Wage gap and temporality in Spain[°].

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Abstract:

There is evidence in Spain that a temporary worker receives a lower wage than he would receive in case he was hiring with a permanent contract. Using the Stochastic Frontier Approach we estimate a wage equation and the "wage inefficiency" determinants and obtain that these wages differentials remain after controlling for human capital variables and other individual characteristics. We compare this result with gender discrimination that has been widely analysed in the literature. Our results indicate that to be women reduce the potential wage in an 18.5% while this reduction is about 7% in the case of temporary workers.

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Key words: wages differentials, temporary workers, stochastic frontier, inefficiency

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I. Introduction

Some empirical studies find that, after controlling for observed and unobserved heterogeneity in personal and job-related characteristics, permanent workers earn around 10% to 15% more than temporary ones (see Jimeno and Toharia 1993; and Davia and Hernanz, 2004). In an efficiency wage framework, Sanchez and Toharia, 2000 shows that the average wage is below the mean value in sectors where the number of temporary workers is high. Using the insider-outsider theory, Bentolila and Dolado, 1994, explain that the augment of temporary contracts can induce an increase of permanent worker's wages. If permanent workers (with high firing cost) control Unions and they set wages, then the existence of temporary contracts increases their bargaining power.

The number of temporary contracts in Spain was disproportional after the reform of year 1984. In 1994, 1997 and 2001 took place new reforms, trying to achieve a more balanced situation by restricting the use of temporary contracts and by reducing mandatory firing costs under new permanent contracts. Afterwards, these reforms were not effective to reduce the rate of temporality that remains around the level of 30% in 2005.

The success of temporary contracts relates to general facts. Prior to the reform of the labour market, taken on 1984, it was a long period (from 1975 to 1984) of dramatic destruction of employment. Therefore the necessity of diminish the high unemployment rate have motivated the reform of 1984 that relaxed the legal restriction to use temporary contracts. Because of this reform,

there was a substitution effect from temporal to permanent contracts, with all the consequences derived to productivity. These contracts became attractive to employers because of both, their short duration and low severance payment. Consequently, from these greater incentives, the new temporary contracts immediately enjoyed a degree of success that far exceeded expectations. The difference in severance payments between temporary and permanent contracts is a key for understanding its success (see Dolado et al, 2002).

The link between temporary contracts and productivity have been analysed recently by Diaz and Sánchez (2004). They obtain, through a stochastic frontier analysis, that the high percentage of temporary contracts has affected negatively productivity. Thurow's (1975) model of job competition assumes that productivity is associated to jobs, not to workers. There are jobs with differences in productivity and firms allocate workers to jobs according to their educational profile. As employers rarely have direct evidence of the specific training costs for specific workers, they end up by ranking workers according to their educational attainment. In this sense, if job productivity relates with jobs as well as workers, the high augment of "bad jobs" is a fact that could explain the negative results obtained about workers' productivity in the OECD ranking for Spain.

As we mentioned above, there is evidence in Spain that both temporary workers earn less and are less productive than permanent workers are; but the question is if temporary workers have enough skills to achieve a better position in the labour market. In this paper, we will analyse these wages differentials

and test if these differences remain after controlling for human capital variables and other individual characteristics. We consider the unexplained differences obtained as an evidence of the contract type discrimination and it is around a 7% in our estimation.

The traditional analysis of discrimination consists in the estimation of an earnings equation by gender, separately, following the work of Oaxaca (1973) and Blinder (1973), assuming that males have a non-discriminatory wage structure. Then, wages gap is decomposed in explained differences due to differences in productivity and unexplained differences attributed to gender discrimination. This methodology has been criticised in two essential ways. Firstly, the residual wage gap could include omitted variables that difficult its interpretation as discrimination. Secondly, because this method uses reduced form wage equations for the two groups and estimates them separately, considering that both groups are identical. However, there may be unobservable differences between the characteristics of the two groups for which the wage equations cannot account. To avoid these difficulties we use the stochastic frontier approach. This econometric method includes a one-sided error to capture the inefficient behaviour of the economic units analysed. The frontier approach is a methodology usually applied to analyse inefficiency in firms' production where a production frontier shows the maximum amount of output attainable with a given level of inputs. If firms do not obtain this maximum level of output, they are inefficient and we could measure their level of inefficiency by the one-sided error term. Likewise, adapting this

