A matter of wages? : Effects of public sector wage policies on the sector choice of highly educated professionals

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Abstract

In this paper, we estimate a Roy sector choice model in order to evaluate the effectiveness of a range of counterfactual public sector wage policies on the attraction of human capital to the Colombian public sector. Using administrative data of recipients of Colfuturo loans for graduate study abroad, we find that wage increases in the public sector are relatively ineffective and have significant effects in wage dispersion. These results inform recommendations for the design of human capital policies for the Colombian state.

Keywords: sector choice, labor market, public sector, human capital.

JEL codes: J24, J45, J48

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Introduction

In this paper, we attempt to estimate the effectiveness and labor market impacts of public sector wage policies aimed at professionals in the Colombian public sector. Our estimations show that this policy is not necessarily effective. Attracting qualified professionals, according to the literature, is associated with improvements in the efficiency of production of public goods and institutional improvements. (Iacovello and Chudnovsky, 2015).

In the Colombian case, the professionalization of the civil service has advanced since the Law 909 of 2004, which regulates the present civil service system and defines different schemes for public sector hiring. However, the wage gap between the private and the public sectors persist for directives and specialized positions, documented by Martínez (2008) and the OECD (2013). This wage gap complicates the attraction of qualified professionals, with negative effects on the quality of planning and implementation of public policies.

The importance of recruiting qualified professionals is accentuated by the importance of New Public Management in contemporary public administration (Hood, 1991). This school, influenced by public choice theories, posits that the public sector can generate incentive structures that can negatively affect the efficiency of public goods provision. These situations open opportunities for the private sector to provide them, which forces the public sector to compete both in the labor market and in the provision of goods and services.

In this theoretical and institutional context, we seek to determine the effects of a counterfactual wage increase in the Colombian public sector, using a sample of beneficiaries of loans for postgraduate studies abroad from Colfuturo, a Colombian NGO. From this dataset we extract academic and work histories before and after postgraduate study.

We use a Roy choice model to analyze these professionals’ sector choices. In this model, sector choices and wage offers in both sectors are simultaneously determined. The model structure corrects for selection bias through the presence of individual factors that impact individual sector choices but do not affect their respective wage offers. In this case, we use self-reported sector preferences. However, there may be unobserved ability factors that can bias our estimates.

Our model estimates for college graduates, before graduate studies, indicate that the effects of an increase of public sector wage offers on choosing to work in the public sector are small, but the effect of public service preferences is confirmed to be positive and statistically significant. For
professionals with graduate degrees, the effects of an increase of public sector wage offers on choosing to work in the public sector are equally small, while the statistical significance of public service preference vanishes and public sector experience is found to be a predictor of sector choice.

Estimates and simulation results inform some policy recommendations for human capital management in the Colombian public sector. In first place, wage policies cannot be the only policy tool to address this situation, given its relatively low effectiveness. Furthermore, we recommend improvements of identification of motivated individuals, as it is a crucial factor in sector choice. Finally, we recommend considering the partial equilibrium effects in the labor market in the event of wage increases in the public sector.

Our principal contribution lies in the joint estimation of wage and sector choice equations, reducing some of the bias due to endogeneity present in the literature. Furthermore, including sector preference measures allows us to control for intrinsic factors not present in standard models. Finally, our policy simulations allow us to predict the effects of a range of wage policies, informing the design of human capital management policies for the Colombian public sector.

Institutional context

The 1970s heralded a reform movement for civil services, which have sought to make the provision of public services more responsive to efficiency criteria, using incentives and organizational arrangements resembling those existent in the private sector under the postulates of New Public Management (Iacovello & Strazza, 2014). The Colombian public sector has adopted this set of practices from the 1990s, with the current regulation in place being the Law 909 of 2004.

This law designates public sector employment as falling in one of the following categories:

- Civil service, recruited through competitive examinations
- Free appointment and removal
- Fixed term public employment
- Temporary employment – provisional employees and contractors
This classification responds to a dual objective: maintaining the independence of the civil service from political pressures, and increasing the effectiveness of the public sector by providing managers with increased autonomy and access to a temporary workforce in case of unforeseen contingencies.

