Extended abstract

Effect of discrimination on labour input allocation by sector

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Abstract

In recent years, new developments have Gender-aware Computable General Equilibrium (CGE) models are a useful tool not just to evaluate gender policies but also to understand if some polices may have uneven effects for men and women. CGE models have incorporated gender features since 2000 mainly by disaggregating labour factors by sex. However, in recent years some authors such as Fontana (2014) has pointed out the importance of including also unpaid household work in this kind of models. The "two-systems" approach makes an attempt to overcome the above-mentioned limit through the integration into the CGE framework of nonmarket activities, but they don't take into account the interaction between market and non-market activities. In a recent paper, Severini et al. (2018) attempts to account for this interrelation by desegregating the mixed incomes between market and non-market activities generated in each production process by male and female

Other features that may be very relevant in the gender-aware CGE, but that have not been incorporated yet, are the labour inefficiencies. Labour market inefficiencies such discrimination have been very studied in the labour and feminist literatura and however they have not been considered. The omission of this feature in the models my biased the simulation results of policy evaluation. Thus, the aim of this paper is to do an exploratory analysis of effects of discrimination on the labour inputs allocations to incorporate it in future gender-awere GCE models.

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Introduction

Gender-aware Computable General Equilibrium (CGE) models are a useful tool not just to evaluate gender policies but also to understand if some polices may have uneven effects for men and women. CGE models have incorporated gender features since 2000 mainly by disaggregating labour factors by sex. However, in recent years some authors such as Fontana (2014) has pointed out the importance of including also unpaid household work in this kind of models. The "two-systems" approach makes an attempt to overcome the above-mentioned limit through the integration into the CGE framework of nonmarket activities, but they don't take into account the interaction between market and nonmarket activities. In a recent paper, Severini et al. (2018) attempts to account for this interrelation by desegregating the mixed incomes between market and non-market activities generated in each production process by male and female

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Under neoclassic theory, an employer with preferences not related to productive efficiency would show higher costs than other employers, and consequently, it will be dropped out from the market due to the free market forces.[2] For this reason, under the neoclassic theory, discrimination disappears in the long term and differences in preferences explain gender wage differential. Actually, Arrow (1973) argues that competitive markets forces tend to drive discrimination toward zero in Becker's model (with preferences for disliking a group): "only the least discriminatory firms survive". In the same line, Aigner and Cain (1977) doubt that a mistaken behaviour, systematically overpay men relative to women, will persist in competitive markets. Nevertheless, Becker (1957, 1971) points out the possibility of the existence of discrimination in the long run because the generality of entrepreneurial skills and the long run elasticity of other factors determine the persistence of a discriminating cost differential in the long run under competitive conditions. Theories such as the monopsony power also assert that frictions in the labour market may avoid the disappearance of discrimination.

Actually, empirical research shows an important magnitude and persistence of discrimination in labour markets so it should have macroeconomic effects on labour inputs allocations and productivity. Different authors such as Esteve-Volart (2000, 2004) and García-Miguez et al. (2003) point out the importance of estimating a macroeconomic model about the cost of discrimination on the

[2]Taking individuals preferences as given make the automatic translation of different prices (wages) for the same good (job) in a loss of total utility is impossible

aggregated output. The main idea is that gender discrimination is macro economically inefficient because the firms do not maximise its productive capacity. They find that these costs are indeed quite substantial. However, they not measure wage discrimination but the "discrimination" in managerial positions using the share of women relative to men.[3] These authors attempt to include the effects of discrimination on growth; nevertheless, they use gender differences instead of gender discrimination for testing their theories due to the difficultIes of measure discrimination accurately. Actually, Luck Tick and Oaxaca (2010) is the only paper taking into account the effect of gender discrimination or unexplained gaps on macroeconomic aggregates such as gender wage gaps. They show that the effect of technological change on the gender wage gaps for los skill levels tends to diminish or disappear altogether once changes in unexplained gender wage gaps are adjusted for.

