

# DRAFT

## Paper Number 15

### **Nursing Workforce Skill Mix and the Competitiveness of Qualified Nurses Pay: a local labour market analysis**

**\*Jean-Baptiste Combes, Bob Elliott and Diane Skåtun**

Health Economics Research Unit, University of Aberdeen, ABERDEEN AB25 2ZD

#### Abstract

The competitiveness of qualified nurses pay varies between regions and has been shown to be related to qualified nursing vacancies. One way hospitals may seek to mitigate the effects of qualified nursing vacancies is to substitute unqualified nurses for qualified nurses. If unqualified nurses pay is more flexible than that of qualified nurses, hospitals will be able to adjust unqualified nurses pay to enable them to recruit these nurses in the areas in which it is most difficult to recruit qualified nurses. This paper tests the hypothesis that the nursing skill-mix is related to the competitiveness of qualified nurses pay. It seeks to explain variations in the nursing skill-mix by variations in the competitiveness of qualified nursing pay between local labour markets.

---

\* *Address for correspondence:* Jean-Baptiste Combes, Health Economics Research Unit, University of Aberdeen, Polwarth Building, Foresterhill, Aberdeen, AB25 2ZD, UK. Email: jeanbaptiste.combes@abdn.ac.uk

## **1. Introduction**

Nurses comprise the largest single staff group in the health service workforce in all developed countries. They account for more than 40% of the staff employed in the NHS in England and are critical to service delivery. Nurses are recruited in local labour markets but in the UK the pay of qualified nurses is set by a Review Body which has established a UK – wide structure which exhibits little regional variation. Earlier research by some of the authors (Elliott et al 2007 and 2009) has established that this pay structure reveals less regional variation than does pay in the private sector, and that as a result the competitiveness of nurses pay differs by region. They further established that, as might be predicted, these differences in competitiveness affected the ability of the NHS to attract and retain qualified nurses (as measured by qualified nursing vacancies) in the different regions.

Where there are unfilled vacancies the NHS might seek to meet the demands for service delivery by other mechanisms, one of these may be substituting unqualified for qualified nurses. Prior to the introduction of Agenda for Change, local flexibility in pay existed. Introduced in 1994 it enabled managers to vary the reward for unqualified nurses in line with local market conditions (Grimshaw, 1999). Agenda for Change was progressively implemented from around 2005 onwards. Our analysis covers the three years up to April 2005.

In this paper we assume that unqualified nurses' wages reveal more local flexibility than qualified nurses pay. We test the hypothesis that the relative flexibility of unqualified nurses pay enabled hospitals to more easily recruit unqualified nurses in those areas in which the pay of qualified nurses was less competitive. We explore whether hospitals sought to substitute unqualified for qualified nurses and thus whether the nursing skill mix is systematically related to local labour market conditions and in particular to the competitiveness of qualified nurses pay. Changes in skill-mix may have important consequences for service delivery and patient outcomes.

Differences in the relative attractiveness of the pay for qualified nurses in the NHS and the pay of private sector employees in the same labour market are distinguished by computing Standardised Spatial Wage Differentials (SSWDs). SSWDs reveal the 'underlying' structure of pay between different areas and regions. We used SSWDs published in Elliott (2006) . We specified an equation to explain the proportion of qualified nurses on qualified and unqualified

ones. Our main variable of interest will be the SSWDs estimated in the first stage. The analysis controls for other determinants of workforce composition (case mix). The General Linear Model is then employed to estimate the parameters.

## **2. The Nursing Skill Mix**

The skill-mix of the health care workforce is an important issue in research at present. A policy which seeks to change the nursing skill-mix needs to identify some tasks that are currently done by nurses which could be done by unqualified nursing staff. Prescott *et al.* (1991) shows that 40 per cent of the work done by nurses in hospitals could be done by HCAs. Duffield *et al.* (2008) also report that many tasks done by nurses could be done by less qualified staff.

Most of the research into skill-mix has focused on the impact of skill-mix on the delivery of care and patient outcomes. Some research has also focused on the economic impact of changing skill-mix. It appears to have established that in many settings substituting unqualified nurses for qualified nurses may improve outcomes and has no adverse impact on patient experience.

Hall (1997) in a review of USA based research reports that employing Health Care Assistants (HCAs) in place of nurses in hospitals lowers costs and has no impact on patient satisfaction or outcomes. Cavanagh *et al.* (1997) in a further review for the USA reveals more mixed results as does Spilsbury (2001) in a review for the UK. Spilsbury reports that some studies show that the quality of care depends upon qualified nurses although others show that tasks currently undertaken by nurses can be done by other less qualified staff without adverse effects on patient care. However the study by Spilsbury does not focus on hospitals.

Buchan & Poz Mario, (2002) reviewing the literature report that changing the skill-mix is not efficient in all situations while Carr-Hill *et al.* (1995) found that in hospitals there is a strong grade effect on care delivery; the better the grade the better the care. In a different setting, a Taiwanese hospital, Lee *et al.* (2005) reports that on the short-run there was no impact on patient outcomes of a reduction of the proportion of Registered Nurses compared to nursing aides.