This reorganization takes place in the midst of a relatively small Colombian state, as only 4.7% of the economically active population is employed by the public sector, less than the Latin American (6-8%, Iacovello & Strazza 2014) and OECD (15%) averages. According to the OECD, there are two main reasons for this phenomenon. In first place, budgetary concerns discourage hiring by the public sector, in order to comply with fiscal limits set by law. Furthermore, normative concerns related to the merit principle of the civil service have resulted in inflexible personnel rules. This rigidity encourages the proliferation of provisional employees, who must leave their posts as soon as the formal civil service examinations fill the post; and contractors, who provide services directly for the organization without being counted as personnel. Contractors are especially abundant in the middle and upper tiers of public organizations. This aspect has both upsides and downsides: increased flexibility in hiring and compensation policies, and the reintroduction of political mechanisms in hiring (OECD, 2015).

Remuneration in the Colombian public sector is linked to a multiplicity of scales regarding an employee’s contract status, education and experience. However, the compensation levels of contractors are not linked to the civil service scales, which obscures the real wage levels in the public sector. Furthermore, there exists a wage gap with respect to the private sector, with higher salaries for secretaries and technicians but lower for professionals, which hinders recruitment for the upper positions of public employment. Finally, compensation is not directly linked to performance, which may discourage efficient goal fulfillment.

This normative structure, coupled with the existing economic incentives, generate competitive pressures in the labor market with the private sector. One of the principal policy recommendations from the IDB (Iacovello & Strazza, 2014) is improving human capital attraction mechanisms in the public sector, noting the importance of monetary compensation and relaxing restrictions in public sector hiring. The importance of attracting qualified personnel lies in its role in improving institutional capacity and an increase of the effectiveness of public goods provision, especially through the professionalization of directive positions. However, the IDB finds no evidence of advances in the required policies for attracting qualified personnel to the public sector, though noting improvements in the merit requirements for the public service.
In summary, the Colombian state is undergoing a modernization process, as it seeks to improve the effectiveness of its public goods and services provision. However, this process has brought an increase of the use of provisional employees and contractors in the public payroll, which, in turn, undermines the dual objectives of public sector independence and efficiency. This necessitates further study of the incentive structures required to attract human capital in order to aid this modernization.

**Literature review**

The analysis of sector choice, wage determinants and human capital has been a historically important topic in economics. Roy (1951) suggested that agents choose the sector most suitable to their skillset, while Ben-Porath (1967) and Mincer (1974) built and found empirical evidence for a model of returns to human capital, understood as education and acquired abilities. Furthermore, Heckman (1974) proposed an econometric framework to correct selection bias due to unobservable variables, applying it to the analysis of sector choice and human capital accumulation (Heckman, 1976; Heckman & MaCurdy, 1982; Heckman & Seldacek, 1990). Finally, the emergence of new statistical and computational techniques has allowed the estimation of structural models, which receive this appellation because they seek to identify and estimate structural or ‘deep’ parameters of models of individual behavior. Their applications include modeling investment choices (Rust 1987), work supply choices (MaCurdy 1981), human capital accumulation decisions (Imai and Keane, 2004) and job sector choice (Keane & Wolpin, 1997; Lee, 2005; Sullivan, 2010).

The interaction of the private and public sectors affects the quality of human capital each sector attracts. Gyourko and Tracy (1988) find positive selection effects for the non-unionized private sector, while the public sector attracts individuals with lower levels of human capital who are more likely to belong to a union, which they describe as ‘crowding-out’. This ‘crowding-out’ has been studied further in the literature, being corroborated by Weibel et al. (2008) and formally modeled by Burdett (2012). Furthermore, the wage gap produced by ‘crowding-out’ is especially salient for more educated workers in the Latin American analysis carried out by Mizala et al. (2012), which finds wage gaps ranging between 7 and 20 percent for workers with postgraduate degrees. However, sector choice does not depend solely on monetary compensation – both van der Gaag y Vijverberg (1988) and Tansel (2005) find that gender is an important determinant of choosing to work for the public sector. These findings point to the importance of intrinsic determinants of sector choice.
Meanwhile, public administration has also studied the use states make of the labor market to achieve its objectives. Historically, Western states have adopted patronage structures, understood as the provision of public jobs to individuals connected to power structures in exchange for political support (Grindle, 2012). However, since the nineteenth century there has been a tendency towards the restriction of public employment to particular structures based on professionalism and merit, defined as bureaucracies. These structures were assumed to be impartial and rational, according to the ideal posited by the German sociologist Max Weber (Grindle, 2012; Oszlak, 1984). However, different visions of bureaucracy emerged in the twentieth century – for example, the public choice school defined bureaucracies as actors interested in maximizing their own welfare, budget and influence (Niskanen 1971, Horn 1995).