This paper contributes to the literature in being the first paper analysing the effect of wage discrimination or unexplained gaps on labour input allocation. Additionally, we analyse the differences by sector of these effects depending on the factor elasticity of substitution and labour intensity.

In order to archive the aims of the paper, we solve a cost minimisation problem with discrimination using an aggregate production function with constant elasticity of substitution (CES) (see the details in section 1). By solving the cost minimisation problem we get three equation by sector that will be estimated by two-stage least with cross-equation restrictions for the Spanish economy from 2005 to 2013. The difficulty of the empirical part arise from how to approximate the coefficient of discrimination by sector. The methods and the database to overcome these difficulties are explained in section 2. We present the result and the conclusions in section 3 and 4, respectively.

1 Theoretical model

The Nobel prize Gary Becker in his book "The Economics of Discrimination" is the first author modelling the discrimination in a neoclassical framework. Based on his model if an individual has a *taste for discrimination*, he or she must act as if he or she were willing to pay something, either directly or in the form of reduced income, to be associated with some persons instead of others. Thus, when actual discrimination occurs, he or she must either pay or forfeit income for this privilege. Different agents, such as employers, co-workers, customers, unions, government may have this *taste for discrimination* and their effect in the labour market would be different.[4] In this paper we focus on the employers

[3]Their assumption is that in absence of discrimination the share of women in managerial positions would be equally to men. It is not a very accurate measure, since differences in the proportions of men and women in managerial positions could be due to human capital differences or preferences.

[4]Based on the Becker's theory, the main outcome of co-workers *taste for discrimination* is segregation and not wage discrimination. Nevertheless, perhaps segregation will not permit equal wages between groups since discriminated workers are too few to allow economies of scale in production, recognising that their numbers must staff all skill levels (e.g., women

taste for discrimination because the aim in this section is to develop a cost minimisation problem with discrimination.

Suppose an employer were faced with the money wage rate (w_i) of a particular factor. If he or she has some "taste for the discrimination", he or she is assumed to act as $w_i\,(1+d_i)$ is the actual cost or the net wage rate after discounting the distaste, where d_i as his discrimination coefficient against this factor i. This employer will discriminate by refusing to hire someone with a marginal value product greater than marginal cost. However, employer discrimination does not alter the criterion of cost minimisation, and the ratio of any two marginal products (MP_i) still equals the ratio of their net factor prices:[5]

$$\frac{MP_i}{MP_J} = \frac{w_i\,(1+d_i)}{w_j\,(1+d_j)} \tag{1}$$

However, equilibrium factor combinations would be quite different in situations of discrimination from those obtained with classical assumptions: there would be a smaller demand for discriminated factors. Moreover, the cost of producing each unit of output would be greater than the minimum cost (without discrimination).[6]

In order to estimate the input function with discrimination we are going to develop the cost minimisation problem describe by Becker (1957). We assume an aggregate production function with constant elasticity of substitution (CES) by sector, with constant returns to scale, two types of labour factors (women and men), and non-labour market input and a productivity:

$$Q_i = A_i \left[\sum_{j=1}^{J} \alpha_{ji} L_{ji}^{\rho} + \left(1 - \sum_{J}^{j=1} \alpha_{ji} \right) K_i^{\rho} \right]^{\frac{1}{\rho}} \tag{2}$$

being Q the value added of the industry i at the region s in the period t,[7] A_i is the technological change of sector i, L_i if the labour input of sex j (j=male or female), K the non-labour input , and α the productivity of one input relative to the other. Note that, $\rho = \frac{\sigma-1}{\sigma}$, where σ is the elasticity of substitution among inputs.

The marginal products can be expressed as:

$$MP_{L_{ji}} = A_i^{\rho} \alpha_{ji} \left(\frac{Q_i}{L_{ji}} \right)^{1-\rho} \tag{3}$$

in construction sector).

[5] He or she just includes the extra parameter in the criterion that is the discrimination coefficient

[6] Although we based on Becker's model, we can arrive to similar conclusions using the statistical discrimination or the monopsony power models i.e. labour inputs allocation is different from the state without discrimination. Moreover, those theories are not incompatible and they can coexist. See, for instance, the search model developed by Black (1995) where a share of firms discriminates against minorities (women in our case) and others have a certain monopsony power to pay minorities less.

