Job Characteristics and Labour Supply

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Job characteristics have been studied from various perspectives. Their influence on labour supply, however, has mostly been neglected. The aim of this paper is thus twofold: First, we propose a consistent conceptual framework, based on Lancaster's approach to consumer theory, for rationalizing such characteristics in conventional theoretical labour supply models. Within this framework, we investigate two main hypotheses: Favorable job characteristics imply (i) lower wage elasticities of labour supply but (ii) larger (less negative) income elasticities. Second, we provide new empirical evidence on the job characteristics-labour supply nexus by estimating a standard discrete choice model using Australian data. The empirical findings lend support to our hypotheses and thus buttress the importance of job characteristics in labour supply decisions.

Keywords: Labour supply; Discrete choice model; Job characteristics

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1 Introduction

Experimental sociologists and psychologists have provided ample evidence from controlled laboratory studies that individuals value work not only as a means of earning income to satisfy their consumption needs but also as a direct source of satisfaction for its social, psychological and non-pecuniary benefits, e.g. Jahoda (1982) or Loewenstein & Issacharoff (1994)[1].

Subsequent empirical work on the role of job characteristics in employment relationships focused largely on their impact on job satisfaction (see e.g. Benz & Frey (2008b)) or, more generally, on life satisfaction (Lüchinger *et al.*, 2010). The findings of these studies suggest that favorable job characteristics are associated with significant higher job and life satisfaction. Another strand of literature, inspired by the seminal work of Rosen (1974), demonstrates that job characteristics may account for wage differentials (Villanueva, 2007, Wells, 2010).[2]

By contrast, few studies so far have focused on the impact of job characteristics on labour supply.[3] An important exception is the seminal paper by Atrostic (1982) who shows that, when taking into account job characteristics, wage and income elasticities of labour supply differ from those usually found

[1]See Warr (2007) for a survey of the literature.

[2]The theory of hedonic wages and the particular impact of job characteristics for this theory have also been extensively studied in the context of labour market search models, see e.g. Hwang *et al.* (1998). Similarly, the value of a statistical life literature, in the tradition of Viscusi (1978), emphasises the importance of earnings premiums for job hazards.

[3]Excellent surveys reporting evidence on elasticities for different countries, different periods and different methods are e.g. Blundell & MaCurdy (1999), Meghir & Phillips (2010) and Keane (2011).

in the literature. Also, Altonji & Paxson (1986) provide evidence that work hours of individuals are heavily influenced by the characteristics of specific jobs. The results of these studies indicate that the quality of a job is an important determinant of labour supply. However, to the best of our knowledge, recent empirical evidence on the role of job characteristics in labour supply decisions is lacking.[4] Thus, this is the first paper analysing the systematic influence of job characteristics on labour supply elasticities using discrete choice models.

Moreover, the conceptualization of job characteristics in labour supply models is far from being clear: Whereas Atrostic (1982) models job characteristics in terms of goods, Altonji & Paxson (1986) completely refrain from an explicit modeling. Alternative approaches, in turn, ascribe observed effects for employment status to specific job characteristics, as for example a high degree of autonomy for self-employed (Benz & Frey, 2008a,b). While data limitations may reasonably account for this methodological heterogeneity in empirical work, they do not, however, for theoretical analysis.

The aim of this paper is to fill both the conceptional and the empirical gap. To do so, in the theoretical part of the paper, we suggest a consistent conceptual framework of modeling job characteristics based on Lancaster's 'characteristics approach' (Lancaster, 1966a,b), originally designed as a fine grain theory to consumer demand. While there is clearly no role for job char-

[4] A potential explanation of why the importance of job characteristics in labour supply decisions has mostly been neglected in recent years is that the literature on labour supply has primarily been concerned with a huge array of econometric issues, in particular since the 1980s. Still, there is not only little consensus about these issues so far, but rather an intense controversy, see e.g. Keane (2011).

acteristics in the standard neoclassical theory of labour supply[5], the main idea of Lancaster's approach is to define preferences over characteristics of commodities rather than over commodity bundles themselves. At the heart of this framework is a (linear) consumption-technology transforming commodity bundles into bundles of characteristics that provide utility to the individual consumer.[6] As these characteristics are readily implemented into conventional choice analysis, our approach can be viewed as a modification of the standard neoclassical model[7] in order to rationalize the existence of job characteristics. This also means that other forms of labour, as e.g. informal or voluntary work, could easily and consistently be accommodated.

Within such a model one would expect differing behavioral responses to increasing monetary incentives depending on the characteristics provided by a specific job. Indeed, using a simple special case of Lancaster's model we illustrate theoretically, that such a conjecture is valid. In particular, we show that a job which provides more favorable characteristics (as e.g. one with

[5]In its simplest form, this theory posits that each individual disposes of a limited amount of time, which he or she chooses to allocate between paid and homogenous work and leisure. This basic trade-off between consumption and leisure ultimately determines the properties of the supply of labour, see e.g. Cahuc & Zylberberg (2004) for an overview of the neoclassical model of labour supply and several extensions of the basic framework.

[6]After all, Rosen (1974)'s seminal work on hedonic wages can be viewed as an augmentation of Lancaster's approach with an equilibrium analysis. Likewise, Sen (1985, 1992) integrates Lancaster's characteristics into his capability approach. This in turn, provides an additional motivation of why agents may, in fact, demand characteristics, since these are conceived as means for functioning achievements–the doings and beings individuals ultimately have reason to value.

[7]In fact, the neoclassical model represents a special case of Lancaster's approach.

a higher degree of autonomy) implies a smaller wage elasticity and a less negative income elasticity of hours worked as compared to a job with less favorable characteristics. Also, we demonstrate that a more favorable job inhibits a smaller substitution elasticity. Empirical support of these findings would then be important by itself, since it would corroborate the results of Atrostic (1982).

In the empirical part of the paper, we employ a standard discrete choice model of family labour supply (van Soest, 1995, Hoynes, 1996) to examine the effect of job characteristics on labour supply elasticities and thus to provide novel evidence on the role of such characteristics in labour supply decisions. Job characteristics are assumed to be objective, measurable and, in particular, individually fixed as we are interested in labour supply responses—given the observed job characteristics rather than studying occupational choice. They are incorporated into the empirical framework by assuming that more favorable characteristics increase the opportunity costs of leisure. Technically, job characteristics are modeled as preference shifters for the number of hours worked.

We test our hypothesis using data from the Household, Income and Labour Dynamics in Australia (HILDA) Survey. The survey contains 12 measures of self assessed job characteristics (Summerfield *et al.*, 2011). Using a confirmatory factor analysis, we extract four factors, namely autonomy related to decision making in a particular job, workload, variety and job security[8]. These factors are then dichotomised into 'good' and 'bad' and we assess whether the resulting wage and income elasticities differ significantly among individuals

[8]See e.g. Wells (2010) for a similar analysis.

having either a 'good' or a 'bad' job.

