ECONOMIC RESEARCH FORUM
منتدى البحوث الاقتصادية
2018

working paper series

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Working Paper No. 1240

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October 2018

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First published in 2018 by
The Economic Research Forum (ERF)
21 Al-Sad Al-Aaly Street
Dokki, Giza
Egypt
www.erf.org.eg

Abstract

This study investigated demand for female labor in Egyptian manufacturing sector. It utilized information provided in the C13 together with data from the ELMPS2012 to estimate wage rate by gender in the C13 and then estimated a labor demand function for females. Determinants included in the analysis covered firm characteristics as well as industry specific characteristics. Results indicated a positive association between female employment on one side and micro and small sized firms and firms that export on the other side. While it suggested a negative association between capital employed by the firm and female labor indicating substitutability. Moreover, results confirmed the important role played by industries in determining female labor demand. Were number of females employed by firms is higher in industries with higher share of firms that export, and in high technology industries. Accordingly, promoting female employment require more openness and integration into global markets and hence more exports specially in labor-intensive. In addition, more attention should be given to policies that encourage and promote micro-startups. Finally, more attention should be given to encouraging high technology industries like Manufacture of basic pharmaceutical products and Manufacture of computer, electronic and optical products, where the highest association with female employment was evidence.

JEL Classifications: D24, J23, J30

Keywords: Female Labor demand; Economic Census; Egypt, Cross wage elasticity, Own wage elasticity.

ملخص

تبحث هذه الدراسة محددات الطلب على عمالة الإناث في قطاع الصناعات التحويلية المصري. استخدمت الدراسة بيانات التعداد الاقتصادي 2013 مع بيانات المسح التتبعي لسوق العمل المصري 2012 لتقدير معدل الأجور حسب الجنس في بيانات التعداد الاقتصادي 2013 ومن ثم تقدير دالة الطلب على العمل بالنسبة للإناث. تتضمن المحددات المستخدمة: خصائص على مستوي الشركة وخصائص متعلقة بالصناعة. وأشارت النتائج إلى وجود ارتباط إيجابي بين توظيف الإناث من جهة وبين الشركات المتناهية الصغر والصغيرة الحجم والشركات التي تقوم بالتصدير من جهة أخرى. وعلاوة على ذلك، أكدت النتائج الدور الهام الذي تلعبه خصائص الصناعات في تحديد الطلب على عمل المرأة. فكان متوسط عدد العاملات الإناث المستخدمات من قبل الشركات أعلى في الصناعات ذات الحصة الأعلى من شركات التصدير، وفي الصناعات العالية التكنولوجيا. وبناءً على ذلك، فإن تشجيع الطلب على عمالة النساء يتطلب المزيد من الانفتاح والاندماج في الأسواق العالمية وبالتالي زيادة الصادرات وخاصة في الصناعات كثيفة العمالة. بالإضافة إلى ذلك، ينبغي إيلاء المزيد من الاهتمام للسياسات التي تعمل على تشجع الشركات الناشئة. وأخيراً، ينبغي إيلاء المزيد من الاهتمام لتشجيع الصناعات ذات التقنية العالية مثل تصنيع المنتجات الصيدلانية الأساسية وتصنيع منتجات الحاسب الآلي والإلكترونيات والبصريات.

1. Introduction

Recently there has been agreement that women's integration both economically and politically is fundamental for economic growth and development particularly in developing nations (Woman UN, 2014; Bayeh, 2016 and Jayachandran, 2015). Labor market outcomes related to women including female labor force participation (FLFP), employment rates and wages, together with access to education, are considered to be the main channels through which women are integrated in the economy. On the economic front, and via its role in enhancing women's relative economic status, female inclusion in the labor market is critical for the country's economic efficiency. On the social front, sluggishness of FLFP negatively affects women's bargaining power and hence their empowerment. That prevents women from reaping the full benefits of economic growth achieved at the macro level and reflects poorly on women's' and children's health and wellbeing (Ackah et al., 2009 and Klasen and Pieters, 2013).

Accordingly, the concern with female access to employment, and education, arises from a concern about resource mobility and capacity utilization. If women are constrained from participating in the labour market, efficient use of resources is not achieved. This issue is of most importance to the Middle East, in general, and to Egypt, in particular, due to the exceptionally low participation rates of females as well as their high unemployment rates. Compared to the world average of 52%, labor force participation rate for Egyptian women is very low ranging between 20% and 25% throughout the 2000s (Center for Economic and Social Rights, 2013). Moreover, while women represent only 23% of the labor force, their unemployment rate increased from 23.7% in 2006 to 27.6% in 2012 (Assaad and Kraft 2013). In addition, women constitute very low share in private non-agricultural wage employment. Finally, around half of the women in the labor force are employed in the informal sector under poor working conditions and relatively low wages (UNDP and Ministry of Economic Development 2010).

Recently, women witnessed significant progress in their education status in Egypt. The gross enrolment ratio in secondary education reached 86% in 2014 (WDI). Literacy rates for adult females aged 15 years and above increased to 67% in 2013 compared to 31% in 2005. Moreover, primary completion rate of females as a present from relevant group reached 104 % in 2013. However, the majority of the unemployed women are educated (94 % of unemployed women reached secondary level in 2012) and after leaving school, 70 % of women are out of the labor force and 15 % are unemployed.

This high and rising educational attainment together with the delayed marriage among young women in Egypt were expected to raise the chances of female participation in the labour market and to decrease their unemployment rates. However, unemployment and inactivity rates among females remain high (Assaad and Krafft 2015a).

The high unemployment and inactivity rates among women are considered to be one of the most important challenges facing Egypt today. On the one hand, this could be attributed to supply side factors related to why Egyptian females choose to withdraw from the labour market, including individual characteristics, household socioeconomic characteristics, as well as norms and traditions shaping gender roles in the society. On the other hand, it could be explained by demand side factors related to employers' choices and preferences or vice versa to firm-specific and industry-specific characteristics, as well as institutions and the macroeconomic environment.