The public choice view of bureaucracies was soon challenged, because some of its predicted consequences were not empirically validated. The study of the motivation of public servants was especially salient, as a response to the postulate of them as only interested in maximizing their own welfare. This field of study finds that an important component of behavior of individual public servants and public organizations is directly attributable to intrinsic traits of individuals and organizations. These intrinsic factors are manifested at an individual level through a concept denominated Public Service Motivation (PSM), which encompasses different dimensions (rational, affective, normative, etc.) of an altruistic motivation of service to society (Perry & Wise 1990, Perry & Hondeghem 2008). Furthermore, public service motivation also depends on the organizational and institutional context (Vandenabeele, 2007). In this way, public administration recognizes that the motivation of public servants lies in a continuum between the purely monetary and the purely altruistic.

The empirical study of the role of PSM in public servants’ choices has shown generally positive results, confirming that it is positively correlated with choosing to work in the public sector (Perry & Wise 1990, Perry & Hondeghem 2008). Furthermore, this relationship with sector choice has been corroborated in a Colombian context (Sanabria, 2016).
Data

Our dataset is composed by 925 beneficiaries of Colfuturo loans for graduate study abroad between 2002 and 2007. This information is supplemented by a follow-up survey carried out in 2013 by e-mail by Sanabria (2016), with 409 responses. The aggregate data include work histories before and after graduate study, academic information on the undergraduate and graduate studies and a self-reported measure of the sector in which the beneficiary would prefer to work.

Table 1 presents descriptive statistics for professionals before graduate studies.

**Table 1 – Descriptive statistics, college graduates**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean</th>
<th>S.D</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works in the public sector</td>
<td>953</td>
<td>24.03%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log.wage</td>
<td>926</td>
<td>14.62</td>
<td>0.748</td>
<td>11.127</td>
<td>16.767</td>
</tr>
<tr>
<td>Experience</td>
<td>967</td>
<td>6.977</td>
<td>4.364</td>
<td>0</td>
<td>27</td>
</tr>
<tr>
<td>Gender (M)</td>
<td>967</td>
<td>59.36%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>967</td>
<td>28.977</td>
<td>4.364</td>
<td>22</td>
<td>49</td>
</tr>
<tr>
<td>Public sector preference</td>
<td>967</td>
<td>9.51%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM undergrad</td>
<td>965</td>
<td>41.04%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AEL undergrad</td>
<td>965</td>
<td>26.74%</td>
<td></td>
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</tbody>
</table>

As the table shows, around a quarter of college graduates worked in the public sector before graduate studies and had approximately seven years of experience. Wages present a low dispersion, due to life cycle considerations and low variance in education and experience levels. Approximately 60% of beneficiaries were male, while beneficiaries with undergraduate studies in STEM (science, technology, engineering and mathematics) and administration, economics and law (AEL) were a minority. Finally, only 9.5% of beneficiaries reported a preference towards the public sector before graduate studies.

Figure 1 presents the sectorial distribution of wages for professionals before graduate studies. As observed, public sector wages are larger than private sector wages, although the difference is not statistically significant.
Figure 1 – Wage distribution, college graduates before graduate study

![Wage distribution graph](image)

Table 2 presents descriptive statistics for professionals after graduate studies.

Table 2 – Descriptive statistics, professionals with graduate degrees

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Mean</th>
<th>S.D.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Works in the public sector</td>
<td>312</td>
<td>25%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log.wage</td>
<td>312</td>
<td>15.2</td>
<td>0.71</td>
<td>12.92</td>
<td>17.86</td>
</tr>
<tr>
<td>Experience</td>
<td>312</td>
<td>15.94</td>
<td>4.93</td>
<td>7</td>
<td>37</td>
</tr>
<tr>
<td>Gender (M)</td>
<td>312</td>
<td>55.45%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Age</td>
<td>312</td>
<td>37.94</td>
<td>4.93</td>
<td>29</td>
<td>59</td>
</tr>
<tr>
<td>Public preference sector</td>
<td>312</td>
<td>7.69%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STEM grad</td>
<td>312</td>
<td>27.24%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AEL grad</td>
<td>312</td>
<td>34.29%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ph.D.</td>
<td>312</td>
<td>12.18%</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

