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Human Health Care and Selection Effects. Understanding Labour Supply in the Market for Nurses *

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Abstract

In this note we study (adverse) selection in a labour supply model where potential applicants are characterised by different vocational premiums and skills. We show how the composition of the pool of active workers changes as wage increases. Contrary to standard results, average productivity does not necessarily increase monotonically in the wage rate. We provide conditions such that a wage increase deteriorates either the average productivity or the average vocation of workers accepting the job. Our results are relevant to understand the potential impacts of a wage increase as a policy aimed at solving shortage in the market for nurses.

J.E.L. Codes: J24, J32, I11

Keywords: nurses labour supply, skill and vocation.

1 Introduction

Both academic and policy oriented literature suggest the existence of a relevant shortage in the labour market for nurses in almost all developed countries (e.g., Antonazzo et al., 2003; Shields, 2004; Simoens et al., 2005). For instance, considering OECD countries, a shortage of about 110,000 nurses (approximately 5% of practicing nurses) is reported for the U.S. in recent years; this same figure climbs up to about 7% of the workforce in Canada, while declining to about 1% in the Netherlands. Only two countries (Spain and the Slovak Republic) are

*"Human health care", a motto suggesting the need of a vocation for being a nurse, has been attributed to Florence Nightingale (1820-1910). She is considered the founder of modern nursing for her powerful devotion to patients. Her book "Notes on nursing" - first appeared in 1860 - and is still considered an important reference in nursing schools. For more details on Florence Nightingale, see, e.g., Bostridge (2008).

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reported to register relatively high unemployment rates for nurses, with workers migrating to other countries.

As nurses represent an important input in the production of a number of health services, it is not surprising that almost all developed countries have started working at identifying a wide array of policies to solve the shortage. Policy options include for instance, at the macro level, promoting the education and training of prospective nurses, and attracting foreign nurses (especially from less developed countries; see, e.g., Aiken et al., 2004); at a micro level, economic disincentives for early retirement, or also improvements in the pecuniary and non-pecuniary components of nurses' compensation are alternative policy responses.

Among pecuniary components of compensation, the wage rate clearly plays a crucial role. Intuitively, increasing the wage rate should be the more simple way to cope with problems of excess demand in the labour market. According to available econometric evidence, however, the labour supply of nurses appears to be fairly unresponsive to changes in the wage rate. For instance, Shields (2004) suggests that the average of the wage elasticities in U.S. studies is about 0.3, implying that following a 10% increase in the wage rate, labour supply will increase only by a mere 3%. Moreover, other empirical studies (including Shields and Ward 2001) point to the potential importance of *non-pecuniary aspects* of the job (e.g., relations with colleagues, training opportunities, and - more generally - job satisfaction) in promoting labour supply. Thus, the simple recipe of increasing the wage rate to solve excess demand issues in the market for nurses can prove to not be particularly effective.

Along this latter line, more serious doubts about the possibility that a wage increase rises efficiency in the market for nurses are discussed by Heyes (2005). In his contribution, Heyes shows the possible negative consequences of a wage increase on the selection of nurses when potential workers can be characterised by a "vocation" for the job. If they are intrinsically motivated by being a nurse, workers receive a non-pecuniary benefit (a "vocational" premium) when performing their job, in addition to the wage rate. The existence of a "vocational" premium implies that, given two individuals characterised by the same outside option but by different intrinsic motivations for the job, the individual with the higher vocation is more likely to accept the job for a given wage rate. Hence, as shown by Heyes, a wage increase can attract many nurses with low intrinsic motivation, so that the average vocation in the population of nurses decreases. If quality of care is somewhat related to nurses' vocation, the previous phenomenon leads to a deterioration in the average quality of services.

However, one main shortcoming of the previous way of reasoning, emphasized e.g. by Nelson and Folbre (2006), is that vocation does not guarantee skill. Registered nurses are today professionals with medical, technical, and organizational competencies. We believe that both intrinsic motivation *and skills* (and the way they are distributed in the population) need to be taken into account to understand workers' selection in the market for nurses. This note precisely focuses on the selection effect of the wage rate in the market for nurses when both vocation and productivity levels characterise the population of potential workers. As in Heyes (2005), vocation corresponds to (the monetary equivalent of) the benefit intrinsically motivated workers obtain from accepting to work as a nurse. We study the characteristics of the labour supply when all nurses receive the same wage independently of their productivity level. In the market with intrinsically motivated workers (i) given the salary and a particular level of vocation, adverse selection on productivity arises as in the standard market without vocation; however, intrinsic motivation can reduce the inefficiency due to this source of market failure; (ii) given the salary and a particular level of productivity, a positive selection on vocation occurs. We consider how the characteristics of nurses accepting the job change with the wage, pointing out that a wage increase can have either a positive or a negative impact both on average productivity and average vocation of workers accepting the job. Thus, an increase in the wage rate can not only deteriorate average vocation of workers accepting the job as Heyes (2005) has already shown, but it can also deteriorate average productivity. Interestingly, only when productivity has a sufficiently larger impact on workers' rationality constraint relative to vocation, average productivity in the market is non-decreasing in the wage rate.

