrumental variables procedure

As stated above, one way to estimate an equation in the presence of one (or more) endogenous regressor(s) is the method of Instrumental Variables (IV). The latter consists in estimating two equations. In the "first-stage regression", a reduced form equation is estimated by expressing any potential endogenous variable as a linear combination of all exogenous variables in the model. Among the latter are variables that are instrumental variable candidates or "instruments" for the endogenous regressors; which will be discussed later. The fitted values are obtained from this regression model. The second step consists in regressing the dependent variable of interest on all the exogenous variables and the fitted values from the first equation. This regression is called the "second-stage regression". The model can be estimated using two-stage least squares.

The suitability of the IV framework relies heavily on the choice of instruments in the model. First, the relationship between the number of instruments and the number of

endogenous explanatory variables is crucial. In the case where the number of instruments is the same as the number of endogenous variables, the regression parameters are said to be exactly identified. If the number of instruments is larger than that of the regressors, then the regression parameters are said to be over-identified. Finally, in the opposite situation, the parameters are under-identified. It is only in the first two cases that estimation using IV yields something meaningful. Another concern in the process of identification is the appropriateness of instruments. Before providing a review of the various issues to consider when choosing instruments, it is important to mention that the model needs to be checked for heteroscedasticity prior to any testing. Indeed, the latter affects the standard errors estimated in the first-stage regression model and renders testing unreliable. As in the case of OLS, within the IV estimation framework, there are a number of tests available to detect the presence of heteroscedasticity. Breusch-Pagan (1979), Godfrey (1978) and Cook and Weisberg (1983), all cited in Baum *et al* (2002), independently derived a test of whether there exists a relationship between the disturbances and certain indicator variables. White (1980) and Koenker (1981) derived a statistic based on a similar reasoning except that their tests did not assume normality. These tests of heteroscedasticity are suitable if the latter is a problem in the IV regression and not elsewhere in the system. Pagan and Hall (1983) derived a statistic that does not require this assumption and is therefore used in this chapter. The statistic follows a chi-square distribution with number of degrees of freedom equal to the number of explanatory or predictor variables in the original regression. Since first stage regression results are used to draw inferences on the validity of instruments, one should also perform a test for heteroscedasticity on the first-stage regressions. This is done using a White-Kroenker test which uses a statistic distributed as a Chi-square and equal to nR^2 where R^2 is the R-squared from a regression where the squared residuals of the original regression are regressed on the variables from the original equation. The results of

the tests mentioned above indicate whether an Eicker-Huber-White "sandwich" robust variance-covariance matrix (see Baum *et al* (2002), for more details) should be used in subsequent estimation. Once the appropriate type of variance/covariance matrix is identified, parametric tests can be performed on the model. The next section describes the methodology used to investigate the suitability of the instruments.

<u>Instrument validity tests</u>

There are two conditions for a variable to be a good instrument. First, it should be highly correlated with the relevant endogenous variable and, second, it should be orthogonal to the error process of the structural equation, in other words, it should not affect the dependent variable in the latter (see Wooldridge (2002) and Baum *et al* (2002)). According to Wooldridge (2002), both of these requirements are crucial for the process of identification. However, unlike the first condition, the second one cannot be readily tested as it concerns unobservable disturbances. However, if the model is over-identified, one can perform a test of over-identifying restrictions which consists in investigating whether additional instruments are independent from the error term in the main regression model.[18] There are a number of variations of this test. One of these developed by Sargan (1958), cited in Baum *et al* (2002), consists in estimating an auxiliary regression model in which the dependent variable are the IV residuals from the main regression model, regressed on exogenous variables and identifying instruments. The Sargan statistic has a nR^2 form. Basmann (1960) cited in Baum *et al* (2002), developed a similar test in which the auxiliary regression does not impose the over-identification restrictions. Both tests are not valid if heteroscedasticity is present in the system. A Hansen J statistic can be used in this case. For a detailed description of the derivation of the latter see Hansen (1982). The Hansen J statistic is an extension of the Sargan test described above. It is distributed as a χ^2 random

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[18] See Wooldridge (2002) chapter 6 for a detailed discussion of this test.

variable with degrees of freedom equal to the difference between the total number of independent variables and the number of instruments. This test cannot be used to test subsets of instruments, which can be useful in some cases. For this purpose, researchers can use a "difference-in-Sargan" or C statistic. It is obtained by taking the difference between the Sargan statistic of the restricted fully efficient regression and the Sargan statistic of the unrestricted but consistent regression. The C test has the null hypothesis that the chosen variables are adequate instruments. It follows a χ^2 distribution with degrees of freedom equal to the number of over-identifying instruments used. The C statistic can be used to test the exogeneity of instruments that can be either included or excluded exogenous variables. In the case where excluded exogenous variables are being tested, these are not in the restricted equation. If included exogenous variables are being tested, they are taken as endogenous variables in the restricted equation. Regarding the issue of instrument relevance, when there is one endogenous variable, an indicator of the latter is the R^2 from the first stage regression (see Bound *et al*, 1995). It has also been argued that an F statistic of no less than 10 also indicates relevance (see Staiger and Stock, 1997).[19] Once the appropriate instruments are determined, one can test for the exogeneity of the regressors. If they are found to be exogenous, then the use of OLS leads to a more efficient estimator (Wooldridge, 2002).

Testing exogeneity of regressors

There are a number of ways to test for exogeneity of regressors. The Durbin-Wu-Hausman test is probably the most common approach. Originally the statistic involved burdensome calculations. However, a more tractable regression- based test was devised. The test consists in comparing the estimators obtained using 2SLS to those obtained via OLS. There exist different versions of this test and the inferences provided may differ in finite

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[19] See Shea (1997) for a discussion of models with more than one endogenous regressor.

samples. Take $\hat{\beta}^c$ and $\hat{\beta}^e$ to be the estimators that are consistent under the null hypothesis of and the alternative and consistent if the null only is true respectively. The Hausman (1978) statistic is computed as follows:

H= $n(\hat{\beta}^c - \hat{\beta}^e)'D^{-1}(\hat{\beta}^c - \hat{\beta}^e)$ where the matrix D can take various forms depending on the version of the test being used (Baum *et al*, 2002).

In the presence of heteroscedasticity, the computation of the Hausman test in Stata might generate negative statistics and wrong degrees of freedom. Therefore, Baum et *al* (2002) recommend using the C statistic described earlier to test for the exogeneity of regressors if heteroscedasticity is a problem.

It is important to mention the disadvantages of 2SLS. First, Wooldridge (2002) states that IV estimators can be inconsistent if the instruments are weak (meaning if instruments are correlated to the error term of the structural equation). Since one cannot observe the latter, there is no real indication of the magnitude of the inconsistency. One should be cautious in the case where there is little correlation between instruments and endogenous regressors. Furthermore, if the instruments used are weakly correlated with the endogenous variable, then the standard errors are likely to be very large and the IV estimators will not converge on a normal distribution. According to Bound *et al* (1995), one should be wary of adding instruments even in the case of large cross-sections. Adding instruments that are not (or only slightly) relevant will lead to inconsistent IV estimates (Shea, 1997). Second, Wooldridge (2002) notes, that in the presence of an endogenous variable, IV methods cannot be unbiased as under the usual distributional assumptions one cannot find the expected value of the 2SLS estimator. The author adds that another pitfall with 2SLS is that the standard errors in this framework are much larger than in regular OLS. The extent of the problem depends on the quality of instruments among other things. In the presence of

instrument irrelevance, the finite sample distribution of the instrumental variable estimator moves away from normality posing difficulties for inference.

6 Empirical results

This section starts by describing briefly the preliminary work conducted in order to determine an appropriate model of hours of work before investigating the two restrictions of the unitary model (income pooling and Slutsky symmetry) and looking at the potential impact of distribution factors.

Modelling hours of work

As mentioned in the methodology section, the model needs to be interrogated for heteroscedasticity before any further testing is conducted. Results reported in table A1.2 (Appendix 1) show that the hypothesis that disturbances are homoscedastic is rejected in all first and second stage regressions. Therefore, the computation of variances in all regression models is done using the Eicker/Huber/White/sandwich estimator.

 A series of preliminary regression models for males and females are used to investigate the suitability of various instruments for wages that have been used in the literature. These include: highest educational level attained, years of schooling, tenure, region, a quadratic in age, mother's and/or father's education. In addition, various interaction terms can also be used as instruments such as interaction between age and tenure and/or education. The final set of instruments for the male and female wages were found to be tenure on the present job and education. First stage regression results are displayed in tables A1.3 and A1.4 (Appendix 1). Results do not vary much between the specification with pooled non-labour income and the one where male and female non-labour incomes are introduced separately. All the F statistics show that the instruments chosen are highly correlated with the wage, as they are well above the rule of thumb of 10 discussed in the methodology section. Both F

and Shea statistics are higher for women perhaps indicating better instrument relevance than for men. Regarding instrument orthogonality, the J-Hansen statistics reported indicate that the null hypothesis of instruments being valid jointly is not rejected at a conventional level of statistical significance for both women and men. Examining the individual orthogonality test for identifying instruments (on the basis of the C statistic), it can be seen that tenure on the job is orthogonal to both male and female hours, with the results for females being marginal at the 10% level of significance. Education is also found to be orthogonal to hours of work, with the results for males being marginal at the 10% level of significance. In many studies such as Chiappori *et al* (2002), education is included as an explanatory variable in the structural equation however a decision is made not to include it in this study first as its inclusion washes out the wage effects, and second in order to keep male and female specifications comparable to ensure that results of further tests are not due to different specifications. Once the appropriate set of instruments are found, one can test for own wage exogeneity for both male and female equations. As shown in the last row of table A1.3, the male wage is found to be exogenous to labour supply behaviour while the female wage is endogenous. This result is not sensitive to the definition of non-labour income used. The male equation can thus be estimated using OLS while the female equation will be estimated using IV with tenure on the present job and education as instruments for the wage. Regarding independence of the two equations, the Spearman correlation coefficient between "unobservables" in the male and female equations is found to be equal to -0.028 and the test of independence of errors leads to a non-rejection of the independence hypothesis. Therefore, male and female regression models can be estimated separately. Two sets of model estimates are reported in the first instance: one with non-pooled income and the other with pooled income. Results are reported in tables 1.5 and 1.6

below. While the preferred estimation procedures seem to be OLS for males and IV for

females, both are reported here.

Table 1.5(a): Hours-of-work regression model estimates with non-pooled non-labour income for males and females

Dependent variable: monthly hours of work

Independent Variables	OLS Males	IV Males	OLS Females	IV Females
male_wage	-13.8289***	-13.8784***	-11.6123***	-15.7391***
	(2.5646)	(5.3806)	(2.7972)	(3.5464)
female_wage	1.8880	1.9039	19.3931***	32.4343***
	(2.0106)	(2.4377)	(3.0525)	(5.8288)
male_income	-0.0130***	-0.0130***	-0.0048	-0.0057
	(0.0053)	(0.0052)	(0.0056)	(0.0059)
female_income	-0.0057	-0.0057	-0.0212*	-0.0202*
	(0.0061)	(0.0061)	(0.0117)	(0.0121)
childlessthan5	0.9651	0.9667	-35.3435***	-35.7038***
	(2.2140)	(2.1965)	(3.6036)	(3.6046)
child5to11	5.7286***	5.7343***	-19.8369***	-19.1116***
	(2.0937)	(2.0321)	(2.9570)	(2.9293)
childolderthan12	4.7732**	4.7765**	0.1381	1.6676
	(2.2416)	(2.2925)	(2.9491)	(2.9349)
age	0.1131	0.1133	-0.9332***	-0.9259***
	(0.0959)	(0.0961)	(0.1140)	(0.1168)
london	3.2075	3.2136	-10.5462**	-11.8699**
	(4.2028)	(4.1351)	(5.2246)	(5.2567)
south	1.5176	1.5226	0.7359	0.6939
	(2.3072)	(2.2809)	(3.3324)	(3.3602)
eastanglia	5.7733	5.7796	7.8159	9.0723
	(3.9246)	(3.8779)	(6.6063)	(6.5946)
midland	3.6472	3.6497	-3.9400	-3.2328
	(3.2039)	(3.1698)	(3.6055)	(3.6265)
north	0.5687	0.569	-0.4655	-0.3796
	(2.8326)	(2.8149)	(3.230)	(3.2640)
wales	-2.1737	-2.1747	1.8934	2.7681
	(2.7587)	(2.7483)	(3.3385)	(3.3345)
Constant	194.7660***	194.8403***	166.7425***	148.3789***
	(7.1814)	(10.6563)	(9.1732)	(11.4610)
R-squared	0.0612	0.0557	0.2019	0.1861
Sample size	1415	1415	1415	1415

Notes: (***) denotes significance at the 1% level
(**) denotes significance at the 5% level
(*) denotes significance at the 10% level
(f) denotes a variable that has been omitted from the regression model
Base category for regional dummy: Scotland
Hansen J statistics for males and females respectively (pooled income): 10.6 and 12.4
Hansen J statistics for males and females respectively (non-pooled income): 10.4 and 12.2
Exogeneity test (chi-square test with one degree of freedom) for male and female own wage
in male and female regression models respectively: 0.186 and 6.435 (non-pooled income)

Table 1.5(b): Hours-of-work regression model estimates with pooled non-labour income for males and females

Dependent variable: monthly hours of work				
Independent Variables	*OLS Males*	*IV Males*	*OLS Females*	*IV Females*
male_wage	-13.8341***	-13.7887***	-11.5856***	-15.7225***
	(2.5736)	(5.4025)	(2.7836)	(3.5239)
female_wage	1.7837	1.7691	19.6172***	32.6542***
	(2.0062)	(2.4471)	(3.0711)	(5.8109)
couple_income	-0.0105***	-0.0105***	-0.0103*	-0.0106*
	(0.0041)	(0.0041)	(0.0061)	(0.0064)
childlessthan5	1.4195	1.418	-36.4114***	-36.6480***
	(2.1821)	(2.1614)	(3.4405)	(3.4350)
child5to11	6.2430***	6.2378***	-21.0125***	-20.1490***
	(2.1086)	(2.0257)	(2.8354)	(2.8492)
childolderthan12	5.3177**	5.3147**	-1.087	0.5878
	(2.1953)	(2.2370)	(2.8635)	(2.9088)
age	0.1028	0.1026	-0.9171***	-0.9116***
	(0.0971)	(0.0977)	(0.1154)	(0.1182)
london	3.0983	3.0926	-10.2838**	-11.6404**
	(4.2086)	(4.1421)	(5.2391)	(5.2676)
south	1.5710	1.5665	0.6141	0.5865
	(2.3134)	(2.2842)	(3.3238)	(3.3570)
eastanglia	5.6908	5.6849	8.0122	9.2464
	(3.9063)	(3.8621)	(6.5396)	(6.5401)
midland	3.5717	3.5694	-3.7694	-3.0818
	(3.1952)	(3.1633)	(3.6197)	(3.6364)
north	0.6142	0.6140	-0.5732	-0.4745
	(2.8270)	(2.8104)	(3.2240)	(3.2613)
wales	-2.2341	-2.2332	2.0231	2.8832
	(2.7658)	(2.7560)	(3.3538)	(3.3502)
Constant	195.4482***	195.3799***	165.5110***	147.2601***
	(7.1998)	(10.6143)	(9.3435)	(11.5177)
R-squared	0.0605	0.0548	0.1995	0.1837
Sample size	1415	1415	1415	1415

Notes:　(***) denotes significance at the 1% level
(**)　denotes significance at the 5% level
(*) denotes significance at the 10% level
(f) denotes a variable that has been omitted from the regression model
Base category for regional dummy: Scotland
Hansen J statistics for males and females respectively (pooled income): 10.6 and 12.4
Hansen J statistics for males and females respectively (non-pooled income): 10.4 and 12.2
Exogeneity test (chi-square test with one degree of freedom) for male and female own wage
in male and female regression models respectively: 0.198 and 6.45 (pooled income).

Table 1.5 and 1.6 above report the male and female regression models using both the IV procedure and OLS with non-pooled and pooled income respectively. There are no differences between the two procedures for males confirming that the use of OLS is appropriate. For females, the impact of their own wage (and to a lesser extent their spouse's one) is sensitive to the estimation procedure selected, which probably indicates that the female wage is endogenous to female hours.

The regression models reported above seem to fit female data better than male data as shown by the respective female and male R squared of 0.18 (IV procedure) and 0.06 (OLS procedure). The austerity of the specification for both gender groups and a possible lack of variation of male hours could partially explain why the independent variables in the model fail to account for more than 20% of the variation in female hours and account for less than 10% of the variation in male hours. However, the estimates are generally consistent with the literature findings as will be shown below. Indeed, results reveal that whether income is pooled or not pooled, the effect of a change in female wage on female hours is always positive and significant at the 1% significance level. For instance, a 1% increase in the female wage will increase female total monthly hours by 0.33 on average and *ceteris paribus*. The effect on female hours of the male wage is always negative and significant at the 1% significance level, a 1% increase in the male wage will decrease female total monthly hours by 0.14 on average and *ceteris paribus*. The wife's labour supply is clearly sensitive to both her own and her husband's wage. Regarding elasticities, the uncompensated elasticity for female is computed to be equal to +0.25 and her cross wage elasticity with respect to her husband's wage is found to be -0.12. These estimates are close to those reported by Clark *et al* (2002). Husbands are not sensitive to their wives' wages but respond negatively to an increase in their own wage. A 1% increase in the male wage will decrease male total monthly hours by 0.14 *ceteris paribus*. For males, the own wage elasticity is of -0.08 which

confirms the general view in the literature that men's labour supply's response to a change in the wage is more inelastic than that of their wives. Clark *et al* (2002) had found the male wage elasticity not to be statistically significant. Potential reasons for the divergence between the estimates of Clark *et al* (2002) and those of the present analysis will be discussed below. The man's income elasticity with respect to his own income is -0.006 and the female's income elasticity with respect to her own income is -0.02; which again is in line with estimates by Clark *et al* (2002). With respect to regional effects, only the London dummy seems to affect female labour supply at the 5% significance level as a woman living in the capital is likely to work 12 hours less per month than a woman living in Scotland on average and *ceteris paribus*. A woman's age impacts negatively on her supply of hours as a year increase in her age leads to a reduction of 0.9 in the number of monthly worked. Age is not a significant predictor of male hours of work. The presence of a pre-school child does not affect male hours of work but has a significant and important impact on female hours. Indeed, the presence of a child aged less than five reduces a woman's monthly labour supply by 36 hours on average and *ceteris paribus*. The presence of a child aged between five and 11 also has a strong negative impact of female hours as it reduces female labour supply by 20 hours on average and *ceteris paribus*. This result is common in the literature and attributed to the fact that it is mainly women that are responsible for childcare (see chapter two). For males, the presence of a child aged between five and 11 increases male labour supply by six hours per month. Finally, the presence of a child older than 12 does not affect female labour supply but does increase male monthly hours by five. This suggests an asymmetric effect of children with men increasing their hours to respond to the extra financial demands of children. The proposition of income pooling needs to be tested in order to determine which specification is more appropriate.

Testing income pooling

In the male regression model, male non-labour income is found to be statistically significant at the 5% significance level while the impact on female non-labour income on male labour supply is found not to be statistically different from zero. This suggests that income is not pooled even though the Wald test on equality of coefficients of male and female non-labour income yields a statistic of less than unity, which means that the hypothesis of equality of effects cannot be rejected. The Wald test of equality of coefficients on male and female non-labour incomes in the female regression model yields a chi-square statistic of 1.57 which, at one degree of freedom, implies not rejecting the null hypothesis of equality of effects. However, only female non-labour income has a significant impact on female labour supply, revealing that couples do not pool non-labour income. Both the results of female and male regression models show the potential weakness of statistical tests if the estimated effects are not well determined. Indeed, it makes little sense to test the proposition if one effect is equal to zero and the other is not equal to zero. The definition of non-labour income used in the model can also potentially affect the results of the different tests conducted. As pointed out by Schultz (1990), non-labour income comprises many different components and it is important to test whether these elements can be treated as an aggregate. In order to further explore this issue, male and female regression models that include separately the different components of non-labour income are estimated (see table A1.5 in Appendix 1). Different types of non-labour income impact differently on male and female labour supply, which as discussed above, undermines the use of the pooling test. Finally, as mentioned in the data section, for 5% of couples investment income is reported for the couple and an individual measure is obtained by dividing the measure by two. It is important to explore the income pooling test with a measure of income that does not include investment income. Results of a regression model

with this measure of income are reported in table A1.6 of Appendix 1. Unlike the other regression models, both the male and female non-labour incomes (without investment) are significant in both male and female regression models. However contradictory results are found for both gender groups as the hypothesis of income pooling is upheld for males (F statistic of 0.16) and rejected for females (F statistic of 4).

<u>Testing symmetry</u>

Before conducting the symmetry test, it is important to mention that the results obtained in the previous section reveal that overall, it is better to use a disaggregated measure of non-labour income to analyse household behaviour, however, assuming a pooled measure of non-labour income (which is not far fetched as a number of surveys do not have detailed information of recipients and sources of non-labour income) it is important to test whether Slutsky symmetry holds. The t-statistic of 0.15 is lower than the critical value of 1.96 at 5% significance, which means that the hypothesis of symmetry is upheld. In other words, the effect of an income compensated change in the male wage on his wife's hours of work is equal to the effect of an income compensated change in the female wage on her husband's hours. This result is in contradiction with that of Clark *et al* (2002), but provides a strong argument in favour of a crucial assumption of the neoclassical framework in general. Symmetry is a consequence of rational choice, which is at the core of consumer behaviour theory. Without symmetry, inconsistent choices are made (Deaton and Muellbauer, 1980). Therefore, the data seem to support an important assumption of neoclassical analysis. There are a number of elements that could explain the discrepancy between the empirical results in this chapter and those of Clark *et al* (2002). First, Clark *et al* (2002) use data from another wave of the BHPS. Second, they employ a different specification as they estimate male and female labour supply equations in a simultaneous model allowing for a correlation in disturbances. Finally, as mentioned in the empirical review, Clark *et al* (2002) use a

slightly different specification as they incorporate a number of measures that are not included in the present analysis (gender role, religious attendance).

Incorporating distribution factors to the model

If a distribution factor is found to have an impact on labour supply, this provides indirect support for bargaining approaches. One would expect distribution factors to affect male and female labour supply in opposite directions. The regression models for males and females are estimated using both IV and OLS procedures. Results are displayed in tables A1.7 to A1.10 in Appendix 1. After checking that IV and OLS remain the appropriate estimation procedures for males and females respectively, distribution factors are introduced into the labour supply regression models. Before looking at the impact of the various distribution factors on labour supply behaviour, it is important to mention that both OLS and IV procedures yield similar results for distribution factors. The only impact that seems sensitive to the estimation procedure selected is the impact of the female wage on female hours (and to a lesser extent the impact of the male wage on female hours). Table 1.6(a) and (b) below display the results.

Table 1.6 (a): Hours-of-work regression model estimates with distribution factors

Dependent variable: monthly hours of work

Independent Variables	OLS Males	IV Females	OLS Males	IV Females
male_wage	-13.8324***	-15.7859***	-13.8107***	-15.7818***
	(2.5674)	(3.5552)	(2.5664)	(3.5529)
female_wage	1.9334	32.5968***	1.7504	32.7182***
	(2.0530)	(5.9012)	(2.0247)	(5.8808)
male_income	-0.0129***	-0.0057	-0.0130**	-0.0057
	(0.0053)	(0.0059)	(0.0053)	(0.0058)
female_income	-0.0057	-0.0202*	-0.0056	-0.0203*
	(0.0061)	(0.0121)	(0.0061)	(0.0121)
childlessthan5	0.9799	-35.6163***	0.7943	-35.3561***
	(2.2153)	(3.6457)	(2.2154)	(3.6158)
child5to11	5.7653***	-19.0241***	5.6172***	-18.8880***
	(2.1332)	(2.950)	(2.0954)	(2.9337)
childolderthan12	4.7993**	1.7045	4.6602**	1.8978
	(2.2399)	(2.9342)	(2.2429)	(2.9443)
age	0.1081	-0.9253***	0.1249	-0.9472***
	(0.0982)	(0.1169)	(0.0971)	(0.1186)
london	3.1991	-11.8977**	3.3673	-12.2075**
	(4.2084)	(5.2575)	(4.2148)	(5.2758)
south	1.4686	0.6133	1.9134	-0.1050
	(2.3332)	(3.3994)	(2.3160)	(3.3926)
eastanglia	5.7225	8.9699	5.9226	8.7255
	(3.9447)	(6.6112)	(3.9210)	(6.6210)
midland	3.6017	-3.3184	3.7858	-3.5319
	(3.2081)	(3.6328)	(3.2068)	(3.6237)
north	0.5654	-0.3801	0.7249	-0.6956
	(2.8344)	(3.2631)	(2.8372)	(3.2552)
wales	-2.1963	2.7177	-2.3883	3.1882
	(2.7702)	(3.3396)	(2.7717)	(3.3736)
sex_ratio (1)†	0.6628	1.1425	f	f
	(2.7759)	(3.6758)		
sex_ratio (2) ††	f	f	-10.6425	21.4771
			(10.0854)	(16.7304)
constant	194.1349***	146.8207***	205.0477***	127.4981***
	(7.6858)	(13.1813)	(12.2210)	(21.518)
R-squared	0.0605	0.1857	0.0562	0.1864
Sample size	1415	1415	1415	1415

Notes: (***) denotes significance at the 1% level
(**) denotes significance at the 5% level
(*) denotes significance at the 10% level
(f) denotes a variable that has been omitted from the regression model
(†) ratio of the number of males whose age falls in the age category of the husband over
the number of females whose age falls in the ages fall in the category of the wife in a particular county.
(††)ratio of the number of males whose age falls in the age category of the husband over the number of females whose age
falls in that same age category.
Variable definitions are found in table 1.2

Table 1.6 (b): Hours-of-work regression model estimates with distribution factors

Dependent variable: monthly hours of work

Independent Variables	OLS Males	IV Females	OLS Males	IV Females
male_wage	-13.7911***	-15.7038***	-13.8884***	-15.7285***
	(2.5657)	(3.5474)	(2.5673)	(3.5507)
female_wage	2.0892	32.6914***	2.0161	33.0385***
	(2.0298)	(5.8468)	(2.0569)	(5.8954)
male_income	-0.0132**	-0.0051	-0.0132***	-0.0048
	(0.0053)	(0.0059)	(0.0053)	(0.0058)
female_income	-0.0057	-0.0205*	-0.0057	-0.0206*
	(0.0061)	(0.0122)	(0.0061)	(0.0122)
childlessthan5	0.6592	-35.5955***	0.5402	-35.2175***
	(2.1937)	(3.6024)	(2.1919)	(3.6552)
child5to11	5.6320***	-19.1845***	5.5266***	-18.8419***
	(2.0958)	(2.9230)	(2.1658)	(2.9514)
childolderthan12	4.9719**	1.7388	4.9496**	1.8244
	(2.2623)	(2.9401)	(2.2562)	(2.9380)
age	0.0986	-0.9520***	0.1054	-0.9757***
	(0.0958)	(0.1200)	(0.0971)	(0.1209)
london	3.2714	-11.4725**	3.2804	-11.5210 **
	(4.2162)	(5.2527)	(4.2184)	(5.2580)
south	1.5061	0.8648	1.6077	0.5354
	(2.3120)	(3.3547)	(2.3417)	(3.4115)
eastanglia	5.7352	9.4733	5.8223	9.1913
	(3.9257)	(6.6062)	(3.9444)	(6.5802)
midland	3.5608	-3.1536	3.6459	-3.4233
	(3.1979)	(3.6310)	(3.2123)	(3.6410)
north	0.5691	-0.2752	0.5686	-0.2723
	(2.8298)	(3.2509)	(2.8304)	(3.2489)
wales	-2.0908	2.7785	-2.0266	2.5786
	(2.7592)	(3.3357)	(2.7775)	(3.3475)
sex_ratio[†]	f	f	-1.5406	5.0202
			(3.4150)	(4.666)
age_difference	15.4061*	4.6811	17.6875*	-3.6110
	(8.6821)	(13.4718)	(9.9533)	(15.9872)
female_older	3.2783	8.3125**	3.3798	7.9768**
	(2.6733)	(4.0104)	(2.6871)	(4.0303)
constant	194.6462***	147.1208***	195.5321***	142.0094***
	(7.2364)	(11.8035)	(8.0310)	(13.3840)
R-squared	0.0570	0.1892	0.0570	0.1888
Sample size	1415	1415	1415	1415

Notes: (***) denotes significance at the 1% level

(**) denotes significance at the 5% level

(*) denotes significance at the 10% level

(f) denotes a variable that has been omitted from the regression model

[†] ratio of the number of males whose age falls in the age category of the husband over

the number of females whose age falls in the ages fall in the category of the wife in a particular county.

Variable definitions are found in table 1.2

The impact of the various variables does not seem to vary much when distribution factors are introduced compared to when they are not. This shows that wage and income effects are not sensitive to the specification chosen. As shown in table 1.6 (a), both measures of the sex ratio, introduced in turn, are found not to have an impact on the labour supply of husbands or wives, thus confirming the previous result of Clark et *al* (2002; 2004). It is difficult to establish however, whether this is due to the fact that sex ratios represent bargaining power, but that the latter has no influence on labour supply or whether there is not enough variation in sex ratios in the UK to allow their impact on labour supply to be determined. Age difference seems to have a marginal impact on male labour supply with an increase in the difference increasing the supply of male hours. Age difference does not seem to influence female labour supply behaviour. However, if the wife is older, her labour supply increases by 7 hours per month *ceteris paribus*. This impact is consistent with the notion that older women might have lower bargaining power and therefore increase their labour supply. However, since the model does not account for household production, this result needs to be interpreted cautiously. The question of whether the age difference variable and female older dummy can be considered as distribution factors if they only impact on one spouse arises? Surely, the notion of bargaining should involve effects on both agents. In other words, one would expect measures of bargaining to impact on labour supply of both spouses. Nevertheless, the introduction of these variables does show that the early neoclassical approach needs to be expanded to include variables other than own attributes and exogenous factors.

7   Concluding Comments

The first part of this chapter attempted to summarize the theoretical debate on the formulation of labour supply models for couples. For a long time, the family was treated as a single entity and the welfare of its members was considered as one. Strong assumptions such as Slutsky properties and income pooling were held in order to analyse behaviour. As shown in the theoretical review, a number of promising approaches have been developed in recent decades with the aim to look more closely at interactions among members.

However, empirically, researchers face a number of hurdles as shown by the current chapter. The issue of identification of wage and non-labour income effects remains a challenge. This chapter has relied on the IV procedure to identify wage effects for females. However, as stated in Blundell *et al* (1998): "instrumental variables based on arbitrary exclusion restrictions (…) may provide no solution since these variables are probably correlated with tastes for work" (p. 827). The authors use tax policy reforms in the UK to identify wage and income responses. A survey of other studies that have used policy reforms to analyse labour supply behaviour is found in Blundell and MaCurdy (1999). This methodology is referred to as a "natural experiment approach" in the literature. Blundell and MaCurdy (1999) argue that the latter is becoming increasingly popular in labour supply analysis. It relies on simple estimation procedures and consists in comparing (at least) two groups with similar characteristics: one of which was affected by a certain event (a policy for example) and one which was not. The panel nature of the BHPS could provide data for this type of experiment, analysing, for example, the impact of the Working Family Tax Credit on a couple's labour market behaviour.[20]

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[20] See Blundell (2000).

As discussed earlier, the testing of the income-pooling proposition does not always yield meaningful results as income effects are often not well determined and the result of the test is found to be dependent on the definition of non-labour income used. This undermines the finding that the assumption of Slutsky symmetry is verified by the data as it relies on the existence of a single measure of non-labour income. Nevertheless, the fact that the data seem to satisfy the assumption of symmetry does constitute important evidence in favour of neoclassical theory.

Introducing the concept of bargaining power in the analysis of household labour supply has undoubtedly enriched economic modelling and broadened its scope. However, models that rely on this notion presuppose that measures of bargaining can be readily developed from empirical data. As was demonstrated in this chapter, it is challenging to find measures that are exogenous to household behaviour but influence male and female labour supply in a way that can be interpreted as "bargaining".

As in the case of labour supply responses, another way to analyse income pooling and bargaining would have been to rely on a natural experiment. Lundberg and Pollak (1996) argue that non-labour income might be correlated to past and present household behaviour and is also likely to be correlated with determinants of household consumption. Therefore, they question the outcome of pooling tests that rely on non-labour income. The authors state that "the ideal test of the pooling hypothesis would be based on an experiment in which some husbands and some wives were randomly selected to receive an exogenous income change" (p.145). As mentioned previously, this approach was followed by Lundberg *et al* (1997). However, it presupposes that detailed household expenditure data is available; and the data used in this thesis do not seem suitable for this purpose.