With respect to the professionals surveyed in 2013, after their graduate studies, only 312 people reported their wages. As wages are indispensable for estimating the model, we only report summary statistics for the sample who reported their wages.
The follow-up survey finds that about a quarter of respondents work in the public sector, with approximately 16 years of work experience. A 55.45% of respondents are male, and graduate studies in STEM (science, technology, engineering and mathematics) and administration, economics and law (AEL) are predominant. Most of respondents earned masters’ degrees, as only 12.2% report a PhD. Finally, reported preferences to the public sector decrease, as only 7.7% report a preference for working in the public sector. This follow-up survey is representative of the set of beneficiaries previously reported.

Figure 2 presents the sectorial distribution of observed wages for professionals with graduate studies. The private sector has higher mean wages than the public sector, with a statistically significant difference.

**Figure 2 - Wage distribution, professionals with graduate degrees**

Finally, it is necessary to note that professionals in our dataset are not representative of professionals in Colombia. As the Annex 1 presents, we find through the Continuous Household Survey of 2005 and the Great Integrated Household Survey of 2013 that the average Colombian with a college degree is older and has less reported income than Colfuturo beneficiaries. This divergence can be explained by the age characteristics of respondents, as they pursue graduate studies at relatively earlier ages, and by the presence of unobservable abilities that influence both their performance in the labor market and the decision of pursuing graduate studies abroad.
We propose a Roy (1951) sector model to explain the sector choice of the professionals in our datasets, where agents choose their preferred sectors according to the individual wage offers in each sector, their preferences towards the public sector, their gender and their age. Simultaneously, each sector offers wages based on individual characteristics following a Mincer (1974) wage equation.

Individuals are assumed to derive different utilities of working in the private and public sectors. Respectively,

\begin{align*}
1) & \quad U_p = \ln w_p + X'\beta_p + \epsilon_p \\
2) & \quad U_0 = \ln w_0 + X'\beta_0 + \epsilon_0
\end{align*}

Public sector

Private sector

However, it is not possible to identify absolute utility levels, only relative differences. This requires normalizing the utility of working in the private sector to zero. The relative utility is expressed as:

\begin{align*}
3) & \quad U^* = \ln(w_p) - \ln(w_0) + X'\beta^* + \epsilon \\
& \quad \text{Normalized utility}
\end{align*}

We assume $\epsilon$ is normally distributed, with mean zero and variance one, in order to ensure identification of the variance parameters in the wage equations.

Wage offers are separately determined by sector, with $Z$ denoting the matrix of wage determinants.

\begin{align*}
4) & \quad \ln w_p = Z'\delta^p + \eta_p \\
5) & \quad \ln w_0 = Z'\delta^0 + \eta_0
\end{align*}

Public sector

Private sector

These determinants vary across the respective models for college graduates and professionals with graduate degrees, but maintain a Mincer structure.

We estimate the model twice over two subsets of the data – college graduates before graduate studies, and professionals with graduate degrees. In the case of college graduates, the determinants of wages are experience, the square of experience, gender, and two dummy variables marking whether the undergraduate degree was in STEM or AEL. Furthermore, the model includes Colfuturo cohort
fixed effects. For professionals with graduate degrees, the determinants of wages are experience, the square of experience, gender, two dummy variables marking whether the graduate degree was in STEM or AEL, a dummy marking whether the earned degree was a PhD, and Colfuturo cohort fixed effects.

Finally, we assume that \( \begin{pmatrix} \eta_p \\ \eta_0 \end{pmatrix} \) have a joint normal distribution, with mean \( \begin{pmatrix} 0 \\ 0 \end{pmatrix} \) and covariance matrix \( \begin{pmatrix} \sigma^2_{\eta_p} & \sigma_{\eta_p \eta_0} \\ \sigma_{\eta_p \eta_0} & \sigma^2_{\eta_0} \end{pmatrix} \).

Identification of the model parameters requires the existence of factors in agents’ utility functions that only affect observed wages through their effect on sector choices, providing variation between individuals. For college graduates, this exclusion restriction is satisfied by public sector preferences, while for professionals with graduate degrees the relevant factors are public sector preferences and public sector experience.

The model is estimated using full information maximum likelihood (FIML), where all parameters in the model \( (\delta^0, \delta^p, \beta, \sigma^2_{\eta_p}, \sigma^2_{\eta_0}, \sigma_{\eta_p \eta_0}) \) are jointly estimated. The derivation of the log-likelihood function of the model is described in Annex 2.