More generally, our note is related to the growing literature on workers' intrinsic motivation and incentives[1]. Within that literature, the papers closest to our note are those considering the selection of motivated workers by employers. Handy and Katz (1998) show how nonprofit firms may screen out non motivated managers through a policy of lower wages, whereas Delfgaauw and Dur (2007) examine how the firm can attract and select highly motivated workers to fill a vacancy when workers' motivation is private information. Since our note describes how the characteristics of labour supply change with the uniform wage in a labour market when workers are intrinsically motivated, our approach to selection issues is obviously different.

The remainder of the note is structured as follows. We first describe the model in Section 2. We present the analysis of the four-types of potential applicants case in Section 3, and then extend our main results to a more heterogeneous population in Section 4. Section 5 briefly concludes with the policy implications of our results with regard to the wage rate and the shortage of nurses.

2 Intrinsically motivated workers enter the labour market

Since we are interested exclusively in the supply-side of the market for nurses, we do not explicitly model firm behavior here. We assume that potential applicants for the job have *two* characteristics: a *productivity* (or *skill*) parameter $\theta_i \in \{\theta_1, ..., \theta_n\}$, where $\theta_i < \theta_{i+1}$ $\forall i = 1, ..., n$ and $\theta_1 > 0$, and a *vocation* parameter $\gamma_j \in \{\gamma_1, ..., \gamma_m\}$, where $\gamma_j < \gamma_{j+1} \forall j = 1, ..., m$ and $\gamma_1 \geq 0$. We call $F(\theta, \gamma)$ the

[1] Among others, Besley and Ghatak (2005), Francois (2000) and (2003), Siciliani (2009).

cumulative distribution function (CDF) of the population of potential workers.[2]

Potential workers' outside option depends on their productivity, and is called $r_i(\theta_i)$. It can be interpreted as "home production", that is, the production potential applicants obtain when staying out of the labour market and working at home. Typically, the outside option is increasing in potential workers' productivity: the more workers are productive in the market, the more they are productive outside. For simplicity, we assume that $r_i(\theta_i) = \theta_i$.

The vocation parameter γ_j represents the benefit workers receive from accepting to work as a nurse and measures their "vocational premium". Workers can not, therefore, benefit from their intrinsic motivation if they do not enter the market. By slightly abusing notation, we assume that the parameter γ_j also corresponds to the monetary equivalent of the vocational premium; this implies that it affects potential workers' net reservation wage, as we discuss below.[3]

We assume that workers receive a uniform wage, either because productivity (and vocation) is workers' private information, or for institutional reasons (standardized contracts exist as in public hospitals). Potential applicants accept the job if and only if the total benefit they receive from the job is higher than their reservation wage. The total benefit to the worker is given by the wage rate plus the "vocational" premium γ_j. As potential workers' reservation wage is $r_i(\theta_i) = \theta_i$, a potential applicant with characteristics (θ_i, γ_j) accepts the job when wage in the market is w_0 if and only if:

$$\theta_i \leq w_0 + \gamma_j \Longleftrightarrow \theta_i - \gamma_j \leq w_0 \tag{1}$$

In the absence of any vocation (i.e., $\gamma_j = 0$), the previous inequality reads $\theta_i \leq w_0$ and the uniform wage leads to the well-known adverse selection problem: (i) market exchange can be inefficiently low (few workers accept the job), and (ii) only workers with low productivity are active in the market (average productivity of workers accepting the job is low). Moreover, in the standard market without vocation, a wage increase always has a positive impact on average productivity of active workers (average productivity of active workers is increasing in the wage). These standard results can be verified in Mas-Colell *et al.* (1995) model of adverse selection in the labour market.

Looking at inequality (1), interestingly we observe that:

1. for given productivity θ_i and wage rate w_0, potential workers with high vocation are more likely to accept the job. This implies a *positive selection effect on vocation.*

[2] The present model recalls a discrete version of Mas-Colell et al. (1995) model of adverse selection in the labor market. In their baseline model many identical firms can hire workers. Each worker produces the same output using a constant returns to scale technology in which labour is the only input.