In our study, we show that labour supply decisions critically depend on the characteristics provided by a specific job. This result holds both for men and women. While previous studies have documented differing elasticities depending on whether job characteristics have been taken into account at all (e.g. Atrostic (1982)), the present study shows that this result also holds for the distinction between good and bad job characteristics. More specifically, differences of average wage and income elasticities by job characteristics are significantly different from zero based on bootstrap standard errors. Our main hypothesis, lower wage elasticities and less negative income elasticities for better job characteristics, is confirmed for all four factors. Also, our results indicate that omitting job characteristics from labour supply models imply both larger wage and income elasticities.

Our findings complement the literature in important ways. First, we extend the standard neoclassical model of family labour supply allowing for job characteristics to shed light on the nature of the relationship between such characteristics and labour supply elasticities. Second, we incorporate job characteristics into an empirical discrete choice model of labour supply to test whether differences in choices of individual hours worked are brought about by differences in non-pecuniary qualities of a specific job. We thus provide for both a theoretical and empirical link between job characteristics and the number of hours worked. Finally, we show that these differences in hours worked translate into significantly different labour supply elasticities. Our findings are fundamental, since they indicate that labour supply is strongly driven by job-related determinants other than the wage rate and

non-labour income.

Furthermore, given that the quality of jobs differs not only across individuals and their personal characteristics, but also across countries, our findings may contribute to explain cross country variations in labour supply elasticities that have been recently documented by Bargain *et al.* (2012). Additionally, our results are highly relevant for the design of the tax system, especially for low income families, see e.g. Blundell & Shephard (2012) for a recent analysis, and also for optimal income taxation in general, see Meghir & Phillips (2010) and Keane (2011).

The remainder of the paper is organised as follows. The next section provides an overview of Lancaster's characteristics approach to consumer theory and derives and illustrates our main hypothesis within this framework. Section 3 first gives on overview over the Australian tax and transfer system and subsequently sets up the empirical model and describes our data. Section 4 presents the results and Section 5 ends with some concluding remarks.

2 Theoretical Background

In this section we first summarise the main insights of Lancaster's consumer theory (Lancaster, 1966a) relevant for our analysis and will then develop a special case of his model in order to derive and illustrate our main hypotheses.

2.1 Lancaster's characteristics approach to consumer demand

The main idea of Lancaster's approach is that goods, per se, do not provide utility to the consumer but instead the characteristics these goods possess. The same good may possess more than one characteristic, and the same characteristics may well be obtained by more than one good. Moreover, characteristics are considered to be objective and measureable. For instance, a meal provides (i) a certain caloric content, (ii) a nutritional composition, (iii) aesthetic characteristics, but also (iv) the material device for a social dinner.

The technical relationship that transforms goods into characteristics is called the (linear) consumption technology.[9] Utility or preference orderings are assumed to rank collections of characteristics whereas collections of goods are only ranked indirectly through the characteristics they possess. Formally, Lancaster's consumer-choice programm can be stated as follows:

$$\max_{z} \quad U(z) \tag{1}$$

$$\text{subject to} \quad px \leq k \tag{2}$$

$$\text{with} \quad z = \Phi x \tag{3}$$

$$z, x \geq 0. \tag{4}$$

where $U(z)$ is a standard neoclassical utility function operating on character-

[9] Inspired by the criticism of Hendler (1975), who argues, based on a large psychological evidence, that there is no strong reason for the technology to be linear, Rustichini & Siconolfi (2008) have recently extended the analysis to allow for a nonlinear consumption-technology.

istics and defined on characteristics-space (C-space). The budget constraint $px \leq k$ is defined on goods-space (G-space). The equation system $z = \Phi x$ represents the transformation between G-space and C-space where the matrix Φ describes the consumption technology of the economy. Consumer choices can either be studied in the goods-space (as in the traditional analysis) or in the characteristics-space.[10]

As the focus of the present paper is on job characteristics and labour supply, we will now develop a special case of the above model in order to derive testable implications about the relationship between the characteristics provided by a specific job and the individual's choice of hours worked. To do so, consider $N+1$ goods, i.e. $x = (L_1, L_2, \ldots, L_n, \ldots, L_N, C)'$, where C denotes a consumption good and each of the other N goods, L_n, represents a specific amount of time spend on consuming that respective good. Therefore, each L_n is called an activity in the following and the total amount of time spent on these activities is normalised to unity, which implies $\sum_{n=1}^{N} L_n = 1$.[11] Moreover, we assume that each activity provides K characteristics while there is only one characteristic specific to the consumption good. The respective consumption technology Φ is a $(K+1) \times (N+1)$ matrix. Since we focus on labour supply, it is further assumed that consumption fails to provide any of the K characteristics related to activities and none of the activities provides the consumption characteristic. Consequently, each entry of the matrix Φ,

[10] One important example of an analysis in the C-space is the so called efficiency substitution effect which implies that consumers may change goods collections as a result of compensated relative price changes, simply in order to obtain the same characteristics collection in the most efficient manner.

[11] Note that a more elaborated version of this framework also allows consumption being a time consuming good (Lancaster, 1966a).

denoted by $\phi_{kn} \geq 0$, determines the amount of characteristic k provided by spending one unit of time on activity n. There are thus several activities that provide various combinations of characteristics. In general, however, characteristics cannot reasonably assumed to be unique to one specific activity. For instance, a certain level of autonomy may well be provided by both job-related and recreational activities.

Applying this approach directly to an empirical setup, however, faces two key problems: First, it not only requires information about all the coefficients ϕ_{kn} in order to construct Φ but also about the individuals' chosen amounts of each activity L_n. Second, assumptions on the individual choice sets have to be made, since not everybody can reasonably choose every L_n.

The present approach, therefore, focusses on two activities: A *labour activity* providing a remuneration and certain amounts of selected characteristics and a *residual activity*, possibly containing both recreational and volunteering activities, which provides certain amounts of the same selected characteristics. Moreover, we abstract from occupational choice in our cross-sectional setting and only consider quantitative differences regarding hours worked, given specific job characteristics. More precisely, we fix the job characteristics at their empirically observed value and assume that an individual engages exclusively in this specific labour activity.

As the focus of the empirical analysis will be on couples' labour supply, we interpret C as consumption of the family in the following and denote each spouses' time spent on the labour and residual activity as L_1,L_2 and

$1-L_1, 1-L_2$, respectively. The vector x can thus be written as

$$x = (L_1, 1-L_1, L_2, 1-L_2, C)'. \tag{5}$$

Furthermore, confining the theoretical analysis to one (job-) characteristic per spouse only and normalizing some of the coefficients to unity, the consumption technology Φ reduces to the following simple form:

$$\Phi = \begin{pmatrix} \phi_1 & 1 & 0 & 0 & 0 \\ 0 & 0 & \phi_2 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{pmatrix} \tag{6}$$

The third characteristic is exclusively obtained by the consumption good, whereas the other two characteristics are obtained as a linear combination of the labour and the residual activity by each spouse, respectively. For example, a given amount of autonomy is realised with a specific number of working hours in combination with a certain amount of leisure time.

The parameter ϕ_i $(i = 1,2)$ measures the productivity of the labour activity relative to the residual activity in generating one unit of the respective characteristic. As the residual activity, $1-L_i$, is a combination of several distinct activities, including recreational ones and volunteering, we assume $\phi_i < 1$ $(i = 1,2)$ in our subsequent analysis. This indicates that there is at least one activity which is more productive in obtaining that characteristic.