methodology to the analysis of wage differentials, the earnings frontier will describe the highest potential income associated with a given stock of human capital. If the worker earn less than its potential wage (underpayment), that represents inefficiency in the transformation of human capital variables (schooling, experience, and tenure) into earnings. Moreover, this methodology allows us to know if identical observable workers in terms of productivity can achieve different potential wage.

There is a growing literature that uses the stochastic frontier approach to estimate earnings functions. Among others, we can find the contributions from Hofler and Polacheck (1985), Herzog, Hofler and Schlottmann (1985), Polachek and Yoon (1987), Daneshvary et al. (1992), Hunt-McCool and Warren (1993), Polachek, and Robst (1998). Robinson and Wunnava (1989) paper is one of the first attempts to measure discrimination using the frontier methodology. They estimate a wage frontier for women and measures wage discrimination as the relative distance between the observed wage and the estimated frontier. More recently, Dawson et al. (2001) uses the stochastic wage frontier to estimate the relative underpayment of females and men and argue if really it is an evidence of discrimination. Lang (2000) estimates and earning frontier to search for systematic differences and discrimination between native and migrants in Germany. Garcia et al. (2001) analyse the wage differences by gender and the existence of gender discrimination in Spain.

The efficiency frontier methodology contributes to a better estimation of the wages gap and discrimination in the following aspects. It establishes a

relationship between the maximum wage attainable by an individual, given their human capital and other personal characteristics, according to the neo-classical theory instead of considering an average wage obtained by the estimation of a reduced wage equation. Then, the earnings function, represent the relation between the human capital variables (inputs) and the maximum wage attainable (output) and allows to comparing the wage obtained by a worker with their potential and theoretical wage. In addition, the frontier method gives interesting information in three aspects. First, the frontier approach, like the traditional wage equation procedure, estimates the determinants of wages. Second, it allows evaluating the individual gaps, or inefficiency, between the frontier and the obtained wage and third, it is possible to analyse the variables that can explain the wage inefficiency through the model of inefficiency effects proposed by Batesse and Coelli, 1995.

The paper is organised as follows: in section 2 we analyse the stochastic frontier methodology and its application to the earnings equation. Section 3 shows the data and variables. Section 4 provides the discussion of results. Finally, in section 5 we present the concluding remarks.

II. Stochastic frontier and the inefficiency model

We use the Stochastic Frontier Approach to estimate an earnings frontier, adding to the standard earnings equation a one-sided error term representative of the wage inefficiency or underpayment. Specifically, we use

the model of Battese and Coelli (1995), which is a panel data version of Aigner et al. (1977) approach, in which we estimate the wage inefficiency using the stochastic frontier and explain simultaneously this inefficiency by a set of variables. This approach avoids the inconsistency problems of the two-stage approach, when analysing the inefficiency determinants[i].

The Battese and Coelli (1995) model is:

$$Y_{it} = f(X_{it};\beta)\exp(v_{it} - u_{it}) \quad (1)$$

Where X is the set of inputs; β is the set of parameters, v_{it} is a two-sided term representing the random error, assumed to be iid $N(0, \sigma_v^2)$; u_{it} is a non-negative random variable representing the inefficiency, which is assumed to be distributed independently and obtained by truncation at zero of $N(\mu_{it},\sigma_u^2)$. The mean of this distribution is assumed a function of a set of explanatory variables:

$$u_{it} = \sum_i \delta_i Z_{it} + \Psi_{it} \quad (2)$$

Where Z_{it} is a (Mx1) vector of variables that may have effects over individuals' efficiency, δ_i is a (1xM) vector of parameters to be estimated and Ψ_{it} is a

random variable defined by the truncation of the normal distribution with zero mean and variance σ_u^2.