Changing the skill-mix might result in deterioration in the quality of nursing jobs and this may have an impact on the health care delivery and patient outcomes. Studies have focused on the effect of a change in skill-mix on the health care workforce: on workload, satisfaction, hierarchy, and organisation. Walker *et al.* (2007) showed that a change in skill-mix in acute care wards and

operating services in an Australian hospital changed the way the work was done leading to the hiring of more unqualified staff. Such changes in the organisation of work have been argued to be counter productive by Hancock (1992), Ivor (1994) and Hall (1997). Changes in the organisation of work can result in the jobs of nurses changing from holistic practice towards more task based work. A study which elicited the opinions of nurses and HCAs on changes in skill-mix in a hospital ward (Daykin *et al.*, 2000) reported that nurses viewed this as deskilling resulting in a change from a holistic approach to task oriented practice. In contrast HCAs saw it as an opportunity to obtain new skills. Further the authors showed that according to nurses themselves their job was already task oriented.

Thus research provides no strong evidence of any harmful effects of changing the skill-mix by employing a greater proportion of less qualified nursing staff though this may be because such effects are difficult to measure. There is some evidence that quality is related to presence of qualified nursing staff and clearly nurses have concerns that changing skill mix changes practice and this again may lead to deterioration in quality and in the patient experience. However where they are unable to recruit sufficient numbers of qualified nurses quality and patient experience may be lower than desired and changing the skill mix so that the vacant jobs for qualified nurses are redesigned and undertaken by unqualified staff may be a solution.

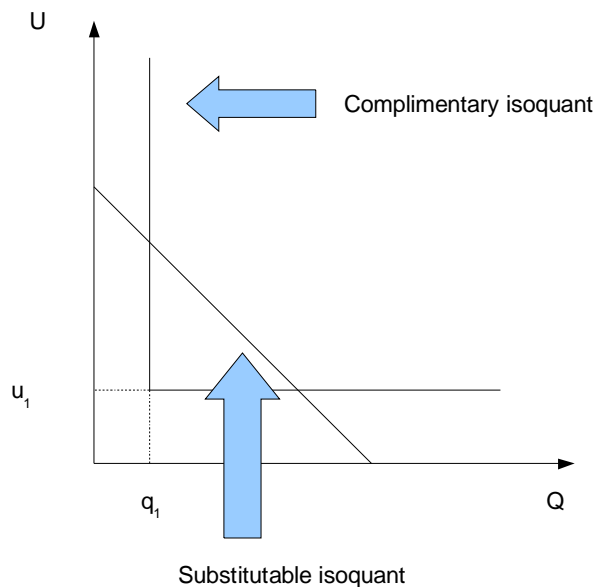
### **3. The Drivers of Skill-mix:**

The drivers of changes in skill mix are changes in the relative costs of employing qualified and unqualified nurses, and changes in the technical possibilities and institutional rules that enable skill-mix to be changed. This is illustrated below. Where there are two labour inputs Q (for Qualified nursing staff) and U (for Unqualified nursing staff), the relative pay of the two inputs drives (for a given production function) the proportions in which the two inputs are employed. An isoquant shows the different combinations of Q and U that can produce a given level of health service. The shape of the isoquant reflects the degree of substitutability between qualified and unqualified nurses which in turn reflects the technical possibilities and institutional rules governing the substitution possibilities. A family of isoquants, an isoquant map, shows the different levels of service that can be produced by employing both more qualified and more unqualified nursing staff.

The degree of substitutability, allowed by the prevailing technology and institutional rules, is illustrated by the degree of convexity of the isoquant. If inputs are perfect substitutes then the

isoquant will be a straight line. If inputs are perfect complements then the isoquant kinks at 90° for there is only one combination of qualified and unqualified nurses that can be employed to produce a given level of service. These are shown in Diagram 1 below.

**Diagram 1**



More generally it would be assumed that qualified and unqualified nurses are less than perfect substitutes that there is more than one combination of the two that can produce a particular level of service. The budget constraint illustrates the level of expenditure and the slope of the budget constraint the relative costs of employing qualified and unqualified nurses.

When the isoquant map and budget constraints are combined they reveal an equilibrium, the highest level of service that can be attained for a given level of expenditure and set of relative costs of employing qualified and unqualified nurses. This equilibrium is shown at point  $(l_{q1}, l_{u1})$

in Diagram 2. Here the relative price of the two inputs is  $rp_1 = -\frac{p_{q1}}{p_{u1}}$ . Suppose that we observe a

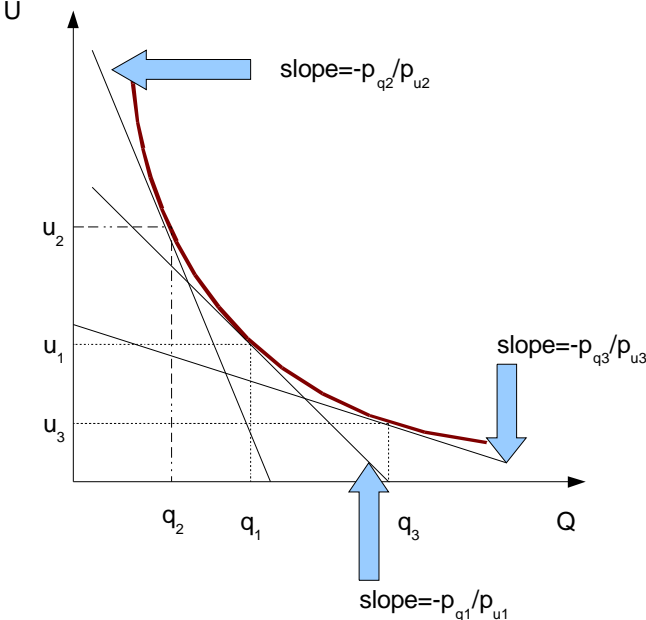
change in the relative price to  $rp_2 = -\frac{p_{q2}}{p_{u2}}$ , with  $rp_2 > rp_1$ , the relative price of input Q has

