MEN *versus* WOMEN: SUBSTITUTE OR COMPLEMENTARY IN LABOR MARKET?

Paulo R.A.Loureiro[1] / *Adolfo Sachsida*[2]

ABSTRACT

This paper uses an econometric approach to classify men and women as substitutes or complementary in Brazilian formal labor market. Two regressions were estimated to verify the robustness of the results. The findings indicate that men and women are complementary in Brazilian formal labor market.

Key words: labor market, wages, substitute and complementary.
JEL: J7, J16, J42

INTRODUCTION

New questions appear for policy-makers since the demand for female in the labor market increases. For example, the importance of verification – and measures – the existence of wage gap between genders and the implications for discriminatory behavior.

Wage gaps do not implicate in discriminatory behavior by the firms. However, when this gap does not relate human capital will be characterized the discrimination. In a study for Brazilian labor market, Barros, Ramos & Santos (1992) use data

1. Mestrado em Economia de Empresas e Professor Assistente da Universidade Católica de Brasília, e-mail: paulo@ucb.br.

2. Mestrado em Economia de Empresas e Professor Assistente da Universidade Católica de Brasília, e-mail: sachsida@pos.ucb.br.

controlled by age and education. They conclude for the presence of discrimination between genders.

Becker (1957) argues that differential wages can be explained by human capital stock. Polachek & Kim (1994) propose that; if discrimination between genders arises by no equal opportunities, then the economy loses allocate efficiency.

Lazear & Rosen (1990) suggest another explanation for wage gaps. The authors propose that the wage gap between male and female is a result of a maximizing profit behavior adopted by firms. It is postulated that men and women have identical distribution of human capital in the job, but women had a superior qualification at home, then the employer prefers to promote the man, because the probability of women remains in the firm is lesser than men.

Frijters (1997) proposed an alternative explanation for discrimination. The author qualifies the discrimination as a result of a struggle between groups to control a scarcity of resources (jobs and/or wages). This view makes possible the occurrence of discrimination between identical groups.

This article has as its main objective to classify men and women as substitutes or complementary in Brazilian formal labor market in the period Jan-1986 to Dec-1996. The article was organized as follows; chapter 2 explains the methodology used. Chapter 3 reports econometric results and chapter 4 is reserved to the conclusion.

1. METHODOLOGY

Brazilian Ministry of Labor and Social Security tabulated the monthly data about labor and wages in the period from Jan-1986 to Dec-1996. The data can be obtained in the General Register of Employment and Unemployment (CAGED). The data about GDP can be obtained in the Central Bank of Brazil.

The data about labor and wages is referred to formal sector. These data were divided in two groups following the educational level: primary (complete eight years of study) and high school (complete twelve years of study). In each subgroup the data was separated by gender.

The article uses an econometric approach to estimate two regressions (one for primary and one for high school) with changes in the demand for female labor as dependent variable and male wages as independent variable. The signal of

independent variable determines complementary (negative) or substitutability (positive) between men and women in the labor market.

The regression will be estimated by ordinary least squares (OLS) to verify the signal of the coefficient of the variable average male wages. A negative signal indicates that men and women are complementary in labor market, substitutability between male and female will be characterized by a positive signal of this variable.

The formulation of econometric model is similar to Hamermesh (1982) and Peinado (1992). The general form of the model is:

$$(1)\ Em_{it} = f(Sm_{it}, Sh_{it}, GDP_{t})$$

Where

i = educational level (1 = primary, 2 = high school)

t = time

Em = number of females hired in the month

Sm = average real wage of female hired in the month

Sh = average real wage of male hired in the month

GDB = Brazilian GDP in January 1997 prices.

The equation (1) needs a variable scale to represent the demand equation. Hamermesh (1982) adopts trend. This article adopts GDP, similar to Hamermesh (1976).

Analysis of equation (1) must be focused in the variable average real wage of male (Sh), because the signal of this variable determines complementary (negative) or substitutability (positive) between men and women in the labor market.

2. ECONOMETRIC RESULTS

Two statistical tests were made before estimating the regressions. First test intends verify the order of integration of the series. This procedure avoids spurious regressions. Table 1 shows the Dickey-Fuller test.