Can policy-makers rely on the unitary model to analyse a couple's hours of work? Based on the discussion above, it looks sensible to assert that couples do not seem to consider both

male and female non-labour income as one measure. On the other hand, as discussed earlier, wage effects do not seem sensitive to the definition of non-labour income used which might indicate that the unitary model is suitable to evaluate wage responses (assuming rather unrealistically that the budget constraint faced by the household is linear). However, in order to allocate benefits and other non-labour income, governments should be able to judge who, in the household, is most vulnerable. This presupposes that interactions among members can be modelled. Most of the models that provide alternatives to the earlier form of the neoclassical framework (also known as unitary model) rely on the concept of bargaining; the empirical modelling of which is far from easy.

Finally, this chapter only addresses these issues for dual-earner couples. The analysis is therefore subject to potential selection bias. The next chapter investigates propositions from the unitary model and the introduction of concepts that are not normally considered in a neoclassical framework on all couples.

Chapter 2

A study of the labour market participation behaviour of British couples

1   Introduction

The first chapter analysed the labour supply behaviour of couples where both spouses work. However, by doing so, it did not explicitly address the issue of labour market participation. Female labour market participation has significantly increased over the last decades in the European Union and in the United Kingdom more specifically. However, promoting married women's participation in the labour market remains a target set in the European Commission's Employment Guidelines. The latter stress the need to encourage the return of married women to employment, address gender gaps and assist women achieve a balance between work and family life (Prieto-Rodriguez and Rodriguez-Gutierrez,

2003). The need to establish an appropriate framework for the analysis of participation is thus crucial for policymakers.

This chapter has three different aims. First, a regression model for a couple's participation in the labour market is estimated. As will be shown in the literature review, this type of model has not been widely used before. Second, two tests conducted on hours-of-work equations in the first chapter, namely income pooling and the impact of distribution factors, are replicated here in the context of a model of labour market participation of couples as done in Del Boca (1997). Finally, the working status of the husband's mother when the husband was a teenager is introduced into the model. This variable, which is not normally considered in the traditional neoclassical model of labour supply, provides a proxy for the type of environment a husband grew up in and is likely to reflect "cultural" considerations. It has not, to our knowledge, been used in previous models of married women participation in the United Kingdom.

2 Background

The sexual division of labour in the household and married women's participation in the labour market are strongly interlinked. According to Becker (1991), women are considered to have a comparative advantage in the household while men are argued to possess that advantage in the market. Indeed, historically, men have been the providers of food and shelter while women have stayed at home to care for their progeny. This is partly due to the fact that women are biologically more implicated in the rearing and feeding of children than men, whose role somewhat becomes less important when the egg is fertilized; and partly due to differences in returns to investment in human capital between men and women. However, comparative advantage is not the only criteria used to explain the division of labour in households. Complementarities also play a role as both gender groups

are needed to produce certain commodities. This reduces the strict division of labour in time and investment. Becker (1991) argues that the fact that women have traditionally devoted themselves to household work, demonstrates that comparative advantage has played a greater role than complementarities in the division of labour in the household. However, the author concedes that "complementarities cannot be unimportant, especially in modern times; women are becoming less specialized in household activities, and men are spending more time at household activities" (p.40).

For a long time, motherhood and employment were not considered compatible. Mothers did not work when their children were of school age and when they did, they mostly had part-time jobs with lower wages. Childless women had higher lifetime earnings as they benefited from more labour market experience in often higher paid jobs. Married women's intermittent work patterns during their childrearing years partly explain why employment rates of women in the United Kingdom have been consistently lower than men's. However, the gap between the male and female employment rates is at an all time low as the labour force participation of married women, and more specifically women with pre-school children, has been rising throughout the second half of the twentieth century while opposite trends have been found regarding male participation (Robinson, 2003).

A number of factors have lead to the increase in the labour market participation of married women among which the increase in real earnings of women (or in other words, the opportunity cost of being a housewife) and decreased fertility (Becker, 1991). Other factors include the introduction of the contraceptive pill, the increased availability of consumer durables that facilitated and shortened the time needed for housework, as well as a growing service sector. A further factor that can also explain the increase in the labour force participation of women is the change in attitudes regarding women's role in society (Fernandez, 2007). Indeed, more egalitarian views regarding women's participation in the

labour market have emerged mainly in the mid-1970s, although this evolution may have started to slow down in the early 1980s (Thornton *et al*, 1983). The link between gender-role attitudes and labour market participation is investigated in chapter three.

This increase in female participation, even if studies have found that it was mainly in part-time work, is one of the factors behind the decline of the "male breadwinner family" in Britain and has helped increase women's freedom (Creighton, 1999). Although it was never universal, the male breadwinner model of family behaviour has, in many social classes and for a long time, been the model that best described the way families were organised (Lewis, 2001). In this context, women's earnings were seen as "pin money" and not as vital to their family's welfare whereas male earnings were considered as the main source of income for the household. However, the increase in participation of women in the labour market, the decrease in male employment and wages of the less-skilled as well as a reduction in the wage gap have all contributed to increase the share of women's participation in total family income (Harkness *et al*, 1997). Nowadays, the "male-breadwinner" household has become less common and alternative working arrangements are generally found in families. However, the move from a male-earner to a dual-earner model of the family or, equivalently, the weakening of the former, is not really clear cut and today the social reality is probably closer to a one-and-a-half earner model as women often earn lower wages and work fewer hours than men (Lewis, 2001).

The different issues mentioned above show that policymakers have had to adapt to a changing social environment through a number of reforms and the introduction of new legislation. Government policies themselves have also contributed to some of these changes both directly and indirectly. While no specific policy is being investigated in this chapter, a brief overview of British policy with respect to gender in the labour market in the last decades is in order.

In the 1970s, a number of policies were designed to improve the status of women in the labour market. The Equal Pay Act was introduced to prevent employers from paying different wages to men and women for the same job and the Sex Discrimination Act made it illegal for employers to discriminate on the grounds of gender when recruiting. At the household level, welfare policies have been based on male-breadwinner families for a long time. The latter implied full employment of the male household head while the wife cared for both the children and the elderly, and depended financially on her husband. Nowadays, governments are assuming the existence of an adult rather than a male breadwinner model (Lewis, 2001). During the last decade, the labour government committed to design policies that "make work pay" thus addressing the issues of "worklessness" for both women and men and trying to curb the incidence of child poverty. An important tool used to this effect has been the Working Family Tax Credit (WFTC), launched in 1999, which replaced the Family Credit scheme that was introduced in 1988. The latter was paid by the Benefits Agency to the main carer in the family. In contrast, the WFTC is administered by the Inland Revenue and has a higher earnings threshold. It is mostly administered through the wage packet and also includes a childcare credit available to all claimants. The provision of formal childcare is another way to encourage participation of women in the labour market. However, in that area, the United Kingdom has lagged behind in comparison to other European countries. The National Childcare Strategy was thus developed by the New Labour government to address this issue (Rake, 2001). Other policy instruments that encourage mothers to remain in employment are Maternity leave, introduced in 1976, and Maternity pay. Both have been modified a number of times increasing the duration of leave allowed and reducing the conditions necessary to be eligible for them. Finally, some policies indirectly affect married women's participation although they are not specifically

targeting them. Unemployment benefits, for example, can discourage a woman from employment in the case her husband becomes unemployed.[21]

The paragraph above reveals the importance of selecting an appropriate framework to study the labour market behaviour of couples. The different issues to consider as well as a review of the main work conducted in this area are outlined in the next section.

3 Theoretical and Empirical Review

Before reviewing studies that have analysed a couple's labour market participation, an overview of the main theoretical issues to consider is conducted.

3.1 Modelling a couple's labour market participation

When analysing labour supply behaviour, one can either model hours of work or participation in the labour market or both. In the neoclassical framework, the analysis of individual participation is based on the existence of a reservation wage. An individual will not participate in the labour market if the wage offered for a particular job is lower than their reservation wage. The reservation wage is a function of a number of variables including income, assets, number and age of children, and tastes (Deaton and Muellbauer, 1980). When the analysis is extended to the couple, complications arise and the modelling is less straightforward (Blundell *et al*, 2007). Blundell and MaCurdy (1999) demonstrate how to derive the likelihood functions and first-order conditions for two of the four potential regimes followed by the household under the assumption that the household maximizes a single utility function. A detailed discussion of these computations is not done here as it does not serve the purpose of this chapter which is mainly empirical. The authors also state that in the unitary model:

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[21] See Kell and Wright (1990).

> corner solution conditions (which) state that if one individual is at a corner
>
> solution, it is the reservation wage of that individual rather than the market
>
> wage that affects the labour supply decision of the partner. As in the case of the
>
> income pooling assumption, this is far from innocuous, implying as it does that
>
> the 'outside option' value of paid work for a non-participant does not influence
>
> the allocation of consumption and leisure within the household. (p.1661)

Unlike the case of hours-of-work, in which a number of pieces of research have questioned the unitary model, the research on this aspect of labour market participation is much sparser. This is probably due to the fact that modelling a couple's decision-making in the context of participation has proved to be more challenging than in the hours-of-work framework. According to Duguet and Simmonet (2007), the main problems encountered in modelling couples' participation are first, that it is likely that characteristics that determine labour market participation also affect marriage formation. Second, econometrically, the restrictive coherency condition necessitates that the parameter associated with the working status of one individual is set to zero in their spouse's labour force participation equation which according to the authors amounts to "eliminating the true simultaneity of the couple's decision" (p.160). This issue is discussed further in the methodology section. Some research has modelled a couple's participation using strong assumptions in order to avoid the problem of coherency mentioned above. Van Soest (1995) uses a structural model that he labels "an extension of the single individual labour supply model" (p.63) in which the set of hours of work individuals choose from is made discreet. One extension of his model allows for tax policy simulations. Bjorn and Vuong (1997) develop a model of a couple's participation in the labour market based on a Stackelberg game in which each spouse maximizes their own utility and the husband (who is the leader) knows his wife's reactions. They allow the decision of the wife to enter into the determination of the husband's reservation wage and explore the conditions under which identification is

feasible. Their model is based on strong theoretical assumptions which result in complicated computations. The authors acknowledge this but justify their approach by stating that it yields highly plausible results. Kooreman (1994) compares the implications of five models (Nash, Stackelberg (male leader), Stackelberg (female leader), Pareto-optimal and mixed) in the context of a couple's labour market participation decisions. The author finds that all models apart from the one assuming only Pareto optimality yield sensible estimates. The empirical results of the articles mentioned above will be reviewed later in the section. They all have in common a reliance on a strong theoretical framework. It is important to note that these papers constitute an important contribution to the emerging literature on game theory and econometric modelling. However, it is beyond the scope of this thesis to analyse in depth the behaviour of couples using a game theory approach. In this chapter, a decision is made to adopt an ad hoc approach for the empirical analysis. No specific theoretical model is taken as a benchmark to avoid imposing constraints on the modelling. The chapter is mainly an empirical exercise. The model used to conduct the analysis is described in the econometric methodology section. The tests conducted on hours-of-work equations in the first chapter are applied to participation equations as done in Del Boca (1997). There are two sets of tests conducted. First, the income pooling test that amounts to testing whether male and female non-labour incomes have equal effects on the probability of participating in the labour market. Considering they do would imply that all non-labour income can be aggregated into one measure. The second set of tests attempts to check whether distribution factors (defined in the first chapter) impact on labour force participation. The first distribution factor used is the sex ratio. Two different economic models, the collective model and Grossbard's demand and supply model, stipulate that there exists a negative relationship between labour force participation rates and sex ratios. The first step in decision-making is described differently in the two models.

It is during this phase that access to income is determined. In Grossbard's demand and supply model, household production is crucial to the analysis. The couple defines terms of trade between housework and access to income (equivalent to a quasi-wage). The collective model recognizes the importance of household production but does not necessarily include it in the modelling of the decision-making. The second step in decision-making is similar in both models whereby each individual in the couple maximizes their utility taking into account the constraint of a pre-defined access to non-labour income (Grossbard and Amuedo-Durantes, 2007). Education can affect the predictions of the model. As mentioned by Grossbard (1984, 1993), cited in Grossbard and Amuedo-Dorantes (2007), educated individuals might not seek material compensation in the first step or may enjoy more egalitarian marriages whereby housework is performed by a third party. This means that they have lower quasi-wages and less access to income in the second phase. This would lead to a smaller relationship between employment decisions and sex ratios (in other words marriage market conditions). The other distribution factors, age difference and whether the wife is older, which were used in the first chapter, are also included in the analysis. It is important to note that these variables do not exclusively have a "bargaining" interpretation. Indeed, it could be that as the age difference widens, the man might retire earlier and the woman is left working.

As in the case for hours of work, employment decisions of husbands and wives are likely to be interlinked and strongly correlated. If the husband becomes unemployed, two different effects come into play. The "added worker effect" is when the wife seeks work due to the loss of income that resulted from her husband losing his job (income effect) and to the fact that the husband can now spend his time in the household (substitution effect). As stated in Bingley and Walker (2001), it is the ability of households to counter the husband's loss of employment through ways other than an increase in the wife's labour supply that

determine the magnitude of these effects. The second effect to come into play is the "discouraged worker" effect which represents the fact that as the husband becomes unemployed, the wife anticipates that she won't find a job either. Furthermore, she might consider that if she starts a new job, her husband may lose his entitlement to benefits depending on the type of welfare system in place. In the literature, a number of studies have looked at the added worker effect by exploring the impact of a husband's unemployment on his wife's working status. In this piece of research, the added worker effect cannot be studied directly as the husband's working status is not included in the participation decision (see below). The added worker effect has also been studied indirectly through the mother-in-law working status as done in Del Boca *et al* (2000). The authors argue that the fact that the mother-in-law was working when she was the same age as the wife's shows that the household approves women's work in the labour market and therefore, in the case where the husband loses his job, he will not discourage his wife from trying to work to compensate for the loss of income. On the other hand, the case where the mother-in-law was not working might be an indication that the household's approach to women's work is rather conservative and therefore will not approve of the wife taking a job even if the husband becomes unemployed. Rather than taking the view that the mother-in-law work status proxies for an added-worker effect, this chapter adopts the view that it mainly corresponds to a "cultural" factor.

3.2 Introducing a novel dimension to the model of a couple's labour market participation

The notion that the work status of a male's mother when he was a teenager can impact on his wife's current labour force status does not feature in standard models of female labour force participation. However, different social science literatures can provide potential reasons why such a relationship might exist between the two variables. Fernandez *et al*

(2004) mention the work of Freud who claims that individuals choose spouses that resemble their opposite-sex parent. They also refer to the transmission of preferences between parents and their children (which will be discussed in chapter three). The authors develop a model in which there are two channels that can explain why the wife of a man whose mother worked is more likely to work herself. The technology/endowments channel and the preference channel. Both lead to similar results. The first amounts to a husband being productive in housework and the second describes a situation whereby having a working mother has impacted on the husband's tastes and attitudes making him therefore more likely to have a working wife. Indeed, the parents' behaviour and the environment in which an individual is raised both determine his/her gender role socialization from childhood (Thornton *et al*, 1983). Analysing the effect of mother-in-law on a woman's work behaviour shows that "cultural" considerations can impact on labour market participation and this is not acknowledged in the neoclassical context. The fact that daughters-in-law behave like their husbands' mother can be due to assortative mating considerations. As defined by Becker (1973) positive assortative mating refers to a "positive correlation between the values of the traits of husbands and wives" (p.100) and is assumed to be fairly common. These traits can be intelligence, race, religion, social status or education among others. Indeed, regarding the latter, it is widely acknowledged that in the majority of couples, years of schooling of spouses are positively correlated (Pencavel, 1998). For some psychological attributes however, such as the tendency to dominate or aggressiveness, correlation can be negative. Positive assortative mating can help explain the polarization process whereby there has been an increase in dual-earner households and in the number of households where nobody works (Del Boca *et al*, 2000). Finally, it is important to note that the effect of mothers-in-law on their sons' wives also has a temporal dimension. The

increasing presence of working women in one generation changes the expectations of the next generation and pushes younger women to invest more in human capital.[22]

The different subjects mentioned above have all been analysed in the literature on married women participation. An overview of this literature, mainly for the United Kingdom, is provided in the next section

3.3   A review of the literature

The subject of labour market participation has been analysed for different purposes and with various methodologies. This review attempts to highlight the main concerns and findings of the literature with an emphasis on studies whose aims are close to the ones of this chapter.

3.3.1   Married women's labour market participation

As in the case of hours of work, it is more common in the literature to model married women and male participation separately treating the partner's participation as exogenous. While the participation decision of men has not attracted much interest (probably because participation rates for men tend to be high and do not vary much); a number of studies on British data have explored the participation decisions of working women. Greenlagh (1980) finds that an increase in the female predicted wage increases the likelihood of participation. The elasticity of participation with respect to wage is found to be 0.355. An increase in the number of children aged less than 10 years of age reduces the probability of participation. Income effects on participation are negative and significant. The elasticity of participation with respect to the couple's income if the wife was not in employment is found to be equal to -0.452.

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[22] This is analysed in Fernandez *et al* (2004) where authors investigate the impact of World War II on the behaviour of two generations of women.

Layard, Barton and Zabalza (1980) use the 1974 General Household Survey to estimate a logit model for married women's participation. They find an elasticity of participation of 0.5 with respect to the woman's own wage and -0.3 with respect to her husband's wage. The responsiveness to changes in income is not found to be very large (elasticity of -0.04). They also find that the age of the youngest child is an important determinant of participation. Finally, they establish that a woman married to an unemployed man is 31 percentage points less likely to be working herself. Joshi (1986) analyses female participation using the Women and Employment Survey conducted in 1980. Three different specifications modelling three different measures of participation in the labour market are used. These are: (i) the probability of women working full-time, (ii) the probability of women working and (iii) the probability of women being in the labour force (working or seeking work). The models are estimated using OLS. Wages for non-workers are estimated using an earnings function including work experience and occupation. The elasticities of female economic activity rate, work and full-time work with respect to wages are found to be equal to 0.19, 0.32 and 1 respectively. The three main determinants of female participation are found to be: earnings capacity, unearned or non-labour income and the presence of dependent children.

Main and Reilly (1994) use data from the 1986 Social Change and Economic Life Initiative to estimate a logit model of married women's participation for Great Britain. The own wage elasticity of participation for women is found to be equal to 0.704 whereas income effects are found to be poorly determined. The husband's wage is found to negatively impact on his wife's participation.

Another branch of the literature analyses changes in the female labour force participation. While this is not the objective of the current chapter, a review of the work undertaken in this area will be informative. Gomulka and Stern (1990) use a time series of cross sectional

data from the Family Expenditure Survey to analyse the change in female participation in the United Kingdom between 1970 and 1983. They use growth accounting to analyse whether the change in participation was due to a change in behaviour or a change in characteristics of the female population. They estimate a series of reduced form probits and find that family structure has the biggest impact on participation. The husband's net earnings negatively affect participation. A decrease of 10 percent in the latter increases the probability of participation by half a percentage point. Other studies have concentrated on the analysis of joint participation at the level of the household in order to analyse whether the macroeconomic trends of an increased participation of men and a decreased participation of women also holds at the level of the household.

Booth *et al* (1999) use the BHPS panel data from 1991 to 1995 to analyse the difference in participation rates between men and women, however they do not limit themselves to married individuals. They use the method of Gomulka and Stern (1990) noted above to disentangle the sources of differences. A reduced form model is estimated. The authors find that the presence of children negatively affects both gender groups but the impact of children on women is much greater than that on men. The authors conclude that family responsibilities still largely impact on the work behaviour of women but not that of men. In order to proxy labour market conditions, the authors use the U-V (unemployment to vacancy) ratio. They find that lower unemployment leads to higher participation for both men and women. Income from savings and investment is found to increase the probability of work for men.

Gutierrez-Domenech and Bell (2004) use the labour force survey Spring quarter from 1984 to 2002 to study the participation of women in the labour market as well as analyse the change in participation. They estimate a series of structural/ reduced form probits. They find that age and region affect participation as well as higher levels of education which

increases the likelihood of participation. Furthermore, the number and age of children are important determinants of participation.

The research of Neumark and Postlewaite (1998) is of interest as it has a similar objective to that of this chapter in the sense that it attempts to include variables that are not normally included in the neoclassical framework. The authors attempt to explain the rise in the labour force participation rate of women in the United States in the twentieth century. Their paper examines the role of the relative income of other women in the household in explaining the rise in participation of women in the labour market. They assume that every couple considers its position compared to a particular couple that serves as a benchmark. If one woman in the household engages in paid work, the reservation wage of the other woman in the household determined by the difference in utilities between staying at home or working, will most likely decrease as they might not share childcare as they used to or socializing might become more expensive. The introduction of the work status of the sister-in-law to the labour participation equation shows that women with sisters-in-law that are working are seven percentage points more likely to be in employment. Furthermore, the probability of being employed for women whose sisters are not employed increases by 16 to 25 percentage points (depending on the specification) if their sister's husband's income is higher than that of their husband.

Finally, the added worker effect in the United Kingdom has been analysed in various studies. Bingley and Walker (2001) estimate married women labour supply functions integrating unemployment spells of spouses in their model. They use data from 15 pooled cross-sections from the Family Expenditure Survey from 1978 to 1992 and apply a multinomial probit random utility framework to model the decision to work part-time, full-time or not participate (voluntarily) in the labour market. They estimate wage regressions for part-time and full-time work and predict incomes. They find that children render it less

likely for a woman to engage in full-time work with the age of the youngest child having the strongest impact. The effect of the husband's employment status varies depending on whether he has been unemployed for a short or a long period. They choose a representative family to simulate changes in some variables. The regional monthly unemployment rate lowers the probability of participation for women with a one percentage point increase decreasing employment by 0.8%.

The different studies reviewed above provide an overview of the main research conducted in the subject of married women participation in the labour market mainly in the United Kingdom. This chapter attempts to analyse married men and women participation decisions simultaneously, which researchers have been reluctant to do for the reasons outlined in the theoretical section.

3.3.2 Couples' labour market participation

Bjorn and Vuong (1997) use a Stackelberg game framework to model a couple's participation decision. Expressions for the reservation wages are explicitly derived. The model itself is complex, therefore only the main results are considered here. The study is conducted on American couples in 1982. A husband is found to have a lower reservation wage when his wife works. On the other hand, a wife will have a higher reservation wage when her husband works. Younger children increase a wife's reservation wage. With respect to age, women are found to be more likely to work at 32 rather than earlier or later in life.

Kooreman (1994) uses Dutch data from 1985 to model a couple's participation decision. For men, the decision is between part-time and full-time work. Non-labour income is found to be non-significant for both males and females. After preliminary tests, a decision is made to constrain the correlation between male and female decisions to zero. The female

wage is found not to impact on male decisions while the male wage is found to affect the wife's preferences for work. Furthermore, results show that *ceteris paribus*, a husband is more likely to work part-time if his wife works whereas a wife is more likely to work if her husband does as well. Kooreman (1994) notes that differences between the various theoretical models are small and that cross-wage effects explain most of the interdependence of participation decisions.

Duguet and Simmonet (2007) use French data to analyse the joint participation decisions among couples. Their objective is to determine whether an individual takes into account their spouse's utility from work in their decision to participate in the labour market. They develop a model where the utility of work, not the decision itself, is taken into account into the decision process in order to "bypass the problem of coherency restriction" (p.161). They estimate a reduced form model where they introduce four sets of explanatory variables. Individual characteristics among which are included age, education, health status, spouse characteristics (the same as those included for the individual), children, and finally variables representing labour market conditions. They find that when spouse participation is treated as endogenous, the probability that the husband will participate in the labour market increases when his spouse works as well but the reverse is not true as they find no effect of the husband's employment status on the wife's participation. With respect to local labour market conditions, women do not seem sensitive either to the unemployment rate or to the job creation rate while male participation is negatively affected by the first but not the second. The presence of children decreases the probability that a wife will participate in the labour market. The husband's participation is also found to be affected by the father-in-law's occupation. People from outside Europe are found to have a lower probability of participation and the wife's education is found not to impact on male participation while husband's education is.

Del Boca (1997) tests the income pooling hypothesis using two samples of married couples from the 1993 Bank of Italy Survey's of Household Income and Wealth. The first sample includes all families and the second only families that have children aged less than six. She estimates participation equations and allows income effects to change according to the identity of the additional income's recipient. The equality of non- labour income effects on participation is rejected for the total sample but not for the sample of couples with preschool aged children. A second test that is conducted is whether extra-household factors influence labour supply decisions. The variables used to this effect are the number of subsidized childcare places in a particular region and the population sex ratio. Both are found to be significant in the wife's equation but not in the husband's.

Del Boca (1997) models the joint decisions of husbands and wives to work using a bivariate probit model. She tests for income pooling and introduces two distribution factors, the number of subsidized childcare places and the population sex ratio, into the analysis. She finds that the correlation coefficient between the two equations representing male and female participation is significant and positive indicating complementarities in behaviour. She obtains different results for families with children under five and the sample of all families. For the whole sample, income pooling is rejected but not for the sample of families with pre-school children. The woman's non-labour income does not affect male participation in the sample of all families but has a significant negative effect using families with pre-school children.

A further paper that looks at the effect of distribution factors is Grossbard and Amuedo-Dorantes (2007). The authors use the American Current Population Surveys from 1965 to 2005 at five year intervals to study the impact of sex ratios on female labour force participation. They find that there is a negative relationship between the two variables. An increase in the ratio from 1 to 1.10 reduces the labour force participation rate of married

women by 2.5 percentage points. They also use interactions between sex ratios and education levels to check whether the effect of the sex ratio varies according to the education level of women. They find that in two regions, education contributes to decreasing the impact of sex ratios on participation probably for the reasons explained earlier.

This chapter follows Del Boca (1997) and uses a bivariate probit framework to analyse a British couple's participation in the labour market. A further aspect that has not been analysed for the United Kingdom before, is also explored, which is the role of the mother-in-law in explaining the labour market behaviour of her son's wife.

3.3.3 Female labour market participation and mother-in-law work status

A number of studies have analysed the impact the work status of the mother-in-law on the working behaviour of their son's wife. It is important to note that most studies introduce the variable in a model of female participation (not a couple's one).

Del Boca *et al* (2000) use the Bank of Italy Survey from 1995 to investigate the determinants of wives' participation decisions which include the labour status of mothers and mothers-in-law when they were the wife's age. They consider their effect on participation and argue that it can proxy for an added-worker effect. They estimate four specifications of a probit model of female participation. Male participation is not explicitly modelled. An analysis of education differences/similarities within couples indicates the prevalence of assortative mating. The fact that the mother or mother-in-law worked when they were the woman's age has a significant and positive effect on her participation in the labour market. The husband's unemployment status does not impact on his wife's participation apart from the specification where the latter is interacted with mother and mother-in -law work behaviour.

Two other papers that investigate the impact of mother-in-laws' working behaviour are Fernandez *et al* (2002, 2004). The first study investigates a number of aspects relating the mother-in- law's behaviour and education to the behaviour of the wife. This is done using American data from the General Social Survey. In the first paper, a simple probit is used where the dependent variable is the wife's work status. In all specifications, the working behaviour of the mother-in-law is found to positively impact on the probability that a wife works. In the specification with all the controls included, it is found that having a working mother-in-law increases the probability that the woman works by 32 percentage points. They also examine whether the mother-in-law's education is a good predictor of the wife's education and find that a more educated mother-in-law increases the level of education of the wife. The second paper uses the same data and, in addition, the "Female Labor Force Participation and Marital Instability" dataset. The first part of the paper is very similar to the previous one. In the second part, the second dataset is used to model the impact of mother-in-law working on the wife's participation which results in a finding that having a working mother-in-law increases the probability that the wife works by 24 percentage points. Finally, the impact of World War II is used as an external shock to provide exogenous variation in the number of men raised by working mothers.

Kawaguchi and Miyazaki (2009) study the impact of the working status of a man's mother when he was an adolescent on the labour market participation of his wife. They use Japanese data from a series of cross-sections. They find that the wife of a man whose mother was working part-time or was self-employed when he was an adolescent is less likely to work than the wife of a man whose mother was a housewife. Results reveal that men whose mothers worked full-time when they were 15 are four percentage points more likely to have full-time working wives than other men. However, the estimated effects are

not always significant. The authors also analyse the impact of a mother's working status on her son's gender roles.

4 Data

The first chapter only considered couples where both spouses work. The study was thus subject to selection bias. In this chapter, the analysis is extended to all heterosexual couples that are married or cohabiting. The construction of the new sample is detailed in the next section.

4.1 Dataset construction

In order to model participation, the dependent variable needs to be defined. This is constructed as a binary variable that equals 1 if the individual has been working as an employee or self-employed, part-time or full-time, in the week before the interview. It is also equal to 1 for respondents who have a job although they did not work in the week in question. One relevant caveat is that people looking for work are normally considered in the labour force but for the purposes of this study are considered not to be working. The decision to participate in the labour market is influenced by wage offers. Only the wages of those who work are known but the participation decision concerns all individuals. Therefore, it is important to estimate wage offers for the entire sample. In order to do this, a two-step Heckman procedure is used. The first stage probit equation is estimated for all men and women of working age irrespective of marital status. Variables included in this regression are the following: age, health status, parents' work status, ethnicity, regions, education, house ownership, male unemployment rate for men and women, marital status, cohabitation status, number and ages of children, annual household non-labour income. Results are displayed in Table A2.1 (Appendix 2). The inverse Mills ratio is constructed

from this regression and included in the wage regression. In the latter only variables that are available for all observations are considered. Job tenure, occupation and industry could have been useful predictors of wages but are not available for people who do not work and are therefore excluded from the analysis. The final set of variables retained for the wage regression analysis comprise: age and its quadratic, education and regions. Predicted wage offers are then obtained from this regression. An overview of the results from the Heckman procedure is provided in the empirical section.

The same variables that were used to predict hours of work in the first chapter are now used to predict participation and include apart from the predicted wage, male and female non-labour income, the presence of at least one child aged less than 5 years-old, between 5 and 11 years- old or more than 12 years-old, the unemployment rate (to proxy for local labour market conditions), and age (see tables 2.1 (a) and (b) below).

The distribution factors are the same as those described in chapter one but are now computed for all couples (see tables 2.1(a) and (b) below). Finally, the variable representing the mother-in-law's work status is constructed using the answers to the question of whether a man's mother was working when he was 14. Three dummy variables are constructed. The first is equal to 1 if the husband's mother was working, the second is equal to one if the individual does not know whether his mother was working, or if his mother was deceased or did not live in the household. The last variable is equal to 1 if she was not working. The latter two categories cannot be merged into one. It is important to note that this variable captures a different effect from one indicating whether the mother-in-law worked at the time of the survey. If the mother-in-law was working at the time of the survey, this might have meant that the wife would have benefited from less help with childcare (if she was depending on the family to provide it) and would have discouraged participation. The impact of the working status of the mother when the husband was aged

14 is exogenous to participation today and is intended to capture preferences. The base category for estimation is chosen to be having a mother that was not working when the husband was aged 14, since the miscellaneous category cannot be used for this purpose.

