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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 the average productivity and/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 be not 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.¹

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* need to be taken into account to understand workers' selection in the market

¹ Work by Heyes (2005) has been extended by Taylor (2007) and Heyes (2007). In particular, Taylor shows that nurses will be underpaid by a monopsonistic NHS.

for nurses. This note precisely focuses on the selection effect of the wage rate in the market for nurses when both productivity levels and vocation characterise the population of potential workers. In our framework: (1) potential workers' outside option depends on the workers' skill, as in Mas-colell's et al. (1995) seminal model of adverse selection in the labor market and, (2) vocation corresponds to the benefit intrinsically motivated workers obtain from working as a nurse, as in Heyes (2005). As is well known, adverse selection inefficiencies arise when the salary offered by firms in the market is uniform, that is it does not depend on the workers' productivity. Thus, we study the characteristics of the labour supply when wage in the market for nurses is uniform. In the market with intrinsically motivated workers (i) given the uniform salary and a particular level of vocation, adverse selection on productivity arises as in the standard market without vocation; (ii) given the uniform salary and a particular level of productivity, a positive selection on vocation occurs.

By investigating the labour supply of nurses, we consider how the characteristics of active nurses 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 active workers. Thus, an increase in the wage rate can not only deteriorate average vocation of active workers as Heyes (2005) has already shown, but it can also (and simultaneously) deteriorate average productivity. Interestingly, only when vocation has a sufficiently larger impact on workers' rationality constraint relative to productivity, average productivity of active workers can be decreasing in the wage.

More generally, our note is related to the growing literature on workers' intrinsic motivation and incentives (see, e.g., Besley and Ghatak, 2005; Francois, 2000, 2003; Siciliani, 2009). 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 heterogeneous as for productivity levels and intrinsic motivation, our approach to selection issues is obviously different from the previous studies and refers to adverse selection "in markets".

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 $\theta_i \in \{\theta_1, \dots, \theta_n\}$, where $\theta_i < \theta_{i+1} \forall i = 1, \dots, n$ and $\theta_1 > 0$, and a *vocation* parameter $\gamma_j \in \{\gamma_1, \dots, \gamma_m\}$, where $\gamma_j < \gamma_{j+1} \forall j = 1, \dots, m$ and $\gamma_1 \geq 0$. We call $F(\theta, \gamma)$ the cumulative distribution function (CDF) and $f(\theta, \gamma)$ the probability distribution function of the population of potential workers. The present set-up recalls a discrete version of Mas-Colell *et al.* (1995) model of adverse selection in the labor market.² We enrich this baseline model by considering also workers' vocation for the job.

Potential workers' outside option depends on their productivity, and is called $r_i(\theta_i)$. It can be interpreted as the production, or the utility potential applicants obtain when staying out of the market for nurses. Typically (and as in Mas-Colell *et al.* 1995), the outside option is increasing in potential workers' productivity: the more workers are productive in the market for nurses, 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

Following Mas-Colell *et al.* (1995) and Heyes (2005), we assume that workers receive a uniform wage. This assumption - which implies standard inefficiencies due to adverse selection in the labour market - can have different justifications: first, productivity (and vocation) is workers' private information; second, in public hospitals - as, in general, in the public administration - contracts are generally standardized and characterised by a uniform wage policy, with a-priori defined career steps; finally, a fix salary can be the optimal "incentive" policy in those sectors. Indeed, a theoretical justification for offering a uniform wage in sectors producing welfare services is provided by the multitask principal-agent analysis. In particular, Holmstrom and Milgrom (1991) show that - in presence of different tasks for the agent - an optimal incentive contract can be to pay a fixed wage, independent of any measured performances. It is quite easy to

²In their baseline model many identical firms can hire workers. Each worker produces the same output using a constant technology to scale technology in which labour is the only input.

³A 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.

translate multi-tasking in the market for nurses: just think for instance to the task of injecting drugs to patients (measurable) and the task of treating patients with tender loving care (definitively difficult to measure). An incentive contract based on the number of injections (the only measurable performance) would bring agents to concentrate only on this task, forgetting the other one. That is why a uniform wage policy can be better in this case.⁴

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:

$$\theta_i \leq w_0 + \gamma_j \iff \theta_i - \gamma_j \leq w_0 \quad (1)$$

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 in the market with intrinsically motivated workers:

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. 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 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 we will show next (see Proposition 1 and Remark 3), 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

⁴Note that, as a consequence of the uniform wage assumption, while workers’ reservation utility is increasing in the skill level, being more productive brings workers no particular advantages in the market for nurses.