Table 1 explicits that variables related to real wages are stationary (I(0)), while variables related to employment and GDP were stationary only in first differences.

The second test made was the Granger causality test. This test does not define the endogenous or exogenous variables, but defines a temporal precedence between variables.

Table 1
Augmented Dickey-Fuller test with constant and trend[a]

Variable	ADF(C,T)[b]	Number of lags[c]
lsm1	-4.3196**	4
lsh1	-4.0026*	3
lsm2	-4.6239**	3
lsh2	-4.5307**	1
leml	–1.7797	16
Δlem1	-5.4258**	12
leh1	-1.2239	13
Δleh1	-5.3670**	12
lem2	-1.6456	14
Δlem2	-6.6392**	13
leh2	-1.6000	13
Δleh2	-5.7553**	12
ΔIGDB	-3.3516	14

a) Tests was madden for the logs of the variables and Δ **indicates first difference**.
b) * and ** indicate rejection of unit root at 5% and 1%, respectively.
c) The number of lags follows the statistical procedure suggested by Doornik & Hendry (1994).

After the Granger causality test four answers are possible: i) men wage precede changes in the demand for female labor; but the reverse is not true; ii) changes in demand for female labor precede men wage; and the reverse is false; iii) men wage precedes changes in the demand for female labor, and the reverse is true; iv) there is no temporal precedence between the variables.

The proposed model in this article needs the alternative (i) above, because this alternative permit the analysis of complementary/substitutability as proposed in this study. Otherwise, that is, after finding alternative (ii), (iii) or (iv) the procedure of estimation of elasticity and, consequently, the analysis of complementary / substitutability should be changed.

Before implementing Granger causality test, it is necessary to choose the number of lags for each equation. By using the Scharwz Criterion (SC), Hanna-Quin (HQ) and Final Predictor Error (FPE) - that consists in a penalty for the inclusion of more variables – were chosen four lags for the variables related to eight years of study and three lags for the variables related to twelve years of study. Table 2 shows the result of Granger causality test.

Table 2
Granger causality test[a]

lsh1 →Δ **lem1 (accept)**	Δ**lem1** →lsh1 (reject)
Tests of significance of each variable	Tests of significance of each variable
variable F(num,denom) Probability	variable F(num,denom) Probability
Δlem1gr F(4,119) = 20.346 [0.0000]**	lsh1gr F(4,119) = 32558 [0.0000]**
lsh1gr F(4,119) = 2.7875 [0.0296]*	**Δlem1gr F(4,119) = 1.4001 [0.2381]**

lsh2→Δ **lem2 (accept)**	Δ**lem2**→lsh2 (reject)
Tests of significance of each variable	Tests of significance of each variable
variable F(num,denom) Probability	variable F(num,denom) Probability
Δlem2gr F(3,122) = 9.0424 [0.0000]**	lsh2gr F(3,122) = 37759 [0.0000]**
lsh2gr F(3,122) = 3.629 [0.0150]*	**Δlem2gr F(3,122) = 0.1617 [0.9219]**

* and ** indicate rejection of the null hypothesis that variable is not significant at 5% and 1%, respectively.

a) The variables related to demand for labor was taken in first difference, because they are not stationary in levels.

The F tests in table 2 suggest the acceptance of alternative (i), that is, men wage precedes changes in the demand for female labor; but the reverse is not true. After these two statistical tests, we can estimate the models proposed in section 2.

Table 3 explicit the results of the regression for the variable changes in the demand for female labor with primary (eight years of study) (ΔlEm1)[3]. The signal of variable male wages with primary (lSh1) is negative indicating a complementary between males and females in the labor market for this educational level.

3. Note that this variable is in first difference to avoid the problem of spurious regression.

In table 3, R^2 Harvey is the R^2 against a random walk, RESET is the Ramsey test for model specification, Xi^2 verifies the existence of heteroscedasticity in the residuals, ARCH checks whether the residuals have an autoregressive conditional heteroscedasticity, AR is a Lagrange multiplier test for serial correlation. Normality is a test to verify the normality of the residuals[4]. These tests suggest a good specification of this model.