Most of the empirical literature addressing Labor markets outcome related to women in Egypt focused on supply side factors (Assaad and El-Hamidi 2001 and 2002; El-Hamidi 2003; Assaad

2000; 2002 and 2004; Hendy 2011; Nazier and Ramadan 2016) while demand side factors are left out mainly due to the unavailability of data. Accordingly, Female labor market outcomes in Egypt have for long been regarded as a supply-side issue. This paper aims to fill the gap in the Egyptian literature on the demand-side factors affecting women's participation in the labor market, taking advantage of the newly available Economic Census 2013 data. Accordingly, the analysis aims to examine main determinants of female labour demand in Egypt.

2. Theoretical background and Literature Review

Economic theory states that demand for labor is a derived demand from demand for goods and services. Moreover, demand for labor is treated as any other demand model in the economic literature; with a measure of labor demanded as the dependent variable and a set of key determinants as the independent variables (Bashier and Wahban 2013). On the theoretical front, we can distinguish between static and dynamic labor demand models. The current paper falls under the static demand models.

Static labor demand models investigate the long-run effects of an exogenous shock, i.e. the outcome in the labor market, after the adjustment process has been fully realized. Hence it does not consider the existence of adjustment costs and is not capable of analyzing the path of employment towards the equilibrium (Lichter et al. 2012). The standard form of the static labor demand theory reflects how employers decide on the quantity of labor used in production and how these quantities respond to marginal changes in product demand and factor prices. It is basically a branch of production theory, that study the mechanism through which product market shocks and shocks to prices in input markets transmit to employment and wages. Where the structure of production is a crucial component of this transmission mechanism. Accordingly, most progress achieved simply reflects progress made in production theory (Addison et al. 2014).

To derive labor demand equations, labor demand theory starts with is a representative profit-maximizing (cost minimizing) firm that can change the amount of the labor used in production without bearing extra cost. Through solving the firm optimization problem in the long run the conditional and unconditional demand functions are derived. This implies identifying the production function and assumes strictly increasing and strictly concave functions. In this context, different specifications have been used advancing from the standard Cobb-Douglas production function, through CES, to generalized Leontief or translog functions. The estimated labor demand function is then used to estimate labor demand elasticity and the elasticities of substitution between different inputs (Addison et al. 2014).

A review of the international empirical literature reveals that in contrast to the short-run dynamic analysis, there have been many studies estimating long- run labor demand. In the case of Egypt, there is a relatively large literature that provides both theoretical and empirical investigation and explanation of employment, unemployment and their determinants in general and for females in particular (Assaad 2008; Assaad et al. 2000; Awad 2003; El Ehwany and El-Laithy 2000; El-Megharbel 2007; Fawzy 2002; Nassar, 2011 and Radwan 2002; Ibrahim 2013; Atta and Shehata 2008; Hassan and Sassanpour 2008; Dessus and suwa-Eisenmann 1999; Assaad and El-Hamidi 2001 and 2002; El-Hamidi 2003; Assaad 2000; 2002 and 2004; Hendy 2011 and Nazier and Ramadan 2016). However, these studies are either macro studies that use national time series or sector (industry) level data or micro level studies that use data from labor or household surveys and are, hence unable to address the demand side factors associated with female employment and

participation in the labor market.

Accordingly, labor demand, in general, and female labor demand, in particular, is a rather neglected topic in the empirical labor economics literature in Egypt. This could be mainly due to a lack of establishment-level micro data. To our knowledge, no prior documented empirical study of female labor demand at the micro level of disaggregation – i.e., using firm-level data-- exists in Egypt. In this context, the main aim of this study is to fill this gap in the Egyptian literature taking advantage of the newly available Economic Census 2013 data.

3. Conceptual Framework and Methodology

This study utilizes a model based on a labor demand equation that is obtained from the firm's cost minimization problem. It follows standard practice and adopts the dual approach of a cost minimization problem under a constant output (Hamermesh 1993; Litcher et al. 2012). Accordingly, the econometric model underlying the estimation of female labor demand is based on the assumption of cost-minimizing firms and a Hicks-neutral Cobb-Douglas demand function for the representative firm *i* in sector j*:*

$$Y_{ij} = A^{\gamma} L_{ij}^{\alpha} K_{ij}^{\beta} \qquad (1)$$

Where Y denotes real output, A is total factor productivity; K is capital stock[1]; L is units of labor employed; α and β denote the factor share coefficients and γ represents the increase in efficiency in the production process.

Correspondingly $\mathrm{MP_L} = \frac{\partial \mathrm{Y}}{\partial \mathrm{L}} = \mathrm{A}^{\gamma}\alpha\frac{\mathrm{Y}}{\mathrm{L}}$ is the marginal product for labor while $\mathrm{MP_K} = \frac{\partial \mathrm{Y}}{\partial \mathrm{K}} = \mathrm{A}^{\gamma}\alpha\frac{\mathrm{Y}}{\mathrm{LK}}$ is the marginal product for capital. Labor and capital are utilized by a profit-maximizing firm until the value of the marginal product of each factor equal its cost i.e. the VMP for labor equals the wage (w) and the VMP of capital equals its user cost (r).

Solving this system simultaneously and taking natural logarithm and manipulation, the firm's demand for labor can be written as follows

$$l_{ij} = \lambda_0 + \lambda_1 y_{ij} + \lambda_2 w_{ij} + \lambda_3 k_{ij} \qquad (2)$$

Where lower letters indicate logarithmic values. By definition λ_1 is the output elasticity of labor demand and λ_2 is the wage elasticity of labor demand.