increased (or the relative price of U has decreased) and consequently a smaller quantity of Q is used  $(l_{q2} < l_{q1})$ , and a larger quantity of U is used  $(l_{u2} > l_{u1})$ . Respectively, if we observe  $rp_3 > rp_3$

with  $rp_3 = -\frac{p_{q3}}{p_{u3}}$ , then the relative price of input Q has decreased (or the relative price of U

increased) and consequently a larger quantity of Q is used ( $l_{q3} > l_{q1}$ ) and a smaller quantity of U is used ( $l_{u3} < l_{u1}$ ).

**Diagram 2**



This simple economic framework shows how a change in the relative costs of employing qualified and unqualified nurses will determine the relative proportions in which they are employed: the skill mix.

*3.1 Impact of institutions and technology*

One determinant of the slope of the isoquant is institutional rules that govern the substitution possibilities and which either inhibit or encourage the use of unqualified nurses to undertake tasks that would otherwise be done by qualified nurses. A second determinant of the slope is technological factors that affect substitution. There is relatively little research revealing how institutional rules and technology have affected the nursing skill mix in the UK and where there has been it is sometimes confused. In the following we seek to clarify the issues.

Two studies for the US have shown how the change in the reimbursement scheme for Medicare in the early 80s increased the level of capital employed and also increased the ratio of qualified nurse to unqualified nurses; this is an example of technology/skill complementarity (Pope, Menke 1990, 1990; Acemoglu & Finkelstein, 2008). For the UK (Buchan, 2005) has argued that

technological innovation has also increased the demand for qualified nurses. These developments reduce the scope for substituting unqualified for qualified nurses and change the slope of the isoquants.

However neither changes in the general level of funding for hospitals or in general workload need affect skill mix. A change in the funding of hospitals would be illustrated in Diagrams 2 in a shift of the budget constraint and it is clear that alone this will not change skill mix. Similarly any change in general workload will not change skill-mix, everything else equal, it will merely shift the isoquants inwards or outwards. But a change in the type of care provided in hospitals could well change skill mix. In the UK there was a change in the balance of care provided by the primary and secondary sectors in the nineties as a result of the drive to reduce the time patients spent in hospital. Discussed by Richards *et al.*, (2000) this development may well have changed skill mix. The accompanying switch in resources from the secondary to the primary sector will have shifted the hospital budget constraint toward the origin and if the least skilled task were no longer undertaken this will have changed required skill mix.

### 3.2 *Impact of changes in relative labour costs*

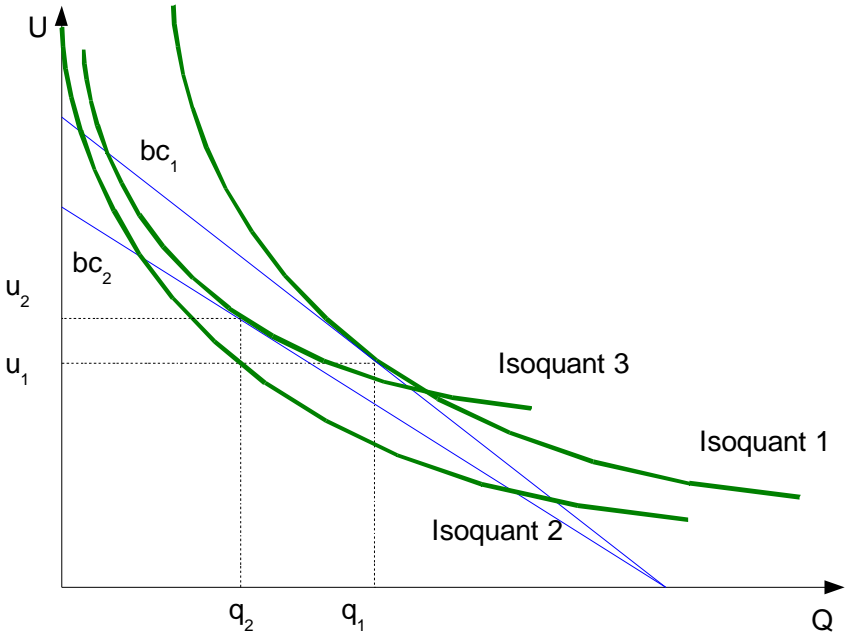
Any change in the relative costs of employing qualified and unqualified nurses changes the slope of the budget constraint. In Diagrams 2 above any increase in the pay of qualified nurses relative to unqualified nurses steepens the budget constraint while any increase in the relative pay of unqualified nurses flattens the budget constraint; both developments would be expected to result in a change in skill mix.

