# Pay or Conditions? The Role of Workplace Characteristics in Nurses' Labour Supply

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**Abstract**. Empirically rigorous studies of nursing labour supply have to date relied on extant secondary data and focused almost exclusively on the role of pay. Yet the conditions under which nurses work and the timing and convenience of the hours they work are also important determinants of labour supply. Where there are national pay structures and pay structures are relatively inflexible, as in nursing in European countries, these factors become more important. One of the principal ways in which employers can improve the relative attractiveness of nursing jobs is by changing these other conditions of employment. This study uses new primary data to estimate an extended model of nursing labour supply. It is the first to explore whether and how measures of non-pecuniary workplace characteristics and observed individual (worker) heterogeneity over non–pecuniary job aspects impact estimates of the elasticity of hours with respect to wages. Our results have implications for the future sustainability of an adequately sized nurse workforce and patient care especially at a time when European healthcare systems are confronted with severe financial pressures that have resulted in squeezes in levels of healthcare funding.

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**Introduction**

Nurses constitute a major part of the healthcare workforce. They greatly outnumber physicians in most European countries [1]. The sustainability of an adequately sized and trained nursing workforce is key to ensuring sustained high quality patient experience and care and to the sustained delivery of healthcare services. The most recent recession and subsequent slow growth in many European countries has resulted in severe financial pressures in many health care systems, particularly where these are publicly financed as in the UK. These pressures threaten the sustainability of the nursing workforce. Policies focusing on cost containment can result in reductions in available funding for nurse training and education, declines in the level of nursing staff, and pay freezes. Each of these has implications for future nurses' labour supply when nursing labour supply levels are already under pressure due to nurse ageing [2].

Pay is but one aspect of the total rewards from work. The conditions under which people work, the hours they work, the timing and convenience of these hours and the fringe benefits offered are all important labour supply determinants. This is particularly true for nursing. Yet to date much of the research conducted by economists into the labour supply of nurses, and indeed employees more generally, has focused almost exclusively on pay. Thus though we now know much about how labour supply responds to pay changes we know little about how employees' hours of work are influenced by these other aspects of work. Where labour supply is relatively insensitive to wages, using non-pay instruments may be more cost-effective in influencing labour supply. Moreover where pay structures are rigid, or there is little pay flexibility these other factors are also likely to be more important. The exception is likely to be where underlying inflexibility in these other conditions exists. In this case a large driver in the hours people work will likely be due to individual worker differences in

preferences. This paper explores these issues using a unique primary data set constructed for the UK.

Pay and conditions in the UK NHS are covered by the contract "Agenda for Change", which includes a Job Evaluation Scheme covering all non-medical NHS staff. This determines bands within which all occupations covered by the contract sit. Agenda for Change is underpinned by a national salary scale up-rated as a result of recommendations of the NHS Pay Review Body. The new structure has reduced local pay discretion– though this was already limited for qualified nurses – and increased the rigidity of the pay structure[2]. Such a pay structure is less likely to reflect the relative advantages and disadvantages of jobs.

To date empirical studies of nursing labour supply in the UK have relied upon the interrogation of large secondary data sets. Importantly, these studies are by their nature restricted to identifying employment characteristics common to a wide range of jobs and to those characteristics of jobs which the data set has captured. Other studies have used panel data techniques to control for unobserved individual heterogeneity resulting from unmeasured characteristics of jobs but they cannot by their nature evaluate these characteristics.

This study extends previous nurses' labour supply analysis by exploring a range of characteristics of nursing jobs that have previously gone unmeasured. These relate to job type and workplace characteristics such as different shift patterns nurses work, whether they work weekdays only, the influence they have over their shift patterns and the type of work setting they work in (different hospital departments, primary care or care home setting). Individual worker heterogeneity in preferences over job attributes is captured by how much importance

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[2] While "Agenda for Change" does have provision for recruitment and retention premia at national and local level, limited use has been made of this option. The new system explicitly sets out criteria and procedure for offering premia and as such can be argued will tend to make the pay structure more rigid than under the previous system where drift may adjust for local labour market conditions.

nurses attach to a variety of general job characteristics. These include the importance of: job security, flexibility of working hours, what time of day hours are worked, how predictable hours of work are, the availability of over-time pay, promotion prospects, pay, and working in a job that helps others. Using a rich data-set specially designed to identify underlying non-pecuniary workplace characteristics as well as worker heterogeneity; we measure whether and how they impact nurses' labour supply decisions in the UK. We do so to distinguish their importance in nurses' labour supply and in so doing to better understand, not only the nursing labour market but the role of employment characteristics and individual preferences over these characteristics in general labour market decisions.

The importance of exploring non-pecuniary workplace characteristics and preferences over these characteristics as a non-wage policy instrument has been emphasised in an earlier study [3]. Generally, research on labour supply has highlighted that the hours individuals work may indeed be influenced by specific job characteristics and has proposed that more attention be given to the role of non-wage job specific characteristics when modelling labour supply [4].

*Previous Studies on the Impact of Pecuniary Factors*

Previous empirical studies focussing on pecuniary factors have found that while wages are a significant determinant of nursing labour supply, the magnitude of the effect is small as measured by the own-wage elasticity (see Antonazzo and Scott et al (2003) and Shields (2004) for reviews of the literature [5, 6]). Askildsen and Baltagi et al (2003) note the relatively small impact of wages on hours supplied and question whether this general finding reflects the selection of individuals entering the nursing profession or whether it reflects omission of other key relevant factors from the supply analysis [7]. The implication is that estimated wage elasticities are biased and in particular biased downwards. Using panel data

to control for individual heterogeneity they find that the wage effect is indeed underestimated if workplace characteristics such as shift work, a feature common to the profession, are not controlled for explicitly. Rice (2005) also utilises panel data and controls for individual heterogeneity to limit the problem of omitted variable bias [8]. Working night shifts and the absence of managerial roles for nurses were significantly negatively correlated with hours supplied. A more recent cross-sectional study estimated a sample selection corrected labour supply model including controls that characterise the shift pattern of registered nurses in Finland and further controlled for the workplace setting in which nurses work [9]. The results also highlighted the importance of contractual arrangements in nurses' hours supplied.

While these studies found non-pecuniary workplace and job characteristics to influence the labour supply elasticity, the question of the extent to which they impact labour supply decisions was first analysed by Di Tommaso et al (2009) who explicitly modelled Norwegian nurses' shift type (daytime or shift work) and workplace setting (hospital and primary care) choices in a multi sector labour supply framework. Their main findings were that whilst nurses' labour supply is relatively inelastic with respect to wage as in previous studies, nurses' labour supply is far more responsive to shift work type and workplace setting. Following in the spirit of Di Tommaso et al (2009), a more recent study estimated a structural multi-sector model of nurses' labour supply in different occupations to explicitly account for the entry and exit decisions in and out of the nursing profession in relation to other occupations as well as investigating choice of shift work type [10]. The results also suggest that nurses' labour supply may be more responsive to changes in wages than previously thought when allowing for entry and exit into and out of the profession as a consequence of wage changes. The labour supply elasticity is found to vary across shift-types as in Di Tommaso et al (2009). However, unlike Di Tommaso et al (2009), the authors argue that offering wage differentials across shift types to reduce nurse shortages may lead to

movements across shift types from existing nursing stock rather than attracting nurses working outside the profession.