3.1 Estimation

The study examines labor demand for females versus males. Thus, adding subscript *f* indicating females and adding a disturbance term ε_{fij} to equation (2) the labor demand equation for female estimated is specified in equations 3:

$$l_{fij} = \lambda_{f0} + \lambda_{f1} y_{ij} + \lambda_{f2} w_{fij} + \lambda_{f3} w_{mij} + \lambda_{f4} k_j + \beta_{Zf} Z + \beta_{fIND} IND + \varepsilon_{fij} \qquad (3)$$

Disaggregating labor inputs in this way i.e. by gender and distinguishing males' and females' wages would allow as to examine the relationship between demand for males and females as distinct types of labor. Of special interest will be the coefficients λ_{f2}, λ_{f3}. Where

λ_{f2} is Own-wage elasticity of demand for females; defined as the percentage change in females

[1] Due to difficulties in constructing firm level measures of capital cost I follow Addison et al. (2005) and consider capital as a quasi-fixed factor. Hence, capital is believed to adjust only partially within one period, due to adjustment costs, whereas labor is considered to adjust instantly to their long-run equilibrium, Accordingly the analysis is only concerned with the optimal choice of variable inputs, thus capital stock is used as a regressor in the labor demand functions instead of its user cost.

employment (L_f) induced by a 1 percent increase in females wage rate (W_f) keeping output and prices of all other factors constant:

$$\eta_{ff} = \frac{\%\Delta l_{fij}}{\%\Delta w_{fij}} \qquad (4)$$

λ_{f3} is cross-wage elasticities of demand for females, defined as is the percentage change in the demand for female employment (L_f) induced by a 1 percent change in the wage rate of males (W_m) keeping output and prices of all other factors constant:

$$\eta_{fm} = \frac{\%\Delta l_{fij}}{\%\Delta w_{mij}} \qquad (5)$$

If the cross- elasticity is positive indicating that an increase in the wage rate for males would increase the demand for females, the two are said to be *gross substitutes*. If the cross-elasticity is negative hence an increase in the wage rate of males reduces the demand for females, the two are said to be gross complements[1].

Since labor demand in a firm is expected to depend on firm-specific characteristics. The basic labor demand model is augmented by a set firm level characteristics. Variables included in the regression at the firm level are:

1. Formality,
2. Firm size and age,
3. Legal form,
4. Dummy for whether the firm export or not,
5. A measure of productivity.
6. Region where the firm is located.
7. Share of workers in each occupation.

Thus, equation (2) is augmented by adding vector Z including firm specific effects to examine effect of firm-specific characteristics on Labor demand.

Moreover, industry characteristics are expected to affect female labor absorption in each firm. As firms in different industries usually operate under different technologies this may result in varied labor demands. For example, employment generation could be higher in labor- intensive industries than in resource-intensive ones. The paper tried to capture industry-specific effects through two alternatives. First -assuming that this is a source of industry-specific differences- including industry dummies IND for four digits industries as explanatory variables. Second, through including variables reflecting industry characteristics. Industry-specific characteristics calculated at the four-digit level include:

1. Capital-labor ratio.

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[1] It is worth noting that whether they are gross substitutes or gross complements depends on the relative sizes of the scale and substitution effects. If for example they are substitutes in production. A decrease in males' wage rate will have opposing effects on females' employment, there is a substitution effect: for a given level of output, employers will now have an incentive to substitute males for females in the production process and reduce females' employment. However, there is scale effect: a lower males' wage reduces costs and employers will be encouraged to increase output and employment of all inputs, including females. If the scale effect is smaller than the substitution effect, females' employment will move in the same direction as males' wages, and the two groups will be gross substitutes. In contrast, if the scale effect is larger than the substitution effect, females' employment and males' wages will move in opposite directions, and the two groups will be gross complements.

2. Share of firms that export
3. Average productivity
4. Average firm size
5. A measure of technological intensity. Where I followed the classification of industries proposed by Eurostat that classified the industries in the manufacturing sector according to the technological intensity into four main groups: High technology (HT), Medium High technology (MHT) and Low technology (LT) and Medium low technology (MLT)[1].

Adding those sets of variables to equation (2) results in the full empirical model in equation (3) for female labor demand that will be used in this study. Variable definition and construction are reported in appendix 1.

This empirical model specification has several estimation issues that are worth noting. **First**, our main data source is the Egyptian Economic census 2013 "C13". While this set of data provide wages disaggregated by occupational groups, it does not include wages classified by gender. Yet our estimation model for female labor demand requires wages for females at the firm level. Thus, this study uses a two-stage estimation technique to estimates female wages at the firm level.[2] This technique permits combining comprehensive wage information available from the ELMPS 2012, with the information available from the C13. The two-stage approach combines the ELMPS 2012 with the C13 to estimate female wages by firm for the C13 sample. This usually comprise the following three steps:

3.2 Identifying firm characteristics available in the ELMPS2012 and the C13

In this stage the ELMPS2012 and the C13 questionnaires were compared to identify common firm variables found in the two datasets. This was not a major limitation on the analysis, because the two data sets include a fair number of common variables like location, industry, occupation, sector…etc.., The choice of the set of explanatory variables included is based on a careful review of the wage literature as well as an in-depth investigation of the correlation between the common set of explanatory variables and the wage measures. Variables included were: firm size, share of female workers, sector, and industry and governorate dummies.

3.3 Estimating female wage using the ELMPS2012 data

This is the first step of the two-step estimation technique. The ELMPS2012 is used to estimate wages by gender for individual female/male i as a function of the common set of firm j characteristics where she/he works chosen in the previous step. A log-linear function of wages per female/male, w_{fij}, is estimated as follows

$$\ln w_{fij} = X_j'\beta + \eta_{fij} \qquad (4)$$

[1] Details of the aggregation are available in Appendix 1.

[2] This methodology is inspired by statistical modeling in the area of poverty mapping. It is a recently developed methodology, which permits the imputation of consumption and welfare indicators from one survey, into another survey. Specifically, income data in one survey is combined with demographic and household data available in another survey in order to derive statistically reliable estimates of poverty and inequality (Elbers et al., 2003). In this paper, a similar methodology is adopted but to address missing sex-disaggregated wage data in the C13 using available firm-level wage and employment characteristics in the ELMPS 2012.

Where X_j is a vector of characteristics of firm j where individual i works; and η_{fij} is a disturbance term that is distributed as N(0, σ^2). Moreover, bootstrapping was performed to estimate the standard errors.

3.4 Predicting wages by gender per firm for the C13 sample

This stage uses the estimated coefficients of the regression models in the previous step and the C13 data to predict wage rate per female/male by firm in the C13 data $\widehat{w}_{fij}$.

Second, product demand shocks are expected to change labor demand for all firms in the same industry in a similar fashion. Thus, estimating labor demand equation without controlling for these shocks would lead to biased estimates. This study attempts to control for this by estimating conditional labor demand functions. Including output in the conditional labor demand functions is expected to account for at least a part of the product demand shocks hence reducing the bias (Hasan et al. 2007 and Fajnzylber and Maloney 2005, Nazier 2013).