Table 2.1(a): Variables' definition

	Variable name	*Variable description*
Individual working status		
	male_working	Binary variable that is equal to 1 if the husband worked during the week preceding the interview or in the case he did not, if he has a job and 0 otherwise
	female_working	Binary variable that is equal to 1 if the wife worked during the week preceding the interview or in the case she did not, if she has a job and 0 otherwise
Wage		
	male_wage	Predicted male hourly wage in natural log
	female_wage	Predicted female hourly wage in natural log
Non-labour income		
	male_income	Continuous measure. Monthly male non-labour income obtained by dividing the yearly non-labour income of the previous wave by 12. It includes transfer, benefit, pension and investment income
	female_income	Continuous measure. Monthly female non-labour income obtained by dividing the yearly non-labour income of the previous wave by 12. It includes transfer, benefit, pension and investment income
	couple_income	Continuous measure. Sum of male and female non-labour incomes
Children		
	childlessthan5	Binary variable that is equal to 1 if there is at least one child aged between 0 and 4 in the household and 0 otherwise
	child5to11	Binary variable that is equal to 1 if there is at least one child aged between 5 and 11 in the household and 0 otherwise
	childolderthan12	Binary variable that is equal to 1 if there is at least one child aged between 12 and 18 in the household and 0 otherwise
Age		
	age18_24_m	Binary variable that is equal to 1 if the husband's age is between 18 and 24 years and 0 otherwise
	age25_34_m	Binary variable that is equal to 1 if the husband's age is between 25 and 34 years and 0 otherwise
	age35_44_m	Binary variable that is equal to 1 if the husband's age is between 35 and 44 years and 0 otherwise

	Variable name	*Variable description*
	age45more_m	Binary variable that is equal to 1 if the husband's age is higher than 45 and 0 otherwise
	age18_24_f	Binary variable that is equal to 1 if the wife's age is between 18 and 24 years and 0 otherwise
	age25_34_f	Binary variable that is equal to 1 if the wife's age is between 25 and 34 years and 0 otherwise
	age35_44_f	Binary variable that is equal to 1 if the wife's age is between 35 and 44 years and 0 otherwise
	age45more_f	Binary variable that is equal to 1 if the wife's age is higher than 45 and 0 otherwise
Unemployment rate	male_unemployment	Male unemployment rate. Continuous variable. Constructed at the county level or unitary authority level.[23]
	female_unemployment	Female unemployment rate. Continuous variable. Constructed at the county level or unitary authority level.[24]
Distribution factors	sex_ratio	Continuous variable. It is equal to the number of males whose age falls in the age category of the husband over the number of females whose age falls in the category of the wife in a particular county
	age_difference	Continuous variable (percentage). It is equal to the subtraction of the female age from the male age and the division of the result by the male's age
	female_older	Binary variable that is equal to 1 if the wife is older than her husband
Mother-in-law working status	motherinlaw_work	Binary variable that is equal to 1 if the husband's mother was working when he was 14 years old and 0 otherwise
	motherinlaw_not_work	Binary variable that is equal to 1 if the husband's mother was not working when he was 14 years old and 0 otherwise
	motherinlaw_misc	Binary variable that is equal to 1 if the husband's mother was deceased, not living in the household or if the husband does not know and 0 otherwise

[23] Source: Office of National Statistics (2004a)
[24] Source: Office of National Statistics (2004b)

4.2 Descriptive statistics

An analysis of all couples of working age in the sample reveals that 70% of all the households considered in this chapter are dual-earner households in which both spouses are working. It is more than twice as common to have a female not working rather than a male in a household as 17% of households in the sample are male breadwinner households and 6% female. Finally, in 7% of households in the sample both spouses are unemployed. The proportion of married men working in the sample (0.88) is found to be higher than that of married women (0.76). Males have higher predicted wages in all households. Furthermore, predicted wages for both males and females are the lowest in households where neither the husband nor the wife is working. They are the highest in dual-earner households.[25] Female non-labour income is on average higher than male non-labour income. However, this result does not hold in all types of household. Male non-labour income is higher in female-breadwinner and non-earner households. In both cases, men have higher benefit and pension incomes (see appendix 2, table A2.3). In dual-earner households and male-earner ones, benefit income is higher for females. Even though the measure of benefit income is from the past year, there is bound to be a strong link between benefit income and participation in the labour market as benefits tend to be administered (or not) based on work status. With respect to the unemployment rate, the sample estimates are similar to the ones computed by the office of national statistics of 5.5% for males and 4.3% for females in April-June 2003. Household working patterns vary with the education level of spouses. Indeed, the only type of household in which the wife is, on average, more educated than her husband, is the female-earner household. The qualification difference is the smallest in dual-earner couples. Finally, male-earner

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[25] See Jacobsen and Rayack (1996) for a discussion of single-earner male wage premium.

households have the highest qualifications' difference. This might suggest that the individual with the comparative advantage in the labour market (in other words with the highest education level) will engage in paid labour.

The highest number of pre-school children and children aged between 5 and 11 years-old is concentrated in male-breadwinner households while female-breadwinner households are the opposite. This confirms the common result in the literature that women are still the ones largely responsible for childcare and therefore less likely to work if they have young children. Both the male unemployment rate and the sex ratio are higher in female earner and zero earner households suggesting that men's employment is sensitive to regional macroeconomic conditions and demographic composition. The correlation between the two variables is negative and weak suggesting they are not capturing the same effects. The female unemployment rate is invariant across household types. With respect to age difference, men are on average older in female earner or no earner households, this can be indicative of the fact that men can retire while their spouse is still working for the former or that women care for their partners for the latter and is also confirmed by the fact that the average ages for these two types of households are higher. In addition, the highest proportion of men in female-breadwinner households is older than 45 years of age, which could suggest that men might retire early while their wives continue working.

Finally, regarding the mother-in-law's work status, the lowest proportion of households where the mother-in-law was working when the respondent was aged 14, is the zero earner ones, while the highest one is in the dual-earner households suggesting that work behaviour might be transmitted inter-generationally. It is important to note that the high proportion of individuals in the miscellaneous category is due to the fact that a number of respondents did not reply to this question because it was not administered in the particular wave in which they became part of the sample.

Table 2.1(b): Descriptive statistics

	All households	*Dual-earner households*	*Male earner households*	*Female earner households*	*Zero-earner households*
male_working	0.8758				
female_working	0.7592				
male_wage	2.43	2.45	2.42	2.36	2.29
	(0.24)	(0.23)	(0.24)	(0.27)	(0.21)
female_wage	2.15	2.18	2.09	2.12	1.98
	(0.26)	(0.25)	(0.24)	(0.26)	(0.24)
age18_24_m	0.0337	0.0324	0.0347	0.0392	0.04
age25_34_m	0.2189	0.2333	0.2343	0.1046	0.1257
age35_44_m	0.3173	0.3445	0.3189	0.1569	0.1657
age45more_m	0.4301	0.3898	0.4121	0.6993	0.6686
age18_24_f	0.0606	0.0551	0.0651	0.0588	0.1086
age25_34_f	0.2480	0.2635	0.2625	0.1503	0.1314
age35_44_f	0.3287	0.3483	0.3449	0.2418	0.1543
age45more_f	0.3620	0.3321	0.3275	0.5490	0.6057
male_unemployment	0.0650	0.0638	0.0651	0.0727	0.0711
	(0.03)	(0.03)	(0.02)	(0.02)	(0.03)
female_unemployment	0.0439	0.0434	0.0439	0.0471	0.0464
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
male_income	169	98	139	521	675
	(411)	(348)	(338)	(568)	(500)
female_income	173	127	276	137	439
	(266)	(214)	(314)	(201)	(419)
couple_income	342	226	413	662	1116
	(510)	(428)	(457)	(603)	(543)
childlessthan5	0.1867	0.1598	0.3471	0.0719	0.1486
child5to11	0.2840	0.2792	0.3861	0.1373	0.1943
childolderthan12	0.2207	0.2257	0.2213	0.2092	0.1771
sex ratio (1) [†]	1.1566	1.1402	1.1556	1.2303	1.2686
	(0.3035)	(0.3015)	(0.2919)	(0.2466)	(0.3635)
sex ratio (2) [††]	0.9920	0.9914	0.9892	0.9914	1.0060
	(0.0734)	(0.0725)	(0.0703)	(0.0700)	(0.0906)
age_difference	0.0452	0.0404	0.0478	0.0737	0.0643
female_older	0.1533	0.1609	0.1584	0.1046	0.1029
motherinlaw_work	0.5267	0.5621	0.4707	0.5033	0.32
motherinlaw_not_work	0.3851	0.3553	0.4360	0.4052	0.5486
motherinlaw_misc	0.0882	0.0826	0.0933	0.0915	0.1314
Sample size	2641	1852	461	153	175

Notes: [†] ratio of the number of males whose age falls in the age category of the husband over
the number of females whose age falls in the ages fall in the category of the wife in a particular county.
[††]ratio of the number of males whose age falls in the age category of the husband over the number of females whose age
falls in that same age category

5 Econometric methodology

In this section, the bivariate probit framework, which is used to model a couple's labour market participation is described.

5.1 Bivariate Probit model

As explained in the theoretical section, this chapter is mainly empirical in nature and follows the work of Del Boca (1997). In order to model the couples' participation decision, a bivariate probit is used. The latter consists of two probit equations estimated as a system that allows for correlation in unobservables between the two equations. In this model, there are four mutually exclusive possible outcomes in relation to couples work behaviour. Either both partners work, or the husband works and the wife does not, or the wife works and the husband does not, or both partners do not work. Each household is allocated to one of the four outcomes.

The two equation model is specified as follows:

$$y*_m = X'_m \beta_m + \varepsilon_m$$

$$y_m = 1 \qquad\qquad \text{if } y*_m > 0,$$

$$y_m = 0 \qquad\qquad \text{if } y*_m \leq 0$$

$$y*_f = X'_f \beta_f + \varepsilon_f$$

$$y_f = 1 \qquad\qquad \text{if } y*_f > 0,$$

$$y_f = 0 \qquad\qquad \text{if } y*_f \leq 0$$

$$\varepsilon_m, \varepsilon_f \sim BVN(0,0,1,1,\rho)$$

Where $y*_m$ and $y*_f$ are latent variables for labour supply, X'_m and X'_f are the male and female vectors of explanatory variables, and BVN (...;.) denotes "bivariate normally distributed".

Let $P_{11}, P_{10}, P_{01}, P_{00}$ be the probabilities associated with the four outcomes.

$$P(y_m = 1, y_f = 1 \mid X_m, X_f) = F(X'_m \beta_m, X'_f \beta_f, \rho)$$

$$P(y_m = 1, y_f = 0 \mid X_m, X_f) = F(X'_m \beta_m, -X'_f \beta_f, -\rho)$$

$$P(y_m = 0, y_f = 1 \mid X_m, X_f) = F(-X'_m \beta_m, X'_f \beta_f, -\rho)$$

$$P(y_m = 0, y_f = 0 \mid X_m, X_f) = F(-X'_m \beta_m, -X'_f \beta_f, \rho)$$

Where F is the bivariate normal cumulative distribution function operator and ρ is the correlation coefficient between the unobservables in the two equations. The likelihood function for this model is the following:

$$L_{BIVARIATE} = \prod_{y_m=1, y_f=1} F(X'_m \beta^m, X'_f \beta^f; \rho) \prod_{y_m=0, y_f=1} F(-X'_m \beta_m, X_f \beta_f; -\rho) *$$
$$\prod_{y_m=1, y_f=0} F(X'_m \beta_m, -X'_f \beta_f; -\rho) \prod_{y_m=0, y_f=0} F(-X'_m \beta_m, -X'_f \beta_f; \rho)$$

If the correlation coefficient is equal to zero, it implies that the participation decisions of the spouses are not interlinked and two separate univariate probits can be estimated instead. A likelihood ratio test can be performed to test whether the correlation coefficient is equal to zero. The test statistic, distributed as a chi-squared with one degree of freedom, is computed as follows:

$$\lambda_{LR} = 2[\ln L_{BIVARIATE} - (\ln L_1 + \ln L_2)]$$

Where $L_{BIVARIATE}$, L_1 and L_2 are the likelihood functions of the bivariate probit and the two univariate probits respectively; with $L_1 = prob[y_m = 1] = \Phi(x'_m\,\beta_m)$ and $L_2 = prob[y_f = 1] = \Phi(x'_f\,\beta_f)$. However, this can also be conducted using the Wald test on the correlation coefficient.

Before estimating the model, the issue of identification needs to be addressed. In other words, one has to establish whether it is possible to uniquely identify, using the available sample data, all the parameters estimated. If more than one set of parameters is consistent with the model, the latter is said to be under-identified. There are a number of ways to address this issue. In this context, a useful one could be exclusion restrictions. The male unemployment rate is included in the male regression (but not in the female one) and the female unemployment rate in the female regression (but not in the male one). Furthermore, an individual's own age is included in each regression model. Furthermore, according to Wilde (2000), in the recursive bivariate probit model (of which the present model is a special case), exclusion restrictions are not necessary if there is enough variation in the data. In other words, enough of the variables used are continuous. This is clearly the case in the current application.

It could be argued that either husbands' or wives' work status need to be introduced in their partners' labour force participation equations. However, due to a coherency restriction, the coefficient on the husband's (or wives) status in the wives' (or husbands') regression is imposed to be equal to zero. As mentioned in the review section, it has been argued that constraining the coefficient of the spouse's employment to zero implies that simultaneity of decision-making regarding participation in the labour market is not properly accounted for. However, in this chapter, we take the view that allowing for correlation in the unobservables reduces substantially this particular problem. Furthermore, the impact of the employment status of one spouse on the participation of the other is likely to be partly

taken into account through the inclusion of the wage and non-labour income of the spouse in the individual's participation decision. It is important to note that identification is less feasible if a spouse's employment status is introduced in the individual's regression model. For all the reasons outlined above, following Del Boca (1997), the bivariate probit framework chosen here is not recursive. Not taking into account the effect of the husband's employment on his wife's participation implies the added worker effect cannot be readily examined. The impact of the male unemployment rate on female participation could have approximated the latter but this was not found to be statistically significant. The system of equations to be estimated is as follows:

$$
\begin{aligned}
y_m^* = a_m &+ b_m wage\_m + c_m wage\_f + d_m inc\_m + e_m inc\_f \\
&+ g_m age25\_34 + h_m age35\_44 + k_m age45\_more + \\
&n_m ch\_05 + p_m ch\_511 + q_m ch\_12m + r_m ue\_m + \varepsilon_m
\end{aligned}
\qquad [6.1]
$$

$$
\begin{aligned}
y_f^* = a_f &+ b_f wage\_m + c_f wage\_f + d_f inc\_m + e_f inc\_f \\
&+ g_f age25\_34 + h_f age35\_44 + k_f age45\_more + \\
&n_f ch\_05 + p_f ch\_511 + q_f ch\_12m + r_f ue\_f + s_f work\_m + \varepsilon_f
\end{aligned}
\qquad [6.2]
$$

The coherency restriction mentioned previously imposes the constraint that $s_f = 0$, which we impose in this particular case.

In order to evaluate the goodness of fit of the model Mc Fadden R-squared can be computed. The latter is equal to: $1 - \dfrac{L(full\,model)}{L(restricted\,model)}$ where the full model is represented by equations [6.1] and [6.2] above and the restricted model is represented by equation [6.2] and the following equation: $y_m^* = a_m + \varepsilon_m$ for males and equation [6.1] and the following equation: $y_f^* = a_f + \varepsilon_f$ for females.

The income pooling test consists in using a Wald test to establish whether the following parametric equalities hold in the model above:

Male equation: $H_0 : d_m = e_m$ versus $d_m \neq e_m$ [6.3]

Female equation: $H_0 : d_f = e_f$ versus $d_m \neq e_m$ [6.4]

In the second phase, distribution factors are introduced in equations [6.1] and [6.2] above in turn starting with the sex ratio, then age difference and the female older dummy (see table 2.4). In the last phase, the mother-in-law working status is introduced to the basic model above (see table 2.5).

5.2 Marginal effects

The coefficients obtained in the bivariate probit indicate whether the impact of an effect is significant and whether it increases or decreases the probability of observing the outcome of interest. In order to compute the quantitative effect of variables on the outcomes of interest, marginal effects can be derived. Conditional and marginal probabilities are used in this chapter to compute the relevant marginal and impact effects. The marginal effect on the conditional probability gives the marginal effect of a change in an explanatory variable on the probability that an individual is working conditional on their spouse working as well. The marginal effect on the marginal probability gives the marginal effect of a change in an explanatory variable on the probability that an individual is working irrespective of the work status of their spouse. Greene (1996, 2000) and Christofides *et al* (2001, 2002) show how to obtain marginal effects in the context of a bivariate probit (See Appendix 2 for derivations of marginal effects). Standard errors for these effects are computed using the delta method.

5.3 Computing elasticities

The wage elasticity of participation is equal to the percentage change in participation over the percentage change in the wage. Let E_{wi} be the male (or female) wage elasticity of participation:

$$E_{wi} = \frac{\partial P_i}{\partial \ln W_i} * \frac{1}{\overline{P_i}} \qquad \text{for } i = m, f \qquad [6.5]$$

Where $\overline{P_i}$ is the sample proportion of males (females), W_i is the male (female) wage and $\frac{\partial P_i}{\partial \ln W_i}$ represents the marginal effect of the log wage on the probability of participation.

The income elasticity of participation is equal to the percentage change in participation over the percentage change in income. There are three income elasticities to compute. The male and female income elasticity of participation for males and females are respectively equal to:

$$E_{ym} = \frac{\partial P_f}{\partial y_m} * \frac{\overline{y}_m}{\overline{P}_f} \qquad [6.6]$$

Where $\overline{P}_f$ is the sample proportion of females and $\overline{y}_m$ is the male non-labour income. $\frac{\partial P_f}{\partial y_m}$ represents the marginal effect of male non-labour income on the probability of female participation

$$E_{yf} = \frac{\partial P_f}{\partial y_f} * \frac{\overline{y}_f}{\overline{P}_f} \qquad [6.7]$$

Where $\overline{P}_f$ is the sample proportion of females and $\overline{y}_f$ is the sample mean female non-labour income. $\frac{\partial P_f}{\partial y_f}$ represents the marginal effect of female non-labour income on the probability of female participation

The pooled income elasticity of participation for males is equal to:

$$E_{ym} = \frac{\partial P_m}{\partial y_{mf}} * \frac{\overline{y}_{mf}}{\overline{P}_m}$$
[6.8]

Where $\overline{P}_m$ is the sample proportion of males and y_{mf} is the pooled non-labour income.

$\dfrac{\partial P_m}{\partial y_{mf}}$ represents the marginal effect of pooled non-labour income on the probability of

male participation.

6 Results

Before looking at the results of the bivariate probit model, a quick review of the findings from the two-step Heckman procedure is provided. Both the selection equation and the wage regression estimates are displayed in tables A.2.1 and A.2.2 of Appendix 2. The probit regression model for labour market participation of all males and females in the working age population yields results that are broadly consistent with economic theory. The probability of working increases with education for both gender groups. Being other than white reduces the probability of participation. Marital status only impacts on male participation while being disabled reduces the probability of participation for males and females. Home ownership (either outright or with a mortgage) increases the probability of working for both males and females. The presence of children reduces female participation in the labour market. With respect to the wage equations, the inverse of the Mills ratio is found to be statistically significant for both males and females, which indicates the presence of selection bias. Furthermore, the coefficient on the Inverse Mills ratio is found to be negative. While this can be seen to be counter-intuitive as it indicates that unobservables that positively influence the wage will negatively influence participation, the result is nevertheless plausible (see Ermisch and Wright (1994)) and common.

The bivariate probit results, reported in tables 2.2 and 2.3, show that effects are well determined overall. Furthermore, the model converged after thirty iterations. This indicates that identification did not seem to pose a problem in the model. Results reveal that spouses' participation decisions at the level of the household are related in all specifications. Unobservable factors that determine male and female participation are positively correlated as the likelihood ratio test on the correlation coefficient being zero is rejected in all specifications. This result contradicts the finding of Kooreman (1994) using Dutch data but is consistent with Del Boca (1997) for Italian data. It is difficult to assess whether this is due to the nature of the data (different countries) or to differences in modelling. The positive sign on the correlation coefficient might be an indication of assortative mating (which was discussed in the theoretical section). Unobservable factors other than wages, non-labour income, age and the number of children affect male and female participation in the same way. These could be related to traits of character such as ambition or similar attitudes to work. Assortative mating is discussed in detail in Becker (1973). The author argues that men tend to marry women with similar traits (race, height, intelligence). Therefore, if an individual has a trait that encourages participation in the labour market, and that is not controlled for in the model, it is likely that their spouse has the same trait. Exceptions occur for wage rates or traits that are complementary in household production.

Table 2.2 below shows the results of the bivariate model with male and female non-labour income introduced separately. The income pooling test, described in equations [6.3] for males and [6.4] for females in the preceding section, yields t-ratios of 0.05 and 43.94 for males and females respectively. The hypothesis of equality of income effect is thus rejected for females but not for males. In other words, husbands seem to pool non-labour income but wives do not. This shows that the unitary model's assumption of income pooling holds

for males but not for females. This result is not implausible. One of its interpretations could be that women tend to consider the non-labour income they receive as theirs (for their own consumption or their children's) while men tend to consider the non-labour income they receive as a household one. Maybe men still act as breadwinners even if their wives do not seem to have similar views. Unlike in the first chapter, income effects are well-determined. Therefore, the preferred specification is one where income is pooled in the male equation but not in the female. In the male regression model (equation [6.1]), the constraint $d_m = e_m$ is imposed on the data.

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Table 2.2: Bivariate probit results (income pooling test)

	Bivariate probit	
	Male	*Female*
male_wage	1.2567***	-0.1799
	(0.1371)	(0.1149)
female_wage	0.3925***	1.3644***
	(0.1332)	(0.1194)
male_income	-0.6333***	-0.2703***
	(0.0681)	(0.0672)
female_income	-0.6641***	-1.1501
	(0.1255)	(0.1131)
age25_34_m	-0.2023	†
	(0.2074)	
age35_44_m	-0.3302	†
	(0.2151)	
age45more_m	-0.6281***	†
	(0.2002)	
age25_34_f	†	-0.1472
		(0.1408)
age35_44_f	†	-0.3967***
		(0.1477)
age45more_f	†	-0.5742***
		(0.1393)
male_unemployment	-4.7027***	†
	(1.4173)	
female_unemployment	†	-1.0795
		(2.5133)
childlessthan5	0.2442**	-0.4893***
	(0.1235)	(0.0823)
child5to11	0.2895***	-0.0662
	(0.1040)	(0.0730)
childolderthan12	0.1652*	0.1561**
	(0.1007)	(0.0782)
Constant	-1.4173***	-0.7195***
	(0.3406)	(0.2853)
Correlation coefficient	0.3114***	
	(0.0497)	
Likelihood ratio test	35.3881	
	(0.0000)	
Log likelihood	-1860.264	
MacFadden R squared	0.1403	0.1237
Sample size	2641	

Notes: *** denotes significance at the 1% level
** denotes significance at the 5% level
* denotes significance at the 10% level
† indicates the variable is omitted from the regression;
Base categories for the age for males and females are age18_24_m and age18_24_f respectively
The t ratios for the test of equality of male and female non-labour income effects are equal to 0.05 for males and 44 for females

The results for the constrained model are reported in table 2.3 below. As in the case of hours of work (see chapter one), the specification with pooled non-labour income and the one with non-pooled income yield very similar results. The Mac Fadden R squared values computed for male and female regressions respectively equal 0.1403 and 0.1237 which shows that the set of explanatory variables included in the model provide a satisfactory fit for the data in the current application. The effect of most variables is well-determined and generally consistent with predictions from economic theory.

Table 2.3: Bivariate probit estimates and corresponding marginal effects

	Bivariate probit (equations 6.1 and 6.2)		Marginal effects[+] (equations 6.1 and 6.2)			
	Male	Female	Marg(m)	Marg(f)	Cond(m)	Cond(f)
male_wage	1.2556***	-0.1803	0.1704***	-0.0515	0.1422***	-0.0794***
	(0.1370)	(0.1149)	(0.0199)	(0.0328)	(0.0174)	(0.0319)
female_wage	0.3964***	1.3649***	0.0538***	0.3898***	0.0204*	0.3680***
	(0.1321)	(0.1194)	(0.0178)	(0.0338)	(0.0155)	(0.0327)
male_income	f	-0.2718***	f	-0.0776***	0.0047***	-0.0751***
		(0.0669)		(0.0191)	(0.0014)	(0.0185)
female_income	f	-1.1469***	f	-0.3276***	0.0197***	-0.3171***
		(0.1122)		(0.0326)	(0.0038)	(0.0317)
couple_income	-0.6401***	f	-0.0869***	f	-0.0709***	0.0151***
	(0.0607)		(0.0092)		(0.0082)	(0.0032)
age25_34_m	-0.2022	f	-0.0298	f	-0.0246	0.0050
	(0.2073)		(0.0332)		(0.0278)	(0.0055)
age35_44_m	-0.3296	f	-0.0490	f	-0.0405	0.0082
	(0.2150)		(0.0351)		(0.0296)	(0.0059)
age45more_m	-0.6259***	f	-0.0920***	f	-0.0763***	0.0154***
	(0.2000)		(0.0323)		(0.0276)	(0.0058)
age25_34_f	f	-0.1471	f	-0.0433	0.0026	-0.0420
		(0.1408)		(0.0426)	(0.0025)	(0.0414)
age35_44_f	f	-0.3965***	f	-0.1191***	0.0069**	-0.1158***
		(0.1477)		(0.0463)	(0.0029)	(0.0452)
age45more_f	f	-0.5738***	f	-0.1732***	0.0100	-0.1601***
		(0.1393)		(0.0437)	(0.0030)	(0.0433)
male_unemployment	-4.6979***	f	-0.6376***	f	-0.5205***	0.1106***
	(1.4865)		(0.2005)		(0.1648)	(0.0404)
female_unemployment	f	-1.07911	f	-0.3082	0.0186	-0.2983
		(2.5133)		(0.7178)	(0.0433)	(0.6948)
childlessthan5	0.2415**	-0.4895***	0.0293**	-0.1558***	0.0304***	-0.1584***
	(0.1228)	(0.0823)	(0.0132)	(0.0283)	(0.0097)	(0.0279)
child5to11	0.2860***	-0.0666	0.0355***	-0.0192*	0.0297***	-0.0251
	(0.1027)	(0.0730)	(0.0117)	(0.0213)	(0.0093)	(0.0207)
childolderthan12	0.1611*	0.1556**	0.0205*	0.0429**	0.0143	0.0380*
	(0.0989)	(0.0782)	(0.0118)	(0.0207)	(0.0097)	(0.0200)
Constant	-1.4251***	-0.5671				
	(0.3387)	(0.3513)				
Correlation coefficient	0.3117***					
	(0.0496)					
Likelihood ratio test	35.4947					
	(0.0000)					
Log likelihood	-1860.2878					
MacFadden R squared	0.1403					
Sample size	2641					

(+) marg(m) is the marginal probability of male participation, marg(f) is the probability of female participation, cond(m) is the marginal probability of male participation given female participation, cond(f) is the probability of female participation given male participation

Notes: Constraint $d_m = e_m$ is imposed in specification I;

*** denotes significance at the 1% level
** denotes significance at the 5% level
* denotes significance at the 10% level
f indicates the variable is omitted from the regression; Base categories for the age for males and females are age18_24_m and age18_24_f respectively

In the regression model presented in table 2.3, male labour market participation is sensitive to the own wage and to that of their partner while a female's participation only depends on her own wage. Although it is important to note that the effect of the male wage on female participation is close to the margin of being statistically significant. For men, an increase in either wage has a significant and positive impact on the probability of working on average and *ceteris paribus*. In the male equation, the test of whether the difference between the two wage effects is equal to zero yields a chi-square value of 14.22. Therefore, the difference between the effects of male and female wages on male participation is statistically significant. The marginal effects show that a 10% increase in the male wage results in a 1.7 percentage point increase in the probability that a male works whereas the same increase in the female wage results in an increase of 0.5 of a percentage point. The male elasticity of participation with respect to the male wage is equal to 0.19 which is highly inelastic. For women, a 10% increase in their own wage increases the probability of participation by 3.9 percentage points on average and *ceteris paribus*. The female elasticity of participation with respect to her own wage is equal to 0.51 which is again inelastic. This estimate is comparable to that computed by Layard *et al* (1980), Greenlagh (1980) and Main and Reilly (1996). This might suggest that female elasticities of participation with respect to their own wage have remained relatively stable over the last two decades. Finally, a test of the hypothesis that the impact of the male wage on male participation is equal to the impact of the female wage on female participation yields a chi square statistic of 0.33 which means that the hypothesis cannot be rejected. This means that own wage effects are similar across gender groups. Regarding cross wage effects; as noted earlier, there exists an asymmetry of response as male participation depends on female wages but the reverse effect is statistically not different from zero.

Income effects are well determined for both males and females. An increase in male or female non-labour income decreases the probability of a female working on average and *ceteris paribus.* A hundred pounds increase in male non-labour income reduces the probability of working for females by 0.7 percentage points while the same level of increase in female non-labour market income reduces the probability of working by 3.3 percentage points on average and *ceteris paribus.* The elasticity of female participation with respect to male and female non-labour income is equal to -0.02 and -0.08 respectively. The estimate is different to that of Greenlagh (1980) but comparable to that reported by Layard *et al* (1980).

An increase of a hundred pounds in pooled income reduces the probability that a man works by 0.9 percentage points on average and *ceteris paribus.* The elasticity of male participation with respect to pooled income is equal to -0.05. An individual's age also impacts on participation. For men, being older than 45 reduces the probability of participation by 9.2 percentage points compared to being aged between 18 and 24. This effect is much larger for women as being older than 45 reduces the probability of female employment by 17.3 percentage points. This could perhaps indicate a cohort effect as older generations of women are less likely to be employed.

The presence of a child aged less than 5 reduces the conditional and marginal probabilities of female participation by 16 percentage points. This result confirms the empirical finding usually detected in the literature namely that employment rates for women with preschool children are lower than those of all other women. Having a child aged between 5 and eleven also reduces conditional and marginal probabilities of female participation but by a smaller amount of 1.9 percentage points. However, the presence of a child aged more than 12 does not affect female participation. The reverse is observed for men as their probability of participation increases with the presence of children of all ages.

The local level female unemployment rate does not seem to impact on married women employment whereas the male unemployment rate does negatively affect male participation in the labour market. A one percentage point increase in the unemployment rate reduces participation by 0.64 of one percentage points. The negative impact of male unemployment on the probability of a male working is larger than on the probability of a male working given his wife is working. This is attributable to the fact that a wife in employment might provide her husband with a network of opportunities in the labour market, though this is fairly conjectural.

A comparison of marginal and conditional probabilities for most of the other variables reveal, for both gender groups, that they have a similar impact on the probability that an individual is working and the probability that an individual is working given their partner is. A notable exception is the impact of the female wage on the probability of male participation which is halved in the case of conditional participation given the wage could proxy for employment status.

Before looking at the impact of distribution factors in the model, a recursive model of a couple's labour market participation is estimated. Results are reported in Appendix 2 (table A2.5). A quick overview of the finding is done here. However, conclusions should not be drawn as it is unclear whether identification is possible in this framework. In the model where male employment status is included in the female participation equation, the own wage effect does not seem to be affected but the impact of the male wage on female participation becomes better determined. Controlling for male employment status, an increase in the male wage reduces the probability of female participation in the labour market. If the male is employed, this increases the probability that his wife will work as well. Interestingly, the correlation coefficient is now negative. In other words, the

unobservables that affect male and female participation are negatively correlated once male

participation is taken into account.