[3] A remark concerning the relationship between the parameter γ_j and the labour outcome is useful at this stage. We could either consider that the vocational premium affects production, both in terms of the number of units produced and/or in terms of the quality of output (as, e.g., in Heyes, 2005). Or we could assume that γ_j simply affects workers' net reservation wage and has no impact on workers' outcome. Again, since the present note focuses on the supply-side of the market, we do not need to specify any relationship between the vocation parameter and firms' output.

2. for given vocation γ_j and wage rate w_0, potential workers with low productivity are more likely to accept the job. This implies the standard *adverse selection effect on productivity.*

As for inefficiencies stemming from adverse selection, it is important to note that point 1 above implies the following:

Corollary 1 *Given the wage rate, vocation can reduce the inefficiency due to adverse selection.*

Proof. In a market where potential workers have no vocation, workers of productivity θ_i accept the job when $\theta_i \leq w$. In a market where vocation matters, they accept the job when $\theta_i - \gamma_j \leq w$. Suppose that the distribution of the parameter θ is the same in the two markets and that $\gamma_1 = 0$.[4] Also assume that the given wage rate is $w_0 = \theta_i$: all types of productivity less than or equal to θ_i enter both the market where vocation does not matter and the vocation-based one. Moreover, if (i) $\gamma_m \geq \theta_{i+1} - \theta_i$ and (ii) $\theta = \gamma_m + w_0 \leq \theta_n$, then at least some intrinsically motivated workers of type θ_{i+1} enter the vocation-based market given wage $w_0 = \theta_i$. Inequality (i) assures that the maximum level of vocation in the population of potential workers is high enough for a type of productivity θ_{i+1} to enter the market given the wage $w_0 = \theta_i$. Inequality (ii) assures that, along the line $\gamma = \theta_i - w_0$, the productivity level corresponding to the maximum vocation γ_m can be inside the set of potential workers. ■

The previous corollary states that, given w_0, if the impact of vocation in the potential workers' rationality constraint is sufficiently high and the maximum level of productivity is sufficiently larger than $\theta_i = w_0$, then more workers are active in the vocation-based market than in the market without vocation and average productivity of active workers is higher in the vocation-based sector.

As already mentioned, the aim of this note is to study the consequences of a wage increase on the characteristics of active workers in a market where vocation matters and wage is uniform.

Let us consider again points 1 and 2. In general we would expect a negative impact of a wage increase on average vocation of active workers (workers with lower vocation also enter the market), and a positive impact of a wage increase on average productivity (workers with higher productivity also enter the market). However, as Proposition 1 and Remark 4 show, the two counter-intuitive results can occur. Since vocation and productivity jointly determine workers' willingness to accept the job, it can be that, as wage increases, either average vocation increases or average productivity decreases. Interestingly, we can exclude the case where average vocation increases and average productivity decreases simultaneously. In other words, at most one of the two counter-intuitive results can occur at a time.

[4] In a sense it is as if, in the non-vocational sector, potential workers joint distribution collapses against the horizontal axis.

3 The four-types case

To study how the average characteristics of workers accepting the job change with the wage rate, we begin with a straightforward case: $\theta_i \in \{\theta_l, \theta_h\}$, with $0 < \theta_l < \theta_h$ and $\gamma_j \in \{\gamma_l, \gamma_h\}$, with $0 \leq \gamma_l < \gamma_h$. Thus, only four types of potential applicants exist: type $A = (\theta_l, \gamma_h)$, type $B = (\theta_l, \gamma_l)$, type $C = (\theta_h, \gamma_h)$, type $D = (\theta_h, \gamma_l)$. Let us assume, $\pi_\theta = prob(\theta = \theta_h)$ and $\pi_\gamma = prob(\gamma = \gamma_h)$. Let us also define $\tilde{w}_{i,j} \equiv \theta_i - \gamma_j$ the wage rate such that an individual of type (θ_i, γ_j) is indifferent between accepting and not accepting the job. We call $\tilde{w}_{i,j}$ the *net reservation wage* of type (θ_i, γ_j) because it represents the worker's reservation wage net of the vocational premium.