One common feature to these labour supply studies is the issue of the underlying selection of individuals being studied. Hours of work are only observed for individuals who have already made the decision to work in the nursing profession. Within labour supply models this has been traditionally dealt with using a Heckman correction mechanism where the labour market participation decision is modelled explicitly and used to correct the censored hours analysis [11]. However once analysis is restricted to one particular occupation there are two selection mechanisms to consider; the decision to work or not and simultaneously if to work, whether to work within the occupation of interest. Makepeace and Marcenaro-Gutierrez (2005) consider this latter decision in terms of the relative pay of the nursing profession compared to alternative professions [12]. For the period 1993 – 2003 they analyse nurses' earnings relative to those of otherwise identical private sector employees controlling for compositional differences between the nursing and private sector workforce. They control for differences in average age, gender composition, qualifications, and geographical employment location. Their central finding is that once controlling for these factors, nurses are paid less than comparable individuals command in the private sector.

If nurses have been persistently underpaid we would predict that it would be difficult to attract and retain nurses in the NHS. Yet over the ten year period 1997 to 2007 the number of qualified nurses and midwives working in the UK NHS rose by 25% alone in England [13]. England experienced rapid growth in the number of qualified nurses and midwives working in the NHS England between 1999 and 2004. However growth contracted and remained flat over the period 2005 to 2007. A significant part of the increase was achieved through

importing qualified nurses. There was also a parallel increase in the number of UK nationals entering the nursing profession [14]. Vacancy rate data collected by the Department of Health (DoH) indicated a fall from 3.7% in 2000 to 2.5% in 2008 [15]. In England the target was to achieve growth of an additional 35,000 nurses between 2001 and 2008. By 2004 the DoH announced that this target had already "been comfortably exceeded". This was before the new pay structure was introduced and the significant three year pay deal it included.

If nurses are poorly paid, why is recruitment not more difficult and why are nursing vacancies not higher? One hypothesis is that low wages may be optimal. In the theoretical literature Heyes (2005) has shown that if nursing is a vocation, where vocation is understood as a desire on the part of the individual to be directly engaged in that particular activity, increasing wages might attract the 'wrong sort' of people [16]. He suggests that low wages are optimal to allow the underlying selection mechanism to match individuals to the profession through the non-pecuniary job aspects. It also supports the contention that there might be underlying characteristics of nursing jobs (and those who are attracted to them) that have not yet been identified and to which nurses attach a positive value. The opportunity to work in a job with a vocational element may be one of these characteristics.

Barigozzi and Turati (2012) extend Heyes (2005) theoretical framework by allowing not only for different vocational but also different skill levels in the selection mechanism [17] and show how their interaction shapes labour supply. The theoretical implication is that the use of wage increases to tackle nurse shortages will only have the desired effect where skills are valued more highly than vocation. However, empirical findings by Elliott et al (2007) show that to fill vacancy rates in local labour markets for nurses crucially depends on the relative competitiveness of nurse's wages to wages in comparative occupations [18]. This is

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particularly important in a labour market that is characterised by a rigid national wage structure as in the case of the labour market for nurses in Britain. Here nurses will self-select into different jobs at different health care facilities conditional on the pecuniary and non-pecuniary job and workplace characteristics.

Drawing on these theoretical implications [16, 17] we argue that the more we can identify and control for all other nursing job attributes and the underlying characteristics of the individuals themselves, the closer we come to understanding the determinants of the labour supply function. Our primary interest is concerns how non-pecuniary job and workplace characteristics impact hours supplied in general in the context of rigid wage structures. We seek to identify how they contribute to changes in the labour supply elasticity. Though, we do not explicitly model the selection into different workplace settings and shift types we control for these in the estimation of hours supplied.

We use original primary data to estimate an extended nursing labour supply model to better understand the role of both the pecuniary and non-pecuniary job characteristics and individual heterogeneity in nurses' labour market decisions, some of which have previously gone unmeasured. Such an understanding is vital at a time of severe public sector funding squeezes coupled with the rigid nature of the wage structure in the nursing profession. The reason is that they may suggest policies to attract nurses other than through pay and may therefore be more cost effective whilst adhering to cost containment pressures.

*Hypothesis*

Standard labour supply theory suggests that the strength of the response of hours of work to wage change depends on the relative magnitude of the income and substitution effects. If the

elasticity of hours with respect to wages is high then wage increases can be used to address labour shortages. Moreover labour market theory also informs us that it is the "whole of the advantages and disadvantages of different jobs" that are relevant to the labour supply decision [19]. Theory suggests that in equilibrium the markets nurses operate in should reveal a match between the trade-offs nurses are prepared to make between pay and other conditions of work and those offered by employers. Workers evaluate a job, based not just on the wage offered, but the total bundle of wages and employment characteristics. Nurses in common with other employees will require higher pay to compensate them for any unpleasant job aspects and work tasks. At the same time worker heterogeneity will also impact employment decisions, where individuals may have variations in preferences for employment characteristics.

The simplest form of the hours supplied model can be written as

$$h = f\left(w, r, x\right) \tag{1}$$

Hours worked, $h$, are some function of wages, $w$, other non-labour or family income, $r$, and a vector of other background characteristics, $x$. Wages are themselves determined within a standard human capital earning function modified according to Rosen (1986) who outlines the situation where equilibrium wage differentials reflect how workers and jobs are sorted where there is heterogeneity in both non-wage characteristics and worker preferences [20].

$$w = f\left(l, j, t\right) \tag{2}$$

where wages are comprised of a part reflecting labour productivity, $l$, and another part reflecting non-pecuniary job characteristics, $j$. The latter can include those directly associated with the job such as workplace conditions relating to risk to life or health, inconvenience of hours worked, the composition of the overall reward bundle in terms of pensions or holidays and factors such as regional differences in amenities. Also included are individual controls, $t$,

relating to individual preference heterogeneity that complete the sorting mechanism the wage should ultimately reflect.

However, the nursing labour market operates within a rigid wage structure and we cannot expect the wage mechanism to reflect the true compensation needed for variation in workplace characteristics given individual worker preferences. We therefore expect these non-pecuniary job characteristics and worker preferences to enter the labour supply function directly as opposed to through the clearing wage. This results in the following modified hours function,

$$h = f\left(w, r, x, j, t\right) \tag{3}$$

Empirically, this allows for testing the following hypotheses: i) Are non-pecuniary workplace characteristics and observed individual preferences over non-pecuniary job aspects significant influences on nurses' labour supply decision, and ii) do they impact the elasticity of hours with respect to wages. A priori we expect the elasticity to be biased downward where these characteristics are not specifically controlled for.

**Methods**

*Data*

Primary data was collected through a random sample of individuals registered with the Nursing and Midwifery Council (NMC), a statutory body set up by Parliament to maintain standards in nursing practice. Working as a registered nurse requires an individual to hold and maintain registration (lasting a period of three years) with the NMC. The register identifies individuals currently practising as a qualified nurse or available to practice. The latter may be working but not as a nurse, or out of the labour force.