Table 3
Results of the regression of variable **ΔlEm1**[a,b]

Variable	Coefficient	Standard Error	t-value	t-prob
Constant	-8.4e-005	0.0003	-0.256	0.7987
$\Delta lem1_{t-1}$	0.5610	0.0958	5.853	0.0000
$\Delta \mathbf{lem1}_{t-2}$	0.1497	0.0930	1.611	0.1101
$lsm1_{t-3}$	0.0008	0.0004	2.077	0.0401
$lsh1_{t-3}$	-0.0011	0.0004	-2.504	0.0137
$\Delta \mathbf{lGDP}_{t-3}$	-0.0005	0.0002	-2.353	0.0204

R^2 = 79,06% F(16, 111) = 26.198 [0.0000] DW = 1.95 RSS = 3.5897e-006
SC = -16.7451 HQ = -16.9699 FPE = 3.6635e-008 R^2 Harvey = 21,12%

AR 1- 7F(7,104) = 1.3791 [0.2219]
ARCH 7 F(7, 97) = 0.6876 [0.6823]
Normality $Chi^2(2)$= 1.0811 [0.5824]
Xi^2 F(21, 89) = 1.2373 [0.2415]
RESET F(1,110) = 2.9324 [0.0896]

a) To determine the number of lags was used the General to specific approach proposed by Hendry.
b) T-k is the order of the lag.

The statistical results presented in table 3 show an adequate performance of residuals (tests AR, ARCH, Normality and Xi^2) and a reasonable performance against the random walk (R^2 Harvey). Since all variables presented in Table 4 are stationary (I(0)), co-integrated tests are not required.

4. More statistical information can be obtained in Doornik & Hendry (1994).

Table 4 shows the regression for the variable changes in the demand for female labor with high school (twelve years of study) (ΔlEm2)[5]. The signal of variable male wages with high school (lSh2) is negative indicating a complementary between males and females in the labor market for this educational level.

The statistical tests in table 4 show an adequate performance of three of four residuals tests (AR, ARCH, and Xi^2), a good performance against the random walk (R^2 Harvey) and a good specification of the model (RESET). The result for the Normality test is not so good, but it is not possible to reject the null hypothesis of residuals with normal distributions at 5% of confidence. Since all variables presented in Table 4 are stationary (I(0)), co-integrated tests are not required.

Table 4

Results of the regression of variable Δ**lEm2**[a,b]

Variable	Coefficient	Standard Error	t-value	t-prob
Constant	-0.0003	7.96e-005	-3.923	0.0002
$\Delta lem2_{t-1}$	0.3571	0.0866	4.122	0.0001
Δ**lem2**$_{t-2}$	0.2357	0.0863	2.730	0.0074
lsm2	0.0003	0.0001	2.462	0.0154
lsh2	-0.0003	0.0001	-2.318	0.0223
lGDP	0.0001	5.12e-005	2.755	0.0068

R^2 = 81,08% F(16, 112) = 29.998 [0.0000] DW = 2.05 RSS = 2.3632e-007

SC = -19.4774 HQ = -19.7012 FPE = 2.38811e-009R^2 Harvey = 34,65%

AR 1- 7 F(7,105) = 0.3120 [0.9471]

ARCH 7 F(7, 98) =0.9085 [0.5032]

Normality Chi^2(2) = 4.6901 [0.0958]

Xi^2F (19, 92) = 0.9397 [0.5374]

RESET F(1,111) = 0.2827 [0.5960]

a) To determine the number of lags was used the General to specific approach proposed by Hendry.
b) T-k is the order of the lag.

5. Again this variable was taken in first difference to avoid the problem of spurious regression.

The coefficient of variable ΔlGDP (tables 3 and 4) shows that female labor reacts in a no homogeneity form to a shock in output. The coefficient is negative for eight years of study (table 3) and positive to twelve years of study (table 4). It is signalizing that an increase of output *per se* increases the demand for high skilled workers.

CONCLUSIONS

The negative signal of the coefficients for male wage (tables 3 and 4) indicate that in Brazilian formal labor market men and women are complementary.

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