The focus of our analysis, however, will be on the impact of an increase in ϕ_i on labour supply decisions. More specifically, such an increase is interpreted as an improvement in the characteristics provided by the working

activity (e.g. a varied job), as the amount of z_i $(i = 1,2)$ increases for a given number of hours worked.[12] Using (6), equation (3) can finally be written as

$$z = \Phi x = \begin{pmatrix} \phi_1 L_1 + (1 - L_1) \\ \phi_2 L_2 + (1 - L_2) \\ C \end{pmatrix}. \tag{7}$$

2.2 Hypotheses

In order to keep the analysis tractable and to derive analytical solutions, we restrict the utility function, defined on the characteristics space, to be of the Cobb-Douglas type. We can thus write the household maximization problem as follows:

$$U(z) = \alpha_1 \ln(z_1) + \alpha_2 \ln(z_2) + (1 - \alpha_1 - \alpha_2) \ln(z_3) \tag{8}$$

$$\text{s.t.} \quad C = w_1 L_1 + w_2 L_2 + R_1 + R_2 \tag{9}$$

$$z = \Phi x \tag{10}$$

where x and Φ are given by equations (5) and (6), respectively. R_i $(i = 1,2)$ is individual i's exogenous amount of non-labour income. The above preference representation implies concavity of the utility function in z_i $(i = 1,2,3)$. Moreover, by transforming the utility function into the goods space, it is straight forward to see that U is concave in L_i and C, i.e. $U_{L_i} < 0, U_{L_i L_i} < 0$

[12] In the empirical part of the paper we further assume that ϕ_i is a discrete variable which takes only two values, ϕ_i^b and ϕ_i^g, representing a bad or good job, respectively. In the following, however, ϕ_i is assumed to be continuous.

and $U_C > 0, U_{CC} < 0$.[13] Furthermore, the utility function is increasing in ϕ_i ($i = 1,2$), i.e. $U_{\phi_i} > 0$, so that an improvement in the quality implies a higher level of individual utility. Finally, favourable job characteristics increase the opportunity costs of leisure, i.e. $U_{L_i\phi_i} > 0$.

Given these specific functional forms, we get:

$$L_i^* = \frac{1-\alpha_i}{1-\phi_i} - \frac{\alpha_i}{w_i}\left(\frac{w_j}{1-\phi_j} + R\right) \tag{11}$$

with $i = 1,2$; $j = 1,2$ and $j \quad i$. Clearly, optimal labour supply L_i^* is decreasing in the level of non-labour income R and the spouses' wage level w_j, whereas it is increasing in the own wage rate w_i and the quality of the job ϕ_i. Using (11) allows us to derive explicit solutions for wage and income elasticities of labour supply:

$$\epsilon_{L_i^*}^{w_i} = \frac{1}{\frac{(1-\alpha_i)(1-\phi_j)}{\alpha_i(1-\phi_i)}\frac{w_i}{w_j+(1-\phi_j)R} - 1} \tag{12}$$

and

$$\epsilon_{L_i^*}^{R} = -\frac{R}{\frac{(1-\alpha_i)w_i}{\alpha_i(1-\phi_i)} - \left(R + \frac{w_j}{1-\phi_j}\right)} \tag{13}$$

with $i = 1,2$; $j = 1,2$ and $j \quad i$. Note that $\epsilon_{L_i^*}^{R} < 0$ as long as $L_i^* > 0$. In empirical applications, however, the income elasticity with respect to non-labour income is typically very small and not well defined for a large share of the population for which non-labour income is zero. In order to account for this shortcoming, we also consider elasticities with respect to potential income,

[13] Note that the characteristics approach in general also allows positive utility, rather than disutility associated with labour. In our case $\phi_i < 1$ accounts for *disutility* of labour.

being defined as the sum on non-labour income and wage income if the total time endowment is devoted to working, see e.g. Cahuc & Zylberberg (2004) and also the discussion in Atrostic (1982) about different income concepts. To derive the potential income elasticity, note that the residual activity is given by $F_i = 1 - L_i$ $(i = 1,2)$ where individual's time endowment is normalised to one. Equation (11) can now be rewritten as follows:

$$L_i^* = \frac{1-\alpha_i\phi_i}{1-\phi_i} - \frac{\alpha_i}{w_i}\left(\frac{\phi_j}{1-\phi_j}w_j + R_0\right) \tag{14}$$

where $R_0 = R_1 + R_2 + w_1 + w_2$. Then, we obtain

$$\epsilon_{L_i^*}^{R_0} = -\frac{R_0}{\frac{(1-\alpha_i\phi_i)w_i}{\alpha_i(1-\phi_i)} - \left(R_0 + \frac{\phi_j}{1-\phi_j}w_j\right)} \tag{15}$$

with $i = 1,2$, $j = 1,2$ and $j \quad i$. Differentiating (12), (13) and (15) with respect to ϕ_i yields our main hypothesis:

$$\partial\epsilon_{L_i^*}^{R}/\partial\phi_i > 0, \quad \partial\epsilon_{L_i^*}^{w_i}/\partial\phi_i < 0 \quad \text{and} \quad \partial\epsilon_{L_i^*}^{R_0}/\partial\phi_i > 0. \tag{16}$$

As a result, our simple model predicts a lower wage income elasticity and a higher (less negative) non-labour as well as potential income elasticity for better jobs (captured by an increase of ϕ_i). Note that those results also imply a smaller Hicksian substitution elasticity $\bar{\epsilon}_{L_i^*}^{w_i}\Big|_{U=\bar{U}}$ for more favorable

job characteristics given the Slutzky equation, i.e.:

$$\bar{\epsilon}^{w_i}_{L^*_i}\Big|_{U=\bar{U}} = \frac{\alpha_i(1-\alpha_i)\left[\frac{1}{1-\phi_i} + \frac{w_j}{w_i(1-\phi_j)} + \frac{R}{w_i}\right]}{\frac{1-\alpha_i}{1-\phi_i} - \frac{\alpha_i}{w_i}\left[\frac{w_j}{1-\phi_j} + R\right]} \tag{17}$$

with $\partial\bar{\epsilon}^{w_i}_{L^*_i}\Big|_{U=\bar{U}}/\partial\phi_i < 0$. Consequently, the smaller substitution elasticity dominates the less negative income elasticity as the wage elasticity unambiguously decreases with ϕ_i. Intuitively, labour becomes relatively more attractive: Substitution towards the residual activity (e.g. leisure) decreases for higher wages whereas the reduction of labour supply for an increase in non-working income is smaller. To test these predictions empirically is the aim of the next section.

3 Empirical Analysis of Labour Supply

Before discussing our empirical model and estimation strategy, we briefly provide some key features of the Australian tax and benefit system.