Third, endogeniety of wages is one identification problem in estimating equation (5). Both labor demand and labor supply depend on real wage thus shocks to labor demand affect wages. Hence, the wage and the disturbance term in the estimated labor demand equation could be correlated, which may lead to biased estimates. In order to be able to consider the parameters of equation (3) as parameters of the labor demand function, we assume that wages are exogenous, i.e. labor supply at the unit of analysis, which is the firm, is perfectly elastic, so that shocks to labor demand do not affect wages. Although this seems to be a strong assumption it could be defended based on two theoretical arguments. First, according to Nickell and Symons (1990), since labor supply and demand depend on two different real wages, the identification problem is reduced. On the one hand, firms use the industry's output price to measures productivity, thus labor demand depends on nominal wages deflated by the producer price. On the other hand, what consumers care about is their real income given their overall consumption basket, hence labor supply depends on nominal wages deflated by the consumer price index (Akhter and Ali 2007 and Slaughter 2001). Second, Hammermesh (1993) pointed out that the appropriateness of this assumption depends on the degree of disaggregation of the data. Usually individual firms choose employment at a given exogenous wage, which means that they face perfectly elastic labor supplies. While, the economy as a whole determines wages according to given exogenous quantities; thus, it faces almost perfectly inelastic labor supply. Given that the data used in this study is at the firm level, their labor supply schedule, is thus closer to perfectly elastic than perfectly inelastic.

4. Data

The present study makes use of two data sets. First, the Egypt Economic Census 2013 "C13" conducted by CAPMAS is the main data source used. It was conducted in Egypt in 2013 with questions referring to 2012. We have access to a 50% random sample of the data, which contains 62,108 enterprises. A main advantage of this data is that it contains very detailed information on establishments and is nationally representative. For example, for each firm we have information on firm characteristics like age, legal form, including foreign ownership, access to finance, annual sales, costs of inputs and labor disaggregated by type and gender, aggregate wage bills by type of labor, but not by gender, in-kind benefits for all enterprises that hire outside labor and number of owners/unpaid workers by type. The data also include information on trade as captured by amount of production exported and both domestic and imported intermediate inputs, capacity utilization, as well as informality based on either "keeping regular accounting books", "having a commercial

registration number" or "contributing to social insurance fund". Hence it provides data for firm-level factors that are expected to affect the demand for labor.

Second, the Egyptian Labor Market Panel Survey 2012, "ELMPS 2012", conducted by the Economic Research Forum (ERF) in cooperation with CAPMAS. It is the third wave of a periodic longitudinal survey that tracks the labor market and demographic characteristics of households and individuals previously interviewed in 1998 and 2006. It provides detailed information on education, employment status and employment characteristics, time allocation, job mobility, wages, parental background at the individual level and household characteristics and household enterprises. This data set is used to complement the C13. It is used to predict female wages by firm as illustrated in the methodology section above. It is also used to obtain the governorate-level variables included in vector GOV to capture social context and to enrich the available information on the specific characteristics of women.

The study focuses on the 12,476 firms in the manufacturing sector (Table 1) with an average age of 11.5 years. The average number of workers per firm is 6.2 workers while the maximum number is 11,130 workers. The average number of females employed is 0.6 per firm. While for males it is 5.7. Average real hourly wages for females is less than that of males; moreover, the variation for females is higher than for males.

Figure 1 shows the average share of females and males by occupation per firm, males exceeds females in all occupations.

The majority of firms are informal[1] (about 83.9%), small sized of 1-3 employees (69.3%), does not export during the survey period (99.7%), individually owned (85.9%) and has an age of less than 12 years (66.1%) (figure 2)

Figure 3 shows that in average the share of employed females from total firm employment is higher for formal firms, if the firm exports, the larger the firm size, for non-individual owned firms and for young (0-3) years old firms and old firms (over 50 years old).

Figure 4 shows noticeable variation in the ratio of female workers from total workers by region. The ratio is higher in Alex and Cairo regions. Alex region has the maximum ratio of 10.9%, followed by Cairo, Canal and Delta regions. South upper Egypt region has the lowest ratio.

Figure 5 shows the percent of female workers by industry from total industry workers. The differences in the distribution of females among industries are remarkable. Manufacture of wearing apparel has the maximum value, followed by Manufacture of basic pharmaceutical products and pharmaceutical preparations, Manufacture of computer, electronic and optical products. While Manufacture of basic metals has the lowest value. This may suggest that female's share is higher in high tech industries.

Looking at female employment in different industries according to the degree of technological intensity. Figure 6 confirms that the percent of female workers by industry from total industry workers is highest in the high-technology HT industries group followed by the low-technology LT group. Moreover, the difference is noticeable as it is almost higher 3 times in the HT group compared to the LT group.

5. Estimated Results

[1] I consider the firm to be formal if it holds accounting statement or reported a commercial Registration-License number or both.

Four versions of the model have been estimated. Model (1) includes only basic labor demand equation regressors. Model (2) added firms characteristics and Model (3) added 4-digit industry dummies. Including the 4-digit industry dummies in the third model explains intra industry variation in demand for female labor. Hence to assess the inter-industry variation in demand for female labor Model (4) includes industry-level characteristics instead of industry dummies.

Table (2) displays the results. As expected when comparing the R-square for the four versions of the model, it is obvious that the explanatory power of the model significantly increases moving from Model (1) to Model (2), which includes firm characteristics, to Model (3), which controls for industry dummies. The R-squared increased from 39% to 60% to 70% respectively. This accounts for the variation in the share of females due to observed and unobserved characteristics at the industry levels.

As expected output has a positive and significant relationship with female employment in all models. Capital has a positive significant association with female labor, but only in Model (1), while it turned to a negative significant association in the other three models.

As expected female wages have a negative significant relationship in all models. Male wages have a positive significant relationship, indicating that as male wages increase, female employment increases, which may point to a possible gross substitution effect.

Confirming what is commonly known about the Egyptian labor market, demand for female employment is higher for informal firms compared to formal ones, but only in Model (3), when we control for industry dummies. This indicates that formality is important in explaining within industry variation in demand for female labor but not to explain between industry variation.