The function coefficients (β) and the inefficiency model parameters (δ) are estimated by maximum likelihood together with the variance parameters: $\sigma^2 = \sigma_v^2+\sigma_u^2$ and $\gamma = \sigma_u^2/\sigma^2$.

Given that inefficiency is the ratio of observed output over the maximum or potential output obtainable for a unit (when there are not inefficiency), the efficiency (EF) of unit *i* in year *t* is[ii]:

$$EF = \frac{f(X_{it};\beta)\exp(v_{it}-u_{it})}{f(X_{it};\beta)\exp(v_{it})} = \exp(-u_{it}) \qquad (3)$$

The efficiency scores obtained from expression (3) take value one when the unit is efficient and less than one otherwise.

The earnings frontier describes the highest potential income associated with a given stock of human capital. We adopt a standard semi-logarithmic earnings equation (Mincer, 1974) adding a one-sided inefficiency error term to obtain a frontier. Then, we consider that the observed wage could be lower than the potential wage an individual could earn given his human capital, and that this potential wage defines the earnings frontier. The distance to the frontier, measured as the difference between potential and observed wages, shows the relative inefficiency in the transformation of human capital into earnings, the called "wage inefficiency". Moreover, the estimated wage

inefficiency is explained by some characteristics of the individuals, incomplete information and other markets imperfections.

As we focus on wage differentials between temporary and permanent contracts, we consider discrimination as one of the possible reasons explaining these differences. The existence of discrimination means that the potential earnings for one group are lower than it should be according to their human capital and then, his position respect to the frontier is affected. From the estimation, we expect a positive relationship between earnings and human capital endowment, according to the direct link between human capital and labour productivity. We also allow for the existence of some kind of discrimination with the introduction of a dummy representing a specific group of workers (women and temporary workers) into the wage equation. If these dummies are statistically significant with a negative sign, we could not reject the hypothesis of discrimination. Notice that we estimate a common frontier for all the sample groups instead of estimate separate earnings functions for different groups. Therefore, we do not restrict wage inefficiency to a disfavoured group measured when comparing to a reference group full efficient.

Then, we estimate the earnings function for the whole sample, adding a term of inefficiency, whose mean is a function of a set of inefficiency determinants:

$$\ln W_{it} = \beta_0 + \beta_1 G + \beta_2 T_1 + \beta_3 T_2 + \sum_{i=4}^{20} \beta_i x_{it} + + v_{it} - u_{it} \tag{4}$$

$$u_{it} = \delta_0 + \sum_{i=1}^{19} \delta_i Z_{it} + \Psi_{it} \quad (5)$$

Where W is the gross hourly wage, x_{it} is the set of human capital variables and other personal characteristics, G is a gender dummy and T_i represents the type of contract dummies. While in the inefficiency model, Z_{it} represents a set of variables that could have effect in explaining the degree of inefficiency in the transformation of human capital into earnings.

III. Data and variables

We use data from the ECPH for Spain (conducted by the Spanish National Institute of Statistics, INE) to estimate a stochastic frontier model to investigate the determinants of wage differentials. We analyse an unbalanced panel of 1308 wage earners currently working 15 or more hours per week, from 1995 to 2000. This is a sample of employed people, which remain in the sample at least three consecutive years. The percentage of temporary workers in 1995 was of 20.42% while in 2000 it diminished until 8.54%. We have a 22.67% of people with university degree (3 and 5 years of university). From 1308 individuals we have around the 20% of women, this percentage is quite stable for the six years of the sample. The rate of temporality for women in 1995 was of 17.24% and it diminishes until 5.26% for 2000. For men the rates of temporality range from 21.18% in 1995 to 9.37% in 2000. In our sample

women have a higher level of education than men reach. The percentage of university degree is around 37.93 % for women and 19% for men in 1995; while for 2000 the percentage of university degree arises to 40.08% for women and 18.4% for men. The 8.48% of temporary workers have university degree in 1995 while it is of 3.17 in 2000.