3.1 The Australian Tax and Benefit System

The key components of the Australian family income tax system are the Personal Income Tax (PIT), the Low Income Tax Offset (LITO), the Dependent Spouse Tax Offset (SPOUTO), the Mature Age Tax Offset (MATO), Medicare Levy (ML) and net of cash transfers under Family Tax Benefits Part A (FTB- A), Family Tax Benefits Part B (FTB-B), New Start Allowance (NSA) and Rent Assistance (RA). These instruments will be used in our empirical

analysis to calculate net household incomes for a given gross income.[14]

The tax base for the PIT, LITO and MATO is individual income, whereas the tax base of the ML and the SPOUTO is partly joint income, due to the withdrawal of exemption limits on family income or the taxable income of the taxpayer's spouse, respectively. Cash transfers under FTB-A are also withdrawn on family income.

The marginal rate scale of the 2009-10 PIT is strictly progressive, beginning with a zero rated threshold of $6,000, followed by rates of 15%, 30% and 38% up to an income of $180,000, and thereafter a top rate of 45%. However, when the LITO is added, strict progressivity is lost. In 2009-10 the LITO provided a tax credit of $1350, phased out at 4 cents in the dollar on individual incomes above $30,000. While the LITO is applicable for low income households, MATO applies to employed persons aged 55 years and over and is equal to 5% of wage and salary income net of deductions up to a maximum of $500. It is reduced for wage and salary income net of deductions in excess of a threshold ($53,000) at a rate of 5%. SPOUTO is accrued in addition to any other offsets to which the taxpayer is eligible. The maximum offset is $2,159, phased out at 25 cents in the dollar on the taxable income of the taxpayer's spouse above $9,254. SPOUTO is not available if the taxable income of the taxpayer is above $150,000 or if the taxpayer is eligible to FTB-B. In addition to the preceding tax offsets, we also account for any other offsets

[14]The aim of this section is to give a detailed description of those parts of the tax transfer system that are taken into account in our empirical analysis. We however do not assess their impact on the overall tax system (e.g. regarding progressivity of the PIT or issues of joint taxation). See Apps *et al.* (2012) for more information.

by assuming that an average national tax reduction of 2% of taxable income applies as a flat rate to all taxpayers (Wilkins, 2009).

The ML raises marginal tax rates by 1.5 percentage points for taxpayers with incomes above specified thresholds for exemption categories or reductions. For a family with more than one child, the exemption threshold income is based on family income and varies with the number of children. In 2009-10 the family income limit for a full reduction for a two-parent family was $31,196, plus $2,865 for each dependent child or student. The exemption is withdrawn at a rate of 10 cents in the dollar above this limit.

FTB-A provides a cash transfer for each dependent child, with the size of the transfer varying with the age of the child. The 'Maximum Rate' of FTB-A in 2009-10 for a child under 13 years was $4,080.44. This maximum payment is withdrawn at 20 cents in the dollar on a family income over $44,165 up to the 'Base Rate' of $1,750.84 pa. The Base Rate is withdrawn at 30 cents in the dollar at a higher family income threshold that depends on the number of dependent children, e.g., for a family with two dependent children, the income threshold for the Base Rate is $98,112.

FTB-B provides a payment of $3,899.41 pa for a family with a child under 5 years. The payment is withdrawn at a rate of 20 cents in the dollar on a second income above $4,745.

RA is a government cash benefit paid to renters residing in private accommodation. Income support recipients and families receiving more than the base rate of FTB A are eligible for the benefit which is paid at the family level. A family comprises a single person or couple together with any dependent children. The amount of RA generally depends on the annual rent

payable, as well as on partner status and the number of dependent children. Similarly, the basic rates of NSA which is an unemployment benefit for individuals aged between 21 and 65 who are willing to undertake a suitable paid employment, vary with partner status and the number of dependent children and are subject to an income test.[15]

3.2 Data and Model Specification

In this section we specify a discrete choice labour supply model along the lines of van Soest (1995) and Hoynes (1996), to obtain estimates of labour supply elasticities with respect to income and wages. The main advantage of the unitary model is that it can be used to study non-linear budget constraints, fixed costs and participation problems in a family labour supply setting.[16] The focus of this paper is on a household labour supply function where both spouses jointly maximise utility. The household's labour supply decision is modeled by a utility function, which is assumed to depend on household's net income (y) and the hours worked of the male (hm) and the female (hf) spouse. Following Keane & Moffitt (1998), this utility function is defined as a second order polynomial with interaction between the wife and the husband terms plus a random disturbance that is assumed to follow

[15]See http://www.centrelink.gov.au/internet/internet.nsf for an overview of the current Australian social security system and http://www.ato.gov.au for more information about the Australian tax system.

[16]Still, it is controversial and researchers have recently tried to figure out whether the unitary model or the alternative approach, namely the collective model of labour supply, better fits the data. While Fortin & Lacroix (1997) finds that the unitary model only fits couples with pre-school-age children, Blundell *et al.* (2007) shows that the unitary model cannot be rejected.

a type I extreme value distribution:

$$\begin{aligned} U_{ij}(y_{ij}, hm_{ij}, hf_{ij}) = & \alpha_1 y_{ij}^2 + \alpha_2 hm_{ij}^2 + \alpha_3 hf_{ij}^2 + \alpha_4 y_{ij} hm_{ij} + \alpha_5 y_{ij} hf_{ij} \\ & + \alpha_6 hm_{ij} hf_{ij} + \beta_1 y_{ij} + \beta_2 hm_{ij} + \beta_3 hf_{ij} \\ & + \gamma_m FSm_{ij} + \gamma_f FSf_{ij} + \epsilon_{ij}. \end{aligned} \tag{18}$$

In order to allow for individual and job characteristics affecting the utility, the coefficients of the linear terms are defined as follows:

$$\beta_l = \sum_{n=1}^{N_l} \beta_{nl} x_{nl} \quad l \in 1,2,3 \tag{19}$$

where x_{nl} represent individual characteristics as well as job characteristics. Moreover, as in Euwals & Van Soest (1999), we include fixed savings from not working for both spouses in order to improve the model's fit. These savings, denoted FSm_{ij}, FSf_{ij}, are non-zero (equal to one) for positive hour choices and are further allowed to vary with observed individual characteristics z_{nk}, i.e.

$$\gamma_k = \sum_{n=1}^{N_k} \gamma_{nk} z_{nk} \quad k \in m, f. \tag{20}$$

Our estimation strategy is based on the conditional logit model.[17] In

[17] As is well known, the most prominent drawback of conditional logit models is the property called independence of irrelevant alternatives (IIA). However, while more general discrete choice models may well circumvent these drawbacks, each of these more flexible specifications faces certain limitations: Whereas the parametric random coefficient model may incur enormously high computational costs, implying that bootstrap standard errors for labour supply elasticities are typically not available, convergence and robustness of the estimation is often problematic for the nonparametric random coefficient model (Cameron & Trivedi, 2005, Ch.18.5). As a result, most

a companion paper (Kunze & Suppa, 2013), however, we demonstrate that wage and income elasticities of labour supply derived from the standard and from (non-)parametric random coefficient models do not differ significantly.[18] We therefore conjecture that our key results carry over to more sophisticated models.