In all models' firm size has a nonlinear association, were female employment increases with firm size until a certain size is reached and then it starts to decrease. Compared to young firms of 1-3 years, firms with 12 or more years have a negative significant association with demand for female labor. This goes in line with the literature that shows that it is young firms or micro-startups of less than 4 years old that dominate job creation in MENA (World Bank 2015).

In line with the descriptive results, female employment is higher for firms that export compared to those having zero exports in all four models. Contrasting to the descriptive results, female employment is higher in individually-owned firms compared to the others forms of ownership. Total factor productivity has a negative significant relationship in all models. This could be due to the fact that high productivity firms have higher levels of worker human capital and may thus be reluctant to hire female labor because of higher turnover.

Concerning share of workers from total workers by occupation, in all models the share of workers in managers and professionals occupation and in the white collars occupation has a negative association with the number of employed females, with the exception of share of workers in white collars occupation in Model (3), which was insignificant.

Looking at the regional dummies, compared to the Cairo region, demand for female labor is significantly higher in all three Lower Egypt regions and lower in the Upper Egypt regions. This contradicts the descriptive statistics that suggested that Cairo region has the highest number of females employed. One possible explanation could be that the descriptive results are due to firm and industry characteristics rather than geographical factors, hence after controlling for the firm and industry characteristics results are different.

The results of Model (4) point to the significance of industry-level characteristics in explaining inter industry variation in demand for female labor. It shows that number of females employed by

firms is higher in industries with a higher share of firms that export, in industries with higher average firm size and in high technology industries. However, the number of females employed by firms is less in industries with higher average TFP. This goes in line with the results of individual firms TFP and again could be explained by the fact that high productivity firms have higher levels of worker human capital and may thus be reluctant to hire female labor because of higher turnover.

6. Conclusion

In Egypt, micro data unavailability lead to neglecting demand side factors when addressing labor markets outcomes for women. The current study takes advantage of the newly available economic census for Egypt C13 in an attempt to fill in this gap in the literature and study demand for female labor in Egyptian manufacturing sector. In this context the study utilizes the information provided in the C13 together with data from the ELMPS2012 to estimate wage rate by gender in the C13 and then estimating a labor demand function for females. Determinants included in the analysis covered firm characteristics as well as industry specific characteristics.

Descriptive statistics showed a large gender gap in employment at the firm level. The average number of females employed is less than one per firm. While for males it is 6 workers. Average hourly wages for females is less than that of males; moreover, the variation for females is higher than for males. In addition, while the maximum wage rate is higher for females the minimum wage rate is lower for females indicating that for the minimum females earn relatively less. Raw data also shows noticeable variation in the average ratio of female workers per firm by region and industry suggesting an important impact for both.

At the firm level, results suggested a negative association between males' wage rate and female labor indicating gross substitutability. Results also indicated a positive association between female employment on one side and young firms (firms 0-3 years old) and firms that export on the other side. At the industry level characteristics, results confirmed the important role played by industries in determining female labor demand. Were number of females employed by firms is higher in industries with higher share of firms that export, and in high technology industries.

Moreover, generally, main findings were very close in the second and forth models, while results for the third model with industry fixed effects were relatively different. The magnitude of the effect of some variables in third model explaining the within industry variation is remarkably different than in the fourth model explaining the between industry variation. This confirms the importance of industry specific effects.

Based on the findings of the current study, some recommendation concerning demand side factors may be suggested in an attempt to promote demand for female labor. First, more openness and integration into global markets and hence more exports specially in labor-intensive sectors such as apparel and garments could have a huge effect on female labor especially since those sectors are female labor intensive. Second, more attention should be given to policies that encourage and promote micro-startups. It is worth noting that the Egyptian government is giving special attention and interest to encouraging micro and small enterprises. However exciting efforts need to be evaluated at regular basis and new efforts should be introduced to insure significant success in this regard. Third, more attention should be given to encouraging high technology industries like Manufacture of basic pharmaceutical products and Manufacture of computer, electronic and optical products, where the highest association with female employment was evidence.

References

Ackah, C., Ahiadeke, C., and Fenny, A., (2009). "Determinants of Female Labor Force Participation in Ghana". Mimeo.

Addison T., L. Bellmann, T. Schank, and P. Teixeira (2005). "The Demand for Labor: An Analysis Using Matched Employer-Employee Data from the German LIAB. Will the High Unskilled Worker Own-Wage Elasticity Please Stand Up?" IZA Discussion Paper No. 1780, Institute for the Study of Labor, September.

Addison, T., P. Portugal, and J. Varejão (2014). "Labor Demand Research: Towards a Better Match between Better Theory and Better Data." IZA Discussion Paper No. 8125, Institute for the Study of Labor, April.

Akhter, N and A. Ali. 2007. "Does Trade Liberalization Increase the Labor Demand Elasticities? Evidence from Pakistan." *MPRA Paper No. 3881*, available online at http://mpra.ub.uni-muenchen.de/3881.

Assaad, R. (2000). "Local Industrial Structure and Female Participation in Paid Work: Evidence from Egypt". International Center for Economic Growth. Economic Policy Initiative Consortium Project

Assaad, R. (2002). "Informalization and De-feminization: Explaining the Unusual Pattern in Egypt". Paper Prepared for Presentation at the Conference on: Rethinking Labor Market Informalization: Precarious Jobs, Poverty, and Social Protection Cornell University (October 18-19, 2002).

Assaad, R. (2004). "Why Did Economic Liberalization Lead to Feminization of the Labor Force in Morocco and De-feminization in Egypt?" Paper prepared for The Center of Arab Women Training and Research (CAWTAR) Mediterranean Development Forum (MDF).

Assaad, R. (2008). "Labor Supply, Employment and Unemployment in The Egyptian Economy: 1988-2006." ERF Working Paper no. 0701, Economic Research Forum, Cairo, Egypt.

Assaad, R. and El-Hamidi, F. (2001). "Is All Work the Same? A Comparison of the Determinants of Female Participation and Hours of Work in Various Employment States in Egypt", in The Economics of Women and Work in the Middle East and North Africa. Mine Cinar (Ed.) Research in Middle East Economics, Vol. 4. Greenwich, Conn.: JAI Press.