Table 2.4(a): Bivariate Probit Estimates (with distribution factors)

Dependent variables: male_working and female_working						
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
male_wage	1.2679***	-0.1627	1.2571***	-0.2849*	1.2650***	-0.1697
	(0.1374)	(0.1153)	(0.1371)	(0.1544)	(0.1379)	(0.1155)
female_wage	0.3484***	1.3480***	0.3969***	1.3480***	0.3463***	1.3505***
	(0.1337)	(0.1196)	(0.1321)	(0.1507)	(0.1337)	(0.1199)
male_income	*f*	-0.2615***	*f*	-0.2717***	*f*	-0.2668***
		(0.0672)		(0.0669)		(0.0673)
female_income	*f*	-1.1545***	*f*	-1.1446***	*f*	-1.1493***
		(0.1127)		(0.1123)		(0.1124)
couple_income	-0.6467***	*f*	-0.6398***	*f*	-0.9311***	*f*
	(0.0608)		(0.0697)		(0.0553)	
age25_34_m	-0.1319	*f*	-0.1566	*f*	-0.1391	*f*
	(0.2123)		(0.1412)		(0.2092)	
age35_44_m	-0.2998	*f*	-0.4045***	*f*	-0.2425	*f*
	(0.2176)		(0.1480)		(0.2181)	
age45more_m	-0.5220***	*f*	-0.5716***	*f*	-0.5214***	*f*
	(0.2075)		(0.1394)		(0.2031)	
age25_34_f	*f*	-0.2882*	*f*	-0.1566	*f*	-0.1546
		(0.1559)		(0.1412)		(0.1422)
age35_44_f	*f*	-0.5292**	*f*	-0.4045***	*f*	-0.4130*
		(0.1605)		(0.1480)		(0.1509)
age45more_f	*f*	-0.6950***	*f*	-0.5716***	*f*	-0.5954***
		(0.1522)		(0.1394)		(0.1453)
male_unemployment	-4.9543***	*f*	-6.5100***	*f*	-4.8234***	*f*
	(1.4935)		(1.4397)		(1.4913)	
Female_unemployment	*f*	-1.4670	*f*	-1.6752	*f*	-1.0969
		(2.5203)		(2.5822)		(2.5151)
childlessthan5	0.2623**	-0.6690***	0.2237*	-0.4913***	0.2914**	-0.4899***
	(0.1244)	(0.0815)	(0.1174)	(0.0823)	(0.1245)	(0.0825)
child5to11	0.2844***	-0.1346*	0.3573***	-0.0709	0.2970***	-0.0685*
	(0.1033)	(0.0715)	(0.0991)	(0.0732)	(0.1034)	(0.0731)
childolderthan12	0.1686*	0.1140	0.1084	0.1549**	0.1621*	0.1564**
	(0.0993)	(0.0770)	(0.0954)	(0.0783)	(0.0995)	(0.0783)
sex ratio (1) †	-0.3383***	-0.2811***	*f*	*f*	*f*	*f*
	(0.1255)	(0.1112)				
sex ratio (2) ††	*f*	*f*	-0.1009	-0.2159	*f*	*f*
			(0.4822)	(0.4976)		
age_difference	*f*	*f*	*f*	*f*	-1.0272***	-0.3281
					(0.4229)	(0.3489)
female_older	*f*	*f*	*f*	*f*	0.0018	-0.0118
					(0.1447)	(0.1073)
Constant	-1.0131**	-0.2550***	-1.2872**	-1.2063**	-1.3781***	-0.6832**
	(0.3698)	(0.3442)	(0.6542)	(0.6043)	(0.3411)	(0.2898)
Correlation coefficient	0.3157***		0.3217***		0.3114***	
	(0.0551)		(0.0550)		(0.0497)	

Likelihood ratio test	33.7113 (0.0000)		35.2934 (0.0000)		35.3127 (0.0000)	
Log likelihood	-1854.1713		-1859.6918		-1855.2605	
McFadden R squared	0.1424	0.1251	0.1404	0.1240	0.1426	0.1238

Notes: *** denotes significance at the 1% level;
** denotes significance at the 5% level
* denotes significance at the 10% level
ʃ indicates the variable is omitted from the regression
Base categories for the age for males and females are age18_24_m and age18_24_f respectively
(ϯ) ratio of the number of males whose age falls in the age category of the husband over the number of females whose age falls in the ages fall in the category of the wife in a particular county.
(ϯϯ)ratio of the number of males whose age falls in the age category of the husband over the number of females whose age falls in that same age category.
The marginal effects for the regressions models displayed in table 2.4(a) are reported in table A2.4 (appendix 2)

The next phase of the analysis consists in introducing distribution factors to the bivariate model discussed above. The results are reported in table 2.4 above. First, the Mac Fadden R squared computed for the male and female regressions with the sex ratio are found to be equal to 0.1424 and 0.1251 and thus broadly similar to the ones reported for the basic specification. Adding the sex ratio to the male regression model does not alter the impact of other variables. The coefficient on the dummy for a woman aged between 25 and 44 becomes better determined and shows that being in this age category reduces the probability of being in employment compared to women aged between 18 and 24. The impact of the presence of a child aged less than 5 increases in magnitude. The sex ratio is significant in both male and female regressions. While this could again question the legitimacy of the early neoclassical model as the latter does not recognize the role of outside variables on labour market participation, the estimated signs on the variable do not seem to provide evidence that it is a good distribution factor as it impacts negatively on both male and female participation. This means that as the number of males relative to females increases in a certain age category, male and female probabilities of participation in the labour market both decrease. With respect to females, the direction of the impact is consistent with a bargaining interpretation. If there are more men relative to women,

women have more power and more access to resources, which leads to an income effect that reduces participation in the labour market. This is not the case for men. Given the sex ratio is assumed indicative of some measure of power, it should have affected men positively. Sex ratios are likely to reflect competition in both the labour and marriage markets for a particular age category. However, the unemployment rate is taken into account in the regression so the result is unlikely to suggest evidence in favour of the existence of a discouraged worker effect. The second measure of sex ratio is found not to be significant in the regression model. This shows the sensitivity of results to the definition of variables. Introducing the age difference to the basic model does not impact on estimates (apart from the coefficient on the dummy for women aged between 25 and 44 which becomes better determined). The age difference is found to have a negative impact on the husband's probability of working and no impact on the wife's. The older the husband compared to his wife the less likely he is to participate in the labour market. Again, this impact could be consistent with a bargaining interpretation as older men can be considered to have greater bargaining power and thus lower labour market participation. However, the fact that it does not affect the wife questions this interpretation since bargaining measures (as discussed in the first chapter) are expected to have opposite and significant effects on both spouses. An alternative explanation is that this effect might also capture the effects of early retirement for men or accumulation of income that allows them to retire or the fact that for health reasons, they stop working while their wives have to continue to do so. Unlike in the first chapter where it was found to affect female hours of work, the binary variable indicating if a wife is older than her husband is found not to have an impact on male and female participation decisions. The next table (2.4b) reports the results of a model with the two significant distribution factors, age difference and sex ratio, introduced collectively.

Table 2.4(b): Bivariate Probit Estimates (with distribution factors)

	Dependent variables: male_working and female_working					
	Male	*Female*	*Marg(m)*	*Marg(f)*	*Cond(m)*	*cond(f)*
male_wage	1.2683***	-0.1655	0.1690***	-0.0472	0.1408***	-0.0748**
	(0.1379)	(0.1156)	(0.0198)	(0.0329)	(0.0173)	(0.0321)
female_wage	0.3326***	1.3511***	0.0443***	0.3852***	0.0137	0.3656***
	(0.1342)	(0.1200)	(0.0178)	(0.0340)	(0.0155)	(0.0328)
male_income	f	-0.2644***	f	-0.0754***	0.0044***	-0.0730***
		(0.0674)		(0.0192)	(0.0014)	(0.0186)
female_income	f	-1.1517***	f	-0.3284***	0.0192***	-0.3182***
		(0.1128)		(0.0327)	(0.0038)	(0.0318)
couple_income	-0.6526***	f	-0.0869***	f	-0.0710***	0.0149***
	(0.0609)		(0.0091)		(0.0081)	(0.0032)
age25_34_m	-0.1247	f	-0.0118	f	-0.0144	0.0030
	(0.2116)		(0.0313)		(0.0259)	(0.0052)
age35_44_m	-0.2506	f	-0.0362	f	-0.0295	0.0060
	(0.2184)		(0.0337)		(0.0280)	(0.0056)
age45more_m	-0.4988**	f	-0.0704**	f	-0.0585**	0.0118**
	(0.2070)		(0.0317)		(0.0267)	(0.0055)
age25_34_f	f	-0.2959*	f	-0.0893*	0.0050*	-0.0869*
		(0.1574)		(0.0499)	(0.0028)	(0.0488)
age35_44_f	f	-0.5279***	f	-0.1606***	0.0090***	-0.1565***
		(0.1606)		(0.0513)	(0.0031)	(0.0504)
age45more_f	f	-0.6887***	f	-0.2093***	0.0117***	-0.2042***
		(0.1525)		(0.0483)	(0.0032)	(0.0475)
male_ unemployment	-4.9357***	f	-0.6588***	f	-0.5372***	0.1129***
	(1.4947)		(0.1978)		(0.1629)	(0.0401)
female_ unemployment	f	-1.4858	f	-0.4236	0.0248	-0.4105
		(2.5207)		(0.7187)	(0.0422)	(0.6963)
childlessthan5	0.2889**	-0.5081***	0.0336***	-0.1620***	0.0336***	-0.1655***
	(0.1250)	(0.0831)	(0.0126)	(0.0287)	(0.0092)	(0.0283)
child5to11	0.2919***	-0.0775	0.0355***	-0.0224	0.0298	-0.0281
	(0.1036)	(0.0733)	(0.0115)	(0.0214)	(0.0092)	(0.0209)
childolderthan12	0.1652*	0.1613**	0.0206*	0.0443**	0.0144	0.0394
	(0.0996)	(0.0784)	(0.0116)	(0.0207)	(0.0095)	(0.0199)
sex_ratio (1)†	-0.1805	-0.3016**	-0.0249	-0.0860**	-0.0146	-0.0792**
	(0.1514)	(0.1319)	(0.0205)	(0.0376)	(0.0165)	(0.0362)
age_difference	-0.7664*	0.0895	-0.1021*	0.0255	-0.0849**	0.04223
	(0.4028)	(0.3157)	(0.0536)	(0.0900)	(0.0436)	(0.0867)
Constant	-1.1604***	-0.2353				
	(0.3789)	(0.3522)				
Correlation coefficient	0.3080***					
	(0.0500)					
Likelihood ratio test	34.2296					
	(0.0000)					
Log likelihood	-1852.2106					
McFadden R squared	0.1432	0.1253				

Notes: *** denotes significance at the 1% level
            ** denotes significance at the 5% level
            * denotes significance at the 10% level;
            f indicates that the variable is omitted from the regression
Base categories for the age for males and females are age18_24_m and age18_24_f respectively

When the sex ratio and the age difference, each significant when introduced on their own in the male regression model, are both introduced in the latter, the sex ratio is no longer statistically significant and the negative impact of the age difference reduces in magnitude. A closer examination of the data reveals that there is a positive correlation (0.52) between the sex ratio and the age difference variable. This is not surprising as the sex ratio is defined as the number of males whose age falls within the age category of the husband over the number of females whose age falls within the category of the wife. For females, only the sex ratio remains significant and does not change in magnitude compared to when it is introduced on its own, which might indicate that the sex ratio represents an impact that is different from the one it has on men.

The last variable to be introduced in the model is the mother-in-law's working status. On the whole, the impact of other variables remains unchanged in either the male or female regression models, although the impact of the male wage on female participation is now significant at the ten percent significance level. A 10% increase in the male wage, reduces the probability of a wife working by 0.5 percentage points with a larger impact of 0.8 percentage points conditional on her husband working. A test of equality of cross-wage effects, which was not conducted earlier as all of the effects were not statistically significant, reveals that the hypothesis of effects of partner's wage being equal and opposite in sign cannot be rejected (chi-square value of 1.60 at one degree of freedom).

Regarding the introduction of the mother-in-law's work status, it is found that a woman whose husband's mother worked when he was aged 14 is more likely to be in employment herself compared to women who have a mother-in-law who was not working. Having a mother-in-law that was working when her husband was aged 14 increases the probability that a woman is working by 7 percentage points on average and *ceteris paribus*. The impact is much smaller than the one obtained by Fernandez *et al* (2004) on US data but larger than

the one obtained by Kawagushi and Miyazaki (2009) using Japanese data. However, the variable does not seem to have an impact on male participation. As mentioned previously, male preferences can be one of the explanations underlying this result. Indeed, men who grew up with a working mother might have a greater propensity to accept women's employment. Furthermore, assortative mating stipulates that spouses are likely to share similar views and preferences. Freud (1927) cited in Fernandez *et al* (2004) predicts that men will probably marry women that are similar to their mothers. One possibility that is not mentioned by Fernandez *et al* (2004) is that men might have suffered from the fact that their mother was working and will therefore discourage their wife from doing. This hypothesis is not supported by the data. Finally, one last explanation for the impact of a mother-in-law's work behaviour on her daughter-in-law's labour supply can be that men with working mothers are used to housework and that this productivity makes it easier for their wives to join the labour market.

Table 2.5: Bivariate Probit Estimates (with mother-in-law working status)

	Male	Female	Marg(m)	Marg(f)	Cond(m)	Cond(f)
male_wage	1.2508***	-0.1892*	0.1696***	-0.0537*	0.1422***	-0.0809***
	(0.1373)	(0.1162)	(0.0199)	(0.0330)	(0.0174)	(0.0321)
female_wage	0.3903***	1.3531***	0.0529***	0.3806***	0.0204	0.3630***
	(0.1326)	(0.1199)	(0.0179)	(0.0428)	(0.0156)	(0.0327)
male_income	f	-0.2650***	f	-0.0753***	0.0071***	-0.0729***
		(0.0675)		(0.0192)	(0.0016)	(0.0186)
female_income	f	-1.1451***	f	-0.3253***	0.0251***	-0.3148***
		(0.1125)		(0.0325)	(0.0043)	(0.0316)
couple_income	-0.6390***	f	-0.0866***	f	-0.1062***	0.0148***
	(0.0607)		(0.0092)		(0.0090)	(0.0032)
age25_34_m	-0.2271	f	-0.0338	f	-0.0281	-0.0056
	(0.2123)		(0.0346)		(0.0292)	(0.0056)
age35_44_m	-0.3558	f	-0.0532	f	-0.0443	0.0088
	(0.2210)		(0.0366)		(0.0310)	(0.006)
age45more_m	-0.6517***	f	-0.0961***	f	-0.0801***	0.0158***
	(0.2075)		(0.0337)		(0.0290)	(0.0059)
age25_34_f	f	-0.1631	f	-0.0133	0.0028	-0.0464
		(0.1425)		(0.0410)	(0.0025)	(0.0420)
age35_44_f	f	-0.3983***	f	-0.1191***	0.0069**	-0.1158***
		(0.1498)		(0.0467)	(0.0029)	(0.0456)
age45more_f	f	-0.5515***	f	-0.1654***	0.0095***	-0.1610***
		(0.1422)		(0.0444)	(0.0030)	(0.0434)
male_unemploymenr	-4.7193***	f	-0.6399***	f	-0.5247***	0.1090***
	(1.4880)		(0.2005)		(0.1655)	(0.0399)
female_unemployment	f	-1.9737	f	-0.2272	0.0372	-0.5462
		(2.4704)		(0.7162)	(0.0468)	(0.6836)
childlessthan5	0.2382**	-0.5025***	0.0290**	-0.1596***	0.0331***	-0.1619***
	(0.1229)	(0.0826)	(0.0133)	(0.0284)	(0.0095)	(0.0280)
child5to11	0.2837***	-0.0782	0.0352***	-0.0225	0.0382***	-0.0281
	(0.1013)	(0.0733)	(0.0117)	(0.0214)	(0.0090)	(0.0208)
childolderthan12	0.1640*	0.1675**	0.0208*	0.0457**	0.0136	0.0407**
	(0.0991)	(0.0785)	(0.0118)	(0.0206)	(0.0428)	(0.0198)
motherinlaw_work	0.0424	0.2680***	0.0058	0.0765***	0.0001	0.0731***
	(0.0806)	(0.0627)	(0.0110)	(0.0179)	(0.0090)	(0.0172)
motherinlaw_misc	-0.0675	0.0646	-0.0095	0.0180	-0.0090	0.0189
	(0.1365)	(0.1098)	(0.0201)	(0.0298)	(0.0167)	(0.0284)
Constant	-1.3911***	-0.8307*				
	(0.3515)	(0.2948)				
Correlation coefficient `	0.3185***					
	(0.0554)					
Likelihood ratio test	34.0872					
	(0.0000)					
Log likelihood	-1850.6218					
Mcfadden R	0.1413	0.1282				

Notes   *** denotes significance at the 1% level
         ** denotes significance at the 5% level
         * denotes significance at the 10% level
         f indicates the variable is omitted from the regression
         Base categories for the age for males and females are age18_24_m and age18_24_f
respectively, for the mother-in-law work status, the base category is: motherinlaw_not_work

7   Concluding Comments

This chapter has used a bivariate probit framework to model the labour market participation decisions of spouses in a couple adding further evidence to a relatively small research literature. Indeed, a number of methodological and theoretical issues complicate the modelling of participation decisions of couples. This chapter has purposefully overlooked the latter and focused on the estimation of an empirical specification. The latter has revealed interesting results. First, it is found that the labour market participation decisions of spouses are interlinked, whereas their hours of work do not seem to be (see chapter one). The traditional determinants of labour supply namely own wage and non-labour income remain important determinants of employment decisions for both gender groups. This framework allows for a testing of the equality of wage effects. The difference in the impacts of male and female wages on male and female participation is not statistically different from zero. As in the case of hours of work, wage effects do not seem to depend on the definition of non-labour income used. However, the unitary model does not seem to provide a fully satisfactory framework of analysis for labour market participation as one of its restrictions (income pooling) does not hold for females. In contrast to the findings in chapter one, the sex ratio is found to have an impact on male and female participation when introduced on its own. However, it is not clear whether the latter can be interpreted as a proxy for bargaining as it impacts on both male and female participation in the same way. Age difference is found to impact on male participation, however, as in the case of sex ratios, it needs to impact on both labour supplies to be considered an appropriate distribution factor.

In the second part of the analysis, one further variable, the mother-in-law working status when the husband was aged 14 is introduced to the model of a couple's labour supply. It is found to negatively impact on wives' participation suggesting that "cultural" parameters

also play a role in explaining behaviour. This result demonstrates that bargaining is not the only issue missing from traditional studies of labour supply behaviour. The related issue of cultural preferences is also likely to play a role in the determination of behaviour. This aspect is the subject of the study of the third chapter of the thesis.

Chapter 3

Gender-role attitudes and labour market behaviour of British couples

1 Introduction

A key finding of the last chapter was that a wife's decision to work is influenced by the employment status of her husband's mother when he was 14 years old. As stated in chapter two, Fernandez *et al* (2004) argue that one possible explanation for this result is that men, whose mothers worked when they were young, might have developed preferences concerning gender roles that make them more likely to have a working wife.

Attitudes, beliefs and social norms are not normally accounted for in economic models as they are "considered to be rather 'fuzzy' variables, whose existence is often recognized but rarely quantified" (Fernandez *et al* (2004), p.1296). There exists, however, an important literature on gender roles in sociology. This chapter's aim is to explore whether including variables that capture an individual's beliefs on the appropriate role of women in the labour

market in a standard neoclassical model of labour supply enriches our understanding of the mechanisms governing a couple's labour market behaviour.

This chapter addresses two research questions. First, an attempt is made to identify the main determinants of attitudes of husbands and wives towards a woman's role in the labour market in Great Britain. This is done using a bivariate ordered probit model, which has rarely been applied in the empirical literature and certainly not in the current context. In doing so, measures of spousal attitudes are constructed. They are then introduced into the basic bivariate probit model used in the last chapter in order to address the second, and primary, research question, which is to assess the extent to which a husband's and wife's attitudes towards a woman's role in the labour market influence a couple's labour market participation behaviour.

2 Background

An analysis of attitudes towards gender roles cannot be complete without a definition of the term "gender roles", as well as a brief history of gender roles in the home and the labour market and the current challenges in this area. These topics have been treated by many disciplines and cannot possibly be done justice in just one thesis chapter. However, a concise review of the various issues provides a necessary background within which to address the research questions posed in this study.

2.1 A definition of gender roles

Differences between men and women have been addressed in several ways by academics from various disciplines. Research on what has been labelled "sex differences", that deals partly with anatomical, physiological and hormonal issues but also with differences in emotions, intellectual and cultural traits, has been conducted mainly by biologists,

sexologists, psychologists and anorthropologists (Lipman-Blumen and Tickamyer, 1975).

According to Holter (1970), another concept, "sex differentiation" has widely, but not

exclusively, been used in sociology to tackle women's position in society, the division of

labour and the difference in power between men and women, often referred to as "sex

stratification" in the literature. One aspect of differentiation concerns norms that govern

the behaviour of men and women and the concept of gender roles. As noted by Holter

(1970):

> A role is the sum of norms directed towards a person occupying a given
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> position. Sex roles, or gender roles, are those norms which are applied to a man
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> because he is a man and, or to a woman because she is a woman (p.54)

As pointed out by Lipman-Blumen and Tickamyer (1975), research on gender roles is

relatively recent but the latter term does not seem to have a unique definition. All of the

terms "sex", "sex role", "gender", "gender identity" and "gender role" have tended to be

used interchangeably in the literature but distinguishing among the latter can be useful.

Although it is clear that there exists more or less subtle differences of definition between all

the notions mentioned above, it is beyond the scope of this chapter, and probably of

economics itself, to look closely into this issue. The terms "gender roles" and "sex roles"

are used interchangeably in this chapter as done by Holter (1970) in the definition above.

The author also provides a further definition that is required for the present analysis. She

labels gender roles as "traditional" if they imply a high differentiation in roles of men and

women and "egalitarian" in the reverse situation. Moreover, Holter (1970) states: "the use

of the terms "traditional" and "egalitarian" is based on the fact that, for centuries, the roles

of men and women have been sharply segregated in the Western world" (p.58). Before

providing a brief summary of the evolution of gender roles, it is important to note that

even though this analysis and the literature in general tend to consider gender roles mainly

from the perspective of women, men also face challenges with respect to their role as father and husband (Scott *et al*, 1998).

In his article on the evolution of gender roles, Davis (1984) argues that in 'hunting and gathering societies', which have existed for almost all of human history; there was a basic division of labour by sex. Males went hunting and women gathered and prepared food and hunted smaller animals. Mothers could not leave their dwelling easily as they had to care for their progeny. Later on, in agrarian societies, most men and women's employment was compatible with their status of parent as they were working inside the home and on the land nearby. This was changed by the advent of the Industrial Revolution that made men leave the house to work in factories, shops and firms while their wives stayed at home to take care of the children and various domestic tasks. Men thus started to be less involved in domestic work and they became the link between their wives and the outside world. Men were "breadwinners" and women "homemakers", an arrangement, which is often referred to as "traditional". This organization of the household is disappearing in industrial countries and being replaced by what has been labelled the "egalitarian system".

According to Beck and Beck-Gernsheim (1995), there are five factors that have helped women free themselves from traditional tasks. First, women nowadays have a longer life expectancy which means that the amount of time dedicated to child rearing is now relatively shorter leaving room for other activities. Second, contraception and abortion have given women more control over their fertility. Third, increased individualization has reduced the duties of the nuclear family towards extended kin, neighbours and friends. Fourth, the increased divorce rate has increased female vulnerability and the need for independent sources of support. Finally, women have been increasingly encouraged to join the labour market when they have become the equal of men in terms of education.

Davis (1984) argues that the "egalitarian system" which is slowly replacing the "breadwinner model" is not free from problems. It has no normative guidelines so couples learn what to expect from each other through experience. Also, and more importantly, "although it brings the wife back into economic production, it does so outside the home and thus in a way incompatible with child raising" (p.413). The author acknowledges that while men as well as women face the incompatibility between work and childcare, it is the latter that have suffered most from it because they have been primarily responsible for domestic tasks in previous systems of division of labour.

There exists an important literature on the impact of a mother's employment on children. Goldscheider and Waite (1991) note that in the early 1960s, the notion that children of working mothers suffered from severe psychological problems was taught in courses on child development studies. Theories of "maternal deprivation" were however proved to be unfounded in later studies. As pointed out in Blau *et al* (2006), there are many factors other than a mother's employment that affect children's outcomes among which: family resources, children's own characters, the role played by their father in their education and the quality of their alternate care. Moreover, there are many parameters that define a child's welfare. However, Hochschild (1989) reveals that women who were interviewed for her book, *The Second Shift*, felt more responsible than their spouse for the home and their children even when he helped with housework. She adds "women felt torn between one sense of urgency and another, between the need to soothe a child's fear of being left at day care, and the need to show the boss she is "serious" at work" (p.8).

Hochschild (1989) also investigates another issue that is closely related to the emergence of the egalitarian household, which is that of housework. This area has been widely explored from both a sociology and economics perspective. As discussed by Harkness (2003), an important issue to consider is whether the change in gender roles in the labour market also

brought about a change in gender roles within households. Husbands of working wives may perform a larger share of the housework or time spent on the latter might have decreased by relying on purchased household help or time saving domestic appliances. A third possibility is that women nowadays carry a "double burden". The author investigates these issues for the United Kingdom and her results will be discussed in the next section. She refers to a further important issue to consider in examining male and female shares of housework which is their relative earnings, as the latter can be a proxy for their bargaining power. The issue of measuring power relations between spouses has been extensively debated in the first chapter, at least from an economics perspective. Even though gender roles and decision-making in the household are closely related issues with egalitarian spouses being more likely to have an equal say on matters related to the family (Scanzoni and Fox, 1980), it is beyond the scope of this chapter to unveil the complex mechanisms of this interaction. Only two specific aspects of the various issues mentioned above are addressed in the present analysis. First, the potential determinants of a couple's attitudes towards male and female roles in the workplace and in the home in Britain are examined. Then, the question of whether these attitudes influence labour market behaviour is subsequently addressed.

2.2 Gender roles in the United Kingdom

The incorporation of questions regarding gender roles in British surveys is not recent. While this chapter does not investigate whether there has been a change in British attitudes in the last half century, a quick overview of British attitudes towards female employment is nevertheless useful.[26] Dex (1988) reviews the main surveys that have looked at attitudes towards female employment in the last 50 years. Among the earlier ones, the author

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[26] For a discussion of attitude change in Great Britain see Scott (1999).

mentions the 1943 Social Survey that explored working women's opinions on female employment in order to evaluate how many women that had started working during the Second World War would remain employed after it. The majority of women then did not approve married women's employment irrespective of their age. She also refers to another survey, conducted in 1965, which investigated the potential of women as additional members of the workforce in a period of economic growth. The 1965 Government Social Survey; *A Survey of Women's Employment* by Hunt (1968), shows that the majority of women approved married women working if they have no children but considered that women with children ought to stay at home. There were differences of opinions between younger non-working women and older ones. Dex (1988) however argues that samples are not directly comparable. Even if there are indications that acceptance of married women's employment has grown between the 1940s and the 1970s, the author advises against making generalisations. In depth analysis and comparisons are possible for data from the 1980s. The *Women and Employment Survey* was conducted mainly in order to evaluate the impact of unemployment on women during recessions. Martin and Roberts (1984) cited in Dex (1988), reveal that a majority of women approved married women's employment but the latter was rarely considered a priority. Attitudes were found to depend on an individual's age, education and work status. Husbands were found to be more traditional than wives as 17% of the former agreed that a woman's place is in the home compared to 11% for the latter.

The *British Social Attitudes Survey* (BSA) is a further source of information on attitudes and was first started in 1983. It has been conducted every year since then and its yearly reports constitute an important source of information on attitudes of British people. Scott *et al* (1998) use data from the 1994 International Social Survey Programme to analyse British gender-role attitudes. While the belief that mothers with young children should be

housewives was commonly held, many also acknowledged the importance of female work as a means for their independence and a financial support to the household. Using the BSA, Crompton *et al* (2003) report that the percentage of men and women, who agree with the statement that a man's job is to earn money and a woman's job is to look after the home, has fallen from 26% and 21% respectively in 1994 to 20% and 15% respectively in 2002. They argue that while attitudes have continued to become more egalitarian in the 1990s, individuals state more traditional views as soon as they are interrogated about more specific scenarios. Indeed, Alwin *et al* (1992) state that while British women have tended to reject the traditional view of separate roles for women and men in the home and the marketplace, they have not fully accepted that their family will be happier if they work. The authors attribute this discrepancy to the "double shift" mentioned previously. In her study of housework division among British couples, Harkness (2003) confirms that women do suffer from a strain on their time. The author states that: "the assumption that children affect only women's time use remains largely true" (p.168). This often pushes women into part-time work or even into leaving the labour market.

3   Theoretical and Empirical Review

There are two different but closely related issues that need to be considered in order to address the two research questions examined in this chapter. This section starts by an overview of the theoretical and empirical research on gender-role attitudes. In the second part, a framework is developed to investigate the impact of gender-role attitudes on a couple's labour market participation.

3.1 Gender-role attitudes

An individual's attitude and opinion has been mainly explored in the psychology and sociology fields but their popularity as a subject of study has fluctuated over the years. There are a number of reasons why researchers have been uneasy about analysing attitudes. Some academics have questioned the reliability of opinion surveys and the usefulness of attitude scales. These criticisms were validated by studies that found mixed results regarding the question of whether there exists a link between attitudes and behaviour (Dex,1988).

Hakim (2003) provides further explanations of why social scientists have been "slow to recognize the importance of attitudes and values as causal factors in their own right" (p.339). These include the fact that sociologists tend to emphasize the role of social structural factors and have hesitated to seek alternative routes. Furthermore, attitudes are relatively "invisible" and can be "volatile". The author also highlights a crucial point in the study of attitudes that has often been overlooked in the literature. She cites Hofstede (1980; 1991), as the first researcher to have pointed out that approval/disapproval of general statements on public beliefs is not a reflection of choice and personal preferences. This distinction has been increasingly acknowledged in the sociological literature. Hakim (2003) states that many secondary analysts have overlooked this point in the study of gender roles, using general attitudes as proxies for personal preferences, which might explain why a number have failed to find a correlation between attitudes and behaviour.[27] She advocates the use of personal work orientations instead of public morality questions in the study of individual behaviour. However, the author approves the use of general gender-role attitudes to study the national trends and compare ideologies across countries (Hakim, 2000).

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[27] See Kraus (1995).

While the point of Hakim (2000; 2003) is legitimate, it does not reduce the significance of the current study. First, the weak relationship between gender-role attitudes and behaviour can be due to methodological failures as acknowledged by Hakim (2000). Second, for economists, the distinction between attitudes as reflecting a society's collective values or an individual preference can be seen as secondary since neither has been incorporated in economic models. Indeed, in her review of the academic research on attitudes, Dex (1988) notes that no reference to economics was made because the latter has not tackled this issue. Since there is no definite economic framework to analyse gender-role attitudes, this section attempts to provide an overview of the various theoretical considerations that could provide a background for the study of attitude formation. The analysis of gender-role formation in this chapter is largely empirical, therefore no specific or unique theoretical framework is outlined.

If gender-role attitudes are considered to proxy individual preferences, then economics cannot fully address the process of their formation. As stated by DiMaggio (1990): "If there is any field of study that economists are willing to relegate to sociology, it is the issue of tastes and their formation" (p.123). Kapteyn *et al* (1980) point to the fact that while some economists have acknowledged the variability of tastes for a long time most of them have tended to choose one of three approaches to deal with preferences. The first group of economists insist on the assumption that tastes are constant. The second adopts the pragmatic approach of leaving the study of preferences to other social sciences, and one last group acknowledges the variability of preferences and develops models to address this type of phenomenon.

One seminal paper by Stigler and Becker (1977) has often been quoted as evidence that tastes can be considered stable over time and do not vary from one individual to another. The authors show that this assumption is even consistent with cases that are usually seen as

contradicting it, such as addiction, tradition, advertising and fashion. They demonstrate that all of these situations can be explained by variations in prices and income. However, Becker (1996) himself has recently developed a new framework to account for the endogeneity of tastes in economic behaviour. The author acknowledges that: "a large number of choices in all societies depend very much on past experiences and social forces" (p.4). He incorporates both social capital and personal capital to an individual's utility. He discusses his new model in the context of addictions, habits and social norms. Indeed, the latter constitute another reason why tastes have not been tackled by economists as they cannot easily deal with the concept of interdependence (DiMaggio, 1990). They tend to assume that individual behaviour does not directly depend on the behaviour of others. This is why they generally ignore the importance of culture, norms and social structure (Becker and Murphy, 2000). In the case where gender-role attitudes are considered to represent social norms, as with preferences, economists do not have a framework for an analysis of the latter either. For all the reasons outlined above, this chapter does not attempt to provide a theoretical model to explain the formation of attitudes. However, a review of related concepts is discussed.

One useful theoretical model to approach the issue of gender is provided by Akerlof and Kranton (2000). The paper attempts to expand the understanding of economic outcomes by introducing the concept of identity to economic theory. In this framework, the individual's utility depends on their sense of self. With respect to gender for example, each individual in society is classified as "man" or "woman" and the fact they act accordingly contributes in defining their identity. Defying the prescribed behaviour results in anxiety and is equivalent to a loss of utility in the model. Related to the concept of identity is that of socialization. The latter is needed to understand the formation of an individual's beliefs. A compact and useful definition of socialization is found in Blau *et al* (2006): "Socialization

is the name given to the process by which the influence of family, friends, teachers and the media shapes an individual's attitudes and behaviour" (p.174). It is through socialization that individuals form their ideas of appropriate gender-role behaviour.

In a series of papers, Bisin and Verdier (1998, 2000, 2001) model the intergenerational transmission of cultural traits. Bisin and Verdier (2001) refer to two types of influences on children[28]: socialization by parents, called direct "vertical" socialization and socialization outside the family called "oblique" socialization. Cultural transmission is a mixture of both. Parents influence the traits acquired by their children and have specific preferences regarding the ones they transmit. In the case where the cultural traits that parents want their children to acquire are only present among a minority of the population, families will spend more resources in socialization. Also, parents are considered to be altruistic in the sense that they will transmit certain traits if they believe the latter will benefit their offspring. However, parents tend to want their children to inherit traits they prefer. Bisin and Verdier (2000) show that in their framework, homogamy in marriage is encouraged among cultural minorities, as couples with similar traits are more efficient at socialization and preserving particular ethnic and religious traits. While the modelling in this paper is undoubtedly innovative in economics, its empirical consequences are not clearly set out.

While the influence of parents is important in the determination of attitudes towards gender roles, variables from an individual's childhood are not the only potential factors that influence the latter. Cronkite (1977) provides a useful framework to analyse the determinants of an individual's attitudes. Her study focuses on couples. Three types of variables potentially influence attitude formation in the model she uses. First, male and female background characteristics shape male and female gender-role attitudes respectively. Second, socioeconomic factors of both spouses influence their own and their partner's

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[28] They attribute terminology to Cavalli-Sforza and Feldman (1981).

attitudes. Third, both husband and wife's attitudes are influenced by "family life-cycle stages". Finally, the model takes into account potential influences that the attitudes of the husband or wife can have on their partner's ones. The following section provides a discussion of all the potential variables that have been identified as influencing the formation of attitudes in the sociological literature.