To understand how average productivity and average vocation of active workers are affected by an increase in the wage rate, one simply needs to know the ranking of net reservation wages for the four applicant types. Note that, $\forall \theta_i \in \{\theta_l, \theta_h\}$, it is true that $\tilde{w}_{i,l} = \theta_i - \gamma_l > \tilde{w}_{i,h} = \theta_i - \gamma_h$. In words: given a level of productivity θ_i, the reservation wage of the type with low vocation is higher than the reservation wage of the type with high vocation. Implying that type A will enter the market for a lower wage than type B, and type C will enter the market for a lower wage than type D. In the same way, $\forall \gamma_j \in \{\gamma_l, \gamma_h\}$, it must be true that $\tilde{w}_{l,j} = \theta_l - \gamma_j < \tilde{w}_{h,j} = \theta_h - \gamma_j$. In words: given a level of vocation γ_j, the reservation wage of the type with low productivity is lower than the reservation wage of the type with high productivity. Hence, type A will enter the market for a lower market wage than type C, and type B will enter the market for a lower market wage than type D. Since type A enters the market for a lower wage than C and B, whereas type D enters the market for a higher wage than C and B, we can conclude that:

Remark 1 *Workers of type $A = (\theta_l, \gamma_h)$ have the lowest net reservation wage, whereas workers of type $D = (\theta_h, \gamma_l)$ have the highest net reservation wage.*

Let us define $\Delta\theta \equiv \theta_h - \theta_l$ and $\Delta\gamma \equiv \gamma_h - \gamma_l$. Whether type B enters the market at a lower wage than type C, or vice versa, depends on the relative difference between vocations and productivity levels. In particular:

Remark 2 *If $\Delta\gamma < \Delta\theta$, workers of type $B = (\theta_l, \gamma_l)$ accept the job at a lower wage than workers of type $C = (\theta_h, \gamma_h)$. If $\Delta\gamma > \Delta\theta$, the opposite occurs.*

To see why this happens, suppose first that productivity has a higher impact than vocation on net reservation wage, hence $\Delta\theta > \Delta\gamma$. In this case, we have $\theta_h - \theta_l > \gamma_h - \gamma_l$, that is $\theta_h - \gamma_h > \theta_l - \gamma_l \Leftrightarrow \tilde{w}_{h,h} > \tilde{w}_{l,l}$. The opposite occurs if the impact of vocation prevails.

Once the ranking of net reservation wages has been established, investigating how average vocation and average productivity in the population of workers accepting the job change when wage increases is straightforward. Obviously, we must distinguish the two cases identified above:

Proposition 1 *(a) When $\Delta\gamma < \Delta\theta$, (1) average productivity of active workers is non-decreasing in the wage rate; (2) average vocation of active workers decreases when w reaches $\tilde{w}_{l,l}$, increases when w reaches $\tilde{w}_{h,h}$ and decreases again when w reaches $\tilde{w}_{h,l}$. (b) When $\Delta\gamma > \Delta\theta$, (3) average productivity of active workers increases when w reaches $\tilde{w}_{h,h}$, decreases when w reaches $\tilde{w}_{l,l}$ and increases again when w reaches $\tilde{w}_{h,l}$; (4) average vocation of active workers is non-increasing in the wage rate. (c) When $\Delta\gamma = \Delta\theta$; (5) average productivity of active workers is increasing in the wage rate; (6) average vocation of active workers is decreasing in the wage rate.*

Proof. See appendix 6.1. ■

The previous proposition shows that, when $\Delta\gamma < \Delta\theta$, a wage increase always has a positive impact on average productivity in the market: given the order with which different types of workers enter the market, average productivity is non-decreasing in the wage. The impact, however, on average vocation can be either positive or negative depending on which workers' type have already entered the market. In a similar way, when $\blacksquare\gamma > \blacksquare\theta$, a wage increase can have either a positive or a negative impact on productivity, whereas, average vocation is non-increasing in the wage.

Proposition 1 describes how both average productivity and average vocation of active workers depend on the wage rate. As mentioned before, we expected a negative impact of a wage increase on average vocation of workers accepting the job since, as wage increases, workers with lower vocation also enter the market. We showed that this is true only when vocation has a higher impact than productivity on net reservation wage ($\Delta\theta < \Delta\gamma$). In the same case, average productivity is non-monotonic in the wage rate. We also expected a positive impact of a wage increase on average productivity since, as wage increases, workers with higher productivity also enter the market. We saw that this is true only when productivity has a higher impact than vocation on net reservation wage ($\Delta\theta > \Delta\gamma$). In the very same case, average vocation is non-monotonic in the wage rate. Moreover, the two intuitive cases are both verified when $\Delta\gamma = \Delta\theta$: average productivity is monotonically increasing and average vocation is monotonically decreasing in the wage. From Proposition 1 it is also clear that at most one of the two counter-intuitive results can simultaneously occur.