Assaad, R. and Kraft, C. (2013). "The Structure and Evolution of Employment in Egypt: 1998-2012". Economic Research Forum Working Paper No. 805.

Assaad, R., & Krafft, C. (2015a). The Evolution of Labor Supply and Unemployment in The Egyptian Economy: 1988-2012. In R. Assaad & C. Krafft (Eds.), *The Egyptian Labor Market in an Era of Revolution*. Oxford, UK: Oxford University Press.

Assaad, R., F. El-Hamidi and A. Ahmedet (2000). "The Determinants of Employment Status in Egypt." Discussion Paper, 88, Food Consumption and Nutrition Division (FCND), International Food Policy Research Institute, Washington, D.C.

Assad, R. and El- Hamidi, F. (2002). "Female Labor Supply in Egypt: Participation and Hours of Work". In Human Capital: Population Economics In The Middle East. Ismail Sirageldin (ed.), Cairo: American University in Cairo Press, pp. 210- 230. ISBN 977 424 711 6

Awad, I., (2003). "Economic Reform, Employment, and Employment Policy in Egypt." Aspects of Structural Reform with Special Reference to the Egyptian Economy, Department of Economics 8th Conference, Cairo, Egypt.

Bashier, A. and N. Wahban (2013). "The Determinants of Employment in Jordan: A Time Series Analysis." International Review of Management and Business Research, Vol. 2 Issue.4.

Bayeh, E. (2016). "The role of empowering women and achieving gender equality to the sustainable development of Ethiopia." Pacific Science Review B: Humanities and Social Sciences, *2*(1), 37-42.

Center for Economic and Social Rights (2013). Egypt Factsheet no 13.

De Ferranti, G. et al. (2002). "Closing the Gap: Technology and Wages in Latin America." The World Bank, Washington.

Dessus, S. and, A., Suwa-Eisenmann *(1999). "*Trade Integration With Europe & Labor Reallocations in the South Mediterranean Countries: The Case of Egypt." ERF Working paper 9918, Economic Research Forum.

Eisner, R., and R. Strotz (1963). "Determinants of Business Investment." in D. Suits, et al (eds.), Impacts of Monetary Policy, pp. 60–337, Englewood Cliffs, New Jersey. Prentice-Hall.

El Hamidi, F. (2003). "Labor Supply of Egyptian Married Women When Self-Employment is an Option: Participation and Hours of Work". Available at SSRN: http://ssrn.com/abstract=1819384 or http://dx.doi.org/10.2139/ssrn.1819384.

El-Ehwany, N., and El-Laithy, H. (2000), "Poverty, Employment and Policy-Making in Egypt: Country Profile." Towards Decent Work in North Africa, 1, International Labor Organization, Geneva, Switzerland.

El-Megharbel, N. (2007), "The Impact of Recent Macro and Labor Market Policies on Job Creation Policies in Egypt." ECES Working Paper No. 123, The Egyptian Center for Economic Studies, Cairo, Egypt.

Elbers, C., Lanjouw, J., and Lanjouw, P. (2003). "Micro-Level Estimation of Poverty and Inequality." Econometrica, Vol. 71, No. 1, January.

Fajnzylber, P. and F. Maloney (2001). "How Comparable are Labor Demand Elasticities across Countries?" World Bank Policy Research Working Paper No. 2658, World Bank, Washington DC.

Fajnzylber, P. and W. Maloney (2005). "Labor demand and trade reform in Latin America." Journal of International Economics 66 (2), 423–446.

Fawzy, S., (2002). "Investment Policies and Unemployment Problem in Egypt." ECES Working Paper No. 68, The Egyptian Center for Economic Studies, Cairo, Egypt.

Fergany, N. (1998). "Dynamics of Employment Creation and Destruction, Egypt, 1990-1995." Research Notes, Vil.11, January. Cairo, Al Mishkat Center for Research and Training.

Hamermesh, D. (1993). Labor Demand. Princeton, NJ: Princeton University Press.

Hasan, R., D. Mitra, and K. Ramaswamy (2007). "Trade Reforms, Labor Regulations, And Labor Demand Elasticities: Empirical Evidence from India." The Review of Economics and Statistics 89(3), 466–481.

Hassan, M. and C. Sassanpour (2008). "Labor Market Pressures in Egypt: Why is the Unemployment Rate Stubbornly High?" paper presented to the International Conference on The Unemployment Crises in the Arab Countries organized by Arab Planning Institute, 17-18 March, Cairo, Egypt.

Hendy, R. (2011). "On Marriage and Labor Market Transitions: A Structural Dynamic Model". Mimeo.

Ibrahim, A. (2013). "The Determinants of Private Sector Demand for Employment in Egypt: 1990-2007." Advances in Management & Applied Economics, 13(1), 163-182.

Jayachandran, S. (2015). "The roots of gender inequality in developing countries." *Economics*. *7*(1), 63-88.

Khaleel, S. and E. Shehata (2008). "Estimation of Demand on Human Labor Input in the Egyptian Agricultural According to Dual Approach." MPRA Paper No. 43398.

Klasen S. and Pieters J., (2013). "What Explains the Stagnation of Female Labor Force Participation in Urban India?*"*. IZA discussion paper series No. 7597, Institute for the Study of Labor, Bonn, Germany.

Lichter, A., A. Peichl and S. Siegloch, (2012). "Micro-level labor demand estimation for Germany." NEUJOBS Working Papers D 10.3, April.

Lichter, A., A. Peichl, and S. Siegloch (2013). "Exporting and Labor Demand: Micro-Level Evidence from Germany." IZA DP No. 7494, Institute for the Study of Labor, July.

Massoud, N. (2008). "Assessing the Employment Effect of FDI Inflows to Egypt: Does the Mode of Entry Matter?" paper presented to the International Conference on The Unemployment Crises in the Arab Countries organized by Arab Planning Institute, 17-18 March, Cairo, Egypt.

Nassar, H., (2011). "Growth, Employment Policies and Economic Linkages: Egypt." Employment Working Paper 85, Employment Sector, ILO, Geneva, Switzerland.

Nazier, H. and Ramadan, R. (2016). "Women's Participation in Labor Market in Egypt: Constraints and Opportunities." Economic Research Forum working paper no. 999, May.