To estimate the model, data from the tenth wave of the Household, Income and Labour Dynamics in Australia (HILDA) survey are used. The survey provides data on a wide range of socioeconomic variables for a representative sample (17,000 respondents) of the Australian population, who have been followed annually since the year 2001. Particularly relevant to this study are the data on job characteristics. The year of analysis is 2010. We focus on households with a partnered or married couple where both spouses have a flexible labour supply. We thus exclude couples in which either spouse is a civil servant, self-employed or student. Several other sample restrictions are imposed: We drop families in which one member of the couple was over 65 years old or younger than 25. Also, we drop observations due to missing or implausible high or low values.[19]. Our estimation sample then consists of 1881 households of couples with and without children.

Table 1 provides some summary statistics of the sample. We observe between 0 and 80 working hours per week, measured in one-hour units. In line with the empirical literature, the discrete labour supply points are chosen

applied work is based on the standard conditional logit model.

[18]These results are in line with recent findings by Haan (2006) and Pacifico (2012).

[19]Specifically, we trim the bottom and top 1% of the distributions of hourly wages, hours worked, and non-working income to exclude outliers.

to represent the actual observed distribution of hours worked in the sample. Specifically, we define 15 alternatives of working hours a household can choose from: Men can choose between non-employment (0-1 hours), regular time (2-45 hours) and overtime (>45 hours), whereas there are two part-time categories (2-25 hours and 26-35 hours), one regular time (36-45 hours) and one overtime category (>45 hours) for women. Figure 1 shows both the actual distribution of hours worked and the resulting discretization for both spouses. The discrete hours points are set to the average number of hours worked observed in each of these intervals, and the average number of hours worked is used to determine the corresponding labour income at that labour supply point.

To estimate the probability that household i chooses one of the 15 alternatives j, we need to know the budget constraint in order to determine the household net income associated with each choice j. For workers, we use their observed annual gross wage. For non-workers, gross wages are estimated by applying a two-step Heckman selection model in order to control for selection into employment[20]. Results of the selection model are presented in table 2. We then calculate the expected gross labour income at different

[20]The participation decision for employment is estimated as a function of age, age squared, education, gender, state, the time spent in the workforce as well as the time being unemployed and family circumstances including marital status, number of children and non labour income. The wage equation additionally includes tenure, occupation and industry whereas the variables describing family circumstances are used as exclusion restrictions. Note further that missing values of unemployed individuals for occupation and industry are either imputed by using past values from the 2005-2009 waves if available or are randomly drawn from the distribution of these characteristics among non-working individuals.

choices of hours worked. The sum of resulting expected gross labour income and other non-labour income for both spouses is used to compute taxes paid and family payments received by both partners based on the relevant tax and transfer system as outlined in the previous section. The annual non-labour income of the couple is computed as the sum of each partner's business income, investment income and private domestic pension. According to table 1, around 46% of wives have non-zero (taxable) non-working income, while 54% of the husbands in the sample have non-zero non-working income.

These income data are used to derive the set of 15 family incomes, net of the taxes and benefits, associated with the discrete time use choices. Hence, the net-household income of household i when choosing alternative j can be written as follows:

$$y_{ij} = w_{im} hm_j + w_{if} hf_j + nly_i + TB(w_{im}; w_{if}; hm_j; hf_j; nly_i; x_i) \tag{21}$$

where w_{if} and w_{im} are the hourly gross wages from employment for women and men respectively; nly_i is the household non-labour income and the function $TB(.)$ represents the tax-benefit system, which depends on the gross wage rates, hours of work, household non-labour income and household characteristics x_i.

Job characteristics are measured using self-assessed items provided by HILDA. We conduct a confirmative factor analysis with a congeneric setup based on 12 selected indicators (see Table 3) and allow for four latent factors, labeled autonomy, security, variety and workload. Each characteristic is assumed to be objectively measurable and refers to a specific amount ac-

cessible through a certain job in line with Lancaster's approach. Moreover, the selection of characteristics is based on both psychological research (Warr, 2007) as well as on data availability. Table 4 provides the results. The factor autonomy is meant to capture opportunities for personal control and employee discretion. By contrast, workload may contain quantitative and qualitative aspects such as task or attentional demands while variety allows for both variation in job content and location. Finally, security accounts for the prospects and imponderability of the (financial) future. Factor scores are predicted and dichotomised using means as thresholds.[21]

4 Estimation Results

Table 5 shows the estimation results of the conditional logit model when job characteristics are either excluded (column 1) or included (column 2). Due to the complex structure of the model interpretation of individual coefficients is not straight forward. Still, all coefficients of the interaction terms containing job characteristics have the expected sign and all of them (except job variety for females) are significantly different from zero. A significant positive coefficient, for example, implies that both utility and marginal utility of labour are increasing with the respective job characteristic. These implications are in line with the predictions of our theoretical model outlined in section 2.2.

Average elasticities of husband's and wife's expected hours worked with

[21]Missing values of job characteristics for non-working individuals are predicted using a probit model with sample selection and the same explanatory variables as for wage imputations. To those individuals with positive hours worked but missing job characteristics (they failed to return the self completion questionnaire) we apply simple regression based imputation techniques.

respect to before tax wage rates, taxable family non-labour income and potential taxable family income are presented in Table 6. In deriving these elasticities, the tax and benefits system described in Section 3.1. is fully taken into account. Furthermore, calculation is based on the frequency approach which consists of simply averaging the probability of each discrete choice over all households before and after a change in wage rates or (potential) unearned income.[22] Own wage elasticities for both men and women are rather small but significantly positive at conventional levels of significance. Also, they are larger for women than for men in line with most of the existing literature. Income elasticities are significantly negative and much larger for the potential income as compared to the family non-labour income as expected. Moreover, both income elasticities are approximately two times larger for women. However, the inclusion of job characteristics clearly reduces both wage and income elasticities indicating that the omission of these non-pecuniary aspects in labour supply models leads to remarkably larger average elasticities.

Figure 2 shows wage and income elasticties by spouse and job characteristic along with their bootstrap-based 95%-confidence intervals. For all four characteristics, we find smaller wage elasticities and less negative income

[22]As a robustness check, however, we also applied the calibration approach (see Creedy & Kalb (2005)) which consists of repeatedly drawing a set of random terms for each household from an EV-I distribution (together with terms for unobserved heterogeneity). This in turn generates a perfect match between predicted and observed choices. Keeping the same draws when predicting labour supply responses to an increase in wages or non-labour income and averaging individual responses over a large number of draws provides robust transition matrices.

elasticties to be associated with better job characteristics, which provides first evidence for our hypothesis. For example, average wage elasticities for individuals with 'bad' jobs (both for men and women) are in the range of .075-.1 whereas those for 'good' jobs are below .05. In order to test our hypothesis explicitly, we bootstrap the difference of the respective elasticities to obtain adequate standard errors. Table 7 demonstrates our key result, namely that wage and income elasticities differ significantly across job characteristics. More specifically, each entry of Table 7 shows, for a given elasticity, its difference for the values of the respective characteristic, along with their standard errors. Clearly, wage elasticities of both spouses are significantly lower for those individuals having a better job. Moreover, potential and non-labour income elasticities are significantly larger. Therefore our findings generally confirm our hypothesis that job characteristics indeed affect labour supply decisions. Less negative income elasticities indicate a less pronounced reduction in labour supply and, together with smaller wage elasticities, imply a smaller substitution elasticity based on the Slutzky equation. Intuitively, labour becomes a relatively more attractive activity as monetary incentives forfeit relevance.