[7] To simplify the notation we not include the subindices t and s nor for the value added neither for the input factors

and

$$MP_{ki} = A_i^{\rho} \left(1 - \sum_{j=1}^{J} \alpha_{ji}\right) \left(\frac{Q_i}{K_i}\right)^{1-\rho} \tag{4}$$

Assuming cost minimisation, the marginal products will be equated with the factor prices (being w labour price and r capital price). Since we want to include the discrimination (or unexplained gap) as in Becker (1957), the wage (input price of labour) will be equated to the marginal product of labour but discounting the discrimination as in equation 1.

Note that we are assuming men's prices as a not discriminatory scheme, [8] i.e. the coefficient of discrimination for men d is 0 by definition. Assuming constant returns to scale, retaining the assumption the log linearity and rearranging the equations we get:

$$\frac{\alpha_{fi}}{1 - \alpha_{fi} - \alpha_{mi}} \left(\frac{Ki}{L_{fi}}\right)^{1-\rho} = \frac{w_{fi}\,(1 + d_i)}{r_i} \tag{5}$$

$$\frac{\alpha_{m_i}}{1 - \alpha_{f_i} - \alpha_{m_i}} \left(\frac{K_i}{L_{mi}}\right)^{1-\rho} = \frac{w_{mi}}{r_i} \tag{6}$$

$$\frac{\alpha_{f_i}}{\alpha_{m_i}} \left(\frac{L_{m_i}}{L_{fi}}\right)^{1-\rho} = \frac{w_{fi}\,(1 + d_i)}{w_{mi}} \tag{7}$$

Taking logarithms, and the definition of the elasticity of substitution we get:

$$ln\left(\frac{K_i}{L_{fi}}\right) = -\sigma ln\left(\frac{1 - \alpha_{fi} - \alpha_{mi}}{\alpha_{fi}}\right) + \sigma ln\left(\frac{w_{fi}}{r_i}\right) + \sigma ln\,(1 + d_i) \tag{8}$$

$$ln\left(\frac{K_i}{L_{mi}}\right) = -\sigma ln\left(\frac{1 - \alpha_{fi} - \alpha_{mi}}{\alpha_{mi}}\right) + \sigma ln\left(\frac{w_{mi}}{r_i}\right) \tag{9}$$

$$ln\left(\frac{L_m}{L_f}\right) = -\sigma ln\left(\frac{\alpha_{mi}}{\alpha_{fi}}\right) + \sigma ln\left(\frac{w_{fi}}{w_{mi}}\right) + \sigma ln\,(1 + d_i) \tag{10}$$

2 Empirical approximation

To see the effect of discrimination on labour allocations by sector, we estimate equations 8, 9 and 10 together by sector using two stages least squares and including cross-equations restrictions for the Spanish regions during the period 2005-2013. Data for labour and capital inputs and their prices are taken from the BD-mores database which compiles and estimate variables such the stock of capital based on national and regional accounts. For the price of capital (r), we calculate it as:

[8] In absence of discrimination women attributes are pay at mens prices

$$r_{it} = \frac{P_{it}Q_{it} - w_{it}Lit}{K_{it}}$$

The biggest difficulty in the empirical approximation arise from measure gender wage discrimination by sector and calculate the discrimination coefficient.[9] The traditional method to distinguish between wage differences due to productivity (attributes) or discrimination is the decomposition of Oaxaca (1973) and Blinder (1973). Nevertheless, this methodology calculate the level of discrimination in average and we need to calculate the discrimination by sector. In order to do that, we estimate the individual discrimination and we aggregate it by sector the index with the decomposability property (Del Río, et al. 2011).[10]

We estimate the individual discrimination as wage that a woman should earn if her attributes are paid at men's prices ($\hat{w}_{fi}^{m}$) minus the wage she earn at women's prices ($\hat{w}_{fi}^{f}$ relative to the wage a woman should earn is her attributes are paid at men's prices $\left(\hat{\omega}_{fi}^{m}\right)$ such that:

$$d_{fi} = \left(\frac{\hat{w}_{fi}^{m} - \hat{w}_{fi}^{f}}{\hat{w}_{fi}^{m}}\right)$$