The variables

The dependent variable used for estimation is the logarithm of gross hourly wage.

The explanatory variables of the wage equation are:

Age: It is the age in years of individual.

Squared age: It is the squared age of individual in years.

Other type of contracts: This is a dummy variable that takes value one when the individual have a non-standard contract zero otherwise.

Temporary: This is a dummy variable that takes value one when the individual is a temporary worker zero otherwise.

Permanent worker: This is the category of reference.

Women: This variable takes value 1 if the individual is a woman and 0 if it is a man.

Education Classification:

Primary: Takes value 1 if the individual has primary education and zero otherwise.

Secondary 1st cycle: Takes value 1 if the individual has the first level of secondary education and vocational and zero otherwise, this education is obligatory. This is the category of reference.

Secondary 2nd cycle: Takes value 1 if the individual has the second level of secondary education and vocational and zero otherwise.

University: Takes value 1 if the individual has completed university education (three or five years) and zero otherwise.

Occupations dummies:

OCU1: Management of firms and Public Administration

OCU2: **Technician and professional scientific**

OCU3: **Technician and professionals of sustain**

OCU4: **Administrative employees**

OCU5: **Retail sale, waiter, waitress, cook workers and employees devoted to the care of persons or children**

OCU6: **Qualified workers of Agriculture and fishing**

OCU7: **Qualified workers of manufacturing, building, and mining industry except workers of machinery and installations**, this is the category of reference.

OCU8: **Fitter of installations and fix machinery and drivers and fitter of movable machinery**

OCU9: **non-qualified workers**

Tenure in Industry: this variable measures the seniority (in years) of individual with the actual employer in any firm that belongs to the industrial sector.

Tenure in Services: this variable measures the seniority (in years) of individual with the actual employer in any firm that belongs to the service sector.

Tenure in Agriculture: this variable measures the seniority (in years) of individual with the actual employer in any firm that belongs to the agriculture sector.

The inefficiency model:

Single: This variable takes value 1 when the individual is single, zero if the individual is married or has partner.

Private Sector: This variable takes value 1 if the individual works in the private sector zero if works in public sector.

Other type of contracts: This is a dummy variable that takes value one when the individual have a non-standard contract zero otherwise.

Temporary: This is a dummy variable that takes value one when the individual is a temporary worker zero otherwise.

Permanent worker: This is the category of reference.

Training: This variable takes value 1 if the worker has received any type of training organized by the firm and zero otherwise.

Primary: Takes value 1 if the individual has primary education and zero otherwise.

Secondary 1st cycle: Takes value 1 if the individual has the first level of secondary education and vocational and zero otherwise, this education is obligatory. This is the category of reference.

Secondary 2nd cycle: Takes value 1 if the individual has the second level of secondary education and vocational and zero otherwise.

University: Takes value 1 if the individual has completed university education (three or five years) and zero otherwise.

Care: This is a dummy variable that takes value 1 if the individual has children in its duty.

Short-run unemployment: This is a dummy variable that takes value 1 when the individual has been unemployed no more than 12 months.

Long-run unemployment: This is a dummy variable that takes value 1 when the individual has been unemployed no more than 12 months.

Household income: This is the value of the household income without the amount of the individual wage.

Immigrant: This variable takes value 1 if the individual has a nationality different from Spanish, zero if it is Spanish.

Immobility: This variable takes value 1 if the individual do not change its residence zero otherwise.

Age: It is the age in years of individual.

Women: This variable takes value 1 if the individual is a woman and 0 if it is a man.

Industry: This variable takes value 1 if the individual works in the industrial sector, zero otherwise.