These results are robust against several variations of the basic framework: First, we have looked at alternative discretizations of the number of hours worked, e.g. an equidistant division as in van Soest (1995)[23]. Second, we have used an exploratory factor analysis as in Wells (2010) instead of a confirmatory one. Third, we have altered the threshold for dichotomizing

[23]More precisely, we have used two equidistant discretizations with either interval length of eight and 10 hours, respectively.

job characteristics, using gender specific means instead of the same mean for both men and women. Fourth, we have varied the number of preference shifters to include e.g. a dummy for higher education and the presence of children aged below four or to exclude all income preference shifters. Finally, for predictions of labour supply effects, we have also used the calibration method whereas the baseline estimates rely on the frequency approach. While each of these changes clearly has an effect on the estimation results and thus on the level of the respective elasticities, the significant differences of these elasticities among job characteristics persist.[24] In sum, our robustness checks therefore buttress our main findings.

5 Concluding Remarks

This paper shows that job characteristics are an important determinant of labour supply decisions. In the theoretical part of the paper we draw upon Lancaster's characteristics approach (Lancaster, 1966a) in order to develop a theoretical framework that allows us to derive testable implications about the relationship between job characteristics and the number of hours worked. More precisely, we extend the unitary model of family labour supply to include job characteristics and demonstrate that wage elasticities are smaller while income elasticities are less negative for individuals whose job provides more favorable characteristics. This in turn implies a less negative substitution elasticity.

In the empirical part of our paper we first show that the omission of

[24] These robustness results are available from the authors upon request.

job characteristics in labour supply models generally implies larger average elasticities. Testing the theoretical predictions using a discrete choice model we find both higher utility and marginal utility of labour given favorable characteristics and that a good job is indeed associated with significantly lower wage elasticities and larger (less negative) income elasticities. These results hold for both men and women. Intuitively, labour becomes relatively more attractive or, put differently, better job characteristics increase the opportunity costs of leisure. Our findings therefore complement earlier empirical evidence by Atrostic (1982). While her findings demonstrate that labour supply elasticities differ depending on whether job characteristics are taken into account or not, our evidence quantifies the differences in labour supply elasticities across individuals for a set of specific characteristics extracted by factor analysis. We document significant differences in labour supply responses across individuals with good or bad characteristics, as e.g. a high or low degree of autonomy.

Our findings are highly relevant from a policy perspective. In particular, as the success of the design of low-income support critically depends on individual labour supply responses and therefore on the quality of jobs these individuals possess. Similarly, our results may have important implications for the optimal design of earnings taxation.

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Table 1: Summary Statistics

	count	mean	sd	min	max
hoursworked	1881	37.85	18.58	0	80
part_hoursworked	1881	22.25	17.78	0	65
educD	1881	0.61	0.49	0	1
part_educD	1881	0.58	0.49	0	1
nwinc	1881	5917.33	16304.59	-24000	121000
nwinc_part	1881	2854.04	8911.64	-8000	78000
nwincNZ	1881	0.54	0.50	0	1
nwincNZ_part	1881	0.46	0.50	0	1
hhnetinc	1881	93154.86	43119.45	0	396253
Nchildren	1881	0.87	1.10	0	7

Notes: Data from HILDA wave 2010. Suffix "_part" indicate variables for wifes. educD equals 0 when respondent has university degree and 1 otherwise. nwinc contains business income, investment income and private pension. nwincNZ is a dummy for non-zero non-working-income.

Table 2: Results for Heckman Wage Esimtation

Panel A: males

	(1) lnhwage		partD		athrho		lnsigma	
age	-0.0194	(-1.36)	0.104***	(3.30)				
c.ageXc.age	0.000140	(0.84)	-0.00254***	(-7.31)				
2.educC	-0.180***	(-6.00)	-0.433***	(-5.56)				
3.educC	-0.192***	(-5.42)	-0.156	(-1.46)				
4.educC	-0.315***	(-8.51)	-0.710***	(-8.16)				
twork	0.0349***	(4.80)	0.0747***	(4.84)				
c.tworkXc.twork	-0.000502***	(-3.57)	0.000503	(1.75)				
tue	-0.0915***	(-5.89)	-0.115***	(-4.58)				
c.tueXc.tue	0.00525**	(3.03)	0.00462*	(2.56)				
tenure_emp	0.0213***	(6.15)						
c.tenure_empXc.tenure_emp	-0.000563***	(-5.34)						
2.maritalC			-0.121	(-1.43)				
3.maritalC			-0.109	(-1.05)				
4.maritalC			-0.197*	(-1.97)				
1.Ndepch14			0.0763	(0.74)				
2.Ndepch14			-0.00365	(-0.03)				
3.Ndepch14			-0.336**	(-2.67)				
nwinc			-0.0000211***	(-13.05)				
_cons	3.262***	(12.94)	0.0771	(0.13)	0.0578	(0.92)	-0.714***	(-50.38)
state	Yes		Yes		No		No	
occup, industry	Yes		No		No		No	
N	3190							
N_cens	681							

Panel B: females

	(1) lnhwage		partD		athrho		lnsigma	
age	-0.0106	(-1.01)	0.122***	(5.62)				
c.ageXc.age	0.000108	(0.88)	-0.00229***	(-9.30)				
2.educC	-0.140***	(-4.57)	-0.190**	(-2.81)				
3.educC	-0.0834*	(-2.31)	-0.364***	(-4.69)				
4.educC	-0.189***	(-5.60)	-0.466***	(-7.25)				
twork	0.0202**	(3.26)	0.110***	(11.06)				
c.tworkXc.twork	-0.000371**	(-3.17)	-0.000833***	(-3.86)				
tue	-0.0378***	(-3.43)	-0.101***	(-4.54)				
c.tueXc.tue	0.00137*	(2.41)	0.00456***	(4.03)				
tenure_emp	0.0195***	(5.26)						
c.tenure_empXc.tenure_emp	-0.000364**	(-2.93)						
2.maritalC			0.0884	(1.19)				
3.maritalC			0.0712	(1.00)				
4.maritalC			-0.0898	(-1.02)				
1.Ndepch14			-0.489***	(-6.36)				
2.Ndepch14			-0.766***	(-9.70)				
3.Ndepch14			-1.046***	(-10.27)				
nwinc			-0.0000225***	(-8.61)				
_cons	2.786***	(12.25)	-1.262**	(-2.94)	-0.107	(-1.05)	-0.741***	(-48.81)
state	Yes		Yes		No		No	
occup, industry	Yes		No		No		No	
N	3625							
N_cens	1263							

Notes: Data from HILDA; sample includes couples and singles, t-statistics in parentheses. Indicated levels of significance are * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3: Job characteristics: Items and Questions

Variable	**Statement**
JC_secure	I have a secure future in my job
JC_stillbusy	The company I work for will still be in business 5 years from now
JC_worryjob	I worry about the future of my job
JC_repetitive	My job requires me to do the same things over and over again
JC_variety	My job provides me with a variety of interesting things to do
JC_newskills	My job often requires me to learn new skills
JC_fast	I have to work fast in my job
JC_notime	I don't have enough time to do everything in my job
JC_intensity	I have to work very intensely in my job
JC_freedomhow	I have a lot of freedom to decide how I do my own work
JC_freedomwhen	I have a lot of freedom to decide when I do my work
JC_choicewhat	I have a lot of choice in deciding what I do at work