We conducted a postal survey of nurses registered with the NMC in the UK in October 2007 and January 2008. Nurses were recruited to the survey by an invitation to take part in our study which had been placed in the NMC quarterly magazine. An advert within the magazine directed readers to a web-link where an on-line survey could be taken or if preferred an address to request a paper survey. In addition 64,000 reply-paid postcard inserts were added to the magazine to request a paper copy of the questionnaire. The survey was in 2 versions, one for those who indicated they were currently employed as a nurse and a separate version for those indicating they were employed in alternative employment or were currently out of the labour market. Of the 2549 valid requests for a paper survey we had 2061 surveys returned, reduced to 1966 usable returns where key combinations of non-missing responses to hours of work, earnings and job satisfaction sections were not-completed. On the basis of requests, this represents a response rate of 77.1%. With the addition of the web-based survey, in total we received 2,116 responses. Midwifes and nurses on long-term sick leave and responses where key information on hours worked or wages was missing were excluded. The final number taken into the analysis comprised 1384 qualified nurses in nursing employment and 89 nurses in non-nursing employment.[3] Respondent characteristics were compared to figures published by the Nursing and Midwifery Council for registered nurses in terms of gender, age and branch of nursing and were found to be broadly comparable. However some sampling bias was identified due to non-random blocking of the invitation to participate within the NMC magazine print-run. We therefore weight the sample for those who were working as qualified nurses using the information from the national Labour Force Survey using individuals with a nursing qualification and working as a nurse. Weights were calculated through 3 categories, gender, age and region of residence and applied in the following analysis.

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[3] Previous studies on nurses' labour supply that have used secondary data were also based on relatively small samples. Skåtun *et al.* (2005) used information on 1076 nurses from the Quarterly Labour Force Survey whilst Rice (2005) based his study on 287 nurses and midwives in the British Household Panel Survey.

*Econometric Methods*

Estimation of Eq. 3 using Ordinary Least Squares (OLS) results in the following issues. The first relates to the classic selection problem and that we only observe actual hours worked where the decision to work within the nursing profession has already been made. This has traditionally been dealt with by using a modified sample selection model that first considers the decision of the individual to enter the nursing profession and then adds the resulting selection mechanism term to the hours of work equation [11]. Here we are not concerned with the selection of registered nurses between NHS nursing employment and being out of the labour market, the selection process previously modelled for UK nurses [3, 21] and traditionally used to study women's labour market decisions. Registered nurses must hold a recognised diploma or degree from a further education establishment. We expect that the more appropriate selection is between recouping that substantial investment either within the NHS nursing labour market or in the general labour market outside the NHS and the nursing profession. Hence, we model the decision between choosing the NHS nursing profession and using the more general element of their human capital to take a job outside nursing.

We therefore only observe the number of hours offered by an individual if the wage received exceeds the wage they would receive elsewhere. We cannot observe both the nursing wage and the wage the same individual would command in alternative employment. We only observe whether Z* (the difference between these two wages) is positive when the individual enters the nursing labour market. This leads to the following selection mechanism

$$z^* = \gamma W + u, \qquad u \sim N(0,1)$$
$$z = 1 \ if \ z^* > 0,$$
$$z = 0 \ if \ z^* \leq 0, \tag{4}$$

with $\mathrm{Prob}(z = 1) = \mathrm{Prob}\,(wage_{market} > wage_{reservation}) = \Phi(\gamma W)$

where Z* can be modelled as a function of the determinants of the nursing market wage and the wage that would be offered in alternative employment. The model for hours supplied can then be written as:

$$H = \beta\mathbf{X} + \varepsilon, \quad \text{observed iff } z = 1, \text{ with } \varepsilon \sim \text{bivariate normal } (0,0,1,\sigma_{\varepsilon,}\rho) \qquad (5)$$

with the sample selection-corrected model having the following expectation,

$$E(H \mid z = 1) \ = \ \beta X + \rho\sigma_{\varepsilon}\lambda(\gamma W) \qquad\qquad (6)$$

This will provide unbiased estimates of the underlying influences of $\mathbf{X}$ on hours supplied where $\mathbf{X}$ includes the wage rate. Estimation of Eq. 6 requires estimation of the inverse Mills ratio from the probit nursing participation model calculated as,

$$\hat{\lambda}_i \ = \ \frac{\phi(\hat{\gamma}\mathbf{W}_i)}{\Phi(\hat{\gamma}\mathbf{W}_i)} \qquad\qquad (7)$$

and included as an additional regressor in the hours regression for individuals who have made the decision to supply positive hours of nursing labour supply.

Another consideration when estimating hours supplied as a function of wages is that both are determined jointly. This requires a correction for the potential endogeneity of the own wage term in the hours equation. We deal with this using an auxiliary earnings regression itself corrected for selection to impute wages for nurses in nursing employment in the hours of work regression.

The above describes an instrumental variable and selectivity bias corrected hours of work regression estimation technique where in addition to the inverse Mills ratio an auxiliary earnings regression itself corrected for selection is used to impute wages for nurses in nursing employment for use in estimation of Eq. 6.

Our data consistently accepted the null hypothesis of no selectivity as indicated by a Wald $\chi^2$ test on the estimated 'inverse Mills ratio' parameter included in the hours supplied equation. We therefore only present results based on an OLS regression on hours that deals with the endogeneity of wages by imputing wages through a sample selection corrected auxiliary wage regression.[4,5]

*Models*

We hypothesised that the wage function within such a rigid market as that of the UK nursing profession will not fully adjust to compensate for differences in job characteristics within the profession. Consequently we expect these features to enter the hours of work decision directly as specified in (Eq. 3). The estimation strategy proceeds as follows. First, we estimate a standard labour supply model. Second, this model is extended to account for non-pecuniary job aspects. Third, a further model is estimated controlling for non-pecuniary job characteristics and additionally non-pecuniary determinants of hours supplied as captured by worker heterogeneity. All three models correct for sample selection.

**Classical labour supply model.** This model estimates a standard labour supply model given by Eq. 1. It employs variables commonly found in general employment surveys [3, 8, 22]. The underlying wage function is characterised by the standard Mincer type human capital model where the market wage is a function of human capital characteristics including experience and education. Experience is measured as the number of years and months in the nursing profession. Education is captured by *(i)* highest nursing qualification obtained and *(ii)*

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[4] We acknowledge that accepting the null hypothesis of no selectivity bias does not come as a surprise and may simply be an artefact of the sampling given that 95% of the sample of nurses participate in the NHS nursing labour market and hence the correction for the participation decision is unlikely to 'fully' correct for the decision to supply labour as a nurse or in other occupations.

[5] The results of the selectivity corrected hours model are available as additional material. Note also that the parameter estimates are quite stable across the different model specifications.

any additional nursing qualifications beyond the standard nursing qualification to estimate the extent of the wage premium inherent in additional specific human capital investment. Note, every nurse has a minimum of a nursing diploma. We further control for gender and a set of geographical dummies for governmental office regions in the auxiliary wage regression.

The dependent wage variable in the auxiliary wage regression, the derived hourly wage rate, is based on all hours supplied (contracted and any overtime hours), and defined as $w = \left[\left(h_c \cdot w_c\right) + \left(h_o \cdot w_o\right)\right] / \left(h_c + h_o\right)$. Here $h_c$ are contracted hours, $h_o$ overtime hours, $w_c$ the contracted wage, and $w_o$ the overtime wage rate. Missing values on variables relating to income and wages can result from respondent's unwillingness to reveal sensitive financial information or from not having a clear picture of their actual gross earnings because the unit of measurement in the questionnaire is not the one recorded on the pay slip. Wage information was therefore collected using a variety of questions[6]. The contracted hourly wage rate was further adjusted for high cost area supplements for London and the Fringe. Overtime pay rates were applied to hours supplied over the standard contracted hours per week of 37.5. Respondents were asked if overtime hours were reimbursed at the normal rate (the contracted hourly wage), time and a half, double, agency, or any other rate.