Service: This variable takes value 1 if the individual works in the service sector, zero otherwise.

Agriculture: This variable takes value 1 if the individual works in the agricultural sector, zero otherwise. This is the category of reference.

IV. Wages differentials

From the frontier approach, we obtain the measure of firm's inefficiency compared with the best observations of the sample. The value of the estimates allows us to explain the differences in the inefficiency effects among workers.

The maximum-likelihood estimates of the production frontier parameters, defined in equation (4), given the specification for the inefficiency effects, defined in equation (5), are presented in Table 1. We obtain the estimated coefficient using the computer program FRONTIER 4.1 (Coelli (1995)). Table 2 presents the tests of the null hypotheses, based on the generalised likelihood ratio (LR) test[iii], concerning the relevance of the inefficiency effects.

TABLE 1

TABLE 2

The variance parameter, γ which lies between 0 and 1, indicates that technical inefficiency is stochastic and it is relevant to obtain an adequate representation of the data. The value of γ picks up the part of the distance to the frontier explained for the inefficiency. In our estimation, the value of the variance parameter γ is around 0.715. That means that the variance of the inefficiency effects is a significant component of the total error term variance and then, deviations from the potential wage are not only due to random factors.

The first test reported in Table 2 reinforces the relevance of the inefficiency effects in the model. Our results strongly reject the null hypothesis, which considers that the inefficiency effects are not present in the model. Then, the frontier model cannot be reduced to a mean-response wage equation (OLS estimation) to represent accurately the data.

The second test picks the jointly effect of the determinants included in the inefficiency model. We strongly reject the null hypothesis that means that these determinants are not relevant to explain inefficiency.

In this method, we estimate only one wage equation for both men and women. The variables included in this equation determine the potential wage. This is a practise potential wage, obtained from the best observations of the sample. Then we expect that human capital variables had a positive sign in the

estimation indicating that people with higher human capital could achieve a higher potential wage. Therefore, a negative and significant coefficient indicates a lower potential wage. We obtain a negative sign for women and temporary workers variables. Thus being everything equal to be women reduce the potential wage available respect to men in an 18.5%. As well to be temporary worker reduce the available potential wage in a 7% with respect to be a permanent worker. Once controlled for human capital variables, individual and occupational characteristics, the differences between the potential wage for men and women and for temporary and permanent worker can only be dues to discriminatory factors.

The wage equation

Here we define the wage frontier as the maximum wage that can acquire an individual given individual, socio-economic and human capital characteristics. As we mentioned above the estimated coefficient of the wage equation are in Table 1.

The **human capital** variables are significant and they have the expected sign. Here we have two sets of variables that pick the effect of education and training in the potential wage of individuals. We have grouped the years of education in five levels: primary education, secondary education first cycle, secondary education second cycle, three years of university and five years of university. Both primary education and secondary education first level are compulsory while individual freely chooses the other three. As we expected, to

have primary education reduce the potential wage that could acquire the individual with respect to have secondary education first cycle, that is the category of reference. Nevertheless, to have second cycle of secondary education or university education (three or five years) increases the potential wage with respect the category of reference that is secondary education first cycle.

The tenure of individuals, measured in years, includes three levels that try to proxy the specific training of individuals by sectors of activity (Industry, Services and Agriculture). Two of the three coefficients have a positive and significant sign indicating that tenure increases the potential wage in the Industrial and Services sectors, but do not have any effect in the Agricultural sector.

The **individual characteristic variables** are age and gender. As we expected as higher is the age of individual higher is the potential wage but this relation is not linear as shows the coefficient of the squared age that is negative and significant. In absence of discrimination, gender is a variable that should not affect the potential earning of individuals. However, the sign of this variable in our estimation is negative and significant. That means that to be a woman reduces the potential available earnings related to man. In this type of estimation, the coefficient of this variable measures the extent of the wage discrimination against women. Similarly, to previous studies of gender discrimination women earn around 18.5% less than men do.