Note: The responses of the statements above have been recoded on a 7-point Likert-type scale

Table 4: Results of Factor Analysis

	Gamma			
	autonomy	workload	security	varied
JC_choicewhat	0.871	0	0	0
JC_freedomhow	0.756	0	0	0
JC_freedomwhen	0.791	0	0	0
JC_fast	0	0.662	0	0
JC_notime	0	0.545	0	0
JC_intensity	0	0.947	0	0
JC_stillbusy	0	0	0.492	0
JC_NOworryjob	0	0	0.562	0
JC_secure	0	0	0.908	0
JC_variety	0	0	0	0.852
JC_NOrepetitive	0	0	0	0.395
JC_newskills	0	0	0	0.497

	Phi			
	autonomy	workload	security	varied
autonomy	1.000	0.047	0.186	0.447
workload	0.047	1.000	0.095	0.365
security	0.186	0.095	1.000	0.332
varied	0.447	0.365	0.332	1.000

Notes: Data from HILDA; all coefficients significant at 1%-percent level.

Table 5: Results of Conditional Logit

	(1)		(2)	
hhnetinc_e	0.0437**	(3.27)	0.0417**	(2.98)
c.hhnetinc_eXc.hhnetinc_e	-0.0000453	(-1.72)	-0.00000425	(-0.16)
hw	-0.0115	(-0.32)	-0.0355	(-0.94)
c.hwXc.hw	-0.00290***	(-7.25)	-0.00291***	(-7.18)
part_hw	-0.0856**	(-3.04)	-0.129***	(-4.20)
c.part_hwXc.part_hw	-0.00122***	(-7.47)	-0.00146***	(-8.55)
c.part_hwXc.hw	0.000857***	(6.43)	0.00105***	(7.56)
c.hwXc.hhnetinc_e	-0.0000138	(-0.17)	-0.000176*	(-2.11)
c.part_hwXc.hhnetinc_e	-0.000104	(-1.62)	-0.000252***	(-3.70)
c.hwXc.age	0.00925***	(7.44)	0.00967***	(7.44)
c.hwXc.ageXc.age	-0.000102***	(-7.67)	-0.000105***	(-7.54)
c.hwXc.Nchildren	0.0115**	(3.04)	0.0118**	(3.12)
c.part_hwXc.part_age	0.00661***	(5.37)	0.00781***	(5.82)
c.part_hwXc.part_ageXc.part_age	-0.0000845***	(-5.96)	-0.0000960***	(-6.27)
c.part_hwXc.Nchildren	-0.0246***	(-6.80)	-0.0260***	(-6.95)
c.hhnetinc_eXc.Nchildren	-0.00322	(-1.36)	-0.00365	(-1.51)
c.hhnetinc_eXc.age	-0.000496*	(-2.06)	-0.000324	(-1.29)
c.hhnetinc_eXc.part_age	0.000289	(1.18)	0.0000349	(0.14)
c.FSmXc.age	0.0596***	(3.65)	0.0593***	(3.60)
c.FSmXc.Nchildren	0.315*	(2.02)	0.294	(1.86)
c.FSfXc.part_age	0.0186***	(4.48)	0.0187***	(4.50)
c.FSfXc.Nchildren	-0.216**	(-2.91)	-0.216**	(-2.90)
1.autonomyCXc.hw			0.0197***	(5.82)
1.workloadCXc.hw			0.0123***	(3.82)
1.securityCXc.hw			0.0133***	(4.09)
1.variedCXc.hw			0.00963**	(2.76)
1.part_autonomyCXc.part_hw			0.0164***	(4.75)
1.part_workloadCXc.part_hw			0.0233***	(6.97)
1.part_securityCXc.part_hw			0.0396***	(11.69)
1.part_variedCXc.part_hw			0.00189	(0.53)
N	28215		28215	
Couples	1881		1881	

Notes: Data from HILDA; t-statistics in parentheses. Indicated levels of significance are * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6: Elasticities

	CL		JCCL
wageelas	0.121***	wageelas	0.0630***
	(7.04)		(3.78)
pottfincelas	-0.178**	pottfincelas	-0.231***
	(-2.97)		(-3.63)
nwtfincelas	-0.00904	nwtfincelas	-0.0135**
	(-1.76)		(-2.58)
part_wageelas_part	0.148***	part_wageelas_part	0.0593**
	(5.84)		(2.61)
pottfincelas_part	-0.395***	pottfincelas_part	-0.451***
	(-4.95)		(-5.38)
nwtfincelas_part	-0.0185***	nwtfincelas_part	-0.0226***
	(-3.85)		(-4.44)
N	28215	N	28215
N_clust	1881	N_clust	1881
Rep	200	Rep	200

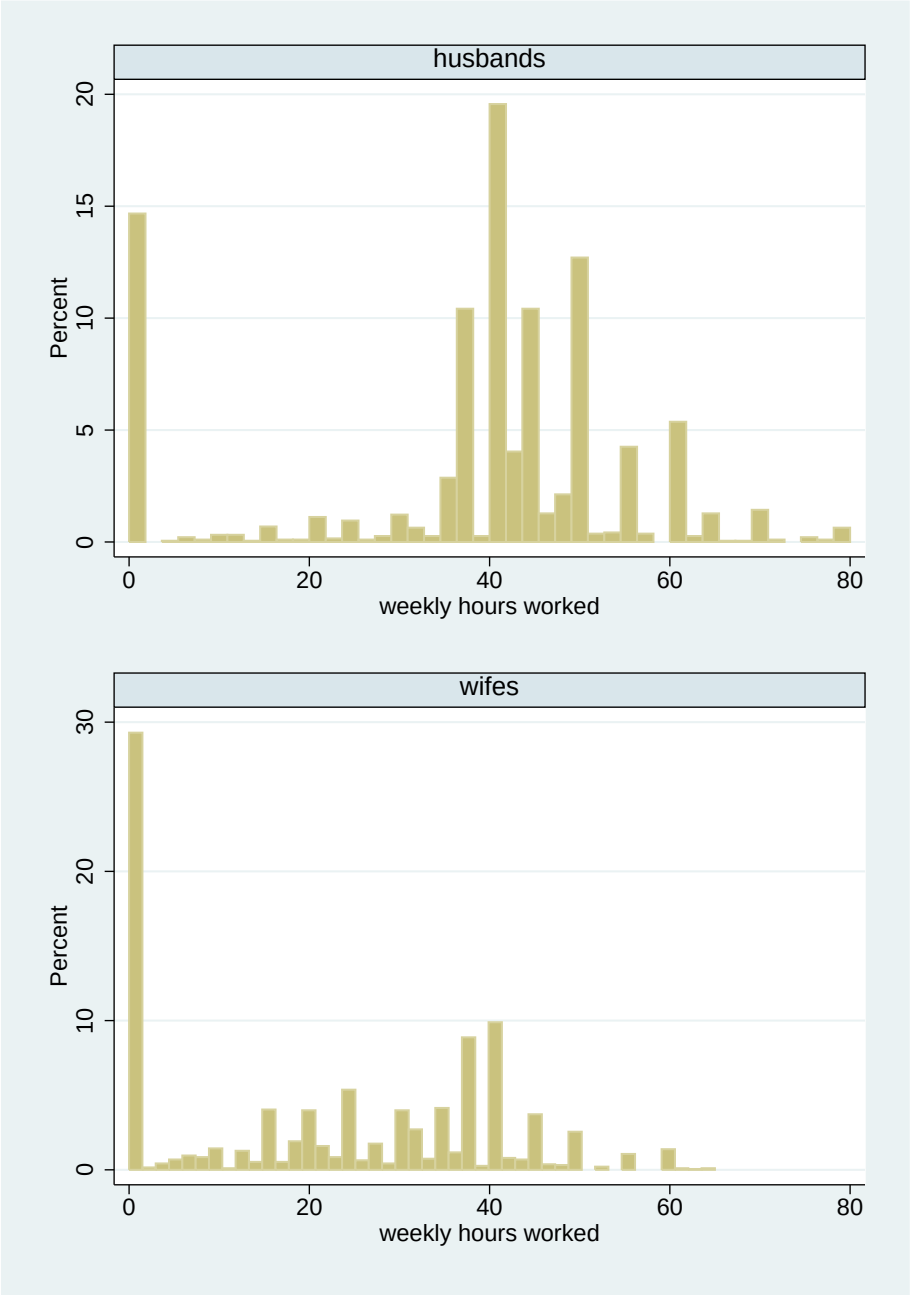
Notes: Data from HILDA; t-statistics in parentheses. Indicated levels of significance are * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 7: Differences in Labour Supply Elasticities