Nazier. H. (2013). "Trade Liberalization and Labor Demand Elasticities: Empirical Evidence for Egypt." *International Research Journal of Finance and Economics,* Issue 111, July.

Nickell, S. and Symons, J. 1990. "The real-wage employment relationship in the United States." *Journal of Labor Economics* 8: 1–15.

Pissaridaes, C. (1993). "Labor Markets in the Middle East and North Africa." Middle East and North Africa working paper series; no. 5., Washington D.C., World Bank.

Radwan, S., (2002). "Employment and Unemployment in Egypt: Conventional Problems, Unconventional Remedies." ECES Working Paper no 70, The Egyptian Center for Economic Studies, August, Cairo, Egypt.

Slaughter, M., (2001). "International trade and labor-demand elasticities." Journal of International Economics 54(1), 27–56.

UNDP and Ministry of Economic Development (2010) “Egypt Progress Toward Achieving the Millennium Development Goals”.

Women, U. N. (2014). “The World Survey on the role of women in development 2014: Gender equality and sustainable development.” United Nations Entity for Gender Equality and the Empowerment of Women.

World Bank (2015). “Jobs or Privileges: Unleashing the Employment Potential of the Middle East and North Africa.” MENA Development Report, World Bank.

Figure 1: Average share of males and females from total workers in each occupation per firm

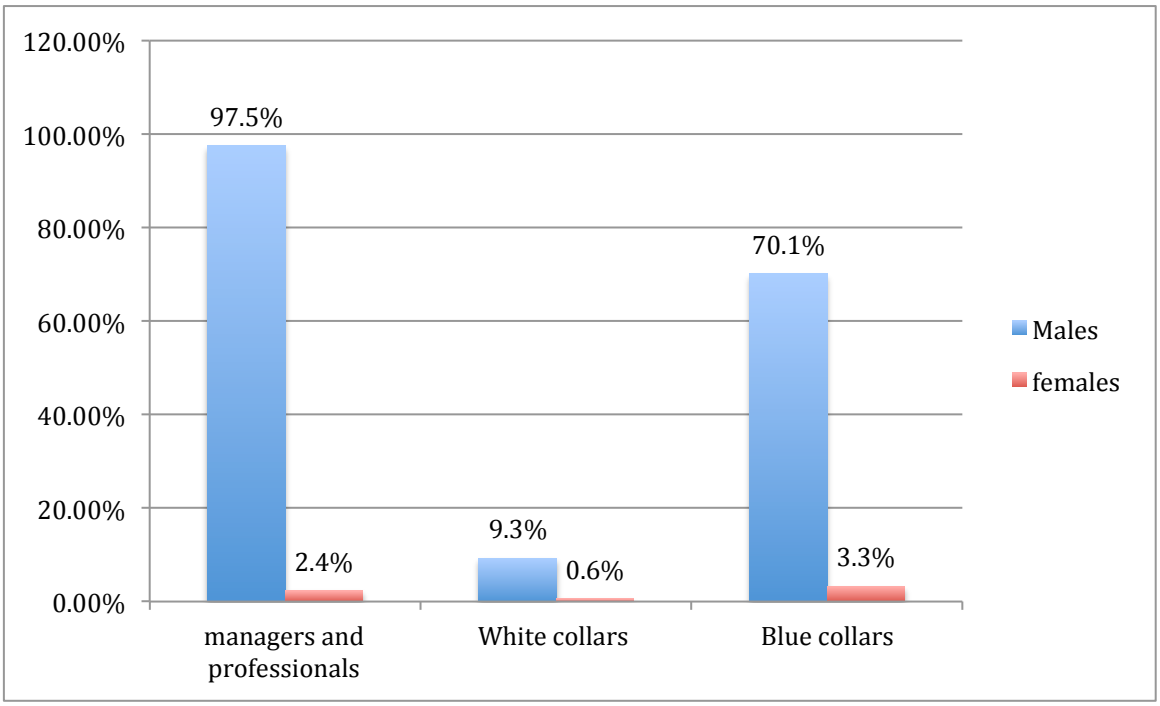

Figure 2: Sample Distribution according to different firm characteristics (%)