Results

Estimates for college graduates are reported in Table 3.

**Table 3 – Model estimates, college graduates**

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Private sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>13.188</td>
<td>0.1198</td>
</tr>
<tr>
<td>Experience</td>
<td>0.1241</td>
<td>0.0227</td>
</tr>
<tr>
<td>Experience^2</td>
<td>-0.004</td>
<td>0.0011</td>
</tr>
<tr>
<td>Gender (M)</td>
<td>0.1877</td>
<td>0.0633</td>
</tr>
<tr>
<td>STEM undergrad</td>
<td>-0.1121</td>
<td>0.0613</td>
</tr>
<tr>
<td>AEL undergrad</td>
<td>0.0968</td>
<td>0.0743</td>
</tr>
<tr>
<td><strong>Public sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>13.033</td>
<td>0.452</td>
</tr>
<tr>
<td>Experience</td>
<td>0.1466</td>
<td>0.0476</td>
</tr>
</tbody>
</table>
As presented in Table 3, the coefficients of the proposed determinants of wage offers present the expected signs and magnitude. These coefficients are statistically significant in the private sector, but only experience and its square are statistically significant in the public sector. With respect to the choice equation, having preferences towards the public sector has a positive and statistically significant effect, as expected, while greater experience levels are also associated with choosing to work in the public sector. Finally, the estimated variances are statistically significant.

Estimates for professionals with graduate degrees are reported in Table 4.

Table 4 – Model estimates - professionals with graduate degrees

<table>
<thead>
<tr>
<th></th>
<th>Coefficient</th>
<th>Standard error</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Private sector</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>14.4908</td>
<td>0.5021</td>
</tr>
<tr>
<td>Experience</td>
<td>0.0582</td>
<td>0.0703</td>
</tr>
<tr>
<td>Experience^2</td>
<td>-0.0012</td>
<td>0.0019</td>
</tr>
<tr>
<td>Gender (M)</td>
<td>0.0846</td>
<td>0.104</td>
</tr>
</tbody>
</table>
As table 4 presents, although the coefficients of the proposed determinants of wage offers present the expected signs and magnitude, very few are statistically significant due to sample size concerns. In the private sector, having a graduate degree in administration, economics or law is
statistically significant and positively correlated with higher wage offers. With respect to sector choice, the only statistically significant determinant of choosing to work in the public sector is having prior public sector experience, while the significance of the role of preferences toward the public sector disappears. Although the effect is not statistically significant, we find that an increased condonation rate for loans increases the probability of choosing to work in the public sector. Finally, all estimated variances are statistically significant.

Policy simulations

We use the proposed model structure and the estimated parameters to analyze the effects of public sector wage policies on agents’ choices. More specifically, we seek to estimate its overall effectiveness, through the response of the average probabilities of choosing to work in the public sector, its effects on the labor market, and the characteristics of individuals who switch sectors as a response.

Sector choice

In this section, we estimate the response of the average probability of working in the public sector to a range of public sector wage offer increases. This estimation uses the wage offer equations and agents’ choice equation, comparing their respective utilities of working in the private sector and a counterfactual range of public sector wage offer changes, between a 25% decrease and a 50% increase in public sector wage offers.

Figure 3 – Sector choice, college graduates
Figure 3 suggests that the effectiveness of a public sector wage increase for college graduates is dubious. The effects on the average probability of choosing the public sector of a 50% increase of the wages offered by the public sector is an increase of 13.6 percent points. Furthermore, it suggests the existence of diminishing marginal returns for this policy.

The response of the average probability of working in the public sector to a range of public sector wage offer increases for professionals with graduate degrees is constructed analogously and presented in Figure 4.

Figure 4 – Sector choice, professionals with graduate degrees

Figure 4 displays that a public sector wage increase for professionals with graduate degrees has limited effectiveness as well. The effects on the average probability of choosing the public sector of a 50% increase of the wages offered by the public sector is an increase of 10.4 percent points. However, diminishing marginal returns seem to be less pronounced than in the case of college graduates.