Background characteristics:

There are a number of variables from an individual's background that can influence their view on gender roles. First, gender is highly likely to determine opinions on roles of men and women as the latter tend to be more conscious of inequality than the former.[29] Ethnicity can influence gender roles as ethnic minorities might socialize children differently than the majority of the population because they have particular traits they want to preserve as discussed by Bisin and Verdier (2000) in the model reviewed above. Ethnicity can also affect gender roles through situational factors such as racial discrimination that might affect employment and job security and thus, indirectly, beliefs about gender roles (Cronkite, 1977).[30]

Religion and religiosity are also likely to influence individual beliefs. Haller and Hoellinger (1994) refer to Weber's 1984 seminal work *The Protestant Ethic and the Spirit of Capitalism*, which discussed the influence of religion in a period of increasing capitalism on people's behaviour and ideology. The authors argue that Protestantism and Catholicism are based on different values. The former has tended to be "more individualistically minded from its beginnings" (p.93). They state that the religious legacy probably still has an impact on people nowadays even though they are generally more secular. Religiosity is a related factor

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[29] See Davis and Robinson (1991) for a review of theories on gender inequality.
[30] For a detailed analysis of the effect of ethnicity on gender roles in the United States see Ransford and Miller (1983).

that could affect gender roles as it indicates the intensity with which individuals practise their religion.

Education is a further variable that is likely to determine attitudes towards women's role in the labour market. According to Holter (1970), individuals with higher educational qualifications are likely to have more egalitarian views because "advanced education entails the indoctrination of democratic and humanistic values, and the examination of traditional beliefs that are not supported by scientific evidence" (p.65). The author also points out that education stresses intellectual capabilities on the one hand, and reduces the importance of emotional and physical attributes on which traditional sex segregation has been based.[31]

Vella (1994) looks at the reverse causality between the two variables. He argues that gender-role attitudes potentially affect decisions regarding human capital accumulation.

Finally, and more directly relevant to the notion of socialization, is the impact of childhood variables on gender-role attitudes. Parental attributes such as the working behaviour and education of an individual's mother and father are both likely to play an important role in the formation of their offspring's attitudes. Vanfossen (1977) states that educated and/or working mothers are likely to have access to more resources and benefit from a higher status which might affect their children's views on women's role. The power balance between parents can also affect their children's beliefs and even override the influence of other variables. If the father is the "boss", mother's education and employment status might then play a secondary role in the determination of their children's idea of sex roles.

Kiecolt and Acock (1988) point out the importance of taking into account family disruption, through death or divorce, in the analysis of attitudes towards gender roles. Another factor related to family structure is the presence of siblings. Vella (1994) states that

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[31] For a detailed analysis of the effect of education on gender roles in the United States see Schreiber (1978) and Kane (1995).

a larger family might lead to the "reinforcement of role model effects through the assignment of family tasks" (p.196). Related variables that might affect gender role are birth order and the gender of siblings (Tomeh, 1978).

One variable from an individual's childhood that is not family-related but that has been linked to the formation of gender-role attitudes is the city size the individual was resident in. In their analysis of the impact of city size on tolerance of sexual nonconformity, Stephan and McMullin (1982) refer to the sociological finding that people in cities tend to be more tolerant of abnormal behaviour. A person living in a city during their youth is therefore likely to have a more egalitarian gender-role attitude.

Socioeconomic characteristics:

This chapter's aim is to test the potential impact of attitudes on labour supply behaviour. According to Molm (1978), while this is a common assumption in the attitudes literature, it is not unlikely that working behaviour affects attitudes as well. Such an assumption, she states, would be consistent with the theory of cognitive dissonance developed by Festinger (1957) that posits that people change their attitudes to make them consistent with their behaviour. The reciprocity of effect between gender-role attitudes and labour market participation will be discussed in more detail later in the analysis. This section's aim is only to review variables related to employment, which are likely to affect attitudes.

Thornton *et al* (1983) posit that work experience is likely to affect female attitudes as it widens their interests outside the home. Cronkite (1977) discusses the potential effect of wives' earnings on men's attitudes. They are likely to welcome additional income to the household, but fear this might affect their bargaining power. Women might enjoy greater financial independence but might fear to upset their husbands. The potential impact of men's earnings on a couple's beliefs is that it renders a wife's work less necessary. Vanfossen (1977) sees social class as having a probable influence on sex-role attitudes.

Wives of blue-collar workers, because they are more likely to face more difficult conditions, might consider that a woman staying at home is fortunate.

Family lifecycle stages:

Age is likely to be an important determinant of attitudes towards gender roles. There are two different effects of age on attitudes. A lifecycle effect implies that individuals become more traditional with time which may be due to lifetime experiences or age itself. A cohort effect also leads to more traditional effects among older people but for different reasons. Indeed, older individuals may be more traditional than younger ones because they grew up in a more traditional environment (Crompton *et al*, 2003).[32]

A number of variables related to marriage have been associated with gender-role attitudes among which are marital status and marital duration. Davis and Robinson (1991) report that men and women who are married, use the experience of their spouse in order to formulate their gender-role attitudes. Finally, the number of children and their age is likely to influence an individual's attitude. Children might make their parents more traditional as the latter might suffer from the work/childcare conflict mentioned earlier in the chapter. On the other hand, Thornton *et al* (1983) suggest the opposite can happen if couples benefit from the wife's employment and do not find it harmful to their offspring.

Before looking at the way these various factors have been analysed in the literature, two further issues need to be addressed. First, Brooks and Bolzendhal (2004) mention that the reason research on gender roles has not continued to flourish in the 1980s is that it has been criticised for focusing solely on background determinants and not on the macro-level dimensions of gender. Recently, a number of studies have acknowledged the role played by various determinants external to the household and not exclusively relevant to one individual. Haller and Hoellinger (1994) look at the potential relationship between gender-

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[32] For an analysis of the relationship between age and family roles see Albrecht *et al* (1979).

role attitudes, on the one hand, and GNP per capita and employment rate, on the other. McRae (1999) indicates that high levels of male unemployment might increase support for traditional views of gender roles. Cross-country analysis has highlighted the potential relevance of the welfare state in the determination of attitudes (see Treas and Windmer (2003)). Second, as mentioned earlier, it is important to note that attitudes of spouses might be related. According to Holter (1970), if attitudes of spouses are positively correlated, this might reflect positive assortative mating, or indicate that one of the spouses has adapted to the other's attitudes.

As explained earlier, most of the research that has addressed the issue of gender-role formation is found in the sociological literature and a minority in economics. A review of the main studies that have analysed the determinants of gender-role attitudes is now conducted. Mason and Bumpass (1975) analyse the sex-role attitudes of ever-married American women under the age of 45 using a 1970 national probability sample. The data include responses to 17 statements that tackle various aspects of sex roles. An analysis of the correlation between various statements reveals that women do not tend to view all aspects of sex roles in the same way. Two attitudes scales are constructed. One reflects "core ideology" and the other "equal labor market rights". Each of these scales is then used as a dependent variable in a binary variable regression model. Age and education are both found to have an effect on attitudes with the latter having the strongest impact on both scales. Religiosity and race are also found to affect both measures of sex-role attitudes while age at marriage, marital status and number of children are not. This leads the authors to conclude that membership in groups with different ideologies contribute more to the formation of attitudes than most demographic variables.

Cronkite (1977) analyses both the determinants of what she calls "normative preferences for family roles" and their trends, using data from the Denver Income Maintenance

Experiment (years 1971 and 1972). The author applies confirmatory factor analysis to obtain three measures (or factors) of attitudes towards gender roles that represent internal differentiation (roles inside the home), external differentiation (roles outside the home) and cohesion (responsiveness to emotional needs). She then uses a simultaneous-equation model with the attitudes of husbands and wives as dependent variables. The model also allows for the potential impact of preferences of one spouse on the preferences of the other. Three models, corresponding to each measure of gender roles, are estimated using two-stages least squares. Ethnicity is found to significantly affect a man's view of roles inside the home with black men being more traditional than white. It is not found to affect male views on the other two dimensions and does not affect female attitudes either. Female earnings are found to render male beliefs more traditional in terms of internal differentiation but exert the opposite effect on external differentiation. The author states that this finding might be due to the fact that men are likely to resent the fact their working wives do less housework but welcome the additional income. Male earnings make their wives more traditional regarding external differentiation but do not affect the other two. Own earnings are not found to significantly affect attitudes for both men and women. Being more educated leads men to have less traditional beliefs in terms of internal differentiation but has the opposite effect on external differentiation. For a woman, being more educated impacts solely on her views on external differentiation causing her to be less traditional. Finally, the impact of an individual's belief on their partner's is found to be positive for both men and women regarding internal differentiation.

Thornton *et al* (1983) investigate a number of issues regarding sex-roles using a US sample of panel data from the July 1961 birth records of first, second and fourth born white children in the Detroit metropolitan area, the mothers of which are interviewed six times over an 18-years period. The authors look at the determinants of sex-role attitudes and

changes in the latter by estimating a series of regression models. The first one models a mother's 1962 sex-role attitude as a function of all the following variables: age, religion, church attendance, own and husband's education, work before marriage, work after marriage until 1962 and the number of children. The authors consider all of these variables to be exogenous, as they argue that most of the events they measure have occurred before the date at which responses to gender-role statements were collected. Results for this first model show that work experience after marriage and before 1962, and the number of children in 1962, both positively affect attitudes in 1962. While this result is expected for the first of the two variables, it is "contrary to expectations" (p.224) for the second. The authors rationalize this finding by saying that many of these women were probably in the process of raising families and felt a need for their husband's help. They cite the strong correlation between measures reflecting men's work and the number of children as providing further support for their hypothesis. Other variables are not found to be significant. Both religiosity and religious denomination become important between 1962 and 1977. The 1962 educational level of the husband is found to impact on his wife's attitudes in 1977.

Thornton *et al* (1983) also study the consequences of sex role attitudes by examining the impact of attitudes held in 1962 on behaviour in 1977 and more specifically education, labour force participation, religiosity, fertility and divorce. Attitudes in 1962 are found to positively impact on work experience after marriage until 1977, and negatively influence fertility in 1977. Finally, the authors examine intergenerational transmission of preferences by estimating separate regression models of attitudes of sons and daughters in 1980 on their mother's attitudes in 1977 and other parental characteristics in 1962 and 1977. Results reveal that attitudes are relatively persistent across generations suggesting that parental attitudes influence attitudes of their offspring.

Morgan and Walker (1983) investigate the determinants of gender-role attitudes using a stratified national probability sample of American adult women from 1975. They aggregate answers to five questions regarding opinions on female and male roles in the labour market into a single continuous variable. The authors use regression analysis to evaluate the impact on women's opinions regarding gender roles, of three categories of variables: labour market opportunities, marital and age characteristics and feelings of competence. Labour market opportunities include current employment status, occupation and education. Marital and age characteristics include marital status, number of children and family income. The third category is actually one variable that aggregates answers to a set of questions on an individual's perceived aptitude to deal with certain situations. This measure is one of "feelings of personal competence". The authors find that women with higher levels of education, women who are currently employed and those with higher occupational status tend to have more liberal views of gender-roles. Age also influences attitudes as older women are found to be more traditional. The variation in both the number of children and the individual's marital status does not seem to explain as much of the variation in attitudes as other variables. The variable on "feelings of competence" is also found to affect opinions on gender roles as having low competence leads to more traditional views, on average and *ceteris paribus*. The authors conclude that even though their model does not fully uncover the mechanisms behind attitude formation (as the R-squared is found to be 0.266), their results show that women who are the most traditional tend to be those that have the least alternatives to staying at home.

Kiecolt and Acock (1988) evaluate the impact of a number of factors on gender-role beliefs with a particular interest in the effect of household type in adolescence. They investigate whether mother-headed households or families affected by divorce or death hold less traditional views on gender roles. They also analyse the impact of a mother's employment

when the individual was aged six, or 16, or both, on their attitudes. The research is conducted using pooled cross-sections from the NORC General Social Surveys from 1972 to 1986. Three types of beliefs are investigated: attitudes towards women in politics, rejection of traditional gender roles and finally; attitudes towards married women's employment. A series of regressions, which have these different attitudes as dependent variables, are estimated separately for males and females.

Findings regarding attitudes towards married women's employment reveal that for both men and women, an increase in age leads to more traditional views while an increase in education leads to less traditional ones. Mother's education has a positive impact on both male and female views regarding this type of belief while mother's employment has no effect. With respect to family structure, the death of a mother leads men to be less traditional in their views of working women, but has no effect on women. Finally, regarding rejection of traditional roles by men, results reveal that only education is significant and positively affects the latter. The same result holds for women. Age is not found to affect this type of belief for men. On the other hand, women become more traditional in this respect as they become older. Mother's employment and education are found to increase a woman's rejection of traditional roles but do not affect a man's. Family structure, on the other hand, is found not to be significant for both men and women.

Dex (1988) uses factor analysis on various sex-roles statements from the Women and Employment Survey to explore what she calls "women's orientations to Employment and the Home". Eleven factors are found to represent various dimensions of a woman's role inside and outside the home and four of these are singled out to construct attitude scales. The four final measures of gender-role atttitudes are personal involvement in work and home, traditional attitudes to gender roles, independence attitudes and financial constraint.

The first three are used as dependent variables in a series of OLS regressions estimated for three samples: childless women, women with children, and all women.

Results for the personal involvement scale show that older women are happier with the idea of staying home than younger ones *ceteris paribus*. The same "perhaps (an) unexpected" (p.101) result holds for more qualified women. However, higher potential earnings and working at the time of the survey both reduced involvement in the home, *ceteris paribus*. Having a young child was found to increase involvement in the home, *ceteris paribus*. The mother's employment status when the respondent was a child is only found to be statistically significant in the sample of childless women. Regarding the traditional attitudes to gender roles scale, results reveal that once again, older women are found to be more traditional than younger ones but unlike the previous scale, educated women are found to be less traditional. The mother's work behaviour, which was not found to affect the personal involvement scale, does impact negatively on traditional attitudes. The last measure studied is the independence scale. Results show that women with higher potential earnings and those with a higher level of education valued independence more. The reverse was found for older women and those women with young children. Family income was found to have the strongest effect on this measure of attitudes compared to all other variables.

Haller and Hoellinger (1994) investigate the determinants of attitudes towards female employment both at the country and at the individual level, using data from the 1988 International Social Survey Programme. Their sample includes Austria, the United States of America, West Germany, Ireland, the Netherlands, Italy and Great Britain. Factor analysis is applied on a series of statements on gender roles. Results show that the latter can be grouped into three dimensions. The first one includes statements that tackle the consequences of women's work. The second dimension refers to women's contribution to

household income, women's independence through employment and family happiness if women work. Finally, the third dimension includes norms towards gender roles. Further investigation revealed that the first and third sets of statements are highly correlated. Therefore, the six statements included in the two dimensions are compounded into a single scale under the label of "gender role attitudes". The items in the second factor are not aggregated and only the statement on the contribution of both spouses to household income is explored in detail.

Three regression models are estimated for each of these measures. The first is based on the whole sample and includes gender, age, education, religious denomination and attendance at religious services as explanatory variables. Findings reveal that women are more egalitarian than men with respect to both the attitudes towards gender roles measure and the attitudes towards double income measure. The second regression model is based on a sample of married females under the age of 60 and adds measures of household income and employment status as explanatory variables. The latter are found to significantly affect both gender role attitudes and attitudes towards double income. A high household income leads to more egalitarian gender-role attitudes but lower approval of the statement that both spouses should contribute to household income. Women's employment makes women more egalitarian for both dimensions. The third regression model is estimated using a sample of employed married women under the age of 60. Instead of household income and employment status, it includes personal income as an explanatory variable. The latter is a significant determinant of both attitude measures.

Finally, in the last part of the analysis, Haller and Hollinger (1994) examine the correlation between attitudes towards gender roles and a series of macro-economic indicators. All but one of the latter are found to be strongly correlated to the gender-role attitude measure. The percentage of Protestants, the GNP per capita and the percentage of the labour force

in the service sector are positively correlated with egalitarianism. The percentage of respondents with close family is negatively correlated to egalitarian attitudes while employment rate of women aged 30 to 44 is not linked to beliefs on gender roles.

The discussion above shows that there are various ways to define gender-role attitudes towards the labour market. Some studies have developed indices of attitudes while others have used separately answers to one or more statements on gender roles. There are also many determinants for the latter: parental characteristics, age, education, family composition, socioeconomic conditions and structural factors. A few studies cited above have failed to acknowledge that the same processes might simultaneously determine attitudes and some of its determinants. This is likely to bias their results. Others have used variables for concepts that are themselves hard to define (e.g; political orientation, feelings of competence). Before discussing the methodology to be used in this chapter to model gender-role attitudes, an overview of the theoretical and empirical literature linking attitudes to labour force behaviour is conducted.

3.2   Gender-role attitudes and labour force participation

Fernandez *et al* (2004) argue that economists tend to be cautious when it comes to introducing a concept such as culture as a parameter in their models largely because they consider it unscientific, both at the theoretical and empirical level, to explain variation in outcomes with differences in beliefs or preferences. Fernandez and Fogli (2009) state that "culture is rather a hazy concept that lends itself to many alternative definitions" (p.147) and argue that it is a challenge to separate cultural influences from economical and

institutional ones. Despite all this, the last decade has seen the publication of a number of papers on the effect of beliefs, attitudes and culture on economic outcomes.[33]

A number of more or less recent studies in economics have addressed the issue of labour force participation and culture at the country level often using information on immigrants to proxy for the latter (See for example Antecol (2000) and Fernandez (2007)). Much less frequently, articles have used attitudes to model the effect of culture at the individual level. The problem of studying gender-role attitudes and labour market behaviour is that it is extremely likely that the causality between the two factors runs both ways. Sociologists have acknowledged this reciprocal relationship and empirical studies tend to focus either on how employment determines attitudes or how attitudes determine employment. One way to avoid the problem of causation is to use variables on one outcome that predate the occurrence of the other.

Another strategy, which is adopted by this chapter, is to follow the work of Levine (1993). The theoretical framework of which is a "straightforward extension of past labor supplies studies" (p.667). The author focuses on women and models the decision to work as a function of the difference between wages and reservation wages (standard labour supply model). However, the paper is innovative in its attempt to extend the neoclassical framework by modelling the taste variable using opinions about sex roles. As discussed earlier, attitudes might represent approval of norms and not personal preferences. However, this does not change the prediction of the model as both will probably affect utility and behaviour. The argument of sociologists relates to the fact that personal attitudes will affect behaviour more than public ones. The paper by Levine (1993) ends with the following agenda for future research that has been pursued in the first part of this chapter:

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[33] See Fernandez and Fogli (2009) for an overview of studies outside the topic of labour force participation.

> If further analyses support this paper's finding that attitudes help predict which women work in a cross section, we still need to understand the determinants of attitudes (…) Finding appropriate instrumental variables-(…)- is an essential part of this research program. (p.677)

Levine (1993) extends the neoclassical model by incorporating a measure of opinions on gender roles in an individual's utility function. He then uses American data from the 1972-1986 General Social Survey to test whether female decision to work is affected by their opinions on gender roles in any given year and whether the rise in labour force participation is partly explained by a change in attitudes. The author restricts his analysis to urban married women with husband present and uses responses to six questions regarding the female role. None of the statements illustrates exactly the effect the author wants to measure. Six variables representing six measures of attitudes are created and no index is constructed. The statements are the following: 'Is it desirable that a male (female) child acts like a boy (girl)'; 'If your party nominated a woman for president, would you vote for her if she were qualified for the job'; 'A woman should be able to have an abortion for any reason'; 'A woman should be able to have an abortion in case of rape'; 'Do you approve or disapprove of a married woman earning money in business or industry if she has a husband capable of supporting her' and finally 'women should take care of running their homes and leave running the country to men'. The potential endogeneity of the responses is acknowledged but there are no instruments to capture the independent effect of attitudes on behaviour.

Vella (1994) uses data from the 1985 Australian Longitudinal Survey to investigate the determinants' of attitudes towards gender roles among individuals aged 16 to 25 years old and their impact on labour market choices. In doing so, the relationship between education and beliefs regarding women's role is investigated. Attitudes can influence the level of education an individual wants to achieve. On the other hand, education itself might

influence attitudes. The author starts by modelling both the demand for education and the formation of attitudes. The model allows for the potential endogeneity of attitudes in the determination of human capital investment. An index of gender-role attitudes is obtained by aggregating an individual's responses to seven statements. Separate regressions are estimated for males and females. The females' regression yields an R-squared of 0.076 while the male one has an R-squared of 0.049. This suggests the model is more suited (albeit marginally) to explain variation in female attitudes rather than male ones. Results show that individuals whose parents are university-educated are more likely to be modern in their opinions on sex-role attitudes. This result also holds for individuals who had a working mother when they were aged 14. On the other hand, having one additional sibling, results in more traditional beliefs. Religion also plays a role in the determination of attitudes as Islam is found to result in more traditional views. Being in a government school influences negatively male attitudes but has no impact on female ones. Finally, attitudes also show some regional variation. A further important finding is that opinions are weakly exogenous to the educational process. With respect to the relationship between beliefs and labour market behaviour, attitudes are found to negatively impact on female hours of work and to be weakly exogenous to the latter. However, they are found not to affect male labour supply. The author then evaluates the impact of attitudes in 1985 on women's hours of work in 1988 and finds similar results with the magnitude of the attitude effect having fallen slightly while that of education increased.

Fortin (2005) uses data from the World Value Surveys (1990, 1995 and 1999) to look at the impact of various types of variables on a woman's decision to participate in the labour market in 25 OECD countries. One type relates to gender-role attitudes, the second type concerns work values and the third addresses issues of leadership and religiosity. Regarding gender role attitudes, the author investigates opinions about several statements. Two of

them concern women's traditional role, the first is: "Being a housewife is just as fulfilling as working for pay", and the second, only available in the last wave, is: "Both the husband and wife should contribute to household income". The third statement concerns women's inner-conflict, "a working mother can establish just as warm and secure a relationship as a mother who does not work" and the last one deals with anti-egalitarian thoughts: " when jobs are scarce, men should have more right to a job than women". In the first instance, the author models the probability of being employed as a function of the various variables mentioned above for men, women and immigrant women. Gender roles are introduced as binary independent variables that equal one in the case of agreement with the statement and zero otherwise. Results show that having traditional opinions on gender roles decreases a woman's probability of working. Gender roles do not seem to affect men's decisions to work. Finally, the second part of her research investigates whether the difference in labour force participation rates across countries can be explained by differences in norms and studies, for every country, the effect of gender norms and work values on the gender pay gap.

Farre and Vella (2007) analyse the intergenerational transmission of attitudes concerning women's role and investigate whether these attitudes impact on subsequent work behaviour. They use different years from the 1979 National Longitudinal Survey of Youth dataset and the Children and Young Adults of the National Longitudinal Survey of Youth. An index of attitudes is constructed by summing the responses to seven statements concerning sex roles. Regression analysis is then used to investigate the relationship between the opinions of children in 2002 (aged 15 to 22) and their mothers' attitudes in 2004. Mothers' attitudes are found to positively impact on their children's ones and is one of the strongest determinant of the latter. Other variables that also affect attitudes are: the education level of both parents and the presence of siblings.

In order to look at the relationship between labour market participation and attitudes, the authors examine the effect of the 1979 attitudes of female respondents on their labour supply in 2004 and the effect of 1979 male respondents' attitudes on the working behaviour of their partners in 2003. The authors test for the exogeneity of the attitudes' measure and find that they need to instrument the latter. In the first set of regressions, 1979 characteristics along with attitudes are used to predict behaviour. In the second set, characteristics in 2004 are added to the regression. Results show, for the female sample, that an increase in the attitude measure by one standard deviation, increases the probability of working by 15 percentage points.[34] The effect of an increase in males' attitudes on their partners' work probability is found to be similar in magnitude.

Albrecht *et al* (2000) analyse the impact of attitudes on both earnings functions and the decision to work full-time for seven European countries (including Great Britain) and the USA. The data come from the 1988 International Social Survey Project. Individuals are asked whether a woman should work part-time, full-time or not at all in three different situations: (i) after getting married and before having children, (ii) in the presence of preschool children, and finally (iii) in the presence of school age children. The authors start by analysing the responses to this question by country and gender. Descriptive statistics for Great Britain reveal that 90% of women and 87% of men approve full-time work before there are any children. These proportions are reduced to 3% and 2% respectively in the presence of preschool children and 17% and 13% respectively in the presence of school age children. Regarding part-time work, both 10% of men and women approve it before there are any children, 35% of women and 27% of men approve it in the presence of preschool children and finally 76% of women and 75% of men approve it in the presence

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[34] The magnitude of this increase is too large to be empirically meaningful.

of school age children. The last set of statistics corresponds to the proportion of individuals who opt for women to stay at home. In the case where there are no children, the proportions equal 1% for women and 3% for men. These estimates increase to 62% and 71% respectively in the presence of preschool children and drop again to 7% and 12% respectively in the presence of school age children.

Albrecht *et al* (2000) then estimate earnings functions for full-time employees aged between 25 and 54 years old and find that attitudes towards gender roles do not influence wages. The authors mention that this might be due to collinearity between attitudes and education or potential experience. In the last part of the paper, they study the impact of attitudes on the probability of working full-time for individuals aged between 25 and 54 years old. They estimate separate models for males and females. The base model for both includes schooling, experience quadratic and marital status. Three variables are then added in the female regression model, which are: household size, a dummy variable indicating if the woman's mother worked and a dummy variable representing attitudes for if the woman approved full-time employment in the presence of children (of any age). The attitude variable is found to be significant and has a positive impact on female labour market participation. In other words, women who approve full-time work in the presence of children are more likely to be working full-time.

Berrington *et al* (2008) apply graphical chain modelling to panel data from the BHPS from 1991 to 1997 in order to look at the relationship between gender role attitudes of women aged between 16 and 39 years old in 1991 and their behaviour. The reason for this particular sample choice is that the authors start with a sample of childless women who are likely to have children in the next six years in order to analyse the impact of fertility and change in employment on attitudes. Factor analysis is used to study the correlation matrix of six attitudinal statements displayed in table 3.1 below and numbered from (1) to (6). One

factor is deemed enough to represent them all, therefore a single measure of attitudes is constructed by summing the responses to the six statements. The analysis is conducted as follows. First, background variables including age, marital status, education, income, mother's employment status and father's social class in youth, are used as explanatory variables in a linear regression modelling attitudes in 1991. Age is found to have a significant negative impact on attitudes with older women being less egalitarian than younger ones. A higher education level or having a mother who worked when the respondent was aged 14 both lead to more egalitarian attitudes. The second step consists in exploring the potential relationship between attitudes in 1991 and changing labour market activity and/or parenthood status between 1991 and 1993. An ordinal variable representing a change in either economic activity and/or parenthood during this period is constructed and comprises of the following categories: no change (or increased hours of work), new parent and no change in economic activity, new parent and decrease in economic activity and no change in parenthood and decrease in economic activity. This variable is then used as a dependent variable in a multinomial logistic regression. The explanatory variables are both the 1991 attitude measure and the background variables. Results reveal that for married women who were in their teens or early twenties in 1991, the probability of becoming a parent does not vary across attitude scores. Among women aged between 23 and 29 in 1991, a third of those who have an attitude score of 17.5 are predicted to become mothers while the proportion decreases to a fifth for those with a score of 24.5. In other words, having more traditional attitudes increases the probability of becoming a parent in this age range. Furthermore, in the case where a woman becomes a mother, more traditional attitudes make her reduce her hours of work or leave the labour market. The analysis is replicated for the period from 1993 to 1995 and 1995 to 1997 but attitudes are not found to be statistically significant predictors of attitude change then.

The survey above has reviewed economic studies that have explored the relationship between gender-role attitudes and employment. It is important to mention that there are a number of sociological studies that have looked at this relationship as well. Smith (1985) finds a significant impact of a wife's employment status on her husband's attitudes towards gender roles. Spitze and Waite (1981) investigate the effect of a husband's perceived attitude towards gender roles on his wife's wok behaviour and find that a husband's attitudes change in the early years of marriage to adapt to their wife's. In addition, a husband's own family experience seems to determine his attitudes (as perceived by his wife).

As demonstrated in the review above, there are a number of issues to consider when analysing gender-role attitudes. First, there is no agreement on a single measure of attitudes. A decision has to be made on whether to use one or more statements and the latter need to be selected. Second, studies that have modelled attitudes have used different variables to explain the formation of gender roles. Determinants of attitudes include parental background, demographic variables and human capital variables among others. Some studies have also used attitudes from previous years to predict current ones. Drawing on findings from both sociology and economics, the next section describes the variables to be used in the analysis paying a particular attention to the selection of the attitude variable.

4 Data

In this section, a description of the variables to be used in the empirical analysis is undertaken before looking at the main descriptive statistics of the sample.

4.1 A measure of attitudes towards gender roles

Every other year, the BHPS collects data on a respondent's attitude regarding various aspects of gender roles with a focus on the position of women in the labour market. This is done by asking respondents to "strongly agree", "agree", "neither agree nor disagree", "disagree" or "strongly disagree" with a series of nine statements. Six of them can be grouped into three types of attitudes as done by Scott *et al* (1996). The remaining three do not correspond to those categories and are classified as "miscellaneous". In selecting a measure of attitudes towards women's role in the labour market to be used in the analysis, a choice has to be made between constructing an index of the various statements reported in table 3.1 below, and selecting one statement that can be seen as representative enough of a traditional ideology of gender roles. As described in the literature review above, studies of opinions regarding gender roles vary in the way they measure the latter and in the aspects they emphasize.

The development of aggregate measures of gender roles in the literature has been a topic of research in its own right in both the psychology and sociology disciplines.[35] The latter often are not confined to roles in the labour market and the home, and tackle various issues. As discussed in the literature review, studies have used different ways to measure gender roles. Some have used a series of statements aggregated into one or more indices either by simple summation or using factor analysis. This is not done in this study for the following reasons. First, there are a number of disadvantages to using an index of attitudes. Summing responses to questions can lead to numerical structures that might not be appropriate. Moreover, merely adding statements is equivalent to assuming each question carries the same weight (Vella, 1994). Investigating the responses to the various questions in the data available, contradictions are sometimes found whereby one individual will have a traditional

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[35] See McHugh and Frieze (1997).

view on one question and a non-traditional one on a question with a very similar meaning. This may undermine the accuracy of an index of attitudes. For similar reasons, factor analysis is not used in this chapter. A decision is made to select one statement that reflects the ideology on women's role in the labour market.

There are a few issues to consider before making a judgement regarding the most suitable statement to use in order to measure attitudes towards gender roles in the labour market. As mentioned by Alwin *et al* (1992), it seems important to distinguish between the "acceptability of a woman working outside the home" and "the perceptions of the possible consequences of her doing so" as women in Britain have become more egalitarian in their views with time, but have not joined the labour market unconditionally because of the potential "double shift" they would face. This issue is closely related to the presence of children, as they are the ones who require their mother's presence most. Since there are no adequate instruments to address the issue of endogeneity of fertility, it would be preferable to choose a question that does not belong to the category that explores the consequences of female work. Moreover, the statement chosen needs to be clear about the aspect it covers. Berrington *et al* (2008) pinpoint a few issues related to the use of statements that measure attitudes. First, some questions can have more than one interpretation or are not specific enough. Particularly regarding the issue of work and children, it seems important to specify whether it is full-time or part-time work that is implied in the question. The use of words such as "husbands" and "wives" also can be misleading among a population that has seen a major increase in cohabitation rather than marriage. Wilkie (1993) mentions the importance of distinguishing between approval of women's work to earn money for "extras" or to support the family.

The statement chosen is "Husband should earn, wife stay at home". The latter seems the least likely to be determined jointly with fertility decisions and the presence of young

children. Furthermore, it has been labelled as: "perhaps the most unambiguous statement" (p.30), by Scott *et al* (1998).

Table 3.1: Classification of gender-role statements

Type of attitude	*Statement*
Consequences of women working	(1) A preschool child is likely to suffer if his or her mother works (2) All in all, family life suffers when the woman has a full-time job (3) A woman and her family would all be happier if she goes out to work
Gender ideology	(4) A husband's job is to earn money; a wife's job is to look after the home and family
Importance of work	(5) Both the husband and wife should contribute to household income (6) Having a full-time job is the best way for a woman to be an independent person
Miscellaneous	(7) Children need a father to be as closely involved in their upbringing as the mother (8) Employers should make special arrangements to help mothers combine jobs and childcare (9) A single parent can bring up children as well as a couple

In the BHPS, the answers to the questions regarding gender role attitudes use a Likert scale.[36] Respondents have a choice between five options. They can "strongly agree", "agree", "neither agree nor disagree", "disagree" or "strongly disagree" with the statement. Less than 2.5% of males and 1.5% of females strongly agree with the fact that a husband's role is to earn money and a wife's to take care of the home. A decision is made to merge the "(dis)agree"/ "strongly (dis)agree" categories into one. Based on the discussion of gender roles earlier in the chapter, an individual is considered as traditional if they "strongly agree" or "agree" with the statement chosen. They are neutral if they reply "don't know" to the question and egalitarian if they "disagree" or "strongly disagree" with the statement.

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[36] It is a scale which measures the level of agreement with a statement and was named after the author who developed it: Likert (1932).

The final measure of attitudes is categorical with three outcomes. A nominal value is assigned to each category as described in table 3.2 below. Two separate variables male_attitude and female_attitude are created to represent male and female attitudes respectively.