	wageelas	pincelas		wageelas	pincelas
autonomy	-0.0535**	0.149**	part_autonomy	-0.0316*	0.0786**
	(-3.25)	(3.20)		(-2.56)	(2.80)
workload	-0.0535**	0.168***	part_workload	-0.0422***	0.142***
	(-3.27)	(3.68)		(-3.69)	(4.17)
security	-0.0315**	0.106**	part_security	-0.0595***	0.238***
	(-3.12)	(3.04)		(-4.40)	(5.30)
varied	-0.0438**	0.129**	part_varied	-0.0309*	0.0787*
	(-2.89)	(3.21)		(-2.55)	(2.55)
N	28215		N	28215	
N_clust	1881		N_clust	1881	
Rep	200		Rep	200	

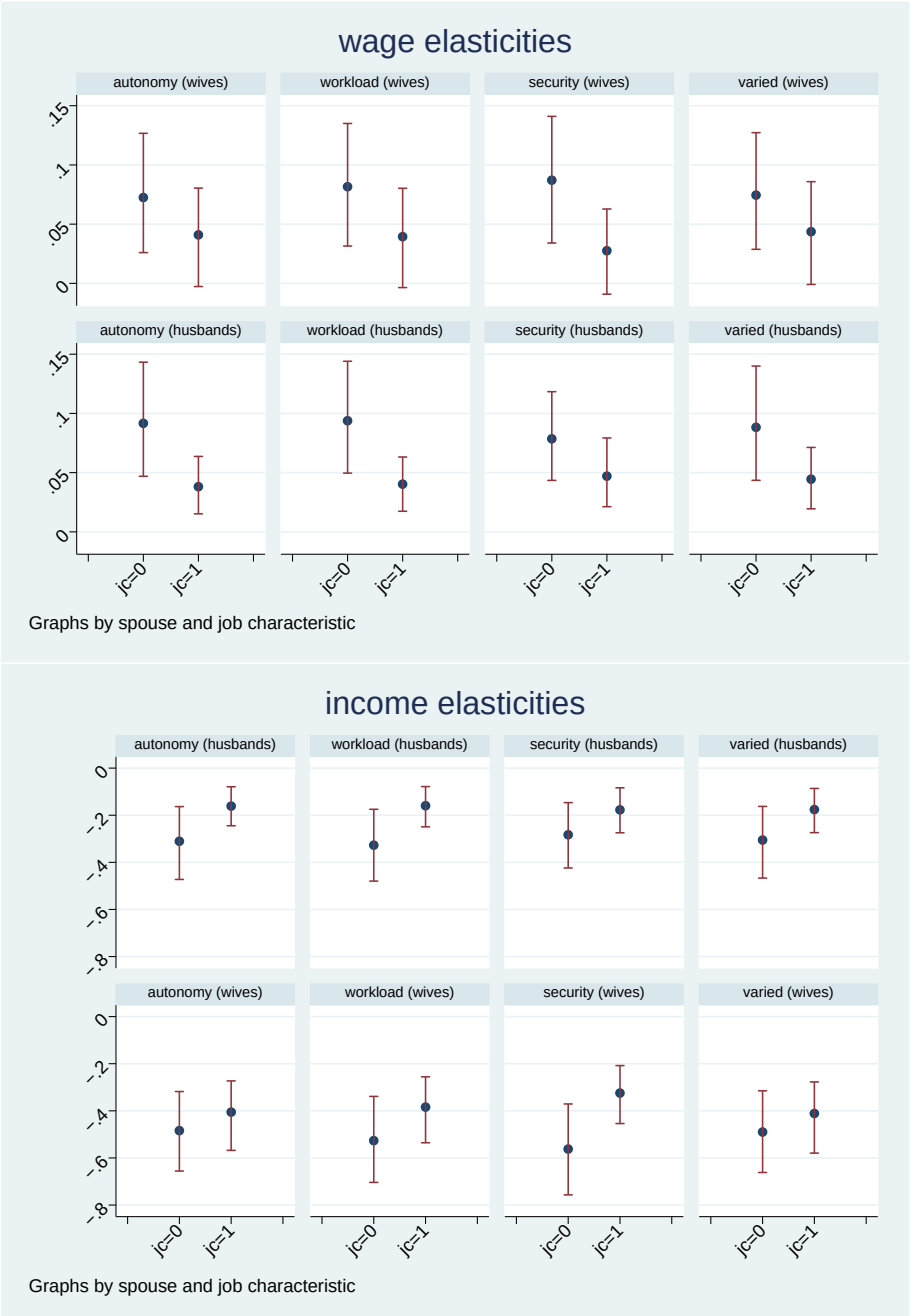
Notes: Data from HILDA; t-statistics, based on $\widehat{se}_{Boot}(\hat{\epsilon}_{JC=1} - \hat{\epsilon}_{JC=0})$, in parentheses. Indicated levels of significance are * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Figure 1: Distributions of hours worked by spouse



Notes: Data from HILDA wave 10; Discretisation husbands: (0-1), (2-45) and (>45); wives: (0-1), (2-25), (26-35), (36-45) and (>45)

Figure 2: Labour Supply Elasticities by Gender and Job Characteristics



Notes: Data from HILDA wave 10; 95% confidence intervals based on bootstrap standard errors (200 rep.). 'jc=0' indicates a 'bad' and 'jc=1' a 'good' job. The underlying concept for income elasticities is potential taxable family income.