### 3.3 *Vacancies and skill mix*

Hospitals that are unable to recruit the required number of qualified nurses may seek to minimise the reduction in service that would otherwise occur by recruiting additional unqualified nurses. In equilibrium hospitals must increase the pay of unqualified nurses if they are to attract more into hospital employment. This is illustrated in Diagram 3 below. For a given budget constraint and set of substitution possibilities as reflected in the slope of Isoquant 1 the desired levels of employment of qualified and unqualified nurses are  $q_1$  and  $u_1$  respectively. Qualified nursing vacancies are equal to  $q_1 - q_2$  and thus the hospital is only able to provide a lower level of service by operating at Isoquant 2. The increase in unqualified nurses pay required to attract more into hospital employment flattens the budget constraint as illustrated by the broken line, but this enables the hospital to employ  $u_2$  unqualified nurses alongside the prevailing level of

employment of qualified nurses,  $q_2$ , and move the hospital onto a higher isoquant at Isoquant 3. Isoquant 3 may not be part of the same isoquant map as to substitute hospital need to change for production function.

**Diagram 3**  
**Vacancies and Skill Mix**



Buchan *et al.*, (2008) have shown that skill shortages result in changes in skill-mix, Grimshaw (1999) that local premiums were introduced to enable hospitals to hire greater numbers of non medical staff on local contracts. Buchan (2002b) argues that vacancies can be underestimated if managers hire unqualified staff instead of qualified staff. Buchan (2005) also reports that the drivers of skill-mix in the UK, identified by government representatives, professional associations, educators, employers and policy analysts, were thought to be skill shortages, the introduction of new more highly skilled roles for qualified nurses (such as the Advance Practice Role), the establishment of new types of service, and changes in the rules and attitudes of the medical profession which had previously discouraged such substitution.



#### **4. The Competitiveness of Qualified Nurses Pay**

The competitiveness of qualified nurses pay is revealed by calculating the difference between standardised spatial wage differentials (SSWDs) estimated for qualified nurses and the SSWDs estimated for their comparators in the private labour market. Private sector SSWDs reveal the ‘underlying’ structure of pay between different areas (Elliott *et. al.* 2007). SSWDs are estimated using standard regression models and those for the private sector reveal substantial variation between different areas.

The theory of compensating wage differentials provides a theoretical framework to explain why the ‘underlying’ structure of pay, as measured by SSWDs, differs between geographical areas (Smith, 1776; Rosen, 1986). Competition in labour markets ensures that the net advantages of different jobs will tend to equality. Thus, we expect to find higher pay in those areas of the country where the cost of living is higher and higher pay in those areas with a less pleasant working environment. Empirical research has provided support for this theory of spatial pay differences (Reilly, 1992; Shah and Walker, 1983; Blackaby and Murphy, 1995).

For the net advantages of jobs in different areas to be equalised, labour must be mobile, labour markets must be integrated and pay structures flexible. Where these conditions are not met, departures from equilibrium will occur. Departures from equilibrium may result from the preferences of those who set pay. Where trade unions have an important role in pay setting, pay is likely to deviate from the rates that would otherwise be paid in the market. Trade unions are likely to be concerned about equity and fair pay, and often seek to negotiate a national rate for the job (see Metcalf *et al.*, 2001). Where this happens they will narrow the distribution of pay and the resulting wage structure will be flatter than would otherwise occur. If the power of trade unions differs between areas (see Blackaby and Murphy, 1991) this will also affect geographical patterns of pay.

The pay of qualified nurses in the period studied here was set by the Nurses and Midwives Review Body and the national structure that it established limited the scope for regional variation in pay. As a result the geographical pattern of pay for qualified nurses exhibited much less spatial variation than did pay in the private sector. The consequence was variations in the competitiveness of qualified nurses pay between different areas. In the following analysis these variations in competitiveness are captured by calculating the differences between the estimated SSWDs for qualified nurses and the private sector in each local labour market. These differences

in competitiveness result in differences in the ability of hospitals in different areas to attract and retain nurses.

## 5. Data

The Annual Survey of Hours and Earnings (ASHE) over the period April 2003 to April 2005 was used to estimate the SSWDs. ASHE superseded the New Earnings Survey in 2004 and contains refinements to the latter. ASHE imputes missing values and weights observations, individuals are assigned to Local Authority District (LAD) areas using the workplace postcodes on the earnings records.

The SSWDs are taken from an earlier study by two of the authors (Elliott et al. 2006). We give a brief description of how the SSWDs are estimated. Using data from ASHE the following model was estimated for the general labour market:

$$\ln w_{ij} = x'_{ij}\beta + v_j + \varepsilon_{ij}$$

Where  $w_{ij}$  is the hourly earnings of individual  $i$  who works in the private sector of the economy in area  $j$ . The vector  $x$  contains all the control variables (age, age2, gender, industry dummies and occupational dummies),  $\varepsilon_{ij}$  are the individual-specific error terms and  $v_j$  are the area-specific effects. The area-specific effects represent the SSWDs and are estimated using a dummy variable for each area. The same model was estimated for qualified nurses to derive a set of SSWDs. The gap was then computed for each area as the SSWDs for nurses minus the SSWDs for the general labour market.