We include **type of contracts** as another source of wages differentials. Here we have three categories: temporal, non-standard arrangements and permanent contract that is the category of reference. Once controlled for human capital variables, individual and occupational characteristics, the type of contract have a negative effect over potential wage. The temporary contract variable decreases the earning potential by 7%.

With the **occupational variables**, we have controlled the wages differentials due to the differences in occupations. The category of reference is qualified workers in manufacturing. Here we obtain the expected sign, the potential wage is higher as higher is the occupational skills.

Wages differentials and the inefficiency model

We can define wage inefficiency as the distance between the wages that earn a particular group of workers and what they could effectively earn given their observed characteristics. These differences (distance to the frontier) could be explained by the existence of labour market imperfections that makes difficult and expensive for workers the job search process.

Table 1 shows the estimated parameters of the model of inefficiency after those corresponding to the wage equation. Now we will comment the most relevant results obtained in relation to the observed wage inefficiency (a positive sign reflects an increase in the inefficiency).

The positive sign of the variable **single** indicates that individuals without couple are more far away from the wage frontier than people with a

couple. **Care** is a variable that proxy the presence in the household of dependants children. The coefficient of this variable is negative and significant what means that individuals with dependants are closer to the frontier. Here we have to notice that both married with dependant children are more efficient in obtaining their potential wage. This result could be related with the signal that this type of workers (especially men) sends to the market in the sense that they are more stable workers. If these characteristics reduce the probability of quit then they could be promoted in a higher proportion than single.

The **household income** is a measure of the non-labour income of the individual we obtain a positive and non-significant coefficient indicating that this variable do not affect wage inefficiency.

To work in the **private sector** increase the distance to the wage frontier. Since 1995, the most part of the job creation were temporal in Spain. The rate of temporality in private sector was twice that corresponding to the public sector. Therefore, to work for private sector is less efficient in terms of individual wages than work for public sector once controlled for individual, socio-economic and human capital variables.

The coefficients of the human capital variables, picked through **training** and **education**, are significant and have the expected signs. The training variable is a dummy that takes value one if the firm provides specific training for the worker. The coefficient of this variable is negative and significant what means that the worker involved in a firms specific training reduce the distant to the wage frontier. We have five dummy variables that

reflect the level of education of individuals. In the wage equation, we have obtained that there are a positive correlation between education and wages. Here we analyse how efficient are the individuals, with the different levels of education, to be more or less close to the frontier. As we expect the individuals with primary education are closer to their wage frontier. People with primary education have a reduced possibility of job match than the rest of worker with higher education. Thus, these workers are more concentrated around their average wages that correspond with the lowest skilled jobs in the ranking of jobs and it implies that they are closer to their potential wage. As the level of education increases, the rank of jobs that could occupy the individual augment and it implies a higher variability in wages. Our results indicate that there are two education groups. The first one related to primary and secondary education (first and second cycle) and the second linked with university studies. In both groups, the most efficient result is associated with the lower level of education, what means that with the highest level of education, workers could occupy a wide range of jobs and then we could find more people with wages below their potential wage.

As we expected individuals that have experienced in previous periods, both **short** and **long run unemployment** are less efficient to be near the average wage related to their individual, social and educational characteristics. One possible explanation is the negative effect that unemployment, overall long run unemployment, has over their reservation wage. Therefore, people

that have unemployment spells have a higher probability of accepting small wages than other individuals with the same capital endowments.

The coefficient of the variable **immigrants** is positive and significant. This result indicates that immigrants are less efficient in obtaining their potential wage than the native people. The immigrants need a period of assimilation to adapt their skills as was analysed by Chiswick (1978). As the immigration is a recent phenomenon in Spain this results are as expected.

As expected, the variable representing **immobility** is positively related to inefficiency. As more reluctant to move the worker be, the greater is their distance to the frontier.