The standard participation and hours of work supplied model control for a quadratic in age, ethnic origin, marital status, and governmental office regions. The reservation wage is modelled by a set of household characteristics thought to affect individual nurse's work/alternative work trade-offs and expected to be determined by factors characterising the underlying nature of the nurse occupation such as shift work and unsocial hours. We therefore

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[6] This was particularly an issue with the introduction of the new pay and grading structure where not all respondents were necessarily aware of the new terminology. Respondents were therefore given the choice of providing their earnings through bands, grades and/or points with additional choices for where on the grade/band spectrum if no specific point was known. Information on band or grade, point, or range within scales was used in conjunction with published pay bands and points as of November 2007.

control for the number of dependent children under the age of 16 in the household as individuals with dependent children are expected to have a higher reservation wage relative to those without. Other things equal, controlling for potential market wage, individuals with dependent children are less likely to participate in the nurse labour market compared to individuals without dependent children. To capture this effect a dummy variable is included indicating whether the youngest child is under the age of 5.

Other household income received may also impact the reservation wage. We include the gross hourly pay (£) of any partner and any other non-labour market income resulting, for example, from state benefits. The latter is a binary variable indicating if the household receives state benefits or not[7]. There is substantial missing information on partner's pay. We therefore include a binary variable indicating whether the partner is unemployed, and a further binary variable indicating whether the partner is in employment but the wage information is missing. This completes the standard labour supply model.

**Workplace heterogeneity.** The first extended labour supply model adds measures of workplace heterogeneity to the classic labour supply model. Non-pecuniary determinants capturing workplace heterogeneity specifically address nursing job aspects relating to contractual working arrangements and workplace setting. We think of these as indicating the degree of control individuals are able to exercise over their hours of work, shift type, rota or work pattern, and measures of the unpredictability of working hours and workplace settings. We assume all of these affect hours worked.

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[7] These include unemployment, child, housing/council, incapacity or any other state benefits as well as income support, child tax credit, working tax credit, job seekers allowance, statutory sick pay and maternity allowance/statutory maternity pay.

Contractual working arrangements are summarised by a set of three types of variables. The first indicates the shift/rota/work pattern that best describes the current nursing job. The second is a dummy variable indicating whether the individual works weekdays only, as opposed to weekends or both. We expect the effect to be negative, capturing relatively less hours supplied by nurses who work weekdays only. Some nurses may also contractually be required to work on-call. A priori we expect on-call work to positively influence hours supplied relative to no on-call work.

Shift-work is a recognised characteristic of the nursing profession, known to the majority of individuals before deciding to enter initial training. We judge it was the degree of control over the management of the shifts/rotas that nurses had that might impact labour supply as opposed to actual shift patterns. Respondents were asked how much influence they have over their shift/rota/work pattern and categorised as 'no influence, small influence and 'large influence'. We expect hours supplied to increase with increasing influence over the shift/rota/work pattern.


The degree to which these workplace characteristics vary is likely to be affected by the workplace setting, the part of the NHS where nurses work. Nurses in hospital environments such as Accident & Emergency departments (A&E) may have more scope for varying hours of work compared to nurses in Primary Care. We include a comprehensive set of 14 workplace settings. These include primary care, care home and health charity setting as well as ten hospital settings relating to different clinical environments (A&E, outpatient, acute, intensive and palliative care, surgery, paediatrics, geriatrics, and mental health departments as well as a category summarising other departments). We add an additional category that subsumes nurses with a different or undefined workplace setting. These will control for some of the heterogeneity present in the nursing labour market. Previous studies also controlled for

workplace setting. Askildsen et al. (2003) allowed for six workplace settings while Kankaanranta and Rissanen (2009) included five to capture their effect on hours [7, 9]. Our comprehensive set of workplace settings includes those in these two studies.

We assume all workplace characteristics to affect job utility and hours supplied.

Additionally we extend the participation and auxiliary wage equation by controlling for shift work. Since shift work is a common feature of the profession commonly known prior to entering the nurse labour market, it may be a significant factor in the participation decision. It may also be compensated through higher wages and is therefore controlled for in the auxiliary wage equation.


**Worker heterogeneity.** The second extended labour supply model adds measures of worker heterogeneity over non-pecuniary aspects to the workplace heterogeneity labour supply model.

Worker heterogeneity for non-pecuniary job aspects is intended to capture personal preferences for these characteristics. Whilst the non-pecuniary job characteristics reflecting workplace heterogeneity are *specific* to the nursing job, we treat the non-pecuniary job characteristics capturing worker heterogeneity as *non-specific* allowing these to encompass non-pecuniary job aspects applicable to any job in *general*. Respondents were asked "When considering *any job in general*, how important are the following factors for you? The importance of: i) the availability of part-time work, ii) job security, iii) pay, iv) paid overtime, v) the time of day that hours are worked, vi) the predictability of worked hours, vii) the flexibility of working hours, promotion prospects, and viii) the importance of helping others from which individuals derive positive utility. The latter is thought to capture the altruistic or vocational element of a job. Answers were stated on a five point ordinal scale: unimportant, not really important, quite important, very important and extremely important.

Preferences for these general non-pecuniary job characteristics are controlled for in the labour supply model and measured as increasing in importance. For ease of interpretation we restricted the final model to treating them as a simple linear scale.

Previously, this type of worker heterogeneity has been analysed in studies on job satisfaction and intentions to and measured as subjective satisfaction or dissatisfaction in relation to the *specific* job the individual undertakes [23, 24].

The importance of part-time work, when hours are worked and how predictable and flexible they are, are assumed to indicate individual time preferences and their wish to participate in the labour market, given the constraints they face in terms of family commitments. These together with the other non-pecuniary preferences over job characteristics may be important labour supply determinants, particularly in labour markets where wage structures are rigid since they will signal to what extent underlying worker preferences matter. From an incentive and Human Resources point of view they may also indicate that 'softer' contractual design approaches should be considered when trying to attract and retain workers.

We expect that as general job security, pay, promotion prospects, and the availability of overtime hours become more important, hours supplied will increase (all other things equal). When the flexibility of working hours, the time of the day hours are worked, and the predictability of working hours are of importance, we expect total hours supplied to fall. If the vocational nature of a job helping others is highly valued by nurses, then we expect this to translate into hours supplied 'above the call of duty'. As the vocational nature of the job increases in importance we expect a positive effect on hours. This third model of nurses'

labour supply also controls for shift work in the participation and auxiliary wage equation. All variable definitions and descriptive statistics are presented in Table I.