To calculate skill mix we use data on head counts and whole time equivalent qualified and unqualified nurses which are published on the website of the Department of Health (<http://www.dh.gov.uk/en/Publicationsandstatistics/Statistics/StatisticalWorkAreas/Statisticalworkforce/index.htm>). We used data for the period from April 2003 to April 2005. The figures reported are from October of the preceding year. During the period studied some trusts merged, where this happened we aggregated the observations to the merged structure. We dropped observations for the “Ambulance trusts” from the data set because they have a very different

workforce structure and the numbers of nurses they employ are few. In total we have 230 Hospital Trusts<sup>1</sup> (HTs) for each of the three years.

Our dependant variable is the proportion of qualified nurses in the total number of nurses (qualified and unqualified). Our independent variables were a set of indicator variables of hospital activity and the SSWD gap. The hospital activity variables were downloaded from the Department of Health website in April 2009.

Table 1 below reports the mean of the proportion of qualified nurses in the nursing workforce. This is shown for all trust and distinguishing Acute from Mental Health Trusts and Teaching Hospital Trusts. The table reveals a large variation between Trusts, from 35% of qualified nurses among all the nurses to 100% and between the types of hospitals from 70% in Teaching Hospital Trusts and 61% in Acute Hospitals Trusts to 35% in Mental Health Trusts.

**Table 1: The Proportion of Qualified Nurses in the Nursing Workforce**

<b>Proportion of Qualified Nurses</b>	<b>P1</b>	<b>P25</b>	<b>P50</b>	<b>P75</b>	<b>P99</b>	<b>STD</b>	<b>N</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>
<b>All trusts</b>	0.484	0.677	0.752	0.872	0.998	0.133	690.000	0.763	0.353	1.000
<b>Acute</b>	0.616	0.713	0.779	0.904	0.999	0.108	417.000	0.802	0.574	1.000
<b>Mental</b>	0.371	0.542	0.610	0.674	0.955	0.107	165.000	0.620	0.353	0.995
<b>Teaching</b>	0.699	0.758	0.842	0.931	0.998	0.089	75.000	0.846	0.699	0.998
<b>Other</b>	0.547	0.725	0.813	0.866	0.997	0.113	33.000	0.797	0.547	0.997

P1(P99) is the figure for which 1% (99%) of the trusts are below this value and 99% (1%) above. P25 is the figure for which 25% (75%) of the trusts are below this value and 75% (25%) above. P50 is the median. STD is the standard deviation, the average gap between the mean value and the values of trusts is equal to STD. N is the number of trusts; Mean is the mean; Min is the minimum and Max is the maximum.

We extracted further data to allow us to control for hospital size. We used the total number of beds as an indicator of the size of the hospital. This variable is highly correlated with a range of other variables associated with the size of the hospital (the total number of non medical staff and the total number of qualified nurses). The variable is computed as the average of the number of beds available (occupied and non occupied) over a year. We hypothesised that the size of a

<sup>1</sup> In the United Kingdom hospitals are grouped into Hospital Trusts, this is the smallest unit we can have information for.

hospital would influence the number of qualified staff employed by a hospital. Czuber-Dochan et al. (2006) report that ophthalmic nurses are more likely to be present in bigger institutions.

The type of activity is measured by two sets of variables. The first indicating is the availability of critical beds<sup>2</sup>. The second the type of hospital (acute, mental health, teaching and other<sup>3</sup>) these are included to capture variations in specialty mix.

We also include a control for the intensity of the work, we proxied the intensity by the proportion of beds that are occupied.

## 6. Empirical model

We estimate the effect of the local labour market on the nursing skill-mix. Differences in the relative attractiveness of pay for nurses in the NHS and in the private sector are distinguished by computing Standardised Spatial Wage Differentials (see above). We measure the skill-mix as described above. We use a General Linear Model (GLM) to regress the SSWD gap on the skill-mix. We control for the case-mix of hospitals, (see above section 5). Our model can be written as:

$$PN_k = \alpha + \beta_1 C_k + \beta_2 (SSWD_k^q - SSWD_j^{private}) + \varepsilon_k$$

$$PN_k = \alpha + \beta_1 C_k + \beta_2 (GAP_{jk}) + \varepsilon_k$$

Where  $PN_k$ , = proportion of qualified nurses in the nursing workforce (qualified and unqualified),  $k$  denotes the  $k^{th}$  hospital trust which is located in within LAD  $j$ . The LAD based SSWDs which were generated from ASHE were allocated to HTs using the postcode of the Trust headquarters.  $C$  = Case-mix of hospitals and  $SSWD_k^q$  = Standardized Spatial Wage Differential of qualified nurses while  $SSWD_j^{private}$  = Standardized Spatial Wage Differential of the private sector.

---

<sup>2</sup> This variable is also correlated with the type of hospital as only one mental health has critical beds and five acute do not

<sup>3</sup> Children hospital, social care

We make the assumption that the private labour market clears, as a result the private sector wage is assumed to be at its natural rate. Thus we do not control for any other local area characteristics for these are assumed captured in the pattern of private sector SSWDs.