Labor market effects

The structure of the Roy model implies the existence of partial equilibrium effects in the labor market, since sector choices and observed wages are simultaneously determined. This necessitates the observation of the distribution of observed wages. However, the main challenge for generating this distribution is the presence of unobserved components in both the wage offers and the utility equations, as the observed data depends of a realization of these random components that is impossible to identify and replicate in practice. For this reason, we use simulation methods to approximate the effect of public sector wage policies on the observed wage distributions.
The simulation method uses the estimation results of the joint distribution of unobservables \((\varepsilon, \eta_p, \eta_0)\). Using the estimated variance-covariance matrix of the unobservable components of the model, we generate 250 realizations of their joint distribution for each individual, in order to simulate each agents’ sector choice as a response to a given wage policy and realizations of the unobservables. This procedure generates a simulated dataset of 231,250 simulated choices for college graduates and 77,250 simulated choices for professionals with graduate degrees.

The following simulations are based on three scenarios: the current situation, a 5% increase of the public sector wage offer, and a 10% increase of the public sector wage offer.

Simulation results for college graduates are presented in Figure 5.

**Figure 5 – Effects on simulated observed wages, college graduates**

![Box plot showing effects on simulated observed wages for college graduates.](image)

The simulation results imply that a 5% increase in public sector wage offers would increase observed wages by 3.9 percentage points, and a 10% increase in public sector wage offers would increase observed wages by 11.4 percentage points. However, observed wage dispersion would increase. The sector breakdown of the simulated observed wages allows us to decompose the effects by sector.
Figure 6 – Effects by sector on simulated observed wages, college graduates

As Figure 6 suggests, public sector wage increases are associated with increased wage dispersion in both the private and the public sectors. However, the effect is more pronounced in the private sector.

Figure 7 presents simulation results for professionals with graduate degrees.

Figure 7 – Effects on simulated observed wages, professionals with graduate degrees
The simulation results imply that a 5% increase in public sector wage offers would increase observed wages by 3 percentage points, and a 10% increase in public sector wage offers would increase observed wages by 9.3 percentage points. Observed wage dispersion increases as well. Figure 8 presents the simulated effects of each policy by sector.

Figure 8 – Effects by sector on simulated observed wages, professionals with graduate degrees

As Figure 8 presents, public sector wage increases are associated with increased wage dispersion in both the private and the public sectors. However, wage dispersion increases are larger in the private sector. This dispersion is larger than in the case of college graduates.

Policy targeting

The results of the simulation exercise can also be used for targeting the proposed wage policies. Using agents’ simulated choices, it is possible to identify and characterize the sociodemographic traits of those who switch sectors as a response to an increase in the wage offered by the public sector.

Tables 5 and 6 present the proportion of simulated agents that switch sectors, sorted by certain traits. We test whether simulated agents with a given sociodemographic trait are more or less likely to switch sectors as a response to a given wage policy with a simple difference of means test. However, statistical inference is conditional on the model parameters.

Table 5 presents the proportion of simulated college graduates agents that switch sectors.
Simulation results for college graduates suggest that, individuals with existing public sector preferences are less likely to switch to the public sector as a response to a public sector wage increase, as well as AEL undergrads. STEM undergrads are less likely to switch with a 5% wage increase, but are more likely to do so with a 10% increase. These results are consistent with estimation results, since the previous groups are less likely to choose the public sector ex-ante; but their expected utilities can change in the case of an increase in public sector wages.

Table 6 presents the proportion of simulated professionals with graduate degrees that switch sectors.

Simulation results for professionals with graduate degrees suggest that individuals with existing public sector preferences are less likely to switch to the public sector as a response to a public sector wage increase, as well as those with previous public sector experience. Males are more likely to switch sectors, as well as professionals with graduate studies in STEM and AEL. However, PhDs are less likely to switch to the public sector as a response to public sector wage increases.
Policy implications

The results of the previous model estimates and counterfactual analyses have implications for the design of public sector wage policies in the Colombian public sector and its mechanisms for attracting and retaining human capital.

First, the results of simulation analysis on the effects of different wage policies show that wage increases alone are relatively ineffective in attracting both college graduates and professionals with graduate degrees. However, estimation results show the potential of long-term policies aimed at identifying and encouraging public sector preferences among recent college graduates, given its importance in attracting young professionals to the public sector. This early experience is crucial in easing the later recruitment of professionals with graduate degrees.