In general, we observe that the relative size of the difference between the two workers' characteristics ($\Delta\theta$ and $\Delta\gamma$) determines the ranking of workers' net reservation wages. Such a ranking, in turn, determines how average vocation and average productivity of active workers change with the wage. Interestingly, while in the standard labour market in which workers display no vocation a wage increase always has a positive impact on average productivity of active workers (e.g., Mas-Colell *et al.*, 1995), here a wage increase can have either a positive or a negative impact on average productivity.

In the next section, we characterise conditions such that average vocation and average productivity of active workers exhibit the same trend depicted in Proposition 1 also with more than four types of workers.

A last remark before moving further: one should notice that the correlation between productivity and vocation does not affect the results in Proposition 1, rather it only "quantifies" the impact of a wage increase on average productivity and average vocation of active workers. In particular, we can state the following:

Remark 3 ***(Correlation between*** θ ***and*** γ***)*** ***(a)*** *Suppose that* $\Delta\gamma < \Delta\theta$ *and the correlation between productivity and vocation is positive (negative). Then, when workers of type B enter the market, we observe a large (small) decrease in average vocation among active workers. When workers of type C enter the market, we observe a large (small) increase in both average productivity and average vocation. When workers of type D enter the market, we observe a small (large) increase in average productivity and a small (large) decrease in average vocation.* ***(b)*** *Suppose that* $\Delta\gamma > \Delta\theta$ *and correlation between productivity and vocation is positive (negative). Then, when workers of type C enter the market, we observe a large (small) increase in average productivity among active workers. When workers of type B enter the market, we observe a large (small) decrease in both average productivity and average vocation. When workers of type D enter the market, we observe a small (large) increase in average productivity and a small (large) decrease in average vocation.*

4 Generalizing the four-types case

We now consider a more heterogeneous population of potential applicants. As before, we investigate how an increase in the wage rate affects the population of active workers, and thus the average vocation and the average productivity of workers entering the market. The four-types example has revealed the importance of the impact of productivity and vocation on net reservation wages. The relative size of the difference between the two workers' characteristics drives the main results in the preceding section. However, generalizing the four-types case without imposing any further assumptions to our model, brings about an unpredictable behavior of both average productivity and average vocation of active workers; we can only exclude the case where the two counter-intuitive cases occur simultaneously:

Remark 4 *Let us consider the general case with many discrete types. How average productivity and average vocation of active workers change with the wage rate depends on the ranking of net reservation wages in the population of potential workers. In general, average productivity and average vocation can be non-monotonic in the wage rate. The two counter-intuitive results, nevertheless, can not simultaneously occur.*

Proof. Suppose that the current wage rate is $w_0 = \tilde{w}_{i,j} \equiv \theta_i - \gamma_j$; this implies that workers of type (θ_i, γ_j) have already entered the market. Average productivity decreases if the next workers to enter the market have productivity $\theta \leq \theta_i$, whereas average vocation increases if they have vocation $\gamma \geq \gamma_j$. Thus, the two counter-intuitive results simultaneously occur if the next workers to enter the market are at least of type $\left(\theta_{i-1}, \gamma_{j+1}\right)$. The less stringent condition such that a wage increase leads to a fall in average productivity and to an increase in average vocation is, thus: $\tilde{w}_{i,j} < \tilde{w}_{i-1,j+1}$. The previous inequality reads $\theta_i - \gamma_j < \theta_{i-1} - \gamma_{j+1}$, which is clearly impossible. This proves the last part of the remark. ■

In what follows, we establish conditions under which either average productivity or average vocation are monotonic in the wage rate. In practice, we generalize conditions expressed in Proposition 1 to the case with many types.

In order to obtain a monotonic behavior of average productivity, we need to establish conditions under which *all* workers with productivity θ_i enter the market before workers with productivity θ_{i+1} for any given vocation. The following remark establishes this condition:

Remark 5 ***(Monotonic average productivity)*** *When $\theta_{i+1} - \theta_i \geq \gamma_m - \gamma_1$ $\forall i = 1, ..., n$, (i) after all types with productivity θ_1 have entered the market, average productivity of active workers is increasing in the wage rate; (ii) average vocation of active workers fluctuates in the wage rate.*