Table I. Variable definitions, means and standard deviations

| Variable names | Definitions | Nurses in nursing ($n = 1384$) | | Nurses in alternative employment ($n = 89$) | |
|---|---|---|---|---|---|
| Age | Age | 45.111 | (9.609) | 47.000 | (8.988) |
| GENDER | =1 if female | 0.905 | (0.294) | 0.898 | (0.305) |
| SINGLE | =1 if single | 0.200 | (0.400) | 0.000 | (0.000) |
| ETHNIC | =1 if ethnicity other than white | 0.091 | (0.287) | 0.067 | (0.252) |
| EXP | Experience | 22.329 | (11.029) | 20.985 | (11.401) |
| $EXP^2$ | Experience$^2$ | 620.120 | (493.529) | 568.867 | (503.051) |
| ED1 | =1 if highest qualification diploma | 0.526 | (0.499) | 0.551 | (0.500) |
| ED2 | =1 if highest qualification higher degree | 0.271 | (0.445) | 0.213 | (0.412) |
| ED3 | =1 if highest qualification degree | 0.067 | (0.250) | 0.067 | (0.252) |
| ED4 | =1 if education missing/other | 0.136 | (0.342) | 0.169 | (0.376) |
| ADQUALI | =1 if additional nursing qualifications | 0.804 | (0.397) | 0.551 | (0.500) |
| LNWAGE | Natural logarithm of derived hourly wage | 2.651 | (0.242) | | |
| TOTHOURS | Total hours including overtime | 37.104 | (10.798) | | |
| PRTWAGE | Partner's derived wage | 8.982 | (10.270) | 11.867 | (14.105) |

| | | | | | |
|---|---|---|---|---|---|
| PNEMP | Partner unemployed | 0.027 | (0.163) | 0.022 | (0.149) |
| PWMISS | Partner's wage missing | 0.385 | (0.487) | 0.292 | (0.457) |
| PEMPMISS | Partner's employment status missing | 0.260 | (0.439) | 0.079 | (0.271) |
| NONLABINC | =1 if in receipt of non labour market income | 0.474 | (0.500) | 0.427 | (0.497) |
| NDPCH16 | No. dependent children aged <=16 | 0.632 | (0.907) | 0.517 | (0.813) |
| KID05 | =1 if age of child <5 | 0.134 | (0.341) | 0.101 | (0.303) |
| WALES | =1 if living in Wales | 0.075 | (0.263) | 0.034 | (0.181) |
| SCOTLAND&NI | =1 if living in Scotland or Northern Ireland | 0.092 | (0.289) | 0.112 | (0.318) |
| LONDON&SE | =1 if living in London or the South East | 0.065 | (0.246) | 0.079 | (0.271) |
| SW | =1 if living in the South West | 0.043 | (0.202) | 0.034 | (0.181) |
| N_ENG | =1 if living in the North of England | 0.474 | (0.499) | 0.483 | (0.503) |
| E_ENG | =1 if living in the East of England | 0.027 | (0.161) | 0.056 | (0.232) |
| E_MID | =1 if living in the East Midlands | 0.138 | (0.345) | 0.146 | (0.355) |
| W_MID | =1 if living in the West Midlands | 0.019 | (0.138) | 0.022 | (0.149) |
| YORK | =1 if living in Yorkshire | 0.068 | (0.251) | 0.034 | (0.181) |
| Worker heterogeneity | | | | | |
| IMP_JS[a] | Importance of job security important | 4.673 | (0.606) | 4.409 | (0.753) |
| IMP_PAY | Importance of pay | 4.265 | (0.793) | 3.966 | (0.769) |
| IMP_POT | Importance of paid overtime availability | 2.768 | (1.243) | 2.250 | (0.992) |
| IMP_WORKHRS | Importance of when hours are worked (time | 3.867 | (1.002) | 3.884 | (1.067) |

| | | | | | |
|---|---|---|---|---|---|
| | of day) | | | | |
| IMP_PREDHRS | Importance of predictability of work hours | 3.937 | (0.929) | 3.874 | (0.974) |
| IMP_FLEXHRS | Importance of flexibility of work hours | 3.780 | (0.962) | 3.539 | (1.108) |
| IMP_PROMPRSP | Importance of promotion prospects | 3.422 | (1.172) | 3.279 | (1.134) |
| IMP_HELP | Importance of job that helps others | 4.215 | (0.870) | 4.287 | (0.848) |
| Workplace heterogeneity | | | | | |
| PAT_SHIFT[b] | =1 if work pattern defined as shifts | 0.275 | (0.447) | 0.091 | (0.289) |
| PAT_DAYS | =1 if work pattern defined as days only | 0.458 | (0.498) | 0.659 | (0.477) |
| PAT_PERMNIGHT | =1 if work pattern defined as permanent nights | 0.068 | (0.251) | 0.011 | (0.107) |
| PAT_FLEXI | =1 if work pattern defined as flexi time | 0.021 | (0.143) | 0.193 | (0.397) |
| PAT_OTHER | = 1 if work pattern defined as other | 0.013 | (0.113) | 0.023 | (0.150) |
| PAT_MULTIPLE | =1 if work pattern defined as multiple patterns | 0.081 | (0.273) | 0.022 | (0.149) |
| DAY_WEEK | =1 if usually work weekdays only | 0.427 | (0.495) | | |
| DAY_WEEKEND | =1 if usually work weekends only | 0.012 | (0.107) | | |
| DAY_BOTH | =1 if usually work both | 0.562 | (0.496) | | |
| WRK_ONCAL | =1 if required to work on call | 0.137 | (0.344) | | |
| INFL_NONE | =1 if no influence over rota/shift/work pattern | 0.143 | (0.350) | | |

| | | | |
|---|---|---|---|
| INFL_SOME | =1 if some influence over rota/shift/work pattern | 0.529 | (0.499) |
| INFL_LARGE | =1 if large influence over rota/shift/work pattern | 0.328 | (0.470) |
| SET1_UND | =1 if work setting is undefined | 0.166 | (0.372) |
| SET1_CAREHOME | =1 if work setting is care home | 0.092 | (0.289) |
| SET1_COMPC | =1 if work setting is community/primary care | 0.190 | (0.392) |
| SET1_CHARITY | =1 if work setting is a charity | 0.024 | (0.152) |
| SET1_HOSPOUT | =1 if work setting is hospital: Outpatients | 0.048 | (0.214) |
| SET1_HOSPA&E | =1 if work setting is hospital: A&E | 0.028 | (0.165) |
| SET1_HOSPACCUTE | =1 if work setting is hospital: Acute | 0.098 | (0.297) |
| SET1_HOSPIC | =1 if setting is hospital: Intensive care | 0.027 | (0.163) |
| SET1_HOSPSURG | =1 if work setting is hospital: Surgery | 0.079 | (0.269) |
| SET1_HOSPPAED | =1 if work setting is hospital: Paediatrics | 0.034 | (0.181) |
| SET1_HOSPGERI | =1 if work setting is hospital: Geriatrics | 0.020 | (0.141) |
| SET1_HOSPPAL | =1 if work setting is hospital: Palliative | 0.012 | (0.107) |
| SET1_HOSPOTH | =1 if work setting hospital: Other | 0.116 | (0.320) |
| SET1_HOSPMENT | =1 if work setting is hospital: Mental | 0.067 | (0.250) |

**Results**

Table II reports the results of the three estimated hours supplied equations. 'Total Hours I' is the hours equation estimated from the standard labour supply model. 'Total Hours II' results show the extended hours specification incorporating non-pecuniary workplace characteristics. 'Total hours III' presents results from the labour supply model including both non-pecuniary workplace characteristics and worker preferences. Since our focus is purely on hours supplied, the corresponding auxiliary wage and participation regressions are shown in the Appendix.

*Total hours in the classic labour supply model*

The determinants of hours in the standard hours of work equation reveal the following. Total hours supplied are significantly increasing in age at a decreasing rate. Gender has a significant negative effect on hours. Female nurses supply on average 3.1 hours of labour less than male nurses. Ethnic background has a large and significantly positive effect on hours supplied. Individuals of ethnicity other than white work 10.5 hours more per week relative to individuals of white ethnic background. No significant differences in hours supplied across regions relative to London and the South East are estimated.

The number of dependent children under the age of 16 significantly reduces hours supplied. So does the presence of children under the age of 5.