Second, our simulation analysis present recommendations for the design of this wage policy. These wage policies increase the overall dispersion of observed wages across sectors, which warrants an analysis of the indirect economic consequences of these interventions. Finally, the targeting analysis allow the identification of population groups with a greater response to wage increases, although the estimated effect sizes render this aspect as relatively unimportant. However, they seem to validate a crowding-out model, where groups who are less likely to choose the public sector displace the existent public servants as a response to increased wages.

Conclusions

The model estimates allow us to improve our understanding of the sector choices of a group of professionals with high levels of human capital. Using the Roy model as a framework, we incorporate a crucial factor, preferences towards the public sector. In turn, our model estimates allow us to simulate the effects of a range of public sector wage policies.

The presented results imply policy recommendations for improvements in the human capital management policies of the Colombian public sector. The main implication of our results is the need to take into account the crucial importance of motivational factors as drivers of sector choices, especially given the low effectiveness of wage policies and their labor market consequences. From this, we find out that sector choices are dependent on the life cycles of individuals. Further work in this area would require a framework addressing concerns about intertemporal accumulation of human capital and the associated sector choices.
Furthermore, our results on the different impacts of public sector preference across the life cycle require further study, as it has no impact on sector choice further in life. This effect necessitates further study on the relationship of evolution across the life cycle of individual attitudes towards the public sector and public service motivation.
References


Annex 1 – Descriptive statistics, Colombians with college degrees and graduate studies

In order to analyze the representativeness of the studied professionals, we use the Continuous Household Survey of 2005 and the Great Integrated Household Survey of 2013 to describe groups with education levels comparable to the professionals in our sample. In both cases, we use fourth trimester data.

Table A-1: Descriptive statistics, college graduates or higher education, CHS 2005

<table>
<thead>
<tr>
<th>Variable</th>
<th>n</th>
<th>Mean</th>
<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender (F)</td>
<td>17264</td>
<td>52.48%</td>
<td>0.50</td>
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</tr>
<tr>
<td>Age</td>
<td>17264</td>
<td>33.98</td>
<td>13.11</td>
<td>15.00</td>
<td>95.00</td>
</tr>
<tr>
<td>Log. wage</td>
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<td>12.36</td>
<td>3.10</td>
<td>4.58</td>
<td>16.59</td>
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<tr>
<td>Public sector</td>
<td>17264</td>
<td>10.38%</td>
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</table>

Table A-2: Descriptive statistics, college graduates or higher education, GIHS 2013

**College graduates**

<table>
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<tr>
<th>Variable</th>
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<th>SD</th>
<th>Min</th>
<th>Max</th>
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</thead>
<tbody>
<tr>
<td>Gender (F)</td>
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<tr>
<td>Age</td>
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<td>40.69</td>
<td>13.54</td>
<td>17</td>
<td>95</td>
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<tr>
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<td>9.21</td>
<td>17.43</td>
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<tr>
<td>Public sector</td>
<td>5331</td>
<td>10.58%</td>
<td>0.31</td>
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</tbody>
</table>

**Postgrado**

<table>
<thead>
<tr>
<th>Variable</th>
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<th>SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
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<tr>
<td>Gender (F)</td>
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<td>54.85%</td>
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<td>Age</td>
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<td>45.733</td>
<td>12.374</td>
<td>22</td>
<td>96</td>
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<tr>
<td>Log. wage</td>
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<td>0.587</td>
<td>12.21</td>
<td>17.50</td>
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<tr>
<td>Public sector</td>
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<td>29.37%</td>
<td>0.456</td>
<td>0</td>
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Annex 2 – Derivation of the model log-likelihood

The basic equations in the models are:

Normalized utility:

\[ U^* = (\ln(w^p) - \ln(w^0)) + X'\beta + \epsilon \]

Wage offer equations by sector:

\[ \ln(w^p) = Z'\delta^p + \eta_p \]
\[ \ln(w^0) = Z'\delta^0 + \eta_0 \]

The likelihood function is defined as:

\[ L = \prod_{i=1}^{n} Pr(d_i = 1|X, Z) f(\ln(w)|X, Z, d_i = 1) \]
\[ \times Pr(d_i = 1|X, Z) f(\ln(w)|X, Z, d_i = 0)^{1-d_i} \]

where \( d_i \) is 1 if the agent works in the public sector and 0 otherwise.