As discussed earlier in the chapter, attitudes towards gender roles and labour market behaviour are likely to be jointly determined. Using the male and female attitude measures (male_attitude and female_attitude) as explanatory variables in a labour supply equation might result in unreliable estimates due to the endogeneity of attitudes to labour market participation. There are two ways to address this problem. Ideally, one can use lagged attitudes as a proxy for current ones. The latter would be exogenous as they pre-date labour market behaviour. Attitudes are not available in wave 12 but are in wave 11, which is equivalent to a two year gap with the dataset used in this chapter. Using wave 11 loses 20% of the original sample, which is deemed too much for the current application. The second solution, which is adopted in this chapter, is to use the regression model of attitudes based on current responses to predict a measure of attitudes. The availability of a number of potential instruments in the dataset is likely to be helpful in this task. As mentioned previously, this method is the one suggested by Levine (1993). As discussed in the theoretical section, there are different aspects that influence attitudes towards gender roles. The next paragraph describes the variables used to model attitudes in this chapter.

4.2   Potential determinants of attitude formation

Sociologists have tended to avoid addressing this issue, or have used variables that predate attitude measurement to minimize the problem. Economists on the other are not inclined to ignore the problem of endogeneity as they argue it can distort the estimated results from their models. This chapter does not pretend to address all of these issues. A choice is made

to minimize as much as possible the inclusion of variables that are likely to be affected by similar factors than attitudes.

As discussed previously, there are three types of variables related to an individual that potentially determine their gender-role attitudes in addition to macroeconomic factors. First, regarding background characteristics, the BHPS data include information on various aspects of an individual's childhood. Respondents are asked about the type of area they were living in at the age of 15. A series of dummy variables is constructed indicating whether the individual mainly lived in an inner city, a suburb, a town, a village, a rural location or moved around. In addition, individuals reveal if they were living with both their biological parents when aged 16, the reason if they were not, and whom they were living with in this case. A set of dummy variables indicating whether the respondent was living with both parents, one parent and one step-parent, only one parent or "other" is constructed.[37] One variable that is included in the model and that has not, to our knowledge, been used before, is the number of books available in the childhood home. The latter provides a good proxy for the effect of non-formal education on the development of gender-role attitudes.

Respondents also answer a number of questions on their parental background including their parents' age at the birth of the individual. This variable contains too many missing observations and is not used in the current analysis. More importantly, the data also include information on whether each parent was working when the individual was aged 14, their occupation, job position, social class, and educational level. Two of these measures are (i) retained: each parent's employment status and (ii) their educational level.[38]

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[37] While the cause for not living with both parents is also available in the data it was not found to be significant.

[38] Social class, occupation and job position are only available for parents who work and it is not clear how the other parents would be classified if those variables are used.

Background variables (other than childhood ones) also include age, education, ethnicity and religion. Although the latter has been identified as an important determinant of attitudes towards gender roles it cannot be included in the present analysis. Indeed, wave thirteen of the BHPS only includes religious denomination for respondents from Northern Ireland (which are excluded from the sample). Regarding other variables measuring religion, the data used in the analysis incorporate information on whether a respondent is a member of, or active in, a religious group. Moreover, wave 11 includes a variable on frequency of church attendance. The latter has been widely used in the analysis of attitude formation (see literature review). A decision is made not to incorporate these variables in the analysis as it is highly likely that similar factors affect both religious behaviour and attitude towards gender roles and there are insufficient instruments in the dataset to address this issue. Furthermore, data from wave 11 are not available for 20% of the sample (as noted earlier). Regarding education, as argued in Vella (1994), the latter can be endogenous to the process of attitude formation. However, full-time students have been excluded from the sample in all samples. In this analysis, a decision is made not to include individuals who are in further training at the time of the survey to minimize the potential issue of endogeneity. This concerns less than 1% of the sample. For the remainder of the sample, the "temporal ordering" of gender-role attitudes and education justifies the "one-way arrow" between the two variables (Molm, 1978, p.524). Educational qualification is included as a set of dummy variables. Finally, age is included as a quadratic in the model (see theoretical section) and ethnicity as a series of dummy variables denoting whether the individual is British White, White (other than British) or from another ethnicity.

The second and third types of variable that determine attitude formation are socioeconomic and family-cycle ones respectively. As discussed earlier, including these in an empirical model of attitude formation is a challenging one due to the interlinked nature

of the various processes determining attitudes and behaviour. Indeed, variables that determine attitudes towards a female role in the labour market are likely to determine participation in the labour market. In addition, while earnings are likely to affect attitudes, the causality is likely to run in both directions. Regarding socioeconomic variables, work experience is not included in the model, as the BHPS data do not include an explicit measure of it although as discussed in chapter one, it can be derived from the "lifetime employment history data" available from the previous wave. Age is taken to proxy for the latter. Non-labour income is introduced into the model and treated as exogenous (see first two chapters). While labour income in the year prior to the interview is available, the latter is not introduced to the regression model as this measure is not likely to vary much from year to year, and is therefore likely to be endogenous to the process of attitude formation. Education is taken to proxy the individual's wage offer. The third type of variable to be included is the age of children. While fertility behaviour, the presence of children, their age and attitude towards gender roles in the labour market are likely to be affected by similar factors, a decision is made to include dummy variables that indicate the presence of at least one child in each of three age categories. As discussed earlier, an attempt is made to minimize this potential problem through the selection of the attitude statement used for the analysis. No distinction is made between married and cohabitating couples as done throughout the thesis. Finally, female and male unemployment rates are included in the regression model to proxy for the impact of an important macro-economic indicator on attitudes. These latest variables also proxy for regional variation, which is not explicitly accounted for in the model. Before reviewing the methodology to be used in this chapter, the data are briefly discussed in the next section.

4.3 Descriptive statistics

Summary statistics for the various variables used in the analysis of attitude formation are reported in table 3.2 below. The variables in the participation equation are not reviewed here as a detailed description of those is found in chapter 2. A closer look at the data reveals a number of notable points. Less than 10% of couples are of a different ethnicity than "White British" and married men are on average two years older than their wives. Similar proportions of married men and women are found at the lowest and two highest educational categories. However, for the two middle categories men have a higher level of qualification than women. Regarding variables related to childhood, family type and area of residence and the number of siblings do not seem to display significant differences across gender. The same holds for parental education and work behaviour, although it is important to pinpoint that the proportion of fathers working is higher than that of mothers, which can be explained by the fact that previous generations did not record high participation among married women. One notable difference between males and females is the number of books reported to have been available in the childhood home. A higher proportion of women report that they had a lot of books, while more men than women, state that they had quite a few or not many books. This can be due to the fact that girls might notice books more than boys or the fact that the latter do not induce their parents to buy books as much as for their daughters.

Finally, mean male and female attitudes show that married women tend to be more egalitarian than married men. This difference is statistically significant as a t-test on the hypothesis that the latter is equal to zero yields a t statistic of -7 thus strongly rejecting the null hypothesis of the equality of means.

Table 3.2: Variable description

Variable type	Variable name	Description	Male	Female
Gender-role Attitude	male_attitude	Ordinal variable that equals 1, 2 or 3 if a male respectively agrees (traditional), neither agrees nor disagrees (neutral) or disagrees (egalitarian) with the statement: "husband should work, wife stay at home"	2.47	
	female_attitude	Ordinal variable that equals 1, 2 or 3 if a female respectively agrees (traditional), neither agrees nor disagrees (neutral) or disagrees (egalitarian) with the statement: "husband should work, wife stay at home"		2.58
Age	age	Continuous variable representing the individual's age in years.	43	41
	age_squared	Continuous variable obtained by squaring the age variable		
	educ0	Binary variable that equals 1 if the respondent has no qualification and 0 otherwise	0.12	0.13
	educ1	Binary variable that equals 1 if the respondent has o levels, a levels, cse grade 2-5 or commercial qualification and 0 otherwise	0.33	0.38
Education	educ2	Binary variable that equals 1 if the respondent has a nursing or teaching qualification, other higher qualification or apprenticeship 0 otherwise	0.38	0.32
	educ3	Binary variable that equals 1 if the respondent has a first degree and 0 otherwise	0.13	0.14
	educ4	Binary variable that equals 1 if the respondent has a higher degree and 0 otherwise	0.04	0.03
Ethnicity	white	Binary variable that equals 1 if the respondent is British, Irish, Welsh or Scottish white and 0 otherwise	0.94	0.95
	other_white	Binary variable that equals 1 if the respondent is white but not British and 0 otherwise	0.04	0.03
	other_ethnic	Binary variable that equals 1 if the respondent is not white and 0 otherwise	0.02	0.03
Number of books in childhood home	books_unknown	Binary variable that equals 1 if the respondent does not know how many books there were in his childhood home and 0 otherwise	0.01	0.01
	books_lot	Binary variable that equals 1 if there were lots of books in the childhood home and 0 otherwise	0.26	0.41
	books_few	Binary variable that equals 1 if there were quite a few books in the childhood home and 0 otherwise	0.38	0.34
	books_not	Binary variable that equals 1 if there were not many books in the childhood home and 0 otherwise	0.34	0.24

Table 3.2: (continued)

Variable Type	Variable name	Description	Male	Female
	inner_city	Binary variable that equals 1 if the individual was living in an inner city area when they were young and 0 otherwise	0.11	0.08
	suburb	Binary variable that equals 1 if the individual was living in an suburban area when they were young and 0 otherwise	0.24	0.24
Type of area of residence during childhood	town	Binary variable that equals 1 if the individual was living in a town when they were young and 0 otherwise	0.28	0.31
	village	Binary variable that equals 1 if the individual was living in a village when they were young and 0 otherwise	0.23	0.22
	rural	Binary variable that equals 1 if the individual was living in a rural area when they were young and 0 otherwise	0.10	0.10
	move	Binary variable that equals 1 if the individual moved around when they were young and 0 otherwise	0.05	0.05
	live_parents	Binary variable that equals 1 if the individual lived with both their biological/natural parents when aged 16 and 0 otherwise	0.8	0.8
	live_mother_stepfather	Binary variable that equals 1 if the individual lived with their mother and stepfather when aged 16 and 0 otherwise	0.05	0.05
Family type during childhood	live_father_stepmother	Binary variable that equals 1 if the individual lived with their father and stepmother when aged 16 and 0 otherwise	0.01	0.01
	live_mother_only	Binary variable that equals 1 if the individual lived with their mother only when aged 16 and 0 otherwise	0.07	0.07
	live_father_only	Binary variable that equals 1 if the individual lived with their father only when aged 16 and 0 otherwise	0.02	0.02
	live_other	Binary variable that equals 1 if the individual lived in foster care or "other" when aged 16 and 0 otherwise	0.03	0.04
	mother_no_educ	Binary variable that equals 1 if the respondent's mother left school without any qualification and 0 otherwise[*]	0.46	0.46
	mother_som_educ	Binary variable that equals 1 if the respondent's mother left school with some qualification and 0 otherwise	0.28	0.25
Mother's educational level	mother_further_educ	Binary variable that equals 1 if the respondent's mother left school with further qualification and 0 otherwise	0.14	0.17
	mother_uni_educ	Binary variable that equals 1 if the respondent's mother left school with university qualification and 0 otherwise	0.03	0.05
	mother_unknown_educ	Binary variable that equals 1 if the respondent does not know his mother's educational level and 0 otherwise	0.09	0.07

Table 3.2: (continued)

Variable type	Variable name	Description	Male	Female
Father's educational level	father_no_ educ	Binary variable that equals 1 if the respondent's father left school without any qualification and 0 otherwise[*]	0.42	0.38
	father_some_ educ	Binary variable that equals 1 if the respondent's father left school with some qualification and 0 otherwise	0.18	0.15
	father_further _educ	Binary variable that equals 1 if the respondent's father left school with further qualification and 0 otherwise	0.25	0.29
	father_uni_ educ	Binary variable that equals 1 if the respondent's father left school with university qualification and 0 otherwise	0.05	0.07
	father_unkno wn_educ	Binary variable that equals 1 if the respondent does not know his father's educational level and 0 otherwise	0.10	0.10
Mother's employment status	mother_not_ work	Binary variable that equals 1 if the respondent's mother was not working when they were aged 14 and 0 otherwise	0.39	0.35
	mother_work	Binary variable that equals 1 if the respondent's mother was working when they were aged 14 and 0 otherwise	0.53	0.57
	mother_work _misc	Binary variable that equals 1 if the individual does not know if their mother was working, if she was deceased or if data on this variable is missing and 0 otherwise	0.08	0.08
Father's employment status	father_not_ work	Binary variable that equals 1 if the respondent's father was not working when they were aged 14 and 0 otherwise	0.03	0.03
	father_work	Binary variable that equals 1 if the respondent's father was working when they were aged 14 and 0 otherwise	0.87	0.84
	father_work_ mis	Binary variable that equals 1 if the individual does not know if their father was working, if he was deceased or if data on this variable is missing and 0 otherwise	0.11	0.12
Number of siblings	siblings	Ordinal variable representing the number of siblings the respondent ever had.	2	2

Variable type	Variable name	Description	Male	Female
Unemployment rate	male_unemployment	Continuous variable. Constructed at the county level or unitary authority level, it equals the ratio of the number of unemployed males over the number of males in the labour force	0.06	0..06
	female_unemployment	Continuous variable. Constructed at the county level or unitary authority level, it equals the ratio of the number of unemployed females over the number of females in the labour force	0.04	0.04
Non-labour income	male_income	Continuous measure. Monthly male non-labour income obtained by dividing the yearly non-labour income of the previous wave by 12. It includes transfer, benefit, pension and investment income	1393 (4092)	1393 (4092)
	female_income	Continuous measure. Monthly female non-labour income obtained by dividing the yearly non-labour income of the previous wave by 12. It includes transfer, benefit, pension and investment income	892 (2440)	892 (2440)
	childlessthan5	Binary variable that is equal to 1 if there is at least one child aged between 0 and 4 in the household and 0 otherwise	0.19	0.19
Presence of children	child5to11	Binary variable that is equal to 1 if there is at least one child aged between 5 and 11 in the household and 0 otherwise	0.28	0.28
	childolderthan12	Binary variable that is equal to 1 if there is at least one child aged between 12 and 18 in the household and 0 otherwise	0.22	0.22
Sample Size			2590	2590

Notes: proportions in each type of variable do not always sum to 1 due to rounding errors

(*) mother_educ_no and father_educ_no also include individuals who never went to school. The latter are included in the same category as those that left school without qualification and they constitute less than one percent of individuals in each gender group

Based on data from the British Social Attitudes Survey, Crompton *et al* (2003) report that in 2002, 20% of men and 15% of women agreed with the statement that "a man's job is to earn money; a woman's job is to look after the home and family". These estimates can appear to be inconsistent with those computed from BHPS data in this study (see table 3.3 below). However, a closer examination of the data reveals that this discrepancy is merely due to the fact that the two sets of estimates are not from comparable samples. In Crompton *et al* (2003), reported statistics are based on a full sample while those of this study are computed from a sample of married couples. This is confirmed by the proportions computed from the whole sample of the BHPS, which yield values similar to those of the BSAS.

The common finding that women are more egalitarian in their attitude to the labour market than men is confirmed by the data. The Pearson's chi-square statistic of the independence of male and female attitudes measures is equal to 14 with 2 degrees of freedom implying that attitudes of male and female spouses in couples are not independent of one another.

Table 3.3: Distribution, by gender, of responses to the attitude statement: "Husband should work; wife stay at home"

	Males	Females
Traditional individual	11.9%	9%
Neutral individual	29.8%	25.4%
Egalitarian individual	58.3%	65.6%
Total	100%	100%

Notes: Sample size: 2590 couples
Pearson chi-square (2) = 14

Descriptive statistics on the relationship between spouses' employment and their attitudes are also analysed (see tables 3.4 (a) to (c) below). The majority of wives of traditional men do work. However, the proportion of wives working is the lowest among traditional males

compared to neutral or egalitarian ones. The sample of traditional women is equally split between those who work and those who don't, with the proportion of women working being the lowest among women with this type of attitude. The proportion of males working shows less variation across male and female attitude type. All of the Pearson chi-square tests of independence between work behaviour and attitudes reject the hypothesis of no correlation between the two variables.[39]

Cross tabulations of gender-role attitude and working behaviour

Tables 3.4 (a): Male attitude and female employment

	Female not working	Female working	Total
Traditional male	41.4%	58.6%	100%
Neutral male	30%	70%	100%
Egalitarian male	17.2%	82.8%	100%

Notes: Sample size: 2505 couples
               Pearson chi-square (2)=101

Tables 3.4 (b): Male attitude and male employment

	Male not working	Male working	Total
Traditional male	19.2%	80.8%	100%
Neutral male	13.2%	86.8%	100%
Egalitarian male	10.2%	89.8%	100%

Notes: Sample size: 2505 couples
               Pearson chi-square (2)= 20

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[39] See Conover (1999) for a description of the Chi-square test of goodness of fit.

Tables 3.4 (c): Female attitude and female employment

	Female not working	Female working	Total
Traditional female	50.7%	49.3%	100%
Neutral female	30.9%	69.1%	100%
Egalitarian female	17.7%	82.3%	100%

Notes: Sample size: 2505 couples
               Pearson chi-square (2)=137

Tables 3.4 (d): Female attitude and male employment

	Male not working	Male working	Total
Traditional female	15.4%	84.7%	100%
Neutral female	15.1%	84.9%	100%
Egalitarian female	10.6%	89.4%	100%

Notes: Sample size: 2505 couples
               Pearson chi-square (2)= 11

The next section describes the empirical model used to investigate the impact of the various factors mentioned on attitude formation, before exploring whether gender-role attitudes affect the labour market participation of a couple.

5 Econometric methodology

This chapter's research agenda is divided as follows. First, a model of couples' attitudes towards gender roles is developed and measures of a couple's attitudes towards gender roles are derived from the latter. Second, these measures are added then to the bivariate probit discussed in the last chapter in order to analyse the impact of a couple's gender-role attitudes on labour market participation.

As described in the data section, the measures of attitudes to be used in this chapter are ordinal in nature with three possible outcomes. Both husbands' and wives' attitudes are to

be modelled. Since it is likely that the two are determined simultaneously, a framework that models jointly the probabilities of husbands and wives' agreeing, disagreeing or being neutral towards the statement chosen is needed. A bivariate ordered probit model is used to this effect. Studies using this framework are rare in economics (see Butler and Chatterjee (1997)) and it has not, to our knowledge, been used to model a couple's attitudes before. The bivariate ordered probit model can be considered similar to a bivariate probit model where the number of categories of the dependent variables exceeds two (see Sajaia (2008) for further details). The model is derived from two latent variables y_m^* and y_f^* that represent male and female attitudes respectively. Assume that these variables are defined as follows:

$$y_{mi}^* = x_{mi}'\beta_m + \varepsilon_{mi} \qquad\qquad [5.1]$$

$$y_f^* = x_{fi}'\beta_f + \varepsilon_{fi} \qquad\qquad [5.2]$$

The general likelihood function for the ith couple is:

$$F(c_{mj} - x_m'\beta_m, c_{fj} - x_f'\beta_f, \rho) - F(c_{mj-1} - x_m'\beta_m, c_{fj-1} - x_f'\beta_f, \rho)$$

Where $F(.)$ is the bivariate normal distribution function operator; m and f denote male and female subscripts respectively and i represents individual observations.

ε_{mi} and ε_{fi} are error terms, β_m and β_f are parameters associated with vectors of explanatory variables x'_{mi} and x'_{fi} where neither include a one (i.e., the constant) in the vector of realizations for the variables. The above framework assumes the following: $E(x'_{mi}\varepsilon_{mi}) = 0$ and $E(x'_{fi}\varepsilon_{fi}) = 0$.

Only discrete realizations of the latent variables are observed. They are male and female aggregated responses to the statement on gender roles discussed above. They are discrete with three possible outcomes (agree, neither agree nor disagree and disagree).

The model is set up as follows:

$$y_{mi} = 1 \ \text{if} \ y_m^* \leq c_{m1} \qquad\qquad y_{fi} = 1 \ \text{if} \ y_f^* \leq c_{f1}$$

$$y_{mi} = 2 \ \text{if} \ c_{m1} < y_m^* \leq c_{m2} \qquad\qquad y_{fi} = 2 \ \text{if} \ c_{f1} < y_f^* \leq c_{f2}$$

$$y_{mi} = 3 \ \text{if} \ c_{m2} < y^*_m \qquad\qquad y_{fi} = 3 \ \text{if} \ c_{f2} < y^*_f$$

c_{m1} and c_{m2} represent the unknown cut-off points (or thresholds) in the male distribution

of attitudes while c_{f1} and c_{f2} represent the female ones. In order to identify the

parameters of the model, exclusion restrictions need to be satisfied.

In terms of attitudes' modelling, various specifications are estimated based on equations

[5.1] and [5.2]. The first specification (specification one) includes all the variables from an

individual's background, their age, introduced as a quadratic and their education level. As

discussed previously, all of these variables are likely to be exogenous to the determination

of attitudes. In the second specification (specification two), male and female non-labour

income levels are added to the model. Even if non-labour income is taken to be exogenous

in this analysis (see data section), it is likely that variables that determine the latter are

similar to those that determine attitudes, which is why it is important to verify the effect of

the introduction of income on the impact of background variables. The third specification

(specification three) introduces unemployment rates to the regression model in order to

look at the impact of an economic indicator on gender roles. This area of research is

relatively recent and the findings from this specification will hopefully contribute to enrich

the small empirical literature on the topic. In the fourth specification (specification four),

variables indicating the presence of children of all ages are added to the regression model.

While efforts have been made to bypass the endogeneity of fertility (see data section);

results for this latest specification need to be interpreted cautiously given the inclusion of

children variables clearly brings this into question.

While all the specifications estimated above did allow for a correlation in unobservables that determine male and female attitudes in couples, they did not incorporate a measure of male attitude in the female equation (or the reverse). Unlike in chapter two where the availability of instruments to identify both equations was limited (if not non-existent), the use of background variables in this chapter might provide adequate instruments to allow for identification. Therefore, the fifth (and last) specification introduces male attitudes into the female regression equation (specification five).

The set-up is then modified as follows:

$$y^*_{mi} = x'_{mi}\beta_m + \varepsilon_{mi} \qquad\qquad [5.3]$$

$$y^*_f = x'_{fi}\beta_f + \gamma_f y^*_m + \varepsilon_{fi} \qquad\qquad [5.4]$$

All the variables are specified as before and a new log likelihood function can be derived.[40]

A series of Wald tests are conducted on each of the specifications above. First, cross-equation tests are performed to determine whether the impact of each dependent variable is the same for males and females. Second, tests are performed to test for the equality of cut off points across gender.[41] In addition, a Pseudo R-squared measure is computed for each model.[42]

The methodology above addresses this chapter's first research question. The next section delineates the various steps needed to address the second one which attempts to investigate the impact of gender-role attitudes on the labour market participation of a couple.

The regression model established earlier is used to construct measures of attitudes. The reason for doing so is the endogeneity problem mentioned in the theoretical and data

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[40] Note that equations 5.1 and 5.2 are equivalent to 5.3 and 5.4 with the constraint that $\gamma^f = 0$.

[41] The Wald test in Stata investigates the hypothesis that the difference in estimated effects between two variables is zero. It is reported as a chi square statistic in large samples.

[42] Stata does not, to our knowledge, easily compute a constant only model in a bivariate ordered probit framework. Therefore, the constant only model is estimated as a single ordered probit model for males and females separately. The resulting R squared is unlikely to be altered by this approximation.

sections. Attitudes towards gender roles and labour market participation are likely to be correlated with each impacting on the other. A measure of attitudes that is not correlated with the errors from the participation equation is needed. Both specifications 4 and 5, that are used to obtain two separate attitude scores, contain identifying instruments and exogenous variables found in the participation equation. Only wages (included in the latter) are not added due to their endogeneity but it is assumed that education is a good proxy for the latter. Age and its quadratic are also included. Performing a formal test of exogeneity of attitudes to labour market behaviour is not straightforward in this setting as the pseudo-residuals from the ordered bivariate probit in Stata cannot, to our knowledge, be extracted easily. In order to obtain a measure of attitudes that is "purged" from the elements that correlate it with employment, a search for instruments that affect attitudes but do not affect labour market participation is undertaken. With respect to the husbands' equation, his mother's labour market behaviour and his ethnicity is found to impact on his beliefs but not on the probability that he works. With respect to the female equation, having a lot of books in childhood and ethnicity both affect attitudes but not the probability of being employed. Using specifications four and five in turn, two sets of predictions of the probabilities of being in each of the three categories are obtained for males and females. Each set of predictions is then aggregated into one measure of attitude for each gender group. The attitude scores are weighted averages with weights provided by the marginal probabilities using either the male or female bivariate ordered probit coefficients. The traditional outcome is given a 1, the neutral a 2 and modern a 3.

These two sets of weighted average scores are used as additional independent variables in the bivariate probit for employment activity (see chapter two for a description of the model).

Before looking at the results of the model, it is important to note that in the bivariate ordered probit model of gender-role attitudes, identification is unlikely to be a problem as there are sufficient variables (from an individual's background) that are present in the male (female) equation and not in the female (male) one. In the bivariate probit of chapter 2, to which measures of attitudes are added, identification is likely to be improved since the variables that are introduced are continuous.

6 Results

The preferred specification for attitude formation was obtained after a series of preliminary regressions were performed. The father's education and employment status when the respondent was aged 14 were not found to affect male and female attitudes. The female unemployment rate was also found not to affect attitudes. The preferred set of regression models is reported in tables 3.4 and 3.5. Even if it was found not to be statistically significant, the number of siblings is retained in the specification, as it is likely to slightly impact on coefficients representing the impact of family structure if it is not controlled for. Husbands and wives' attitudes regarding a woman's role in the labour market are not independent of one another and unobservables that determine them are positively correlated as shown by the significant positive correlation coefficients in tables 3.4 and 3.5 below. This could indicate that individuals with common values tend to marry (positive assortative mating). Furthermore, there does not seem to be significant differences in the underlying structure of male and female attitudes as chi-square tests on the equality of cut-off points for the attitude thresholds do not reject the hypothesis of equality (see table (A3.1) in appendix 3). The effect of age on attitudes varies depending on the specification. For males, the latter is only found significant in the last two specifications. For females, it is significant in specification four only. This might be due to the inclusion of variables

representing the number of children, which allowed for a cleaner effect of the role of age in the formation of attitudes. Both age and its quadratic are significant indicating individuals become more egalitarian with age until they reach 28.5 or 31 for males depending on the specification and 33 for females. The point estimates suggest that males tend to become traditional earlier in the lifecycle than females. A chi-square test in specification 4 for equality of age effects for males and females does not reject the latter suggesting no statistical differences in point estimates (refer to table A3.1). Ethnicity of both husband and wife is a strong determinant of attitudes toward women in the labour market. Being white but not British or being of other ethnic background leads to more traditional attitudes compared to the British white base category. A chi-square test reveals that the impact of ethnicity on male and female attitudes does not vary by gender (refer to table A3.1). This result is consistent with findings from the US literature. The type of region the husband was living in aged 14 does not influence his attitudes in almost all specifications. The effect of being in a rural location compared to the inner city base decreases the probability that a man is egalitarian only in the last specification (although results are marginal at the 10% significance in other specifications). On the other hand, the type of region a woman was living in when she was 14 affects her current attitudes (in all specifications). Being in a town or in a rural location both lead to more traditional attitudes than those who were living in an inner city at the age of 14. The number of books in one's childhood home plays a role in the determination of female attitudes. Women who grew up in homes with a lot of books are more likely to be egalitarian, on average and *ceteris paribus*, than those who grew up without many books. This result holds in all specifications, the variable being significant at the 1% level in all the regressions and is robust to the introduction of the individual's education level. This variable does not seem as important in the determination of male attitudes. This shows the importance of non-formal education for the development of

attitudes. The result is important as such variables have not, to our knowledge, been used in this context before. The educational qualification of a woman's mother does not seem to matter in the determination of her attitudes. However, the educational qualification of a man's mother does influence his attitude. Having a mother who achieved a university degree makes a man more likely to be egalitarian on average and *ceteris paribus* compared to a man whose mother has no education. This is consistent with results from the literature (see Kiecolt and Acock (1988)). A mother's working status when the individual was 14 is an important determinant of their attitudes as an adult. If the mother worked, both husbands and wives have a greater probability to be modern on average and *ceteris paribus*. A chi-square test shows that the impact of mother's employment is the same for male and female attitudes (refer to table A3.1). All of the educational variables are significant at the 1% level. Having any level of education higher than none makes both men and women more likely to be egalitarian on average and *ceteris paribus*. This is consistent with findings from the literature. The impact of education does not seem to vary by gender (refer to table A3.1). The impact of family structure is not consistent across specifications for males. However, in all but the last specification, being in the "other" family type (i.e., foster care) makes men more egalitarian than those who were living with both parents when aged 16. For females, living with their father only at age 16 makes them more traditional than if they were living with both their parents.

In specification two, male and female non-labour incomes are introduced into the regression model. Male non-labour income is not found to affect attitudes towards gender roles. Female non-labour income increases the probability that a woman and a man will be traditional. A chi-square test shows that the effect of non-labour income is not the same

across gender (refer to A3.1). A closer examination of the data reveals that this result is due to the impact of benefit income. Benefits thus re-enforce a traditional view of sex roles.[43]

In specification 3, the male unemployment rate is introduced into the regression model. The latter is found to be significant only in the female equation whereby a higher unemployment rate increases the probability that the wife is modern. This finding does not support the view that suggests a negative relationship between male unemployment and attitudes towards sex roles. The result for females suggests that in difficult economic conditions for men, the wife is more likely to work. A parallel can be drawn between this result and the added worker effect in labour supply analysis.

In specification four, binary variables indicating the presence of children aged less than five, between five and 11 and older than 12 are introduced in the regressions. The presence of children aged less than 5 makes both men and women more likely to be traditional on average and ceteris paribus with the variable being significant at the 1% significance level. The presence of children older than 12 increases the probability of being traditional at the 10% significance level for men and at the 1% significance level for women. This might be proxying an age effect as individuals tend to be more lenient in their views of gender roles when there are no children. Finally, the presence of children aged between 5 and 11 does not impact on attitudes.

Finally, in specification five, the male attitude variable is introduced in the regression model. It is found to be a significant determinant of female attitudes. A more egalitarian male increases the probability that his spouse will be egalitarian.[44] A number of variables that had significant effects in the previous specifications (such as the presence of at least one preschool child or female non-labour income) are no longer found to have an impact

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[43] This might be due to the fact that the welfare state is still based, to an extent, on a traditional view of the family.

[44] Introducing the female attitudes in the male regression model yields similar result indicating the reverse is also true.

here. Their effect is probably absorbed by the male attitude variable. The correlation coefficient is still significant but is now found to be negative. In other words, once male attitudes are controlled for in the female equation, the unobervables that determine male and female attitudes are negatively correlated. The explanation for such a result is probably to be found outside economics. Psychologists have often focused on the impact of personality traits on attitudes and happiness in couples. Holter (1970) mentions issues such as "submissiveness" and "conflict avoidance". The latter might explain the negative correlation in attitudes. If women are conflict avoiders, they will probably be more traditional in their gender-role attitudes as they are aware of the strain of the "double shift" on the couple. On the other hand, if men are conflict avoiders, they might encourage their wives to work if they feel they would like to. This is only a tentative explanation and there are probably many other possible rationales for the negative correlation coefficient obtained. Another interesting result is that the cut-off points for male and female attitudes are now found to be statistically different suggesting that where females define the threshold between say modernity and neutrality is different from where men draw this boundary.