The impact of partner's wage has a significantly reducing effect on hours worked. Missing information on partner's wage does not impact significantly on hours of work supplied. However the direction is estimated to be negative. This suggests that those partners who are employed but did not reveal their earnings, are high earners for this reduces nurses' labour supply by 2 hours per week. This contrasts with the modest negative effect of 0.21 hours that the partner's wage exerts when this has been declared. Further, receipt of non-labour market

income significantly reduces hours by 1.4 hours per week. Whilst the effect of an unemployed partner is insignificant it still confirms a priori expectation as to the direction of the effect, which is positive. The impact of the own wage is significantly positive. The higher the own wage, the higher is the number of hours supplied. This corresponds to an elasticity of hours worked with respect to the own wage of 0.255.

Table II. OLS hours regressions [a, b]

| Independent variables | Total Hours I (Standard) | Total Hours II (Workplace) | Total Hours III (Workplace and Worker) |
|---|---|---|---|
| Age | 0.526** | 0.580** | 0.584** |
| Age$^2$ | -0.009*** | -0.009*** | -0.009*** |
| Gender (female) | -3.151*** | -1.369 | -1.513* |
| Ethnicity | 10.406*** | 9.027*** | 6.528*** |
| Single | 0.400 | 0.690 | 1.092 |
| Wales [c] | 0.345 | -0.767 | -1.394 |
| Scotland & NI | 0.874 | 0.615 | 0.281 |
| South West | 1.434 | 0.799 | 0.466 |
| North England | 1.489 | 1.006 | 0.913 |
| East of England | 1.539 | 1.861 | 1.392 |
| East Midlands | -0.311 | -0.223 | -0.328 |
| West Midlands | 0.974 | 1.006 | 2.548 |
| Yorkshire | 0.450 | -0.119 | 0.198 |
| Predicted Heckman ln wage | 9.453*** | 13.262*** | 13.518*** |
| No. dependent children aged<=16 | -1.719*** | -1.608*** | -1.517*** |
| Age of youngest child < 5 | -3.735*** | -3.707*** | -2.877*** |
| Partner's wage | -0.204*** | -0.174*** | -0.123*** |
| Partner wage missing | -1.754 | -1.867* | -1.185 |
| Partner not employed | 3.579 | 3.647 | 2.858 |
| Partner employment status missing | 0.946 | 0.835 | 0.426 |
| Non-labour income | -1.434* | -0.950 | -0.507 |
| *Shift/rota/work pattern [d]:* | | | |
| Shift mix | | -1.663*** | -1.653*** |
| Permanent nights | | -2.992* | -2.793* |
| Flexi-time | | -0.709 | -0.886 |
| Other | | -3.944 | -2.824 |
| Multiple | | -0.367 | -0.720 |
| Working Weekdays only [e] | | -2.696*** | -2.295*** |
| Required to work on call [f] | | 4.084*** | 3.190*** |
| *Influence over change in shift/rota/work pattern [g]:* | | | |

| | | | |
|---|---|---|---|
| Some influence | | -3.033*** | -2.419*** |
| Large influence | | -3.786*** | -2.900*** |
| *Work setting [h]:* | | | |
| Undefined/Other | | 2.744*** | 2.532** |
| Care home | | 6.082*** | 6.442*** |
| Charity | | -0.957 | 0.261 |
| Hospital Outpatients | | 1.048 | 0.911 |
| Hospital A&E | | 4.613** | 3.433* |
| Hospital Acute | | 2.157* | 1.528 |
| Hospital IC | | 4.856** | 3.705* |
| Hospital Surgery | | 2.685** | 2.181** |
| Hospital Paediatrics | | 1.837 | 1.972 |
| Hospital Geriatrics | | 3.151 | 2.389 |
| Hospital Palliative | | 1.524 | 1.100 |
| Hospital Other | | 2.874*** | 2.790*** |
| Hospital Mental | | 4.630*** | 4.516*** |
| *Importance of:* | | | |
| General job security | | | 0.639 |
| Predictability of hours | | | -1.187*** |
| When hours are worked (time of day) | | | -0.858*** |
| Job helping others | | | 0.366 |
| Pay | | | 1.437*** |
| Availability of paid overtime | | | 1.111*** |
| Flexibility of working hours | | | -1.003*** |
| Promotion prospects | | | 1.209*** |
| Constant | 12.679 | 0.985 | 2.490 |
| Observations | 1384 | 1384 | 1384 |
| $R^2$ | 0.2150 | 0.2882 | 0.3589 |
| Elasticity of hours with respect to own wage | 0.255 | 0.357 | 0.364 |

[a] * significant at 10%, ** significant at 5%, *** significant at 1%

[b] The predicted Heckman ln wage is derived from an auxiliary earnings regression corrected for selection.

[c] The base case is London and the South East

[d] The base case is days only

[e] The base case is working weekends only or weekdays and weekends

[f] The base case is stand by, sleep in, and not applicable

[g] The base case is no influence

[h] The base case is Community based and Primary Care.

*The extended labour supply model*

**Non-pecuniary workplace heterogeneity.** Column three in Table II shows the results when

non-pecuniary workplace characteristics are added to the classic labour supply model.

Shift patterns have a significant impact on the total number of hours worked. Mixed shifts

and permanent night shifts significantly reduce hours supplied, the former by 1.7 and the

latter by 3.1 hours relative to working day shifts only. Nurses working flexi-time, multiple work patterns or other work patterns, do not supply significantly different hours to nurses working day shifts only. Therefore, the work pattern that elicits significantly different labour supply is one described by mixed shift arrangements and permanent night work. Looking at the days of the week hours are worked, nurses only working on weekdays supply significantly fewer hours relative to nurses working weekdays and weekends. The estimated reduction in hours is on average 2.7 hours. Nurses required to work on-call supply significantly more hours relative to those who do not. The estimated increase is 4.1 hours per week. The coefficients on indicators of the influence that nurses have on changes to their shift or work patterns indicates that nurses who have some or a large degree of influence supply significantly fewer hours relative to nurses who do not have any influence over changes in their shift or work pattern. Having some influence reduces hours supplied by 3 hours on average and having a large influence by 3.9 hours per week.

There is evidence that work setting, the particular place of work nurses work in (primary care, care home, A&E, surgery or intensive care for instance), significantly influences hours supplied. Relative to nurses in community based and primary care settings, nurses in care homes work on average longer hours. The same holds for nurses in intensive care, A&E departments, acute settings, surgery and psychiatric hospitals. This may reflect the job demands in these settings or an underlying recruitment problem requiring nurses specialising in these areas to work more hours.

Compared to the standard labour supply model, there is a significant increase in the predicted Heckman ln wage, resulting in a labour supply elasticity of 0.357.

**Non-pecuniary worker heterogeneity.** The final column in Table II (Total Hours III) presents results that add measures of non-pecuniary worker heterogeneity in the form of individual preferences for general job characteristics. With the exception of the importance of general job security and 'a job that helps others', all general job characteristics are significant and of the expected sign.