Being $\hat{w}_{ji} = exp\left(X_{JI}^{'}\hat{\beta}_{J} + \hat{\theta}_{j}\right)$ and $\hat{\theta}_{j} = 0.5\sigma_{\epsilon}^{2}$.[11] After estimating the relative individual discrimination we have to use a measure in order to sum up all information to the indexes for industries and regions. Thus, we adapt the poverty indexes of Foster, Greer and Thorbecke (1984) using the individual discrimination, as Del Rio et al. (2006) have proposed. These indexes show very desirable properties like continuity, dominion, symmetry, invariance to population replications, weak monotonocity and the weak principle of transferences and decomposability. The last property enables one to compute the indexes for subpopulations, allowing the estimation of degrees of discrimination for socioeconomic groups (industries in our case).

$$dr_{\alpha}\left(\upsilon_{fi}\right) = \left(\frac{1}{n}\right)\sum_{i=1}^{k^{*}}\left(d_{fi}\right)^{\alpha}$$

[9]There is discrimination in labour market when two people are treated differently due to its race or sex, when race and sex do not have an effect on the productivity (Altonji and Blank, 1999), so different treatment based on different levels of productivity is not discriminatory.

[10]This method allow us to use the whole sample information to calculate the different returns instead of to break the sample in small pieces to make the calculations

[11]We estimate two ordinary Mincer wage equations by OLS, one for each sex, $ln\omega_{i} = Z_{I}^{'}\beta + \epsilon_{I}$ being i each individual, ω_{i} the hourly wage, $Z_{I}^{'}$ the vector of characteristics, β the estimated coefficients vector, and ϵ_{i} the error term. In the Mincerian equations we include both characteristics related to employees (potential experience, tenure and the level of studies completed) and job characteristics (occupation, time status, type of contract, firm size, type of agreement and economic activity). In the annex we explain the variables in detail and the source, EES.

where k* would be the number of discriminated women and *alpha* a coefficient of "aversion to discrimination". We use $\alpha = 1$, so we aggregate individual degrees of discrimination in a simple way, i.e. all women have the same weight (in fact, this is equivalent to the second term of Oaxaca's decomposition).

In order to estimate the discrimination coefficient by sector, region and time we use the Survey on Income and Living Conditions (EU-SILC). This survey offers information about wages, hours and gender in addition to some demographic and firm variables that we need for approximating labour productivity such as: educational level, year starting to work, type of contract; full-time or part-time; occupation; the economic activity of the local unit (NACE); number of persons working at the local unit).

3 Preliminary results

Table 1 shows the preliminary results before including the gender discrimination gaps. Sectors included in the table 1 are Construction, Transport, storage and communication and Financial intermediation. We are homogenising EU-SILC and national accounts in order to get the results for more sectors. As we have explained in previous sections, estimating the equations 8, 9 and 10 together for each sector and imposing the cross-equation restrictions, we get the elasticity of substitution between inputs. *[Please, take results with caution: database underconstruction]*

Table 1: Preliminary results

	Construction	**Transport, storage and communication**	**Financial intermediation**
Dependent variable: $ln\frac{K}{L_f}$			
$ln\frac{w_f}{r}$	0.05***	0.01**	0.03***
Constant	13.42***	12.85***	12.54***
Dependent variable: $ln\frac{K}{L_m}$			
$ln\frac{w_m}{r}$	0.05***	0.01**	0.03***
Constant	10.85***	12.32***	11.85***
Dependent variable: $ln\frac{L_m}{L_f}$			
$ln\frac{w_f}{w_m}$	0.05***	0.01**	0.03***
Constant	2.60***	0.49***	0.54***

In the next table (under construction) we include the unexplained wage gaps (discrimination) and see how the results changes.

4 Conclusions: "SECTION UNDER CONSTRUCTION"

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