Tables 3.5: Bivariate Ordered Probit Estimates of attitude formation (specifications one to three)

Dependent Variables	Specification one		Specification two		Specification three	
	Male	Female	Male	Female	Male	Female
age	0.0230	0.0173	0.0218	0.0188	0.0238	0.0198
	(0.0183)	(0.0198)	(0.0185)	(0.0199)	(0.0187)	(0.0201)
age_squared	-0.0004*	-0.0003	-0.0004*	-0.0003	-0.0004*	-0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
educ1	0.2148***	0.3488***	0.2107***	0.3429***	0.2001***	0.3459***
	(0.0784)	(0.0773)	(0.0785)	(0.0775)	(0.0795)	(0.0788)
educ2	0.2981***	0.4550***	0.2885***	0.4455***	0.2835***	0.4468***
	(0.0765)	(0.0825)	(0.0767)	(0.0828)	(0.0777)	(0.0844)
educ3	0.5415***	0.7679***	0.5334***	0.7604***	0.5370***	0.7617***
	(0.1003)	(0.1066)	(0.1006)	(0.1068)	(0.1018)	(0.1090)
educ4	0.8674***	0.8179***	0.8621***	0.8132***	0.8741***	0.7907***
	(0.1543)	(0.1820)	(0.1549)	(0.1826)	(0.1574)	(0.1855)
other_white	-0.2351**	-0.3150**	-0.2426**	-0.3147**	-0.2530**	-0.2800**
	(0.1179)	(0.1428)	(0.1182)	(0.1430)	(0.1191)	(0.1459)
other_ethnic	-0.5752***	-0.4238***	-0.5890***	-0.4313***	-0.6024***	-0.4326***
	(0.1532)	(0.1490)	(0.1535)	(0.1490)	(0.1549)	(0.1557)
books_unknown	-0.2637	0.2837	-0.2431	0.2795	-0.2129	0.2037
	(0.2077)	(0.2592)	(0.2080)	(0.2592)	(0.2171)	(0.270)
books_few	0.0685	0.0737	0.0758	0.0769	0.0752	0.0826
	(0.0559)	(0.0645)	(0.0561)	(0.0646)	(0.0567)	(0.0654)
books_lots	-0.0158	0.1572**	-0.0099	0.1619***	-0.0006	0.1805***
	(0.0655)	(0.0663)	(0.0656)	(0.0664)	(0.0664)	(0.0676)
suburb	0.021	0.0108	0.0087	0.0057	-0.0105	-0.0011
	(0.0860)	(0.1014)	(0.0863)	(0.1016)	(0.0871)	(0.1034)
town	0.0311	-0.1785*	0.0176	-0.1831*	0.0002	-0.1889**
	(0.0837)	(0.0963)	(0.0840)	(0.0966)	(0.0849)	(0.0982)
village	-0.0928	-0.1277	-0.1104	-0.1318	-0.1108	-0.1345
	(0.0861)	(0.1007)	(0.0864)	(0.1009)	(0.0876)	(0.1028)
rural	-0.1472	-0.2390**	-0.1634	-0.2441**	-0.1607	-0.2390**
	(0.1014)	(0.1156)	(0.1017)	(0.1158)	(0.1032)	(0.1181)
move	-0.0602	-0.0337	-0.0668	-0.0254	-0.076	-0.0331
	(0.1296)	(0.1394)	(0.1298)	(0.1398)	(0.1312)	(0.1430)
mother_some_ educ	0.0543	-0.0468	0.0453	-0.0458	0.043	-0.0507
	(0.0598)	(0.0650)	(0.060)	(0.0651)	(0.0608)	(0.0661)
mother_further_ educ	0.0249	-0.0632	0.0197	-0.0645	0.0018	-0.06
	(0.0768)	(0.0764)	(0.0769)	(0.0765)	(0.0780)	(0.0779)
mother_uni_ educ	0.4942***	-0.1091	0.5058***	-0.1088	0.5207***	-0.0752
	(0.1688)	(0.1333)	(0.170)	(0.1335)	(0.1743)	(0.1368)
mother_unknow n_educ	-0.1024	-0.1529	-0.0858	-0.14	-0.0815	-0.1474
	(0.0860)	(0.0947)	(0.0864)	(0.0950)	(0.0870)	(0.0961)
mother_work	0.1463***	0.1825***	0.1441***	0.1834***	0.1423***	0.1833***
	(0.0512)	(0.0534)	(0.0513)	(0.0535)	(0.0519)	(0.0542)
mother_work_ mis	-0.037	0.0864	-0.0528	0.1097	-0.0687	0.0988
	(0.0919)	(0.1015)	(0.0922)	(0.1023)	(0.0933)	(0.1041)

Tables 3.5: (continued)

Dependent Variables	Specification one		Specification two		Specification three	
	Male	*Female*	*Male*	*Female*	*Male*	*Female*
siblings	-0.0068	-0.0050	-0.0042	-0.0038	-0.0043	-0.0045
	(0.0134)	(0.0140)	(0.0135)	(0.0140)	(0.0137)	(0.0143)
live_father_ only	0.0189	-0.3229*	0.0201	-0.3250*	0.0373	-0.3298*
	(0.1774)	(0.180)	(0.1779)	(0.1804)	(0.1814)	(0.1860)
live_mother_ only	0.0223	-0.1032	0.0219	-0.0946	0.0273	-0.1161
	(0.0899)	(0.0953)	(0.0901)	(0.0956)	(0.0906)	(0.0966)
live_mother_ stepfather	-0.1880*	0.1166	-0.1717	0.1257	-0.1309	0.1504
	(0.1079)	(0.1122)	(0.1085)	(0.1125)	(0.1101)	(0.1139)
live_father_ stepmother	-0.0062	0.0724	0.0124	0.0535	0.0326	0.0575
	(0.2723)	(0.3327)	(0.2736)	(0.3335)	(0.2736)	(0.3398)
live_other	0.2345*	0.2222	0.2501*	0.2261*	0.2617*	0.2197
	(0.1396)	(0.1387)	(0.140)	(0.1391)	(0.1402)	(0.1402)
male_income			-0.0061	-0.0009	-0.0061	-0.0015
			(0.0060)	(0.0063)	(0.0061)	(0.0063)
female_income			-0.0374***	-0.0300***	-0.0378***	-0.0291***
			(0.0095)	(0.0098)	(0.0095)	(0.0099)
male_ unemployment					-0.316	1.7119*
					(0.9691)	(1.0151)
cut off1	-0.7094	-0.7607	-0.81	-0.7778	-0.7753	-0.6064
	(0.4043)	(0.4064)	(0.4067)	(0.4088)	(0.4197)	(0.4201)
cut off2	0.3296	0.2462	0.2337	0.2317	0.2666	0.3989
	(0.4041)	(0.4065)	(0.4065)	(0.4089)	(0.4195)	(0.4203)
Correlation coefficient	0.2555***		0.2511***		0.2484***	
	(0.0279)		(0.0280)		(0.0284)	
Log likelihood	-4314		-4303		-4209	
Pseudo R squared	0.45	0.50	0.44	0.50	0.43	0.49
Sample size	2590	2590	2590	2590	2590	2590

Notes: (*) denotes significance at the 10% level
(**) denotes significance at the 5% level
(***) denotes significance at the 1% level
Base categories for education, ethnicity, number of books, location, mother's education and employment and type of family are educ0, white, inner_city, mother_no_educ, mother_not_work and live_parents respectively

Tables 3.6: Bivariate Ordered Probit Estimates of attitude formation (specifications four and five)

Dependent Variables	Specification four		Specification five	
	Male	Female	Male	Female
age	0.0342*	0.0398*	0.0370*	0.0208
	(0.0201)	(0.0223)	(0.020)	(0.0225)
age_squared	-0.0006**	-0.0006**	-0.0006***	-0.0003
	(0.0002)	(0.0003)	(0.0002)	(0.0003)
educ1	0.1968***	0.3413***	0.1930***	0.3029***
	(0.0797)	(0.0790)	(0.0785)	(0.0790)
educ2	0.2759***	0.4364***	0.2700***	0.3807***
	(0.0779)	(0.0847)	(0.0773)	(0.0857)
educ3	0.5252***	0.7527***	0.4885***	0.6211***
	(0.1021)	(0.1094)	(0.1032)	(0.1158)
educ4	0.8688***	0.7783***	0.8397***	0.6285***
	(0.1578)	(0.1859)	(0.1579)	(0.1886)
other_white	-0.2449**	-0.2934**	-0.2318**	-0.2468*
	(0.1193)	(0.1463)	(0.1186)	(0.1451)
other_ethnic	-0.5727***	-0.4011***	-0.6193***	-0.2272
	(0.1559)	(0.1566)	(0.1524)	(0.1612)
books_unknown	-0.2099	0.2118	-0.3394	0.1936
	(0.2177)	(0.2706)	(0.2149)	(0.2640)
books_few	0.0778	0.0908	0.0556	0.0843
	(0.0568)	(0.0655)	(0.0564)	(0.0643)
books_lots	0.0029	0.1854***	0.0248	0.1800***
	(0.0666)	(0.0678)	(0.0658)	(0.0666)
suburb	-0.0082	-0.0177	-0.0619	-0.0373
	(0.0872)	(0.1037)	(0.0864)	(0.1018)
town	0.0027	-0.2004**	-0.0261	-0.2019**
	(0.0850)	(0.0986)	(0.0840)	(0.0969)
village	-0.1108	-0.1497	-0.128	-0.1355
	(0.0877)	(0.1032)	(0.0865)	(0.1015)
rural	-0.1593	-0.2482**	-0.2169**	-0.2399**
	(0.1033)	(0.1186)	(0.1017)	(0.1165)
move	-0.0753	-0.031	-0.1822	-0.0192
	(0.1314)	(0.1436)	(0.1298)	(0.1409)
Mother_some_ educ	0.0429	-0.0593	0.0449	-0.0737
	(0.0609)	(0.0663)	(0.060)	(0.0651)
mother_further_ educ	-0.0007	-0.0659	0.0243	-0.0802
	(0.0781)	(0.0782)	(0.0770)	(0.0766)
mother_uni_ educ	0.5013***	-0.0818	0.6142***	-0.109
	(0.1746)	(0.1375)	(0.1765)	(0.1353)
mother_unknown _educ	-0.0779	-0.1503	0.0009	-0.1509
	(0.0871)	(0.0963)	(0.0877)	(0.0943)
mother_work	-0.0031	0.1771***	-0.0029	0.1750***
	(0.0137)	(0.0544)	(0.0135)	(0.0536)
mother_work_mis	0.1417***	0.091	0.1518***	0.1007
	(0.0520)	(0.1044)	(0.0514)	(0.1024)
siblings	-0.0703	-0.0031	-0.0208	0.0012
	(0.0934)	(0.0143)	(0.0929)	(0.0141)

live_father_ only	0.0448 (0.1819)	-0.3100* (0.1868)	-0.1045 (0.1820)	-0.3291* (0.1830)
live_mother_ only	0.0217 (0.0908)	-0.1086 (0.0970)	0.0029 (0.0894)	-0.104 (0.0952)
live_mother_ stepfather	-0.1369 (0.1103)	0.1627 (0.1143)	-0.1808* (0.1083)	0.1483 (0.1122)
live_father_ stepmother	0.017 (0.2744)	0.0938 (0.3435)	0.2302* (0.1388)	0.0511 (0.3349)
live_other	0.2511* (0.1404)	0.2274 (0.1408)	0.0246 (0.2722)	0.1992 (0.1382)
male_income	-0.0053 (0.0061)	-0.0009 (0.0063)	-0.0054 (0.0060)	0.0036 (0.0064)
female_income	-0.0329*** (0.0098)	-0.0223** (0.0102)	-0.0333*** (0.0098)	-0.0085 (0.0107)
male_unemployment	-0.3559 (0.9702)	1.6807* (1.0166)	-0.2694 (0.9719)	1.8708* (1.0095)
childlessthan5	-0.1411** (0.069)	-0.1758** (0.0730)	-0.1453** (0.0688)	-0.1094 (0.0744)
child5to11	-0.0527 (0.0581)	-0.0503 (0.0618)	-0.0532 (0.0580)	-0.0309 (0.0615)
childolderthan12	-0.1076* (0.062)	-0.1758*** (0.0660)	-0.1164* (0.0619)	-0.1157* (0.0674)
male_attitude				0.7322*** (0.1470)
cut off1	-0.6844 (0.4421)	-0.3942 (0.4510)	-0.6596 (0.4405)	1.2063 (0.5567)
cut off2	0.3594 (0.4419)	0.6146 (0.4513)	0.3820 (0.4404)	2.1982 (0.5390)
Correlation coefficient	0.2437*** (0.0285)		-0.3484*** (0.1240)	
Log likelihood	-4200		-4192	
Pseudo R squared	0.43	0.49	0.43	0.49
Sample size	2590	2590	2590	2590

Notes: (*) denotes significance at the 10% level
(**) denotes significance at the 5% level
(***) denotes significance at the 1% level
Base categories for education, ethnicity, number of books, location, mother's education and employment
and type of family are educ0, white, inner_city, mother_no_edu, mother_not_work and live_parents
respectively

These two latest specifications (four and five in table 3.6) are used to predict male and female attitude scores, which are introduced into the bivariate probit model originally developed in chapter two. The male and female score predicted from specification four denoted by predicted_male_attitude and predicted_female_attitude have a mean and standard deviation (in parenthesis) of 2.46 (0.19) and 2.58 (0.17) respectively. The male and female score predicted from specification five denoted by predicted_male_attitude2 and predicted_female_attitude2 have a mean and standard deviation (in parenthesis) of 2.46 (0.19) and 2.53 (0.34) respectively. Incorporating male attitudes in the formation of female ones results in greater variation in the latter even though, on average, female scores from specifications four and five are broadly the same.

The sample used in order to investigate the impact of attitudes on labour market participation is different than the one used to predict attitudes. Respondents that are into further educational training were not removed from the sample in chapter two, as only full-time students were not considered then. Second, some individuals have not provided information on some variables used in the modelling of labour market participation but have answered questions on attitudes and vice-versa. The basic model developed in chapter two is re-estimated on the new sample in order to render results comparable. A decision is made not to impose the restriction of pooled income for males. The results are displayed in table 3.7 below. They are broadly consistent with those obtained in chapter two for females. For males, age effects and the impact of the presence of a child aged less than five becomes better determined while other effects are broadly in line with results from chapter two. The two sets of male and female attitude scores are added to this model. Male and female attitude scores do not seem to significantly impact on the participation decision of males. However, it is difficult to assess whether this is due to the fact that attitudes do not matter or that they do not reflect personal preferences. In the male regression model, own

and cross-wage effects as well as income effects are unaltered after the inclusion of both types of attitude measures. However, there is a slight change in the magnitude of the impact of the female wage on male participation. As expected, the inclusion of the work status of his mother (displayed in table 3.7 below) does not alter results either. This is not the case for females. The introduction of the first set of attitude scores does not impact on own wage effects or income effects but does affect the impact of the male wage on his wife's participation. The latter becomes better determined and increases in magnitude. The impact of a female's own attitude score on her participation is not statistically different from zero while the impact of her husband's is. However, this effect is washed out when the mother-in-law's working status is introduced in the model (as shown in table 3.7). This confirms the hypothesis adduced in chapter two, that the status of a mother's behaviour impact on her son's preferences, which in turn affect his wife's decisions. However, results from the first set of scores suggest that the benefits of introducing the latter are not different from the ones obtained by introducing the mother-in-law's work status in the model. For the second set of scores, it is the female score that is found to impact on female participation. However, this is probably due to the fact that the latter is a linear combination of the male score. An interesting result is obtained when the mother-in-law's working status is introduced into the model as both the attitude score and the mother-in-law's working status remain significant. This might suggest that the impact of the mother-in-law's work status is not only due to an effect on male attitudes. Maybe the other effect identified by Fernandez *el al* (2004) that the husband's productivity in the household also plays a role is at work here. However, investigating this is beyond the scope of this chapter but constitutes an interesting agenda for future research.

It is important to mention that the fact that the estimated effects of attitude scores are not significant is most probably due to the high correlation between wages and attitudes for

both gender groups. This is due to the fact that important determinants of attitudes are also important determinants of wages too (education and ethnicity through the Mills ratio). In order to disentangle these effects; further research needs to be done on the relationship between attitudes and wages. This last aspect of gender-role analysis has not been extensively researched. Albrecht *et al* (2000) are among the rare studies to have looked at the relationship between wages and gender roles.

Table 3.7: Bivariate probit estimates for a couple's labour market participation (with attitude scores)

Dependent variables	Basic specification		Specification with predicted attitudes (from specification four)†		Specification with predicted attitudes (from specification five) ††	
	Male	Female	Male	Female	Male	Female
male_wage	1.2295***	-0.1494	1.2177***	-0.3301**	1.1838***	-0.2979**
	(0.1410)	(0.1182)	(0.1651)	(0.1436)	(0.1614)	(0.1400)
female_wage	0.4828***	1.3746***	0.3975**	1.3259***	0.5166***	1.1312***
	(0.1392)	(0.1232)	(0.1838)	(0.1558)	(0.1495)	(0.1302)
male_income	-0.6201***	-0.2572***	-0.6275***	-0.2747***	-0.6176***	-0.2938***
	(0.0689)	(0.0680)	(0.0700)	(0.0690)	(0.0694)	(0.0691)
female_income	-0.6809***	-1.1471***	-0.6734***	-1.1120***	-0.6631***	-1.1539***
	(0.1288)	(0.1157)	(0.1306)	(0.1165)	(0.1312)	(0.1171)
age25_34	-0.5826**	-0.1634	-0.5674**	-0.1157	-0.5847**	-0.0837
	(0.2754)	(0.1536)	(0.2760)	(0.1559)	(0.2776)	(0.1572)
age35_44	-0.7050***	-0.3879**	-0.6782**	-0.3035*	-0.6987**	-0.2604
	(0.2830)	(0.1608)	(0.2866)	(0.1664)	(0.2877)	(0.1663)
age45more	-1.0563***	-0.6077***	-1.0142***	-0.4579***	-1.0360***	-0.4104***
	(0.2731)	(0.1539)	(0.2884)	(0.1682)	(0.2878)	(0.1664)
male_ unemployment	-4.2464***	ƒ	-4.5372***	ƒ	-4.1249***	ƒ
	(1.5661)		(1.6241)		(1.5746)	
female_ unemployment	ƒ	-0.0822	ƒ	-0.5283	ƒ	-1.7534
		(2.6086)		(2.6608)		(2.6428)
childlessthan5	0.1731	-0.5289***	0.1793	-0.4866***	0.1842	-0.4933***
	(0.1288)	(0.0855)	(0.1311)	(0.0875)	(0.1311)	(0.0879)
child5to11	0.2827***	-0.0669	0.2854***	-0.0450	0.2869***	-0.0479
	(0.1092)	(0.0755)	(0.1100)	(0.0763)	(0.1100)	(0.0768)
childolderthan12	0.2218**	0.1610**	0.2394**	0.2041**	0.2218**	0.2384***
	(0.1057)	(0.0811)	(0.1079)	(0.0848)	(0.1062)	(0.0836)
predicted_male_ attitude†	ƒ	ƒ	0.0200	0.5409**	ƒ	ƒ
			(0.3031)	(0.2397)		
predicted_female _attitude†	ƒ	ƒ	0.2360	0.0977	ƒ	ƒ
			(0.3412)	(0.2682)		
predicted_male_ attitude2††	ƒ	ƒ	ƒ	ƒ	0.1924	0.3531
					(0.2862)	(0.2296)
predicted_female _attitude2††	ƒ	ƒ	ƒ	ƒ	-0.0957	0.5526***
					(0.1260)	(0.0988)
constant	-1.1378***	-0.8213***	-1.6177*	-1.9924***	-1.3543**	-2.3406***
	(0.3967)	(0.3014)	(0.8439)	(0.6554)	(0.6856)	(0.5196)
Correlation coefficient	0.3187*** (0.0514)		0.3177*** (0.0517)		0.3347*** (0.0577)	

Notes: (*) denotes significance at the 10% level
(**) denotes significance at the 5% level
(***) denotes significance at the 1% level
(ƒ) denotes variables omitted from the regression model ;
(†) male and female attitude scores predicted using specification four
(††) male and female attitude scores predicted using specification five

Table 3.8: Bivariate probit estimates for a couple's labour market participation (with attitude scores and mother-in-law working status)

Dependent variables	Bivariate probit with mother-in-law and predicted attitude (1)		Bivariate probit with mother-in-law and predicted attitude (2)	
	Male	*Female*	*Male*	*Female*
male_wage	1.2543***	-0.2288	1.2087***	-0.2123
	(0.1688)	(0.1469)	(0.1644)	(0.1428)
female_wage	0.3782**	1.3070***	0.5109***	1.1296***
	(0.1847)	(0.1562)	(0.1497)	(0.1303)
male_income	-0.6242***	-0.2612***	-0.6145***	-0.2812***
	(0.0703)	(0.0694)	(0.0697)	(0.0696)
female_income	-0.6820***	-1.1278***	-0.6703***	-1.1703***
	(0.1308)	(0.1169)	(0.1314)	(0.1175)
age25_34	-0.6062**	-0.1505	-0.6175**	-0.1193
	(0.2812)	(0.1574)	(0.2827)	(0.1586)
age35_44	-0.7241***	-0.3440**	-0.7381***	-0.3025*
	(0.2927)	(0.1684)	(0.2936)	(0.1682)
age45more	-1.0723***	-0.5081***	-1.0853***	-0.4643***
	(0.2968)	(0.1712)	(0.2959)	(0.1693)
male_unemployment	-4.5958***	*f*	-4.1354***	*f*
	(1.6271)		(1.5764)	
female_unemployment	*f*	-0.3732	*f*	-1.5305
		(2.6647)		(2.6462)
childlessthan5	0.1665	-0.5169***	0.1736	-0.5233***
	(0.1316)	(0.0882)	(0.1316)	(0.0885)
child5to11	0.2743***	-0.0695	0.2782***	-0.0714
	(0.1109)	(0.0768)	(0.1109)	(0.0773)
childolderthan12	0.2425**	0.1974**	0.2224**	0.2277***
	(0.1083)	(0.0849)	(0.1065)	(0.0836)
motherinlaw_work	0.0763	0.2310***	0.0645	0.2251***
	(0.0900)	(0.0693)	(0.0899)	(0.0698)
motherinlaw_misc	-0.0746	0.0652	-0.0612	0.0586
	(0.1449)	(0.1158)	(0.1449)	(0.1164)
predicted_male_attitude†	-0.1251	0.2146	*f*	*f*
	(0.3313)	(0.2596)		
predicted_female_attitude†	0.2743	0.1484	*f*	*f*
	(0.3432)	(0.2696)		
predicted_male_attitude2††	*f*	*f*	0.0886	0.0562
			(0.3095)	(0.2473)
predicted_female_attitude2††	*f*	*f*	-0.0947	0.5570***
			(0.1261)	(0.0988)
constant	-1.3805	-1.5911**	-1.1288	-1.8867***
	(0.8725)	(0.6714)	(0.7270)	(0.5424)
Correlation coefficient	0.3257***		0.3330***	
	(0.0577)		(0.0580)	

Notes: (*) denotes significance at the 10% level
(**) denotes significance at the 5% level
(***) denotes significance at the 1% level
(*f*) denotes variables omitted from the regression model
(†) male and female attitude scores predicted using specification four
(††) male and female attitude scores predicted using specification five

7   Concluding Comments

The first part of this chapter has drawn on both the sociological and psychological literatures to develop measures of attitudes towards gender roles. An analysis of the determinants of the latter reveals that the attitudes of spouses are interdependent. They are influenced by a number of factors from an individual's childhood such as ethnicity, mother's education (for men) and number of books in the childhood home (for women) as well as their educational level. One aspect of attitude determination which has not, to our knowledge been analysed before, is the role of the unemployment rate. The latter is found to affect female attitudes with a higher unemployment rate increasing the probability that the wife is modern. This shows that wives no longer consider themselves secondary workers in the household as they see themselves as important contributors to household income in the case of an economic downturn. As is commonly found in the literature, the presence of children increases the probability of being traditional for both men and women. Finally, having a modern husband increases the probability that a wife is modern herself; which would suggest either that individuals tend to marry partners that have similar views (assortative mating) or that individuals adapt their attitudes to their spouse's.

The introduction of measures of attitudes in the bivariate probit model of chapter two does not impact on own wage and income effects. Furthermore, attitudes do not seem to affect male participation in the labour market. This could suggest that, as predicted by the neoclassical model, price effects remain the stronger determinants of labour supply behaviour with their effects being robust to alternative forms of specifications. Attitudes do play a role in the determination of female participation, but this role varies depending on the specification and definition of attitudes used. Overall, it seems that the mother-in-law effect introduced in chapter two does represent an attitude effect but could in addition, proxy for something else such as the productivity of a husband in housework. Data on

household production, which are available in the BHPS, could be used to investigate this proposition and this is left as an agenda for future research.

Conclusions

In his seminal paper on male labour supply, Pencavel (1986) argued that empirical studies of labour supply have tended to be anchored in strong theoretical frameworks. The author adds that researchers have not been concerned about testing whether the standard assumptions on which these models relied were justified by the data. This has certainly changed in the contemporary labour supply literature. Indeed, the last two decades have seen a proliferation of research on the theoretical modelling of household labour supply. This research was prompted by an increasing dissatisfaction with the assumptions of the early neoclassical framework that treated the family as a single utility-maximizing unit, also known as the unitary model. The latter is the subject of study of the first two chapters.

In chapter one, a model of a couple's supply of working hours is developed. An Instrumental Variables estimator is used to estimate labour supply regression models for males and females in order to test whether an individual's own wage is endogenous to their supply of working hours. Results reveal that wages are exogenous for males but endogenous for females. Furthermore, it is found that there is no correlation in unobservables that determine male and female labour supply, which means that male and female regression models are estimable separately. Labour supply estimates are generally consistent with previous findings for Great Britain. Wage effects do not seem sensitive to the type of non-labour income included in the specification, which might indicate the unitary model can be used to derive wage elasticities for policy purposes. However, wages are not the only indicators used by policymakers. When it comes to the welfare of

individuals, and in particular regarding children, it is important to determine the identity of the person receiving benefits. The unitary model stipulates that the latter does not matter as a household pools income. This proposition of the unitary model is investigated as well as the assumption of Slutsky symmetry. While the test on symmetry appears conclusive in favour of the unitary model, it relies on a pooled measure of non-labour income and therefore might not be valid. Nevertheless, finding that symmetry is upheld constitutes an important result in favour of the neoclassical assumption of rational behaviour. An attempt to test for income pooling reveals the limits of this test when income effects are not well determined. More promising results are obtained with disaggregated measures of income. While this could be interrogated further, the question remains on whether there is sufficient variation in data on each type of non-labour income.

The unitary model has also been criticized for failing to provide insights into the mechanisms governing interactions of individuals within households. In the last two decades, a number of alternative models of household behaviour have been developed. An important concept has surfaced in a number of these models: a spouse's bargaining power. Doss (2003) states:

> Although policymakers may be uncomfortable with the idea of redistributing
> power within households, they must realize that any policy, including a policy
> of doing nothing, will affect the intrahousehold allocation of resources (p.59)

Variables that represent bargaining power have been labelled as "distribution factors" in the collective model. There are a number of ways to measure bargaining power of household members. However, most indicators are likely to be endogenous to household behaviour. In the first empirical chapter, two types of distribution factors are investigated: sex ratios and the age difference between spouses as well as a binary variable indicating if the wife is older than her husband. Unfortunately, results show that sex ratios and the age

difference do not impact on the hours of work of spouses. The variable indicating that the wife is older is significant in the female equation but it is unlikely that the latter reflects bargaining as it is not found to influence male hours. This is not a surprising result as determining appropriate measures of bargaining has been described by Doss (2003) as " the biggest challenges for researchers interested in these issues" (p.46). Therefore, even if the unitary model does not seem to provide an adequate framework for the analysis of labour supply responses, the majority of newer neoclassical models mostly rely on a concept that is extremely hard to tackle empirically.

The first chapter only analysed the supply of hours for couples where both spouses work. In chapter two, the unitary model is explored in the broader context of labour market participation. Joint analyses of the decision to work of spouses are rare in the literature due to a number of theoretical and empirical challenges. A decision is made to apply an ad hoc approach in order not to constrain the analysis. A bivariate probit model is used to model participation decisions among couples. Results show that unlike hours of work, unobservables that determine the participation decision of males are positively correlated to unobservables that determine the participation decisions of their wives. The elasticity of female participation with respect to their wage and non-labour income are generally consistent with findings in the literature.

Regarding testing of the income-pooling proposition, unlike in the first chapter, income effects are well determined and suggest that income is pooled for males but not for females. This echoes the results obtained in chapter one using the measure without investment income. This result might suggest that the unitary model is a good description of male behaviour but not female. While it is plausible that male income is considered to be household income and female income is considered to be her own, the question remains of whether it makes sense to conclude that spouses' behaviours do not fit in a single

framework of household behaviour. The introduction of distribution factors, as in the case of hours of work equations, does not yield promising results. Sex ratios are found to impact both male and female participation in the same direction, which is not consistent with a "bargaining" interpretation while age difference is found to impact only on male behaviour. This confirms the difficulty, flagged in chapter one, of incorporating the notion of bargaining into models of labour supply. Furthermore, a more careful interrogation of bargaining would need to incorporate household production. While an analysis of the latter was deemed outside the scope of this thesis, it is an important aspect of household behaviour. Data on domestic production is available in the BHPS and studies have analysed the domestic work of British couples with promising results (see Harkness, 2003, 2007). This is left as a topic for further research. Finally, incorporating domestic work to the analysis will also allow further investigation of the reasons behind the impact of the working status of a husband's mother on his wife's labour supply. If it is found that the husbands of wives that are influenced by their mother-in-law tend to work longer hours in the household, it would imply that assortative mating is not the only explanation behind the correlation in behaviour of wives and their mother-in-law. However, it is unclear how a formal model of the relationship between a husband's contribution in household production and his mother's influence on his wife would be set up.

The assumptions of the unitary model are not the only subject of debate in the current literature on household labour supply behaviour.

From a more general perspective, the neoclassical model altogether has been criticized by economists and academics from other disciplines for failing to account for dimensions such as culture and preferences.[45] Research has been flourishing in the last ten years to

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[45] See DiMaggio (1990) for examples.

address these issues. The second part of chapter two and chapter three contribute to this emerging literature. In the second part of chapter two, it is found that the work status of the husband's mother when he was aged 14 has an impact on his wife's labour market participation decision. This impact, which has not, to our knowledge, been analysed for Great Britain reveals that the neoclassical model does neglect some important factors in its empirical specifications. Encouraging the labour supply of women will also increase the participation of women in younger generations. However, wage and income effects are in general found not to be sensitive to the inclusion of this variable, which means that policymakers can rely on austere models to make predictions regarding behaviour even if they do not identify all the effects behind certain behaviour. The mother-in-law's work status might be a proxy for a male's attitudes regarding women's role in the labour market. Chapter three uses the rich set of questions on gender roles available from the BHPS to identify the main determinants of attitude formation. This subject has been traditionally assigned to disciplines outside economics. A bivariate ordered probit is used to explore the determinants of attitudes among couples. This methodology is recent and has not been employed in this context before. Results indicate that spouses' attitudes towards gender roles are interdependent. Education, ethnicity and mother's working behaviour play an important role in the formation of both male and female attitudes. For males, mother's education is also important while for females the number of books available in the childhood home constitutes an important factor in the determination of gender-role attitudes. This variable has not been used in previous studies and shows the importance of informal education. Another dimension, which has only been partially looked at in the sociological literature is the impact of male unemployment on gender-role attitudes. It is normally suggested that in an economic downturn, women's role in the labour market will be challenged. Results show that not only is this not the case, but a high male

unemployment rate encourages more egalitarian female attitudes and does not impact on male ones. Having an egalitarian husband is also found to increases the probability that a wife is more egalitarian.

The last part of the thesis investigates the impact of male and female attitudes on their labour market behaviour. Attitude scores do not seem to impact on male participation but male attitudes impact on female participation. This is probably due to a high correlation between wage offers and attitudes. Further analysis shows that the impact of male attitudes is linked to that of the mother-in-law's work behaviour confirming the hypothesis of Fernandez *et al* (2004). The introduction of attitudes (or mother-in-law work behaviour) improves the specification of cross wage effects. However, results suggest that policymakers can still rely on own wage effects and income effects provided by a more austere specification.

This thesis does not provide an unequivocal answer to the question of whether the neoclassical model does constitute an adequate framework for the study of household labour supply. While the pooling assumption implied by earlier neoclassical model seems to be rejected, this obviously affects income elasticities but not the impact of wages. Promising alternative frameworks are hard to implement (at least using British data). However, further research might be able to identify new dimensions of bargaining to introduce to the model, maybe making use of data from previous waves.

A complete questioning of the neoclassical model also requires a collective model to be estimated as the latter is increasingly becoming an alternative to the unitary model within neoclassical economics. However, the latter relies on finding significant distribution factors. Furthermore, as mentioned earlier, a suitable collective model needs to incorporate household production in the analysis.

Another aspect that is not discussed in this thesis is the issue of part-time work, which is an important aspect of female labour market behaviour in the United Kingdom. The latter is bound to be closely linked to the issue of bargaining. One way to analyse the latter would be to estimate a multinomial logit in chapter two, in which the decision being modelled would be between full-time work, part-time work and no work. The problem with BHPS data is that the status of part-time is defined from reported hours.