For example, as individual preferences for promotion prospects become more important, hours supplied increase. All other things equal this may be seen as a signal of ambition or indeed be a prerequisite for successful promotion. The same holds for the importance of paid overtime and pay. As these two job characteristics become increasingly preferred in the individual's utility function, workers supply more hours, ceteris paribus. However, individual preferences regarding the importance of measures reflecting working hours (the importance of the predictability of hours, when hours are worked and the flexibility of working hours) show that hours supplied decline with increasing importance. This may suggest that workers are constrained in choosing hours supplied. Hours supply choices may further be constrained by employer or organisational barriers that cannot align individual preferences over the flexibility and timing of hours supplied with institutional constraints. Euwals (2001) investigated the labour supply, the flexibility of hours and job mobility for a sample of Dutch women over time [25]. Using measures of individual preferences over working hours, he found that women who preferred fewer hours were more likely to exit the labour market and that women remaining in their jobs experienced little variation in hours. The exception are women who prefer a marked change in hours. Of course, hours constraints may particularly apply to women who constitute the majority of the workforce in our sample and in the NHS nurses workforce in general since they often need to balance family and child rearing with their labour force commitments. The negative association between the importance of

flexibility of hours and hours worked may also suggest that nurses who care a lot about the flexibility of hours choose to work less than nurses who do attach less importance to the flexibility of hours worked. While not significant, the sign of the variable capturing the importance of having a job that helps others confirms a priori expectations. The lower (higher) the importance of having a job that helps others, the lower (higher) the number of hours supplied (other things constant).

Finally, inclusion of controls for non-pecuniary worker heterogeneity in addition to controls for workplace heterogeneity increases the size of the predicted wage term slightly relative to the model controlling for workplace heterogeneity. Note that it increases more relative to the classic labour supply model, with the elasticity estimated in this final model increasing to 0.364. Thus, the extended labour supply models both suggest a downward bias in the elasticity of hours with respect to wages compared to the standard labour supply model. The overall increase in the elasticity is mostly attributable to workplace characteristics with worker preferences only adding a small change. However, worker preferences do explain a significant increase in the variation of hours supplied.

**Discussion and Conclusion**

We used a rich primary data set designed to capture the impact of pecuniary and non-pecuniary factors on the labour supply of nurses in the UK. We tested whether nurses' labour supply is sensitive not only to wages but to characteristics of their working conditions and individual worker preferences. We explored how employment conditions and measures of worker heterogeneity may help explain the decision to supply hours in the nursing labour market.

Our results show that standard models of labour supply that cannot account for worker and workplace heterogeneity in non-pecuniary job aspects can cause a downward bias in estimates of the elasticity of hours supplied with respect to wages. The results suggest that hours supplied are more sensitive to wages than would be estimated without controls for such characteristics and in line with previous findings in empirical nurses labour supply studies.

Our modelling strategy is not without limitations. Whilst we have tested for the potential sample selection bias arising from selection into participation in the NHS nursing labour market, we believe acceptance of the null hypothesis of no selectivity may well result from data limitations where the majority of nurses in the sample participate in the NHS nursing labour market. We therefore presented results based on a OLS regression on hours that accounted for the endogeneity of wages. Second, since our analysis is based on cross-sectional data causality is more challenging to assess in this context. However, the use of primary cross-sectional data allows us to explore and indeed acknowledge the role of non-pecuniary workplace characteristics and observed worker heterogeneity over non-pecuniary job aspects. Third, our sample may not be geographically representative. Approximately 50% of nurses in nursing employment in the NHS as well as nurses working in alternative employment who responded to the survey live in the North of England.

Fourth, we cannot say that we have estimated the 'definitive' measure of the elasticity of hours with respect to wages: Hanel et al (2014) have highlighted the importance of explicitly accounting for the entry and exit decisions of nurses when modelling nurses labour supply decisions [10], where these entry and exit decisions might be said to reflect judgements about the 'whole of the advantages and disadvantages' of these different employments. We do not claim we have captured all unobserved worker or job heterogeneity. We have however sought to capture and estimate the impact of what are judged to be the most important of these. Nonetheless as in other studies further biases may be present in our extended model and other

estimation methods that explicitly try to control for this could be employed if only a pure estimate of the effect of wages on hours is required.

This paper contributes to the literature in two important ways. First, when evaluating the results of studies into the labour supply of specific occupations caution should indeed be exercised when considering estimates of the labour supply when the sensitivity of the results can be shown to be dependent on the information used. This will be the case particularly in an occupation which is characterised by non-standard workplace characteristics, as in the nursing occupation.

Second and of greater importance it reveals that individual tastes for job characteristics such as the flexibility, predictability and the timing of hours have an important and significant impact on hours of work supplied. This suggests that some individuals may be constrained in the hours they would be willing to supply. Where actual hours fall short of desired hours this could, in the extreme, lead to an exit from the nurses' profession into alternative employment that matches more closely the individuals' desired hours. It also suggests, that where it is difficult to change individual tastes or preferences over job specific characteristics, recognising that these features are important determinants of the labour supply can be utilised to adapt management practices to take these tastes into consideration where possible. This can provide an important additional instrument apart from wages to influence labour supply. For instance, the significant results relating to the importance of general job characteristics suggest that improving flexible working conditions and professional development opportunities may impact labour supply responses positively. Of course, preferences and tastes over job specific attributes may change over time but due to the cross-sectional nature of our data we cannot observe these. Non-pecuniary job aspects have

previously been measured in terms of subjective job satisfaction. Results provided here on worker preferences for non-pecuniary job aspects complement the general findings from the job satisfaction literature. However, these have usually focused on job satisfaction and turnover issues [24]. In addition, while it can be argued that labour supply remains relatively insensitive to wages, a more cost-effective method of influencing labour supply could be policy targeted at improving working conditions that can be shown themselves to be important determinants of labour supply.

This study has investigated the importance of non-pecuniary workplace and worker characteristics in the labour supply decisions of nurses. We did not set out to test how labour supply decisions differ by choice of workplace setting or shift type. Our modelling approach did not distinguish how the outcome of these choices would impact the labour supply decisions of nurses conditional on the different healthcare settings that nurses are employed in as previously investigated by Di Tommaso et al (2009) and Hanel et al (2014). Their findings suggest that labour supply responses of nurses are more elastic once analysis allows for the self-selection of nurses into different job types and workplace settings. Whilst this is beyond the scope of this paper, it would provide a fruitful extension to work presented here since it will allow investigation of the heterogeneities in work characteristics and distribution of tastes across different healthcare settings and how these result in different setting specific labour supply responses. However, our results identify a source of bias in the elasticity of hours with respect to wages that derive from the contribution on non-pecuniary workplace characteristics including shift types and workplace settings to the change in the elasticity when not explicitly modelled rather than biases arising through selection into particular shift types and workplace settings.

**Appendix. Supplementary Table S1**

Table SI. Sample selectivity corrected hours regressions[a]

| Independent variables | Total Hours I (Standard) | Total Hours II (Workplace) | Total Hours III (Workplace and Worker) |
|---|---|---|---|
| Age | 0.525** | 0.580** | 0.584** |
| Age$^2$ | -0.009*** | -0.009*** | -0.009*** |
| Gender (female) | -3.102*** | -1.392 | -1.482 |
| Ethnicity | 10.507*** | 8.979*** | 6.587*** |
| Single | 0.687 | 0.547 | 1.277 |
| Wales [b] | 0.528 | -0.858 | -1.279 |
| Scotland & NI | 0.913 | 0.605 | 0.293 |
| South West | 1.543 | 0.730 | 0.554 |
| North England | 1.508 | 1.000 | 0.920 |
| East of England | 1.417 | 1.920 | 1.315 |
| East Midlands | -0.330 | -0.215 | -0.340 |
| West Midlands | 0.955 | 1.012 | 2.544 |
| Yorkshire | 0.561 | -0.177 | 0.272 |
| Predicted Heckman ln wage | 9.792*** | 13.110*** | 13.714*** |
| No. dependent children aged<=16 | -1.696*** | -1.619*** | -1.502*** |
| Age of youngest child < 5 | -3.689*** | -3.730*** | -2.845*** |
| Partner's wage | -0.213*** | -0.169*** | -0.129*** |
| Partner wage missing | -2.040 | -1.727 | -1.366 |
| Partner not employed | 3.732 | 3.571 | 2.955 |
| Partner employment status missing | 0.906 | 0.858 | 0.397 |
| Non-labour income | -1.390* | -0.971 | -0.480 |