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.

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 $\pi_\theta = \text{prob}(\theta = \theta_h)$ and $\pi_\gamma = \text{prob}(\gamma = \gamma_h)$. 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 vocation 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 $\Delta\gamma < \Delta\theta$, average productivity of active workers is non-decreasing in the wage rate, average vocation increases for $w \in [\tilde{w}_{h,h}, \tilde{w}_{h,l}]$ and decreases elsewhere. (b) When $\Delta\gamma > \Delta\theta$, average vocation of active workers is non-increasing in the wage rate, average productivity decreases for $w \in [\tilde{w}_{l,l}, \tilde{w}_{h,l}]$ and increases elsewhere. (c) When $\Delta\gamma = \Delta\theta$, average productivity of active workers is increasing in the wage rate, and average vocation of active workers is decreasing in the wage rate.*

Proof. See appendix 6.1. ■

In the proof of the proposition we show that, when $\Delta\gamma < \Delta\theta$, a wage increase always has a positive impact on average productivity of active workers: given the order with which different types of workers enter the market, average productivity is non-decreasing in the wage rate. However, the impact of a wage increase on average vocation of active workers is either positive or negative depending on which workers' type have already entered the market. In particular, average vocation decreases when w reaches $\tilde{w}_{l,l}$, increases when w reaches $\tilde{w}_{h,h}$ and decreases again when w reaches $\tilde{w}_{h,l}$. In a similar way, when $\Delta\gamma > \Delta\theta$, average vocation is non-increasing in the wage; whereas a wage increase has either a positive or a negative impact on productivity. In particular, 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 $\tilde{w}_{h,l}$.

Proposition 1 describes how both average productivity and average vocation of active workers depend on the wage rate. As mentioned before, we expected a positive impact of a wage increase on average productivity since, as wage increases, workers with higher productivity also enter the market. We also expected a negative impact of a wage increase on average vocation of active workers since, as wage increases, workers with lower vocation also enter the market. We saw that a positive impact of a wage increase on average productivity is always assured only when productivity has a higher impact than vocation on net reservation wage ($\Delta\theta > \Delta\gamma$). Whereas, in the very same case, average vocation is non-monotonic in the wage rate. In particular, the counter intuitive effect for average vocation of active workers occurs for $w \in [\tilde{w}_{h,h}, \tilde{w}_{h,l}]$. Similarly we showed that a negative impact of a wage increase on average vocation is always assured only when vocation has a higher impact than productivity on net reservation wage ($\Delta\theta < \Delta\gamma$). Whereas, in this same case, average productivity is non-monotonic in the wage rate. In particular, the counter intuitive effect for average productivity of active workers occurs for $w \in [\tilde{w}_{l,l}, \tilde{w}_{h,l}]$. Not surprisingly, the two intuitive cases are both verified when $\Delta\gamma = \Delta\theta$: average productivity is monotonically increasing and average vocation of active workers is monotonically decreasing in the wage. From the previous discussion, it is also clear that the two counter-intuitive results can not occur simultaneously.

In general, we observe that the relative size of the difference between the two workers' characteristics in the four-types population ($\Delta\theta$ 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 either average vocation or average productivity of active workers exhibit monotonic variations when the wage rate increases.

A last remark before moving to Section 4: 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 other words the correlation between productivity and vocation determines how strong the effects described in Proposition 1 are. In particular, we notice the following. If $\Delta\gamma < \Delta\theta$ and the correlation between productivity and vocation is positive (negative). Then, when w reaches $\tilde{w}_{l,l}$, we observe a large (small) decrease in average vocation among active workers. When w reaches $\tilde{w}_{h,h}$, we observe a large (small) increase in both average productivity and average vocation. When w reaches $\tilde{w}_{h,l}$, we observe a small (large) increase in average productivity and a small (large) decrease in average vocation. In the same way, if $\Delta\gamma > \Delta\theta$ and correlation between productivity and vocation is positive (negative). Then, when w reaches $\tilde{w}_{h,h}$, we observe a large (small) increase in average productivity among active workers. When w reaches $\tilde{w}_{l,l}$, we observe a large (small) decrease in both average productivity and average vocation. When w reaches $\tilde{w}_{h,l}$, we observe a small (large) increase in average productivity and a small (large) decrease in average vocation.⁵

4 Generalizing the four-types case: monotonic average productivity and vocation

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

⁵Interestingly, the correlation between productivity and vocation results to be crucial in the continuous case that is analyzed by one of us in a companion but more technical paper focusing on equilibrium issues (see, Barigozzi and Raggi, 2010). Except for the fact that a positive correlation between productivity and vocation turns out to be a necessary and sufficient condition for counter-intuitive effects to occur, all the other results of this note are confirmed in the continuous setting even if in a less plain and intuitive way.