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Appendix 1

Table: A1.1: Mean and standard deviation (in parenthesis) for components of non-labour income (dual earner couples in wage employment)

	Dual earner couples in wage employment
invest_male_income	31
	(147)
invest_female_income	22
	(108)
trans_male_income	4
	(82)
trans_female_income	9
	(65)
benefit_male_income	15
	(60)
benefit_female_income	81
	(122)
pension_male_income	26
	(156)
pension_female_income	2
	(28)

Note: for variables definitions
see notes to table A1.6 below

Table A1.2: Chi-square statistics for tests of heteroscedasticity

	Males		*Females*	
	Non-pooled income	Pooled income	Non-pooled income	Pooled income
First stage regression White/Koenker nR^2 test statistic	71.38 (0.000)	69.08 (0.000)	42.42 (0.006)	41.78 (0.005)
Second stage regression Pagan and Hall test statistic	40.29 (0.010)	38.03 (0.013)	104.65 (0.000)	97.36 (0.000)

Table A1.3: First-stage regression statistics

	Males		**Females**	
	Non-pooled income	Pooled income	Non-pooled income	Pooled income
Shea statistic	0.1233	0.1232	0.2192	0.2195
F statistic	19.94 (0.000)	19.84 (0.000)	42.79 (0.000)	42.95 (0.000)
C statistic Instrument: tenure (joint significance of dummies)	2.560 (0.7674)	2.597 (0.7618)	9.688 (0.0846)	9.813 (0.0807)
C statistic Instrument: education (joint significance of dummies)	8.630 (0.0711)	8.818 (0.0658)	4.381 (0.3568)	4.529 (0.392)
Hansen J statistic	10.360 (0.2407)	10.609 (0.2249)	12.259 (0.1400)	12.385 (0.1348)
Exogeneity test (wage)	**0.186 (0.6661)**	**0.198 (0.6561)**	**6.435 (0.0112)**	**6.446 (0.0111)**

Table A1.4 First-stage regression estimates

	MALES		FEMALES	
	Dependent variable: male wage		**Dependent variable: female wage**	
	Pooled income	Non-pooled income	Pooled income	Non-pooled income
male_wage	†	†	0.1999***	0.1995***
			(0.0265)	(0.0262)
female_wage	0.2029***	0.2025***	†	†
	(0.0279)	(0.0276)		
male_income	†	-0.0001	†	0.0000
		(0.0000)		(0.0000)
female_income	†	-0.0001	†	-0.0001
		(0.0000)		(0.0000)
couple_income	-0.0001*	†	0.0000	†
	(0.0001)		(0.0000)	
childlessthan5	0.0320	0.0337	-0.0191	-0.0118
	(0.0336)	(0.0352)	(0.0303)	(0.0312)
child5to11	0.1034***	0.1053***	-0.0345	-0.0265
	(0.0256)	(0.0271)	(0.0260)	(0.0262)
childolderthan12	0.0608**	0.0628**	-0.1107	-0.1021***
	(0.0272)	(0.0277)	(0.0254)	(0.0262)
Age	0.0048***	0.0048***	0.0020	0.0019
	(0.0013)	(0.0013)	(0.0014)	(0.0014)
London	0.1410*	0.1407*	0.1168**	0.1146***
	(0.0749)	(0.0753)	(0.0518)	(0.0517)
South	0.0938***	0.0941***	0.0190	0.0198
	(0.0332)	(0.0331)	(0.0322)	(0.0322)
Eastanglia	0.1181*	0.1178*	-0.0607	-0.0619
	(0.0657)	(0.0655)	(0.0562)	(0.0564)
Midland	0.0406	0.0403	-0.0427	-0.0436
	(0.0391)	(0.0391)	(0.0336)	(0.0336)
North	0.0144	0.0146	-0.0038	-0.0033
	(0.0326)	(0.0326)	(0.0307)	(0.0307)
Wales	-0.0148	-0.0150	-0.0471	-0.0480
	(0.0327)	(0.0326)	(0.0309)	(0.0309)
educ1	0.1940***	0.1943***	0.2050***	0.2047***
	(0.0389)	(0.0389)	(0.0319)	(0.0319)
educ2	0.3125***	0.3130***	0.3473***	0.3478***
	(0.0386)	(0.0386)	(0.0336)	(0.0336)
educ3	0.5739***	0.5740***	0.7117***	0.7106***
	(0.0513)	(0.0513)	(0.0429)	(0.0430)
educ4	0.6623***	0.6628***	0.8057***	0.8036***
	(0.0725)	(0.0723)	(0.0722)	(0.0722)
less6mths	-0.1046***	-0.1054***	-0.1284***	-0.1282***
	(0.0392)	(0.0393)	(0.0416)	(0.0416)
7mths_1yr	-0.1157***	-0.1166***	-0.0979**	-0.0949**
	(0.0458)	(0.0462)	(0.0405)	(0.0406)
1yr_3yr	-0.0653*	-0.0660*	-0.0921***	-0.0926***
	(0.0341)	(0.0344)	(0.0354)	(0.0354)
3yr_5yr	-0.0204	-0.0208	-0.0299	-0.0287
	(0.0379)	(0.0381)	(0.0394)	(0.0394)
5yr_10yr	-0.0660*	-0.0664*	0.0077	0.0091
	(0.0345)	(0.0345)	(0.0374)	(0.0373)
Constant	1.4760***	1.4789***	1.2960***	1.3018***
	(0.0921)	(0.0917)	(0.0933)	(0.0931)

Table A1.5: Regression results with disaggregated non-labour income

Dependent variable: monthly hours of work

Independent variables	Males (OLS)	Females (IV)
female_wage	30.6848***	1.5012
	(5.7765)	(1.9941)
male_wage	-17.0943***	-14.9649***
	(3.5838)	(2.5758)
age	-0.8957***	0.1268
	(0.1212)	(0.0921)
childlessthan5	-32.4793***	2.6737
	(3.7274)	(2.3023)
child5to11	-16.3425***	7.5290***
	(3.1464)	(2.2000)
childolderthan12	4.0424	6.0478*
	(3.3221)	(2.3878)
london	-10.9366*	4.3039
	(5.2209)	(4.3091)
south	0.0095	0.9496
	(3.2917)	(2.2829)
eastanglia	7.9174	5.1426
	(6.4287)	(3.9799)
midland	-3.5391	3.4294
	(3.5902)	(3.1867)
north	0.0355	0.7983
	(3.2546)	(2.8000)
wales	3.1103	-2.0135
	(3.3345)	(2.7618)
invest_male_income	0.0001	-0.0062
	(0.0090)	(0.0072)
invest_female_income	0.0028	0.0162*
	(0.0192)	(0.0069)
trans_male_income	0.0033	0.0045
	(0.0029)	(0.0038)
trans_female_income	-0.0155	-0.0327*
	(0.0183)	(0.0158)
benefit_male_income	-0.0068	-0.0409*
	(0.0218)	(0.0162)
benefit_female_income	-0.0518**	-0.0175
	(0.0162)	(0.0098)
pension_male_income	-0.0199*	-0.0257**
	(0.0093)	(0.0098)
pension_female_income	-0.0823**	-0.0089
	(0.0276)	(0.0375)
constant	154.6329***	197.8925***
	(12.2069)	(7.0827)

Notes (see notes to table A1.4 below)

Table A1.6: Regression results with non-labour income (without investment)
Dependent variable: monthly hours of work

Independent variables	Males (OLS)	Females (IV)
female_wage	1.4200	31.3752***
	(1.8866)	(5.2871)
male_wage	-14.7881***	-16.5167***
	(1.8873)	(2.8737)
age	0.1197	-0.9312***
	(0.0887)	(0.1194)
childlessthan5	2.7383	-33.8410***
	(2.4449)	(3.2367)
child5to11	7.6100***	-17.1774***
	(2.0342)	(2.6807)
childolderthan12	6.5395***	3.5071
	(2.1687)	(2.8942)
london	3.7032	-11.2599**
	(4.3335)	(5.7081)
south	1.1120	0.2010
	(2.4808)	(3.2559)
eastanglia	4.9933	8.5932
	(4.9108)	(6.4592)
midland	3.1439	-3.5033
	(2.8805)	(3.7886)
north	0.6675	-0.3832
	(2.5598)	(3.3596)
wales	-2.1155	2.9057
	(2.6429)	(3.4802)
no_inv_male_income	-0.0191***	-0.0109**
	(0.0043)	(0.0057)
no_inv_female_income	-0.0222***	-0.0381***
	(0.0064)	(0.0084)
constant	198.0401***	152.8552***
	(6.3389)	(10.5928)

Notes: (**) denotes significance at the 1% level
(*) denotes significance at the 5% level
(†) denotes significance at the 10% level
Base category for regional dummy: Scotland

Note: variables that are not defined in the main text are as follows:
invest_male_income and invest_female_income represent male and female monthly investment income.
trans_male_income and trans_female_income represent male and female monthly transfer income.
benefit_male_income and benefit_female_income represent male and female monthly benefit income.
pension_male_income and pension_female_income represent male and female monthly pension income.
no_inv_male_income and no_inv_female_income represent male and female monthly non-labour income excluding investment

Table A1.7: OLS and IV regressions results with sex ratio (definition 1)[1]

Dependent variable: monthly hours of work

Independent Variables	OLS Males	IV Males	OLS Females	IV Females
male_wage	-13.8324***	-13.9032***	-11.5954***	-15.7859***
	(2.5674)	(5.3810)	(2.7951)	(3.5552)
female_wage	1.9334	1.9562	19.3283***	32.5968***
	(2.0530)	(2.4706)	(3.0856)	(5.9012)
male_income	-0.0129***	-0.0129***	-0.0048	-0.0057
	(0.0053)	(0.0052)	(0.0056)	(0.0059)
female_income	-0.0057	-0.0057	-0.0212*	-0.0202*
	(0.0061)	(0.0061)	(0.0117)	(0.0121)
childlessthan5	0.9799	0.9822	-35.4123***	-35.6163***
	(2.2153)	(2.1966)	(3.6372)	(3.6457)
child5to11	5.7653***	5.7734***	-19.9008***	-19.0241***
	(2.1332)	(2.0714)	(2.9721)	(2.950)
childolderthan12	4.7993**	4.8041**	0.1168	1.7045
	(2.2399)	(2.2894)	(2.9485)	(2.9342)
age	0.1081	0.0973	-0.9336***	-0.9253***
	(0.0982)	(0.1002)	(0.1141)	(0.1169)
london	3.1991	3.208	-10.5310**	-11.8977**
	(4.2084)	(4.1387)	(5.2316)	(5.2575)
south	1.4686	1.4756	0.7983	0.6133
	(2.3332)	(2.3075)	(3.3746)	(3.3994)
eastanglia	5.7225	5.7315	7.8785	8.9699
	(3.9447)	(3.8977)	(6.630)	(6.6112)
midland	3.6017	3.6053	-3.8834	-3.3184
	(3.2081)	(3.1740)	(3.6252)	(3.6328)
north	0.5654	0.5658	-0.4662	-0.3801
	(2.8344)	(2.8157)	(3.2310)	(3.2631)
wales	-2.1963	-2.1979	1.9209	2.7177
	(2.7702)	(2.7589)	(3.3443)	(3.3396)
sex_ratio (1)	0.6628	0.6636	-0.8772	1.1425
	(2.7759)	(2.7567)	(3.5328)	(3.6758)
Constant	194.1349***	194.2406***	167.8543***	146.8207***
	(7.6858)	(11.0626)	(10.4933)	(13.1813)
R-squared	0.0605	0.0558	0.2019	0.1857
Sample size	1415	1415	1415	1415

Notes: (***) denotes significance at the 1% level

(**) denotes significance at the 5% level

(*) denotes significance at the 10% level

(f) denotes a variable that has been omitted from the regression model

(1) sex ratio definition 1: ratio of the number of males whose age falls in

the age category of the husband over the number of females whose age falls in the ages

fall in the category of the wife in a particular county

Table A1.8: OLS and IV regressions results with sex ratio (definition 2)[1]

Dependent variable: monthly hours of work

Independent Variables	OLS Males	IV Males	OLS Females	IV Females
male_wage	-13.8107***	-13.8822***	-11.6418***	-15.7818***
	(2.5664)	(5.3775)	(2.7942)	(3.5529)
female_wage	1.7504	1.7735	19.5862***	32.7182***
	(2.0247)	(2.4488)	(3.0538)	(5.8808)
male_income	-0.0130**	-0.0130***	-0.0048	-0.0057
	(0.0053)	(0.0052)	(0.0056)	(0.0058)
female_income	-0.0056	-0.0056	-0.0212*	-0.0203*
	(0.0061)	(0.0061)	(0.0117)	(0.0121)
childlessthan5	0.7943	0.7967	-35.1109***	-35.3561***
	(2.2154)	(2.1973)	(3.6147)	(3.6158)
child5to11	5.6172***	5.6255***	-19.6871***	-18.8880***
	(2.0954)	(2.0329)	(2.9575)	(2.9337)
childolderthan12	4.6602**	4.6650**	0.2925	1.8978
	(2.2429)	(2.2936)	(2.9530)	(2.9443)
age	0.1249	0.1251	-0.9475***	-0.9472***
	(0.0971)	(0.0972)	(0.1162)	(0.1186)
london	3.3673	3.3761	-10.7724**	-12.2075**
	(4.2148)	(4.1472)	(5.2394)	(5.2758)
south	1.9134	1.9203	0.2007	-0.1050
	(2.3160)	(2.2879)	(3.3683)	(3.3926)
eastanglia	5.9226	5.9317	7.6032	8.7255
	(3.9210)	(3.8727)	(6.6333)	(6.6210)
midland	3.7858	3.7894	-4.1293	-3.5319
	(3.2068)	(3.1719)	(3.6120)	(3.6237)
north	0.7249	0.7252	-0.6756	-0.6956
	(2.8372)	(2.8190)	(3.2315)	(3.2552)
wales	-2.3883	-2.3897	2.1879	3.1882
	(2.7717)	(2.7598)	(3.3690)	(3.3736)
sex_ratio (2)	-10.6425	-10.6374	14.3715	21.4771
	(10.0854)	(10.0377)	(15.9812)	(16.7304)
Constant	205.0477***	205.1503***	152.7656***	127.4981***
	(12.2210)	(14.2936)	(17.9237)	(21.518)
R-squared	0.0562	0.0562	0.2023	0.1864
Sample size	1415	1415	1415	1415

Notes: (***) denotes significance at the 1% level
(**) denotes significance at the 5% level
(*) denotes significance at the 10% level
(*f*) denotes a variable that has been omitted from the regression model
(1) sex ratio definition 2: ratio of the number of males whose age falls in
the age category of the husband over the number of females whose age falls in that same age category.

Table A1.9: **OLS and IV regressions results with age difference and female older dummy**

Dependent variable: monthly hours of work

Independent Variables	OLS Males	IV Males	OLS Females	IV Females
male_wage	-13.7911***	-13.8703***	-11.4288***	-15.7038***
	(2.5657)	(5.3769)	(2.7827)	(3.5474)
female_wage	2.0892	2.0838	19.2801***	32.6914***
	(2.0298)	(2.4466)	(3.0664)	(5.8468)
male_income	-0.0132**	-0.0131***	-0.0039	-0.0051
	(0.0053)	(0.0052)	(0.0056)	(0.0059)
female_income	-0.0057	-0.0057	-0.0215*	-0.0205*
	(0.0061)	(0.0061)	(0.0117)	(0.0122)
childlessthan5	0.6592	0.6587	-35.2443***	-35.5955***
	(2.1937)	(2.1774)	(3.6013)	(3.6024)
child5to11	5.6320***	5.6301***	-19.9370***	-19.1845***
	(2.0958)	(2.0321)	(2.9494)	(2.9230)
childolderthan12	4.9719**	4.9707**	0.142	1.7388
	(2.2623)	(2.3128)	(2.9556)	(2.9401)
age	0.0986	0.0985	-0.9736***	-0.9520***
	(0.0958)	(0.0962)	(0.1167)	(0.1200)
london	3.2714	3.2693	-10.1218**	-11.4725**
	(4.2162)	(4.1434)	(5.2306)	(5.2527)
south	1.5061	1.5045	0.9109	0.8648
	(2.3120)	(2.2836)	(3.3304)	(3.3547)
eastanglia	5.7352	5.733	8.2274	9.4733
	(3.9257)	(3.8758)	(6.6054)	(6.6062)
midland	3.5608	3.5600	-3.8362	-3.1536
	(3.1979)	(3.1636)	(3.6134)	(3.6310)
north	0.5691	0.5690	-0.3704	-0.2752
	(2.8298)	(2.8108)	(3.2180)	(3.2509)
wales	-2.0908	-2.0906	1.8765	2.7785
	(2.7592)	(2.7493)	(3.3396)	(3.3357)
age_difference	15.4061*	15.4044*	-0.8269	4.6811
	(8.6821)	(8.5916)	(13.4561)	(13.4718)
female_older	3.2783	3.278	7.4558*	8.3125**
	(2.6733)	(2.6748)	(3.9972)	(4.0104)
Constant	194.6462***	193.9697***	166.8312***	147.1208***
	(7.2364)	(10.6861)	(9.5427)	(11.8035)
R-squared	0.0570	0.0574	0.2057	0.1892
Sample size	1415	1415	1415	1415

Notes: (***) denotes significance at the 1% level
(**) denotes significance at the 5% level
(*) denotes significance at the 10% level
(f) denotes a variable that has been omitted from the regression model

Table A1.10: OLS and IV regressions results with all distribution factors

Dependent variable: monthly hours of work

Independent Variables	OLS Males	IV Males	OLS Females	IV Females
male_wage	-13.8884***	-13.8473***	-11.4214***	-15.7285***
	(2.5673)	(5.3745)	(2.7853)	(3.5507)
female_wage	2.0161	2.0028	19.4263***	33.0385***
	(2.0569)	(2.4658)	(3.0940)	(5.8954)
male_income	-0.0132***	-0.0132***	-0.0037	-0.0048
	(0.0053)	(0.0052)	(0.0056)	(0.0058)
female_income	-0.0057	-0.0057	-0.0216*	-0.0206*
	(0.0061)	(0.0061)	(0.0118)	(0.0122)
childlessthan5	0.5402	0.5390	-35.0050***	-35.2175***
	(2.1919)	(2.1745)	(3.6484)	(3.6552)
child5to11	5.5266***	5.5220***	-19.7259***	-18.8419***
	(2.1658)	(2.1030)	(2.9701)	(2.9514)
childolderthan12	4.9496**	4.9468**	0.1872	1.8244
	(2.2562)	(2.3053)	(2.9534)	(2.9380)
age	0.1054	0.1052	-0.9886***	-0.9757***
	(0.0971)	(0.0976)	(0.1181)	(0.1209)
london	3.2804	3.2753	-10.1450**	-11.5210 **
	(4.2184)	(4.1431)	(5.2355)	(5.2580)
south	1.6077	1.6036	0.7042	0.5354
	(2.3417)	(2.3130)	(3.3883)	(3.4115)
eastanglia	5.8223	5.8171	-0.369	9.1913
	(3.9444)	(3.8961)	(3.2166)	(6.5802)
midland	3.6459	3.6439	8.0436	-3.4233
	(3.2123)	(3.1768)	(6.6025)	(3.6410)
north	0.5686	0.5684	-4.0092	-0.2723
	(2.8304)	(2.8096)	(3.6340)	(3.2489)
wales	-2.0266	-2.0258	1.7454	2.5786
	(2.7775)	(2.7644)	(3.3538)	(3.3475)
sex_ratio	-1.5406	-1.5405	3.1524	5.0202
	(3.4150)	(3.3936)	(4.5187)	(4.666)
age_difference	17.6875*	17.6830*	-6.0628	-3.6110
	(9.9533)	(9.8587)	(15.9827)	(15.9872)
female_older	3.3798	3.3791	7.2404*	7.9768**
	(2.6871)	(2.6696)	(4.0146)	(4.0303)
Constant	195.5321***	195.4704***	163.7270***	142.0094***
	(8.0310)	(11.2486)	(10.7306)	(13.3840)
R-squared	0.0575	0.0575	0.2060	0.1888
Sample size	1415	1415	1415	1415

Notes: (***) denotes significance at the 1% level
(**) denotes significance at the 5% level
(*) denotes significance at the 10% level
(f) denotes a variable that has been omitted from the regression model

Appendix 2

Independent variables	*Male*	**Female**
age18_24	0.3553***	0.1589*
	(0.0905)	(0.0845)
age25_34	0.6572***	0.3268***
	(0.0910)	(0.0729)
age35_44	0.6251***	0.3236***
	(0.0817)	(0.0631)
other_white	-0.0546	0.0311
	(0.1403)	(0.1386)
other_ethnic	-0.3271**	-0.3038***
	(0.1436)	(0.1166)
educ1	0.5394***	0.8886***
	(0.1721)	(0.1636)
educ2	0.4198***	0.7533***
	(0.1084)	(0.0911)
educ3	0.3617***	0.6292***
	(0.0818)	(0.0728)
educ4	0.2420***	0.4036
	(0.0812)	(0.0688)
disabled‡	-1.2135***	-0.9592***
	(0.0907)	(0.0828)
mother_work	0.0308	0.0619
	(0.0611)	(0,0499)
mother_work_misc	-0.1011	0.0307
	(0.1094)	(0.0927)
father_work	0.1283	-0.2213
	(0.1681)	(0.1454)
father_work_misc	0.0684	-0.0317
	(0.1869)	(0.1278)
married‡	0.6241***	-0.0572
	(0.0792)	(0.0700)
coh‡	0.2885***	0.0564
	(0.0859)	(0.0702)
divwids‡	0.3671***	0.0710
	(0.1032)	(0.0802)

Table A2.1: (continued)

	Males	**Females**
childlessthan5	0.0092	-0.7413***
	(0.1047)	(0.0650)
child5to11	0.2365***	-0.2378***
	(0.0815)	(0.0548)
childolderthan12	-0.2446***	-0.1209***
	(0.0703)	(0.0544)
mortgage‡	0.7184***	0.5710***
	(0.0647)	(0.0549)
outright‡	0.2325***	0.2295***
	(0.0747)	(0.0694)
Household non-labour income	-0.0527***	-0.0341***
	(0.0033)	(0.0030)
london	0.3093**	-0.11083
	(0.1290)	(0.1094)
south	0.0888	-0.1540**
	(0.0971)	(0.0794)
north	0.0322	-0.0526
	(0.0810)	(0.0688)
eastanglia	0.0120	-0.2181*
	(0.1709)	(0.1336)
midland	0.0677	-0.0935
	(0.0969)	(0.0815)
wales	-0.0856	-0.0895
	(0.0789)	(0.0670)
female_unemployment	-1.6557	4.0860
	(3.9771)	(3.5049)
male_unemployment	-4.5719***	-5.2174***
	(1.8355)	(1.6290)
constant	0.2538	0.4366*
	(0.2373)	(0.1930)
Sample size	4454	4724

Notes: all variables are defined in tables 2.1 (chapter 2) and 3.2 (chapter 3) apart from variables

denoted by ‡ which are defined as follows. "disabled" is a binary variable indicating if the individual

is disabled "married", "coh" and "divwids" are all binary variables indicating whether the individual is married, cohabitating or divorced/widowed respectively. The base category for this set of dummies is single individuals. "mortgage" and "outright" are binary variables indicating whether the individual own their house with a mortgage or outright, with   the base category for estimation being having rented accommodation

(***) denotes significance at the 1% level

(**) denotes significance at the 5% level

(*) denotes significance at the 10% level

Table A2.2: Male and Female wage regressions

	Males	**Females**
age	0.0830***	0.0627***
	(0.0062)	(0.0053)
age_squared	-0.0009***	-0.0007***
	(0.0001)	(0.0001)
educ1	0.7378***	0.8419***
	(0.0617)	(0.0507)
educ2	0.6024***	0.6863***
	(0.0477)	(0.0400)
educ3	0.2850***	0.3237***
	(0.0365)	(0.0340)
educ4	0.1855***	0.1556***
	(0.0335)	(0.0306)
london	0.1852***	0.2484***
	(0.0487)	(0.0494)
south	0.0678***	0.0387
	(0.0279)	(0.0255)
eastanglia	0.1385**	-0.0377
	(0.0571)	(0.0474)
midland	-0.0261	-0.0075
	(0.0290)	(0.0337)
north	0.0297	-0.0006
	(0.0295)	(0.0237)
wales	-0.0330	-0.0663***
	(0.0303)	(0.0233)
Inverse Mills ratio	-0.2582***	-0.2121***
	(0.0880)	(0.0389)
constant	0.3231**	0.5351***
	(0.1383)	(0.1065)

Calculation of marginal effects in a bivariate probit model.

Two types of marginal effects (marginal probability and conditional probability), which are used in chapter two, are derived in this section.
The bivariate probit model used in chapter two is:

$$y*_m = X'_m \beta_m + \varepsilon_m$$
$$y*_f = X'_f \beta_f + \varepsilon_f$$

with

$y_m = 1$	if $y*_m > 0$,	$y_m = 0$	if

$y*_m \leq 0$

$y_f = 1$	if $y*_f > 0$,	$y_f = 0$	if

$y*_f \leq 0$

$$\varepsilon_m, \varepsilon_f \sim BVN(0,0,1,1,\rho)$$

Following Greene (1996, 1998), let $P(y_m, y_f | X_m, X_f) = B[q_m a_m, q_f a_f, q_m q_f \rho]$, $y_j = 0,1$ for $j = m, f$
where $q_j = 2y_j - 1$
$$a_j = \beta'_j X_j$$
and B(.) denotes the bivariate normal CDF.

Define $g_m(c_m, c_f, \rho^*) = \dfrac{\partial B(c_m, c_f, \rho^*)}{\partial c_m}$

$$= \phi(c_m)\Phi\left[\frac{c_f - \rho^* c_m}{\sqrt{1-\rho^{*2}}}\right]$$

and define $g_f(c_m, c_f, \rho^*)$ in a similar way. Let $c_j = q_j a_j$, let γ_m contain all the nonzero elements of β_m as well as some zeros that correspond to variables that are only present in the female equation and finally let γ_f be defined in the same way.
The marginal effect for the conditional probability is derived to be equal to:

$$\frac{\partial \Pr ob[y_m = 1 | y_f = 1]}{\partial X} = \frac{1}{\Phi(X'\gamma_f)}[g_m \gamma_m + (g_f - \Phi_2 \frac{\phi(X'\gamma_f)}{\Phi(X'\gamma_f)})\gamma_f]$$

A similar expression can be derived for $\dfrac{\partial \Pr ob[y_f = 1 | y_m = 1]}{\partial X}$

The marginal effect for the joint probability is equal to: $\dfrac{\delta \Pr ob[y_m = 1, y_f = 1 |}{\partial X} =$

$$g_m \gamma_m + g_f \gamma_f$$

A similar expression can be derived for $\dfrac{\delta \Pr ob[y_m = 1, y_f = 0]}{\partial X}$

Christofides *et al* (1997, 2001) show how to obtain the marginal effect: $\dfrac{\partial \Pr ob[y_m = 1]}{\partial X}$

$$\frac{\partial \Pr ob[y_m = 1]}{\partial X} = \frac{\delta \Pr ob[y_m = 1, y_f = 1]}{\partial X} + \frac{\delta \Pr ob[y_m = 1, y_f = 0]}{\partial X}$$

The same methodology can be applied to obtain the marginal effect: $\dfrac{\partial \Pr ob[y_f = 1]}{\partial X}$

Table A2.3:Mean and standard deviation (in parenthesis) for components of non-labour income (all couples)

	All households	*Dual-earner households*	*Male earner households*	*Female earner households*	*Zero-earner households*
invest_male_income	41	40	47	40	32
	(192)	(186)	(250)	(111)	(115)
invest_female_income	26	27	23	15	25
	(135)	(136)	(163)	(43)	(95)
trans_male_income	4	4	4	2	7
	(68)	(77)	(43)	(14)	(50)
trans_female_income	10	11	9	10	10
	(76)	(78)	(58)	(63)	(101)
benefit_male_income	65	22	41	251	418
	(256)	(217)	(120)	(349)	(419)
benefit_female_income	128	85	224	92	363
	(201)	(125)	(240)	(167)	(407)
pension_male_income	54	29	43	225	207
	(233)	(167)	(194)	(439)	(448)
pension_female_income	7	3	12	11	35
	(55)	(32)	(69)	(66)	(129)
Sample size	2641	1852	461	153	175

Table A2.4: Marginal effects for model with distribution factors

	Marg (m)	*Marg(f)*	*Marg (m)*	*Marg(f)*
male_wage	0.1696***	-0.0464	0.1690***	-0.0484
	(0.0197)	(0.0328)	(0.0198)	(0.0330)
female_wage	0.0466***	0.3843***	0.0463***	0.3856***
	(0.0178)	(0.0338)	(0.0178)	(0.0340)
male_income	†	-0.0746***	†	-0.0762***
		(0.0192)		(0.0192)
female_income	†	-0.3291***	†	-0.3282***
		(0.0327)		(0.0327)
couple_income	-0.0865***	†	-0.0871***	†
	(0.0092)		(0.0092)	
age25_34_m	-0.0186	†	-0.0196	†
	(0.0317)		(0.0314)	
age35_44_m	-0.0436	†	-0.0346	†
	(0.0345)		(0.0337)	
age45more_m	-0.0745**	†	-0.0743**	†
	(0.0321)		(0.0313)	
age25_34_f	†	-0.0873*	†	-0.0455
		(0.0468)		(0.0431)
age35_44_f	†	-0.1610***	†	-0.1242***
		(0.0513)		(0.0474)
age45more_f	†	-0.2113***	†	-0.1800***
		(0.0482)		(0.0457)
male_unemployment	-0.6627***	†	-0.6445***	†
	(0.1984)		(0.1980)	
female_unemployment	†	-0.4188	†	-0.3132
		(0.7185)		(0.7181)
childlessthan5	0.0311**	-0.1627***	0.0341**	-0.1559***
	(0.0129)	(0.0287)	(0.0126)	(0.0284)
child5to11	0.0348***	-0.0224	0.0362***	-0.0198
	(0.0116)	(0.0214)	(0.0115)	(0.0214)
childolderthan12	0.0210*	0.0445**	0.0203*	0.0430**
	(0.0116)	(0.0207)	(0.0117)	(0.0207)
motherinlaw_work	†	†	†	†
motherinlaw_misc	†	†	†	†
sex_ratio	-0.0452***	-0.0802***	†	†
	(0.0167)	(0.0317)		
age difference	†	†	-0.1373***	-0.0937***
			(0.0563)	(0.0996)
female_older	†	†	0.0002	-0.0034
			(0.0193)	(0.0308)

Notes: (***) denotes significance at the 1% level
(**) denotes significance at the 5% level
(*) denotes significance at the 10% level
(†) variable omitted from the regression

Table A2.5: Specification with male and female participation as an endogenous variable

	Model with male participation endogenous	
	Male	*Female*
male_wage	1.2827***	-0.5794***
	(0.1378)	(0.1299)
female_wage	0.4716***	1.2855***
	(0.1330)	(0.1221)
male_income	†	0.0413
		(0.0861)
female_income	†	-0.9907***
		(0.1187)
couple_income	-0.6089***	†
	(0.0604)	
age25_34_m	-0.2353	†
	(0.2065)	
age35_44_m	-0.6885***	†
	(0.1986)	
age45more_m	-0.3506*	†
	(0.2137)	
age25_34_f	†	-0.0966
		(0.1404)
age35_44_f	†	-0.2743*
		(0.1489)
age45more_f	†	-0.4238***
		(0.1414)
male_unemployment	-4.3766***	†
	(1.4789)	
female_unemployment	†	0.8284
		(2.5314)
childlessthan5	0.2886**	-0.5235***
	(0.1244)	(0.0823)
child5to11	0.2915***	-0.1216*
	(0.1028)	(0.0732)
childolderthan12	0.1804*	0.1118
	(0.0995)	(0.0785)
male_working	†	1.3668***
		(0.2249)
female_working	†	†
Constant	-1.6302***	-1.0895***
	(0.3395)	(0.2930)
Correlation coefficient	-0.3970***	
	(0.1193)	

Notes: (***) denotes significance at the 1% level
(**) denotes significance at the 5% level
(*) denotes significance at the 10% level
(†) variable omitted from the regression

Appendix 3

Table A3.1: chi-square statistics (at one degree of freedom) for cross-equation equality of impacts of dependent variables on male and female attitudes

	Specification one	Specification two	Specification three	Specification four	Specification five
age age_squared	2.86	2.59	3.04	1.37	6.88***
other_white other_ethnic	0.71	0.72	0.63	0.68	3.16**
books_unknown books_few books_lot	0.03	0.03	0.02	0.02	0.03
suburb town village rural move	0.002	0.001	0.001	0.001	0.001
live_father_only live_mother_only live_mother_ stepfather live_father_ stepmother live_other	0.01	0.01	0.01	0.01	0.006
mother_som_educ mother_further_educ mother_uni_educ mother_educ_ unknown	8.17***	8.28***	7.5***	7.3***	11.6***
mother_work mother_work_mis	0.0003	0.0006	0.0006	0.0006	0.0003
siblings	0.01	0	0	0	0.04

TableA3.1:(continued)

educ1					
educ2					
educ3	0.003	0.003	0.003	0.003	0.002
educ4					
		0.44	0.33	0.30	0.85
male_income					
		0.37	0.50	0.68	2.36
female_income					
			2.51	2.52	1.90
male_unemployment					
				0.14	0.10
childlessthan5					
				0	0.06
child5to11					
				0.68	0
childolderthan12					
cut off1	0.01	0	0.09	0.24	6.05***
cut off2	0.02	0	0.06	0.18	5.95***

Notes: ** denotes significance at the 5% significance level
*** denotes significance at the 1% significance level