Proof. Since $\tilde{w}_{i,1} < \tilde{w}_{i+1,m}$, it must be the case that $\tilde{w}_{i,m} < \tilde{w}_{i,m-1} < ... < \tilde{w}_{i,2} < \tilde{w}_{i,1} < \tilde{w}_{i+1,m} < \tilde{w}_{i+1,m-1} < ... < \tilde{w}_{i+1,2} < \tilde{w}_{i+1,1}$. These inequalities imply that all workers with productivity θ_i enter the market before workers with productivity θ_{i+1} for any given vocation level. In turn, this means that average productivity of active workers is increasing in the wage rate. Whereas, average vocation increases when wage reaches the value $\tilde{w}_{i+1,m}$, then it decreases till wage reaches $w = \tilde{w}_{i,1}$ and increases again for $w = \tilde{w}_{i+1,m}$. ■

Remark (5) holds when differences in productivity are so important that, taking two contiguous individuals in terms of θ, the difference in productivity is higher than the difference between the highest and the lowest vocational premium. When the latter condition is verified, a wage increase has a positive impact on average productivity, whereas it's impact on average vocation oscillates between positive and negative gains. Note that the condition expressed in the previous lemma is the equivalent of the condition in Proposition 1, part (a), when we refer to more than four worker types.

Moreover, when $\theta_{i+1} - \theta_i \geq \gamma_m - \gamma_1$ $\forall i = 1, ..., n$, for any distribution $F(\cdot)$, $F\left(\widetilde{w}_{i,j}|\theta_i\right) > F\left(\widetilde{w}_{i+1,j}|\theta_{i+1}\right)$ $\forall i$, i.e. $F\left(\widetilde{w}_{i+1,j}|\theta_{i+1}\right)$ first order stochastically dominates (FOSD) $F\left(\widetilde{w}_{i,j}|\theta_i\right)$. In words, taking any two contiguous values of productivity, the CDF of net reservation wages conditional on θ_i lies above the CDF of net reservation wages conditional on θ_{i+1}.

The (extreme) sufficient condition in Remark (5) is more likely to be verified in vocation-based labour markets where skills or abilities are really important, and "vocation" is relatively less important. An example could be that of registered nurses, who need to acquire skills at post-secondary or university-degree level in almost all countries, developed and less developed (e.g., Simoens et al., 2005; Nelson and Folbre, 2006). Remark (5) suggests that, in the market for registered nurses, a wage increase could result in higher average productivity; but nothing will guarantee also a higher average vocation.

As for productivity, we must also introduce specific assumptions in order to observe a monotonic behavior of average vocation. In particular, we must impose that *all* workers with vocation γ_{j+1} enter the market before workers with vocation γ_j for any given productivity level. Remark 6 below establishes the required condition:

Remark 6 ***(Monotonic average vocation)*** *When $\theta_n - \theta_1 < \gamma_{j+1} - \gamma_j \ \forall j = 1, ..., m$, (i) average productivity of active workers fluctuates in the wage rate; (ii) after all types with vocation γ_m entered the market, average vocation of active workers is decreasing in the wage rate.*

Proof. Since $\tilde{w}_{n,j+1} < \tilde{w}_{1,j}$, it must be the case that $\tilde{w}_{1,j+1} < \tilde{w}_{2,j+1} < ... < \tilde{w}_{n-1,j+1} < \tilde{w}_{n,j+1} < \tilde{w}_{1,j} < \tilde{w}_{2,j} < ... < \tilde{w}_{n-1,j} < \tilde{w}_{n,j}$. These inequalities imply that all workers with vocation γ_{j+1} enter the market before workers with vocation γ_j for any given productivity level. In turn this means that average vocation of active workers is decreasing in the wage. Average productivity, on the other hand, decreases when wage reaches the value $\tilde{w}_{1,j}$, then increases till wage reaches the value $w = \tilde{w}_{n,j}$ and decreases again when $w = \tilde{w}_{1,j-1}$. ■

Remark (6) holds when differences in vocation are so important that, taking two contiguous individuals in terms of γ, the difference in vocation is higher than the difference between the highest and the lowest productivity level. When the latter condition is verified, a wage increase has a negative impact on average vocation, whereas it's impact on average productivity oscillates between positive and negative. Note that the condition expressed in the previous lemma is the equivalent of the condition in Proposition 1, part (b), when we refer to more than four workers types. Notice also that, for any distribution $F(\cdot)$, $F(\widetilde{w}_{i,j+1}|\gamma_{j+1}) > F(\widetilde{w}_{i,j}|\gamma_j) \ \forall j$, i.e. $F(\widetilde{w}_{i,j}|\gamma_j)$ FOSD $F(\widetilde{w}_{i,j+1}|\gamma_{j+1})$. In words, taking any two contiguous values of vocation, the CDF of net reservation wages conditional on γ_{j+1} lies above the CDF of net reservation wages conditional on γ_j.