*Shift/rota/work pattern[c]:*

| | | |
|---|---:|---:|
| Shift mix | -1.670** | -1.643** |
| Permanent nights | -3.096* | -2.658* |
| Flexi-time | -0.690 | -0.911 |
| Other | -3.932 | -2.839 |
| Multiple | -0.374 | -0.711 |
| Working Weekdays only [d] | -2.707*** | -2.280*** |
| Required to work on call [e] | 4.085*** | 3.188*** |
| *Influence over change in shift/rota/work pattern [f]:* Some influence | -3.038*** | -2.411*** |
| Large influence | -3.792*** | -2.890*** |
| *Work setting [g]:* Undefined/Other | 2.743*** | 2.533** |
| Care home | 6.086*** | 6.438*** |
| Charity | -0.980 | 0.295 |
| Hospital Outpatients | 1.064 | 0.889 |
| Hospital A&E | 4.583** | 3.470* |
| Hospital Acute | 2.150* | 1.538 |
| Hospital IC | 4.846** | 3.719* |
| Hospital Surgery | 2.696** | 2.167* |
| Hospital Paediatrics | 1.828 | 1.986 |
| Hospital Geriatrics | 3.150 | 2.391 |
| Hospital Palliative | 1.551 | 1.066 |
| Hospital Other | 2.862*** | 2.807*** |
| Hospital Mental | 4.640*** | 4.504*** |
| *Importance of:* General job security | | 0.647 |
| Predictability of hours | | -1.188*** |

| | | | |
|---|---|---|---|
| When hours are worked (time of day) | | | -0.858*** |
| Job helping others | | | 0.365 |
| Pay | | | 1.440*** |
| Availability of paid overtime | | | 1.111*** |
| Flexibility of working hours | | | -1.007*** |
| Promotion prospects | | | 1.212*** |
| Inverse of Mills ratio | 2.105 | -1.083 | 1.409 |
| Constant | 11.552 | 1.542 | -8.549 |
| Observations | 1384 | 1384 | 1384 |
| $R^2$ | 0.215 | 0.288 | 0.359 |
| Elasticity of hours with respect to own wage | 0.264 | 0.353 | 0.370 |

[a] * significant at 10%, ** significant at 5%, *** significant at 1%

[b] The base case is London and the South East

[c] The base case is days only

[d] The base case is working weekends only or weekdays and weekends

[e] The base case is stand by, sleep in, and not applicable

[f] The base case is no influence

[g] The base case is Community based and Primary Care.

**Acknowledgments**

References

1.  OECD: OECD Health at a glance 2013. http://www.oecd.org/els/health-systems/Health-at-a-Glance-2013.pdf (2013)
2.  Simeons S., Villeneuve M., Hurst J.: Tackling nurse shortages in OECD countries. http://www.oecd.org/health/health-systems/34571365.pdf (2005)
3.  Skåtun D., Antonazzo E., Scott A. et al.: The supply of qualified nurses: a classical model of labour supply. Applied Economics **37**, 57-65 (2005)

4. Altonji J.G., Paxson C.H. Job characteristics and hours of work. In: Ehrenberg RG (ed) Research in Labor Economics, pp. pp. 1-55. Jai Press INC., London (1986)

5. Antonazzo E., Scott A., Skatun D. et al.: The labour market for nursing: a review of the labour supply literature. Health Economics **12**, 465-478 (2003)

6. Shields M.A.: Addressing nurse shortages: what can policy makers learn from the econometric evidence on nurse labour supply? The Economic Journal **114**, F464-F498 (2004)

7. Askildsen J.E., Baltagi B.H., Holmås T.H.: Wage policy in the health care sector: a panel data analysis of nurses' labour supply. Health Economics **12**, 705-719 (2003)

8. Rice N.: The labour supply of nurses in the UK: evidence from the British Household Panel Survey. http://www.york.ac.uk/res/herc/documents/wp/05_10.pdf (2005)

9. Kankaanranta T., Rissanen P.: The labor supply of registered nurses in Finland: the effect of wages and working conditions. The European Journal of Health Economics **10**, 167-178 (2009)

10. Hanel B., Kalb G., Scott A.: Nurses' labour supply elasticities: The importance of accounting for extensive margins. Journal of Health Economics **33**, 94-112 (2014)

11. Heckman J.J.: Sample selection bias as a specification error. Econometrica **47**, 153-161 (1979)

12. Makepeace G., Marcenaro-Gutierrez O.: The Earnings of Workers Covered by Pay Review Bodies: Evidence from the Labour Force Survey. http://www.ome.uk.com/Document/Default.aspx?DocumentUid=F285548E-9F4B-4827-A64B-08B92D139FEC (2005)

13. Buchan J., Seccombe I.: An incomplete plan. The UK nursing labour market review 2008. http://www.rcn.org.uk/__data/assets/pdf_file/0015/201282/003302.pdf (2008)

14. Buchan J., Seccombe I.: Fragile future? A review of the UK Nursing Labour Market in 2003. http://www.rcn.org.uk/__data/assets/pdf_file/0006/78630/002468.pdf (2004)

15. Government Statistical Service: NHS hospital and community health services. Non-medical staff. England 1997-2007. http://www.ic.nhs.uk/webfiles/publications/nhsstaff2007/non%20med/Non-Medical%20Staff%20Bulletin%201997-2007.pdf (2008)

16. Heyes A.: The economics of vocation or 'why is a badly paid nurse a good nurse'? Journal of Health Economics **24**, 561-569 (2005)

17. Barigozzi F., Turati G.: Human health care and selection effects. Understanding labor supply in the market for nursing1. Health Economics **21**, 477-483 (2012)

18. Elliott R.F., Ma A.H.Y., Scott A. et al.: Geographically differentiated pay in the labour market for nurses. Journal of Health Economics **26**, 190-212 (2007)

19. Smith A. (1977 (1776)) An inquiry into the nature and causes of the wealth of nations. University of Chicago Press, Chicago

20. Rosen S. The theory of equalizing differences. In: Ashenfelter O, Layard R (eds) Handbook of Labor Economics, pp. 641-692. North Holland, Amsterdam (1986)

21. Phillips V.L.: Nurses' labor supply: Participation, hours of work, and discontinuities in the supply function. Journal of Health Economics **14**, 567-582 (1995)

22. Chiha Y.A., Link C.R.: The shortage of registered nurses and some new estimates of the effects of wages on registered nurses labor supply: a look at the past and a preview of the 21st century. Health Policy **64**, 349-375 (2003)

23. Clark A.E.: Job satisfaction and gender: Why are women so happy at work? Labour Economics **4**, 341-372 (1997)

24. Shields M.A., Ward M.: Improving nurse retention in the National Health Service in England: the impact of job satisfaction on intentions to quit. Journal of Health Economics **20**, 677-701 (2001)

25.     Euwals R.: Female Labour Supply, Flexibility of Working Hours, and Job Mobility. The Economic Journal **111**, 120-134 (2001)