First we test a simple model. In the simple model skill mix is expected to be explained by the SSWD gap; we expect to find a positive coefficient on the SSWD gap. The smaller is the SSWD gap the less competitive is qualified nurses pay. In earlier research it has been shown that the smaller the SSWD gap the higher are qualified nursing vacancies (Elliott *et. al.* 2007 and 2009). If hospitals seek to maintain service levels and substitution possibilities exist they would be expected to hire unskilled nurses to undertake some of the tasks that would have been performed by the vacant posts. Thus the smaller the SSWD gap the smaller (greater) the proportion of qualified (unqualified) nurses

**7. Results**

We first estimated the impact of the SSWD gap on nursing skill mix. The results are shown in Table 2 below which reports the coefficient of the SSWD Gap when this is the only independent variable in the model. The sign is opposite to that expected, revealing that the nursing workforce contains a higher proportion of qualified nurses when the SSWD gap is smaller. The results of this simple specification suggest that as the SSWD gap rises, nursing pay becomes more competitive a lower proportion of qualified nurses are hired.

**Table 2: Impact of the gap on the proportion of qualified nurses**

Proportion of Qualified Nurses	1 <sup>st</sup> Model	
	Coef.	se
SSWD Gap	-0.002***	0.000
Constant	0.757***	0.005

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

If hospitals were able to hire unqualified nurses and substitute them for qualified nurses when they are unable to fill qualified nursing vacancies there might be no reduction in hospital service levels. Yet Hall, Propper and Van Rennan (2006) have shown that where outside wages are high, where nursing wages are less competitive, this is associated with deterioration in hospital service, as measured by an increase in patient mortality. Such an association would not emerge if

hospitals were able to substitute unskilled for skilled nurses as proposed by the naive hypothesis we have tested

Substitution possibilities may be restricted by the skill requirements of particular hospital activities. Some hospital cases may require a particular skill mix and there may be no substitution possibilities. Substitution possibilities may also differ by hospital type. Thus we next estimated a model controlling for hospital case mix and hospital type. In Model 2 this is estimated without controlling for SSWD Gap while in the 3<sup>rd</sup> Model we included both the control variables and the gap.

**Tables 3: Impact of case mix and the gap controlling for case mix on the proportion of qualified of nurses**

Proportion of Qualified Nurses	2 <sup>nd</sup> Model		3 <sup>rd</sup> Model	
	Coef.	se	Coef.	se
<b>SSWD Gap</b>	-	-	-0.002***	0.000
<b>Beds Available</b>	-0.000	0.000	0.000	0.000
<b>Percentage of occupied beds</b>	-0.063	0.069	-0.135*	0.069
<b>HTs with Beds open daily only</b>	0.010	0.018	0.018	0.018
<b>HTs with Critical Care Beds</b>	0.010	0.031	-0.008	0.031
<b>Type of hospital (ref: Mental Health)</b>				
<b>Acute</b>	0.184***	0.033	0.156***	0.033
<b>Teaching</b>	0.229***	0.036	0.185***	0.036
<b>Other</b>	0.166***	0.025	0.153***	0.025
<b>HTs becoming Foundation in 2004</b>	0.014	0.015	0.001	0.015
<b>HTs becoming Foundation in 2005</b>	-0.053***	0.020	-0.054***	0.019
<b>Constant</b>	0.669***	0.071	0.737***	0.071

Note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Model 2 reveals that the proportion of qualified nurses in the nursing workforce is positively associated with the type of hospital; acute, teaching and the residual category ‘other’ all employing a higher proportion of qualified nurses than the omitted category mental health trusts. Those that became foundation hospitals in 2005 employ significantly fewer qualified nurses.

Hospital type remains significant when we once again include the SSWD as in Model 3. As in Model 1 the SSWD gap is significantly and negatively related to the proportion of qualified nurses employed.

## **8. Conclusion**

This paper reports the results of some preliminary estimation. It is intended that the research be developed as follows:

- (i) We shall explore the appropriateness of the underlying assumptions. The first is that the wages unqualified nurses are flexible and can be adjusted to attract unqualified nurses in areas where it is difficult to recruit qualified nurses. We shall test this hypothesis by estimating SSWDs for unqualified nurses following Elliott *et. al.* (2006). The pattern can be compared to that for qualified nurses SSWDs and a comparator group from the private market.
- (ii) We shall explore the assumption that substitution is not between qualified and unqualified nurses but between unqualified nurses and health care assistants as reported by Grimshaw (1999).
- (iii) We shall employ further more detailed data to control for differences between hospitals in case mix which we believe to be a principal driver of substitution possibilities.
- (iv) We shall explore more sophisticated measures of hospital size.

It is of course always possible that qualified and unqualified nurses are not substitutes!