Interestingly, the condition outlined in Remark (6) is, in our setting, equivalent to the condition derived by Heyes (2005) for a decreasing average vocation. Heyes considers the case with only two vocation levels and a continuum of reservation wages. He shows that the probability of observing nurses with high intrinsic motivation monotonically decreases in the wage if $\frac{F(w+\gamma_h)}{f(w+\gamma_h)} > \frac{F(w+\gamma_l)}{f(w+\gamma_l)}$. Heyes' condition *implies FOSD* of the distribution of reservation wages conditional on "*low*" vocation on the one conditional on "*high*" vocation for any distribution $F(\cdot)$.

Given the importance of vocation in determining the ranking of net reservation wages in the population, the condition in Remark (6) could be verified in vocation-based sectors characterised by low-skilled jobs. In those sectors, (gross) reservation wages are (quite uniformly) low, and intrinsic motivation can potentially have an large impact on total benefits from the job. A good example could be that of *nurse aides*, which support registered nurses in providing patients with basic care such as bathing, dressing, personal hygiene, cleaning, and food preparation (see again, e.g., Simoens *et al.*, 2005). In this market, increasing the wage rate could result in a monotonic fall in average vocation; whereas nothing can be said concerning the impact of the wage increase on the average productivity.

5 Concluding remarks

In this note, we investigated the selection effect of a uniform wage in the market for nurses, where workers can be characterised by a "vocational" premium in addition to the usual extrinsic motivation. The possible negative impact of a wage increase on the average vocation of active workers has been analyzed by Heyes (2005) in a setting where productivity is not explicitly modeled. The main contribution of this note is to explain the possible, counter-intuitive, and probably more dramatic, negative impact a wage increase can have on average productivity of active workers. This possible negative effect derives from the interplay between vocation and productivity in determining workers' net reservation wages, and their ranking.

In particular, we show that a wage increase can have an adverse effect both on average productivity and on average vocation of active workers, but that the two counter-intuitive effects can not occur simultaneously. The negative impact of a wage increase on average productivity is more likely to happen in markets where skills are less important than vocation, as for instance in those markets where nurse aides are recruited. A wage increase might not be the most appropriate policy to solve observed shortages of nurses in this case. On the contrary, in markets where skills are more important than vocation, as for registered nurses who must obtain post-secondary or university-degrees, increasing the wage rate can prove to increase average productivity of workers, as in standard non-vocational labour markets, even though average vocation does not show a monotonic behavior. In this second case, an increase in the wage rate could be used to solve observed shortages of nurses.

As a final remark one can interpret the outside option in our model as the salary workers obtain accepting an alternative job. In this case, the labour market would be composed by two sectors, one in which the job allows workers to benefit from their "vocational" premium along with the standard wage rate, and one in which workers just receive the wage rate. This captures the idea that workers who have a vocation for being a nurse can decide to work in industries different from health care; where they do not receive any benefit from their intrinsic motivation, but possibly receive higher extrinsic benefits (a higher wage). Obviously, considering the wage rate as a policy tool to solve nurse shortage needs to recognize the several alternatives that motivated workers are faced with. Empirical evidence on this point is provided, e.g., by Elliott et al. (2007) for Britain: vacancy rates for nurses in local geographical markets are negatively correlated with the gap between the standardised spatial wage differentials for nurses and that of their best alternative in the same market. Attracting skilled nurses will then require higher relative wages, not simply higher wages.