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 3 *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 complete ranking of net reservation wages in the population of potential workers. In general, average productivity of active workers can be decreasing and average vocation can be increasing in the wage rate for some sub-interval of the relevant wages $[\tilde{w}_{1,m}, \tilde{w}_{n,0}]$. 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 $(\theta_{i-1}, \gamma_{j+1})$. 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 4 (Monotonic average productivity) *When $\theta_{i+1} - \theta_i \geq \gamma_m - \gamma_1$ $\forall i = 1, \dots, n$, (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 $\tilde{w}_{i,m} < \tilde{w}_{i,m-1} < \dots < \tilde{w}_{i,2} < \tilde{w}_{i,1} < \tilde{w}_{i+1,m} < \tilde{w}_{i+1,m-1} < \dots < \tilde{w}_{i+1,2} < \tilde{w}_{i+1,1}$. 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 (4) 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 its impact on average vocation oscillates between positive and negative changes. 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 $\theta_{i+1} - \theta_i \geq \gamma_m - \gamma_1 \ \forall i = 1, \dots, n$, for any distribution $F(\cdot)$, $F(\tilde{w}_{i,j}|\theta_i) > F(\tilde{w}_{i+1,j}|\theta_{i+1}) \ \forall i$, i.e. $F(\tilde{w}_{i+1,j}|\theta_{i+1})$ first order stochastically dominates (FOSD) $F(\tilde{w}_{i,j}|\theta_i)$. 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} . In economic terms, this means that for any given level of the market wage, the share of individuals with productivity θ_i accepting the job is never smaller than the share of individuals with higher productivity θ_{i+1} . This is why, increasing the wage rate, will imply an increase in average productivity.

The sufficient condition in Remark (4), even if quite extreme, is more likely to be verified in markets for nurses 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 (4) 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 before, 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 5 below establishes the required condition:

Remark 5 (*Monotonic average vocation*) When $\theta_n - \theta_1 < \gamma_{j+1} - \gamma_j \ \forall j = 1, \dots, m$, (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 $\tilde{w}_{1,j+1} < \tilde{w}_{2,j+1} < \dots < \tilde{w}_{n-1,j+1} < \tilde{w}_{n,j+1} < \tilde{w}_{1,j} < \tilde{w}_{2,j} < \dots < \tilde{w}_{n-1,j} < \tilde{w}_{n,j}$. 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 $w = \tilde{w}_{1,j-1}$. ■

Note that, as we also show in the proof of Proposition 1, the particularly adverse situation in which both average productivity and average vocation of active workers are simultaneously decreasing in the wage rate can occur for some sub-intervals of the relevant wages. Remark (5) 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 its impact on average productivity oscillates between positive and negative changes. Note that the condition expressed in the previous remark 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 $F(\cdot)$, $F(\tilde{w}_{i,j+1}|\gamma_{j+1}) > F(\tilde{w}_{i,j}|\gamma_j) \forall j$, i.e. $F(\tilde{w}_{i,j}|\gamma_j)$ FOSD $F(\tilde{w}_{i,j+1}|\gamma_{j+1})$. 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 . Again, in economic terms, this means that for any given level of the market wage, the share of individuals with vocation γ_{j+1} accepting the job is never smaller than the share of individuals with lower vocation γ_j . This is why, increasing the wage rate, will imply a decrease in average vocation.⁶

Given the importance of vocation in determining the ranking of net reservation wages in the population, the condition in Remark (5) 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 a 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. To do so we analyzed potential workers' decision whether to enter the market for nurses by enriching the standard model of adverse selection in the labor market (Mas-colell's *et al.* 1995) with workers' intrinsic motivation as modeled by Heyes (2005).

Heyes (2005) showed the possible negative impact of a wage increase on the average vocation of active workers without considering workers' productivity. 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

⁶Interestingly, the condition outlined in Remark (5) 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 $F(\cdot)$, which corresponds exactly to the condition $F(\tilde{w}_{i,j}|\gamma_j)$ FOSD $F(\tilde{w}_{i,j+1}|\gamma_{j+1})$ discussed in the main text.