However, using Bayes’ theorem, the conditional distribution of wages can be expressed as:

\[ f(\ln(w)|X, Z, d_i = 1) = f(\ln(w)|X, Z) \frac{Pr(d_i = 1|X, Z, \ln(w))}{Pr(d_i = 1|X, Z)} \]

Replacing in the likelihood function and taking logs, the log-likelihood is defined as:

\[ \ln(L) = \sum_{i=1}^{n} d_i \ln(Pr(d_i = 1|X, Z, \ln(w))) f(\ln(w)|X) \]
\[ + (1 - d_i) \ln(Pr(d_i = 0|X, Z, \ln(w))) f(\ln(w)|X) \]

Using the model structure, it is possible to find expressions for \( Pr(d_i = 1|X, Z, \ln(w)) \) and \( f(\ln(w)|X) \).

The wage offer equations imply that the conditional distribution of wages follows:

\[ f(\ln(w)|X) = \frac{1}{\sigma_{\eta_p}} \phi \left( \frac{\ln(w^p) - Z'\delta^p}{\sigma_{\eta_p}} \right) = \frac{1}{\sigma_{\eta_0}} \phi \left( \frac{\ln(w^0) - Z'\delta^0}{\sigma_{\eta_0}} \right) \]

Furthermore, a person will choose the public sector if its normalized utility is greater than zero.

The probability of this event is:
\[ \Pr(U^* > 0) \]
\[ \Pr((\ln(w^p) - \ln(w^0) + X'\beta + \epsilon) > 0) \]

Replacing with the wage offer equations:
\[ \Pr\left((Z'\delta^p + \eta_p) - (Z'\delta^0 + \eta_0) + X'\beta + \epsilon\right) > 0 \]

Combining the error terms \( \epsilon, \eta_p, \eta_0 \) in a single term, \( \nu = \eta_p - \eta_0 + \epsilon \), we have:
\[ \Pr(Z'\delta^p - Z'\delta^0 + X'\beta + \nu) > 0 \]

However, we can decompose \( \nu \) as a function of \( \eta_p \) and a normally distributed variable, \( e \). This decomposition, applied to the public sector, yields:
\[ \Pr\left(Z'\delta^p - Z'\delta^0 + X'\beta + \frac{\text{cov}(\eta_p, \nu)}{\sigma_{\eta_p}^2} \eta_p + e\right) > 0 \]
\[ \Pr\left(Z'\delta^p - Z'\delta^0 + X'\beta + \frac{\sigma_{\eta_p}^2 - \sigma_{\eta_p, \eta_0} \ln(w^p)}{\sigma_{\eta_p}^2} \ln(w^p) - \frac{\sigma_{\eta_p}^2 - \sigma_{\eta_p, \eta_0} Z'\delta^p + e}{\sigma_{\eta_p}^2} > 0 \right) \]

Given that \( e \) is normally distributed, this expression equals:
\[ \Pr(U^* > 0) = \Phi\left(\frac{Z'\delta^p - Z'\delta^0 + X'\beta + \frac{\sigma_{\eta_p}^2 - \sigma_{\eta_p, \eta_0} \ln(w^p)}{\sigma_{\eta_p}^2} \ln(w^p) - \frac{\sigma_{\eta_p}^2 - \sigma_{\eta_p, \eta_0} Z'\delta^p + e}{\sigma_{\eta_p}^2}}{\sqrt{\sigma_e^2}}\right) \]

where \( \Phi \) is the cumulative normal distribution.

The variance of the error term \( e \), through properties of the normal distribution, is equal to:
\[ \text{var}(e) = \text{var}(\nu) \left(1 - \left(\frac{\text{cov}(\eta_p, \nu)}{\sigma_{\eta_p} \sigma_{\nu}}\right)^2\right) \]

Given this variance, the probability of an agent choosing to work in the public sector is:
\[
\Pr(U^* > 0) = \Phi \left( \frac{Z'\delta^p - Z'\delta^0 + X'\beta + \frac{\sigma_{\eta_p}^2 - \sigma_{\eta_p,\eta_0}}{\sigma_{\eta_p}^2} \ln(w^p) - \frac{\sigma_{\eta_p}^2 - \sigma_{\eta_p,\eta_0}}{\sigma_{\eta_p}^2} Z'\delta^p}{\text{var}(\nu) \left( 1 - \left( \frac{\text{cov}(\eta_p, \nu)}{\sigma_{\eta_p} \sigma_{\nu}} \right)^2 \right)} \right)
\]

The probability of an individual choosing to work in the private sector is derived analogously.