## 9. References

- Acemoglu, D., & Finkelstein, A. (2008). Input and technology choices in regulated industries: Evidence from the health care sector. *Journal of Political Economy*, 116(5), 837-880.
- Adams, A. & Bond, S. 2003, "Staffing in acute hospital wards: part 2. Relationships between grade mix, staff stability and features of ward organizational environment", *Journal of nursing management*, vol. 11, no. 5, pp. 293-298.
- Bach, S. 2000, "Health sector reform and human resource management: Britain in comparative perspective", *International Journal of Human Resource Management*, vol. 11, no. 5, pp. 925-942.
- Blackaby, D.H. & Murphy, P.D. 1991, "Industry Characteristics and Inter-Regional Wage Differences", *Scottish Journal of Political Economy*, vol. 38, no. 2, pp. 142-161.
- Blackaby, D.H. & Murphy, P.D. 1995, "Earnings, Unemployment and Britain's North-South Divide: Real or Imaginary?", *Oxford Bulletin of Economics and Statistics*, vol. 57, no. 4, pp. 487-512.
- Blegen, M.A., Vaughn, T. & Vojir, C.P. 2008, "Nurse staffing levels: Impact of organizational characteristics and registered nurse supply", *Health Serv.Res.*, vol. 43, no. 1 P1, pp. 154-173.
- Bloom, J.R., Alexander, J.A. & Nuchols, B.A. 1997, "Nurse staffing patterns and hospital efficiency in the United States", *SOC.SCI.MED.*, vol. 44, no. 2, pp. 147-155.
- Bloor, K., Hendry, V. & Maynard, A. 2006, "Do we need more doctors?", *J R Soc Med*, vol. 99, no. 6, pp. 281-287.
- Buchan, J. & Poz Mario, D., R. 2002, "Skill mix in the health care workforce: reviewing the evidence", *Bulletin World Health Organization*, .
- Buchan, J. 2000, "Planning for change: Developing a policy framework for nursing labour markets", *International nursing review*, vol. 47, no. 4, pp. 199-206.
- Buchan, J. 2002a, "Global nursing shortages: Are often a symptom of a wider health system or societal ailments", *British medical journal*, vol. 324, no. 7340, pp. 751-752.
- Buchan, J. 2002b, "Nursing shortages and evidence-based interventions: a case study from Scotland", *International nursing review*, vol. 49, no. 4, pp. 209-218.
- Buchan, J., Ball, J. & O'May, F. 2001, "If changing skill mix is the answer, what is the question?", *J Health Serv Res Policy*, vol. 6, no. 4, pp. 233-238.
- Buchan, J. & Aiken, L. 2008, "Solving nursing shortages: a common priority", *Journal of clinical nursing*, vol. 17, no. 24, pp. 3262-3268.
- Carr-Hill, R.A., Dixon, P., Griffiths, M., Higgins, M., McCaughan, D., Rice, N. & Wright, K. 1995, "The impact of nursing grade on the quality and outcome of nursing care.", *Health Econ*, vol. 4, no. 1, pp. 57-72.
- Cavanagh, S.J. & Bamford, M. 1997, "Substitution in nursing practice: clinical, management and research implications.", *J Nurs Manag*, vol. 5, no. 6, pp. 333-339.
- Daykin, N. & Clarke, B. 2000, "'They'll still get the bodily care'. Discourses of care and relationships between nurses and health care assistants in the NHS", *Sociol.Health Illn.*, vol. 22, no. 3, pp. 349-363.
- Druss, B.G., Marcus, S.C., Olfson, M., Tanielian, T. & Pincus, H.A. 2003, "Trends in care by nonphysician clinicians in the United States", *New Engl.J.Med.*, vol. 348, no. 2, pp. 130-137.
- Duffield, C., Gardner, G. & Catling-Paull, C. 2008, "Nursing work and the use of nursing time", *Journal of clinical nursing*, vol. 17, no. 24, pp. 3269-3274.
- Elliott, R.F., Sutton, M., Ma, A., McConnachie, A., Morris, S., Rice, N. & Skåtun, D. 2006, *Reviewing the Market Factor Forces formula*, Report to the Department of Health.
- Elliott, R.F., Ma, A.H.Y., Scott, A., Bell, D. & Roberts, E. 2007, "Geographically differentiated pay in the labour market for nurses", *Journal of Health Economics*, vol. 26, no. 1, pp. 190-212.