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, while the adverse effect on average productivity of active workers is counter-intuitive, the adverse effect on average vocation is fully intuitive. Interestingly, the particularly adverse situation in which both average productivity and average vocation of active workers are simultaneously decreasing in the wage can occur for some sub-intervals of the relevant wage interval. We also show that the two counter-intuitive effects (average productivity of active workers decreasing and average vocation increasing in the wage) 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 necessarily 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 nursing job allows workers to benefit from their "vocational" premium along with the uniform 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 $E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}] = \frac{f(\theta_l, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l)} \gamma_h + \frac{f(\theta_l, \gamma_l)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l)} \gamma_l$. When types A , B and C enter the market, average productivity and average vocation of active workers respectively are $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] = \frac{f(\theta_h, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h)} \theta_h + \frac{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h)} \theta_l$ and $E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] = \frac{f(\theta_l, \gamma_h) + f(\theta_h, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h)} \gamma_h + \frac{f(\theta_l, \gamma_l)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h)} \gamma_l$. Finally, when all the four types A , B , C and D enter the market, average productivity and average vocation of active workers respectively are $E[\theta|w \geq \tilde{w}_{h,l}] = \frac{f(\theta_h, \gamma_l) + f(\theta_h, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h) + f(\theta_h, \gamma_l)} \theta_h + \frac{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h) + f(\theta_h, \gamma_l)} \theta_l = \theta_h \pi_\theta + \theta_l (1 - \pi_\theta)$ and $E[\gamma|w \geq \tilde{w}_{h,l}] = \frac{f(\theta_l, \gamma_h) + f(\theta_h, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h) + f(\theta_h, \gamma_l)} \gamma_h + \frac{f(\theta_l, \gamma_l) + f(\theta_h, \gamma_l)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h) + f(\theta_h, \gamma_l)} \gamma_l = \gamma_h \pi_\gamma + \gamma_l (1 - \pi_\gamma)$. Concerning average productivity and average vocation of active workers the following inequalities hold: $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = E[\theta|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}] < E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] < E[\theta|w \geq \tilde{w}_{h,l}]$ and $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] > E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}]$, $E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,h}] < E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}]$, $E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] > E[\gamma|w \geq \tilde{w}_{h,l}]$. To see why the previous inequalities hold take, for example, the comparison between $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}]$ and $E[\theta|w \geq \tilde{w}_{h,l}]$. Since $\frac{f(\theta_h, \gamma_l) + f(\theta_h, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h) + f(\theta_h, \gamma_l)} > \frac{f(\theta_h, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h)}$ and $\frac{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h) + f(\theta_h, \gamma_l)} < \frac{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l)}{f(\theta_l, \gamma_h) + f(\theta_l, \gamma_l) + f(\theta_h, \gamma_h)}$, passing from $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}]$ to $E[\theta|w \geq \tilde{w}_{h,l}]$ the weight of θ_h increases whereas the weight of θ_l decreases. Thus, $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] < E[\theta|w \geq \tilde{w}_{h,l}]$. **(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 $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{l,l}] = \frac{f(\theta_h, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_h, \gamma_h)} \theta_h + \frac{f(\theta_l, \gamma_h)}{f(\theta_l, \gamma_h) + f(\theta_h, \gamma_h)} \theta_l$ 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 $E[\theta|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}]$ and $E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}]$. 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 $E[\gamma|w \geq \tilde{w}_{h,l}] = \gamma_h \pi_\gamma + \gamma_l (1 - \pi_\gamma)$. The following inequalities hold: $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] = E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{l,l}] < E[\gamma|\tilde{w}_{l,l} \leq w < \tilde{w}_{h,l}] < E[\gamma|w \geq \tilde{w}_{h,l}]$ 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 together, 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 $E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}]$ and $E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}]$. 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 $E[\gamma|w \geq \tilde{w}_{h,l}] = \gamma_h \pi_\gamma + \gamma_l (1 - \pi_\gamma)$. The following inequalities hold: $E[\theta|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] < E[\theta|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] < E[\theta|w \geq \tilde{w}_{h,l}]$ and $E[\gamma|\tilde{w}_{l,h} \leq w < \tilde{w}_{l,l}] < E[\gamma|\tilde{w}_{h,h} \leq w < \tilde{w}_{h,l}] < E[\gamma|w \geq \tilde{w}_{h,l}]$.

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