6 Appendix

6.1 Proof of Proposition 1

(a) $\Delta\gamma < \Delta\theta$ implies that $\tilde{w}_{h,h} > \tilde{w}_{l,l}$ such that, as wage increases, workers enter the market in the following order: workers of type A first, then workers of type B, then workers of type C and finally workers of type D. When only types A accept the job, average productivity and average vocation obviously are $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = \theta_l$ and $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = \gamma_h$. When types A and B enter the market, average productivity and average vocation of active workers respectively are $E[\theta|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}] = \theta_l$ and $E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}] = (1-\pi_\theta)\pi_\gamma\gamma_h + (1-\pi_\gamma)\pi_\theta\gamma_l$. When types A, B and C enter the market, average productivity and average vocation of active workers respectively are $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] = \frac{\theta_h\pi_\theta\pi_\gamma + (1-\pi_\theta)\theta_l}{\pi_\theta\pi_\gamma + (1-\pi_\theta)}$ and $E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] = \frac{\gamma_h\pi_\gamma + \gamma_l(1-\pi_\theta)(1-\pi_\gamma)}{\pi_\gamma + (1-\pi_\theta)(1-\pi_\gamma)}$. Finally, when all the four types A, B, C and D enter the market, average productivity and average vocation of active workers respectively are $E[\theta|w \geq \tilde{w}_{h,l}] = \theta_h\pi_\theta + \theta_l(1-\pi_\theta)$ and $E[\gamma|w \geq \tilde{w}_{h,l}] = \gamma_h\pi_\gamma + \gamma_l(1-\pi_\gamma)$. Statements (1) and (2) of the proposition come from the following observations: $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = E[\theta|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}] < E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] < E[\theta|w \geq \tilde{w}_{h,l}]$ and $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] > E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}]$, $E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}] < E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}]$, $E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] > E[\gamma|w \geq \tilde{w}_{h,l}]$. **(b)** $\Delta\gamma > \Delta\theta$ implies that $\tilde{w}_{h,h} < \tilde{w}_{l,l}$ such that, as wage increases, workers enter the market in the following order: workers of type A first, then workers of type C, then workers of type B and finally workers of type D. As before, when only workers of type A enter the market, average productivity and average vocation of active workers respectively are $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = \theta_l$ and $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = \gamma_h$. When types A and C enter the market, average productivity and average vocation of active workers respectively are $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{l,l}] = \frac{\theta_h\pi_\gamma\pi_\theta + (1-\pi_\theta)\pi_\gamma\theta_l}{\pi_\theta\pi_\gamma + (1-\pi_\theta)\pi_\gamma}$ and $E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{l,l}] = \gamma_h$. When types A, B and C are hired by firms, as before average productivity and average vocation of active workers respectively are $E[\theta|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}] = \frac{\theta_h\pi_\theta\pi_\gamma + (1-\pi_\theta)\theta_l}{\pi_\theta\pi_\gamma + (1-\pi_\theta)}$ and $E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}] = \frac{\gamma_h\pi_\gamma + \gamma_l(1-\pi_\theta)(1-\pi_\gamma)}{\pi_\gamma + (1-\pi_\theta)(1-\pi_\gamma)}$. Finally, when all types are hired by firms, we again find $E[\theta|w \geq \tilde{w}_{h,l}] = \theta_h\pi_\theta + \theta_l(1-\pi_\theta)$ and $E[\gamma|w \geq \tilde{w}_{h,l}] = \gamma_h\pi_\gamma + \gamma_l(1-\pi_\gamma)$. Statements (3) and (4) of the proposition come from the following inequalities: $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{l,l}] < E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}] < E[\gamma|w \geq \tilde{w}_{h,l}]$ and $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] < E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{l,l}]$, $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{l,l}] > E[\theta|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}]$, $E[\theta|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}] < E[\theta|w \geq \tilde{w}_{h,l}]$. **(c)** $\Delta\gamma = \Delta\theta$ implies that $\tilde{w}_{h,h} = \tilde{w}_{l,l}$ such that, as wage increases, workers enter the market in the following order: workers of type A first, then workers of type B and C and finally workers of type D. As before, when only types A accept the job, average productivity and average vocation are $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = \theta_l$ and $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = \gamma_h$. Whereas when types A, B and C are hired by firms, average productivity and average vocation of active workers respectively are $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] = \frac{\theta_h\pi_\theta\pi_\gamma + (1-\pi_\theta)\theta_l}{\pi_\theta\pi_\gamma + (1-\pi_\theta)}$ and $E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] = \frac{\gamma_h\pi_\gamma + \gamma_l(1-\pi_\theta)(1-\pi_\gamma)}{\pi_\gamma + (1-\pi_\theta)(1-\pi_\gamma)}$. Then, when all the four types A, B, C and D are hired by firms, we find again $E[\theta|w \geq \tilde{w}_{h,l}] = \theta_h \pi_\theta + \theta_l (1 - \pi_\theta)$ and $E[\gamma|w \geq \tilde{w}_{h,l}] = \gamma_h \pi_\gamma + \gamma_l (1 - \pi_\gamma)$. Statements (5) and (6) of the proposition come from the following inequalities: $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] < E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] < E[\theta|w \geq \tilde{w}_{h,l}]$ and $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] < E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}] < E[\gamma|w \geq \tilde{w}_{h,l}]$.

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