- Elliott, R.F., Sutton, M., Ma, A., McConnachie, A., Morris, S., Rice, N. and Skåtun, D. The role of the staff MFF in distributing NHS funding: taking account of differences in local labour market conditions. *Health Economics*. Forthcoming.
- Francis, B. & Humphreys, J. 1999, "Enrolled nurses and the professionalisation of nursing: A comparison of nurse education and skill-mix in Australia and the UK", *Int.J.Nurs.Stud.*, vol. 36, no. 2, pp. 127-135.
- Gray, A.M. & Phillips, V.L. 1996, "Labour turnover in the British National Health Service: A local labour market analysis", *HEALTH POLICY*, vol. 36, no. 3, pp. 273-289.
- Griffiths, P. 2002, "Nursing-led in-patient units for intermediate care: A survey of multidisciplinary discharge planning practice", *J.Clin.Nurs.*, vol. 11, no. 3, pp. 322-330.
- Grimshaw, D. 1999, "Changes in skills-mix and pay: Determination among the nursing workforce in the UK", *Work Employ.Soc.*, vol. 13, no. 2, pp. 295-328.
- Grimshaw, D. 2000, "The problem with pay flexibility: changing pay practices in the UK health sector", *The International Journal of Human Resource Management*, vol. 11, no. 5, pp. 943.
- Hall, L.M. 1997, "Staff mix models: complementary or substitution roles for nurses.", *Nurs Adm Q*, vol. 21, no. 2, pp. 31-39
- Hall, E., Propper, C. & Reenen, J.V. 2008, "Can pay regulation kill? Panel Data evidence on the effect of labor markets on hospital performance", *National Bureau of Economic Research*, n. 13376.
- Hancock, C. 1992, "Nurses and skill mix.", *Sr Nurse*, vol. 12, no. 5, pp. 9-12.
- Hayes, L.J., O'Brien-Pallas, L., Duffield, C., Shamian, J., Buchan, J., Hughes, F., Spence Laschinger, H.K., North, N. & Stone, P.W. 2006, "Nurse turnover: A literature review", *International Journal of Nursing Studies*, vol. 43, no. 2, pp. 237-263.
- Horrocks, S., Anderson, E. & Salisbury, C. 2002, "Systematic review of whether nurse practitioners working in primary care can provide equivalent care to doctors", *Br.Med.J.*, vol. 324, no. 7341, pp. 819-823.
- Ivor, R., L 1994, "The health care assistant: Professional supporter or budget", *International Journal of Health Care Quality Assurance*, vol. 7, no. 6.
- Kinnersley, P., Anderson, E., Parry, K., Clement, J., Archard, L., Turton, P., Stainthorpe, A., Fraser, A., Butler, C.C. & Rogers, C. 2000, "Randomised controlled trial of nurse practitioner versus general practitioner care for patients requesting 'same day' consultations in primary care", *Br.Med.J.*, vol. 320, no. 7241, pp. 1043-1048.
- Lee, T., Yeh, M., Chen, H. & Lien, G. 2005, "The skill mix practice model for nursing: measuring outcome", *Journal of advanced nursing*, vol. 51, no. 4, pp. 406-413.
- Marsh, G.N. & Dawes, M.L. 1995, "Establishing a minor illness nurse in a busy general practice", *BR.MED.J.*, vol. 310, no. 6982, pp. 778-780.
- Metcalf, D., Hansen, K. & Charlwood, A. 2001, "Unions and the Sword of Justice: Unions and Pay Systems, Pay Inequality, Pay Discrimination and Low Pay", *National Institute Economic Review*, vol. 176, no. 1, pp. 61-75.
- Pope, G.C. & Menke, T. 1990, "Hospital Labor Markets in the 1980s", *Health affairs*, vol. 9, no. 4, pp. 127.
- Prescott, P.A., Phillips, C.Y., Ryan, J.W. & Thompson, K.O. 1991, "Changing how nurses spend their time.", *Image--the journal of nursing scholarship*, vol. 23, no. 1, pp. 23-28.
- Reilly, B. 1992, "An Analysis of Local Labour Market Wage Differentials", *Regional Studies*, vol. 26, no. 3, pp. 257-263.
- Richards, A., Carley, J., Jenkins-Clarke, S. & Richards, D.A. 2000, "Skill mix between nurses and doctors working in primary care-delegation or allocation: A review of the literature", *Int.J.Nurs.Stud.*, vol. 37, no. 3, pp. 185-197.
- Rosen, S. 1986, "Chapter 12 The theory of equalizing differences" in *Handbook of Labor Economics*, ed. Orley C. Ashenfelter and Richard Layard, Elsevier, , pp. 641-692.

- Sakr, M., Angus, J., Perrin, J., Nixon, C., Nicholl, J. & Wardrope, J. 1999, "Care of minor injuries by emergency nurse practitioners or junior doctors: A randomised controlled trial", *Lancet*, vol. 354, no. 9187, pp. 1321-1326.
- Shah, A. & Walker, M. 1983, "The distribution of regional earnings in the UK", *Applied Economics*, vol. 15, no. 4, pp. 507-520.
- Shum, C., Humphreys, A., Wheeler, D., Cochrane, M.-., Skoda, S. & Clement, S. 2000, "Nurse management of patients with minor illnesses in general practice: Multicentre, randomised controlled trial", *Br.Med.J.*, vol. 320, no. 7241, pp. 1038-1043.
- Sibbald, B., Shen, J. & McBride, A. 2004, "Changing the skill-mix of the health care workforce", *J Health Serv Res Policy*, vol. 9, no. suppl\_1, pp. 28-38.
- Smith, A. 1776, *An Inquiry into the Nature and Causes of the Wealth of the Nations*, Cannogate, UK.
- Spilsbury, K. 2001, "Defining the nursing contribution to patient outcome: Lessons from a review of the literature examining nursing outcomes, skill mix and changing roles", *J.Clin.Nurs.*, vol. 10, no. 1, pp. 3-14.
- Venning, P., Durie, A., Roland, M., Roberts, C. & Leese, B. 2000, "Randomised controlled trial comparing cost effectiveness of general practitioners and nurse practitioners in primary care", *Br.Med.J.*, vol. 320, no. 7241, pp. 1048-1053.
- Vujicic, M. & Zurn, P. 2006, "The dynamics of the health labour market", *Int.J.Health Plann.Manage.*, vol. 21, no. 2, pp. 101-115.
- Walker, K., Donoghue, J., & Mitten-Lewis, S. (2007). Measuring the impact of a team model of nursing practice using work sampling. *Australian Health Review.*, 31(1), 98.
- Wladyslaw J. Czuber-Dochan, Waterman, C.G. & Waterman, H.A. 2006, "Atrophy and anarchy: third national survey of nursing skill-mix and advanced nursing practice in ophthalmology", *Journal of clinical nursing*, vol. 15, no. 12, pp. 1480-1488.