The coefficient of **age** is positive and significant indicating that with age the range of wage that could earn the worker is wider and then the possibility to be far of the frontier higher. This variable has been used traditionally as a proxy of experience. Here we can differentiate between two situations: people that never suffered a dismissal and others that suffered one or more periods of unemployment a long of their working life. Possibly, when individuals belonging to the latest group and are hired again the expected lost of human capital skills reduce the effective wage.

The results related with the **economic sectors of activity** show that to belong to the industrial sector reduces the distance to the wage frontier with respect the agricultural sector that is the sector of reference. We do not obtain significant differences between the services and agriculture sector.

Now we will focus temporality and gender to analyses wages differentials. In the wage equation estimation, we obtain that there are discrimination because either to be temporal or to be woman reduce the potential wage attainable. Now in the inefficiency model we try to explain the distance to the frontier what means the efficiency of approaching to their potential wage.

As we have shown above to be **temporal,** reduce the potential wage about a 7%. Now in the inefficiency model we have obtained a positive and significant coefficient for both temporary and non-standard contract indicating that workers with this type of contracts are more far away from the wage frontier than permanent workers. Here our results could remark that temporality could be a trap for some kind of workers increasing the difficulty of moving to a permanent job.

In the wage equation we obtain that to be **woman** reduce the potential wage in 18.5%. However, we obtain a negative sign for the coefficient of women in the inefficiency model. That means that even women are discriminated in wages they are more efficient in reducing the distant to their wage frontier. Thus, the gender differences reflect females' lower promotion probability not within job discrimination. As women are less promoted, the range of wages that can achieve is reduced compared with men. A recent study of De la Rica et al, 2005 found that the wage gap in Spain is much flatter than in the Northern countries. They explain the differences trough the existence of statistical discrimination especially for the group of women of primary and

secondary education due to the historical low participation rate of this group. They found a composition effect in the overall gender gap when they lump together this group with the group of tertiary education concluding that there is a glass floor for the group of low education while there is a glass ceiling for the group of higher education. Notice that we obtain evidence in favour of the ceiling glass. From the estimation of the wage equation and the inefficiency model, we obtain a narrowed range of variability of wages for women, due of two facts. The first one, related with the loss of the 18.5% of their potential wage and the second because they are more efficient in approaching to their potential wage.

V. Concluding remarks

In this paper, we have studied through the stochastic frontier analysis the wage gap in Spain. Especially we focus in wages differentials due to the type of contract and we have compared it with the gender wage gap. In Spain, the potential wage that can earn women is 18.5% smaller than that corresponding with men while to be temporal reduces the potential wage in a 7%. However, even if the gender gap is higher for women than for temporary workers, women are more efficient in obtaining a wage closer to their earning frontier than temporary workers obtain. One of the explanations of this finding is that this wages differential reflects lower promotion probability not within job discrimination. As women are less promoted, the range of wages that can

achieve is reduced compared with men so they are more efficient because they have less opportunities and it allows being more concentrated around an average wage. In the case of temporary contracts, it could be in any type of job and for any kind of skills what makes a higher level of variability in wages then it makes more difficult to obtain the wage closer to their frontier. Therefore, what we have obtained is that even if temporality is disproportionate in Spain, and has motivated a higher number of reforms; the wages differentials for women are 2.5 times higher than that suffered for temporary workers.

In addition, we have obtained that a higher level of education increases the potential wage. People with primary education and with 3 years of university are closer to their wage frontier. These results indicate that there are two groups of education, the first group with primary and secondary (first and second cycle) and the second group with university studies. The closer to their wage frontier in the first group are individuals with primary education because they only can fill in the lower jobs in the queue of jobs while people with secondary can occupy all the ranking of this group. In the second group, the argument is similar people with five years of university can fill in all the job of this group and then people that are in jobs of a lower category about their skills are far away from their frontier.

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[i] In a two-stage procedure, firstly, a stochastic frontier function is estimated and the inefficiency scores are obtained under the assumption of independently and identically distributed inefficiency effects. But in the second step inefficiency effects are assumed to be a function of some firm-specific variables, which contradicts the assumption of identically distributed inefficiency effects.

[ii] Individual efficiency scores u_i which are unobservable, can be predicted by the mean or the mode of the conditional distribution of u_i given the value of (v_i-u_i) using the technique suggested by Jondrow et al (1982).

[iii] $LR=-2\{\ln[L(H_0)]-\ln[L(H_1)]\}$, where $L(H_0)$ and $L(H_1)$ are the values of the likelihood function under the null and alternative hypotheses. LR has an approximately chi-square distribution with degrees of freedom equal to the number of restrictions.

Stochastic frontier estimates

Table1: Stochastic Frontier Analysis

Wage Equation Estimates			
		Coefficient	t-ratio
Constant	β_0	6,005	77,102
Women	β_1	-0,185	-12,493
Temporary	β_2	-0,070	-4,133
Other type of contract (non-standard arrangement)	β_3	-0,037	-0,739
Age	β_4	0,035	9,461
Squared age	β_5	0,000	-6,793
Primary	β_6	-0,157	-11,274
Secondary 2nd cycle	β_7	0,151	9,888
University 3 years	β_8	0,227	9,896
University 5 years	β_9	0,459	19,282
Management of firms and Public Administration	β_{10}	0,463	19,131
Technician and scientific' professional	β_{11}	0,251	12,760
Technician and professionals of sustain	β_{12}	0,135	8,817
Administrative employees	β_{13}	0,088	5,449
Retail sale, waiter, …	β_{14}	-0,036	-2,252
Qualified workers of Agriculture and fishing	β_{15}	-0,125	-3,568
Fitter of installations and fix machinery,…	β_{16}	-0,008	-0,597
Non-qualified workers	β_{17}	-0,074	-5,048
Tenure in Industry	β_{18}	0,012	12,800
Tenure in Services	β_{19}	0,013	15,250
Tenure in Agriculture	β_{20}	0,003	1,023
Inefficiency Model			
Constant	δ_0	-2,030	-2,720
Single	δ_1	0,258	3,344
Private sector	δ_2	0,547	3,447
Temporary	δ_3	0,249	2,978
Other type of contract	δ_4	0,627	4,332
Training	δ_5	-0,370	-3,688
Primary	δ_6	-0,236	-2,763
Secondary 2nd cycle	δ_7	0,086	1,733
University 3 years	δ_8	-0,156	-1,368
University 5 years	δ_9	0,429	3,636
Care	δ_{10}	-0,147	-2,903
Short-run unemployment	δ_{11}	0,122	3,451
Long-run unemployment	δ_{12}	0,256	3,663
Household income	δ_{13}	0,000	1,293
Immigrant	δ_{14}	0,348	2,383
Immobility	δ_{15}	0,256	3,938
Age	δ_{16}	0,022	3,121
Women	δ_{17}	-0,289	-3,979
Industry	δ_{18}	-0,658	-3,570
Services	δ_{19}	0,073	0,941
Variance Parameter			
	σ^2	0,247	5,311
	γ	0,715	14,135

Table 2: Generalised likelihood-ratio (LR) tests of null hypotheses [(a)]

Null hypothesis, H_0	LR Test Statistic	Critical value
H_0: $\gamma=\delta_0=.....=\delta_{19}=0$	375.28	29.55 [(b)]
H_0: $\delta_1=.....=\delta_{19}=0$	481.08	30.1

[(a)] The test statistics have a χ^2 distribution with degrees of freedom equal to the difference between the parameters involved in the null and alternative hypothesis.

[(b)] As γ takes values between 0 and 1, in H_0: $\gamma=\delta_0=.....=\delta_{19}=0$ the statistic is distributed according to a mixed χ^2 whose critical value is obtained from Kodde and Palm (1986).