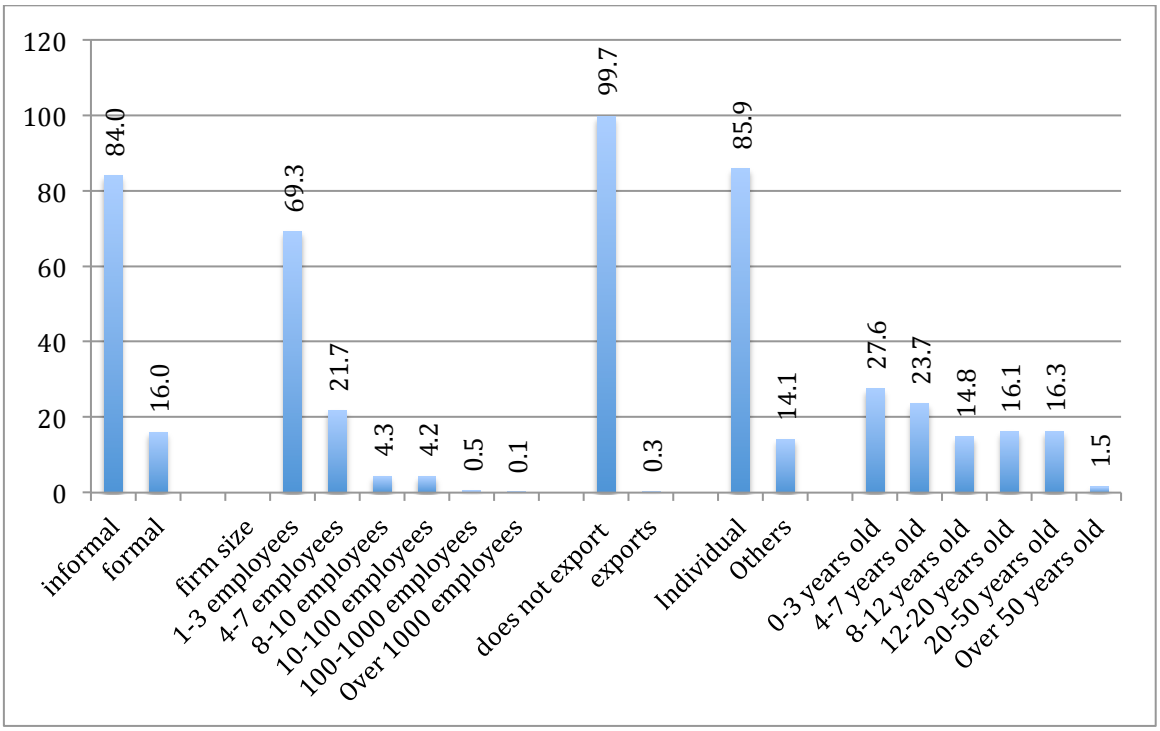

Figure 3: Average Share of Female Workers per firm by firm characteristics

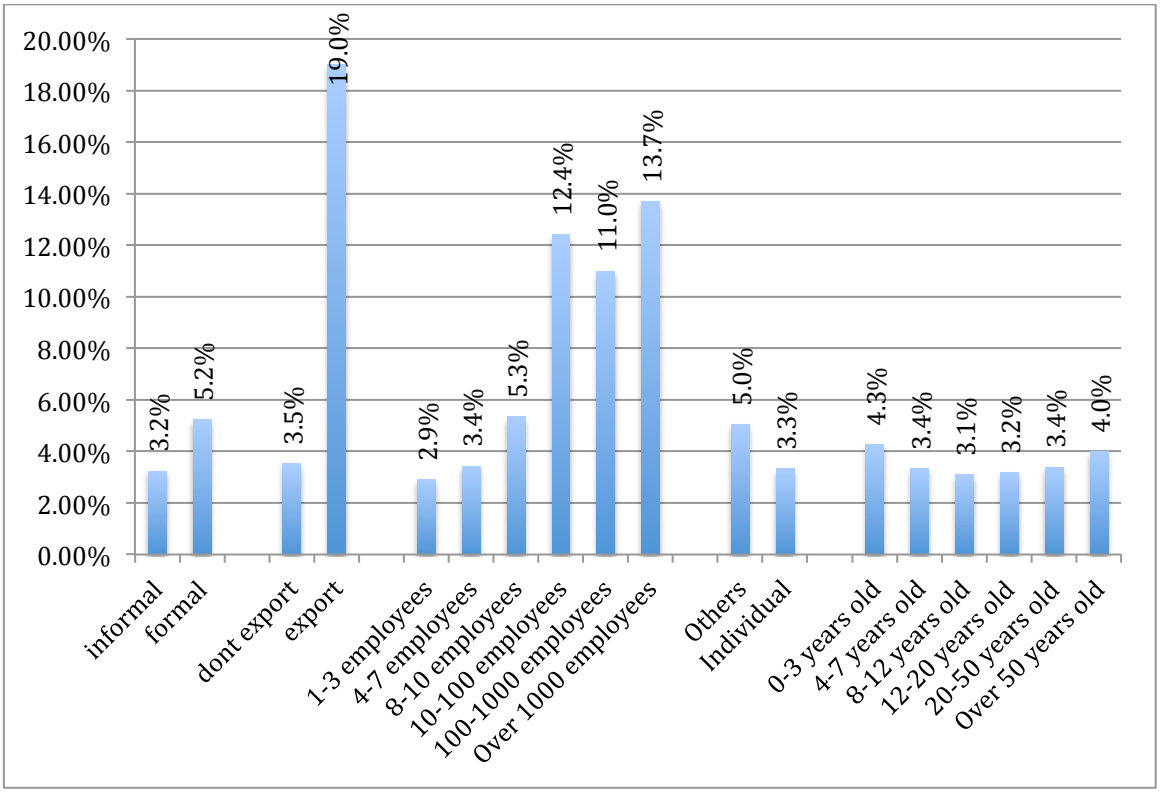

Figure 4: Percent of number female workers by region

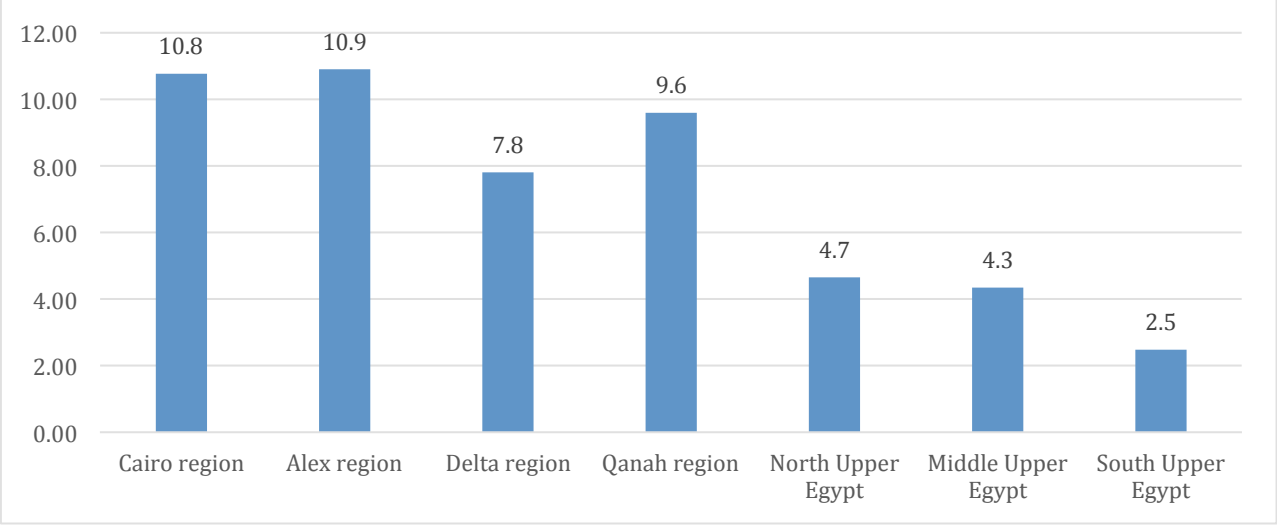

Figure 5: Percent of female workers by industry from total industry workers

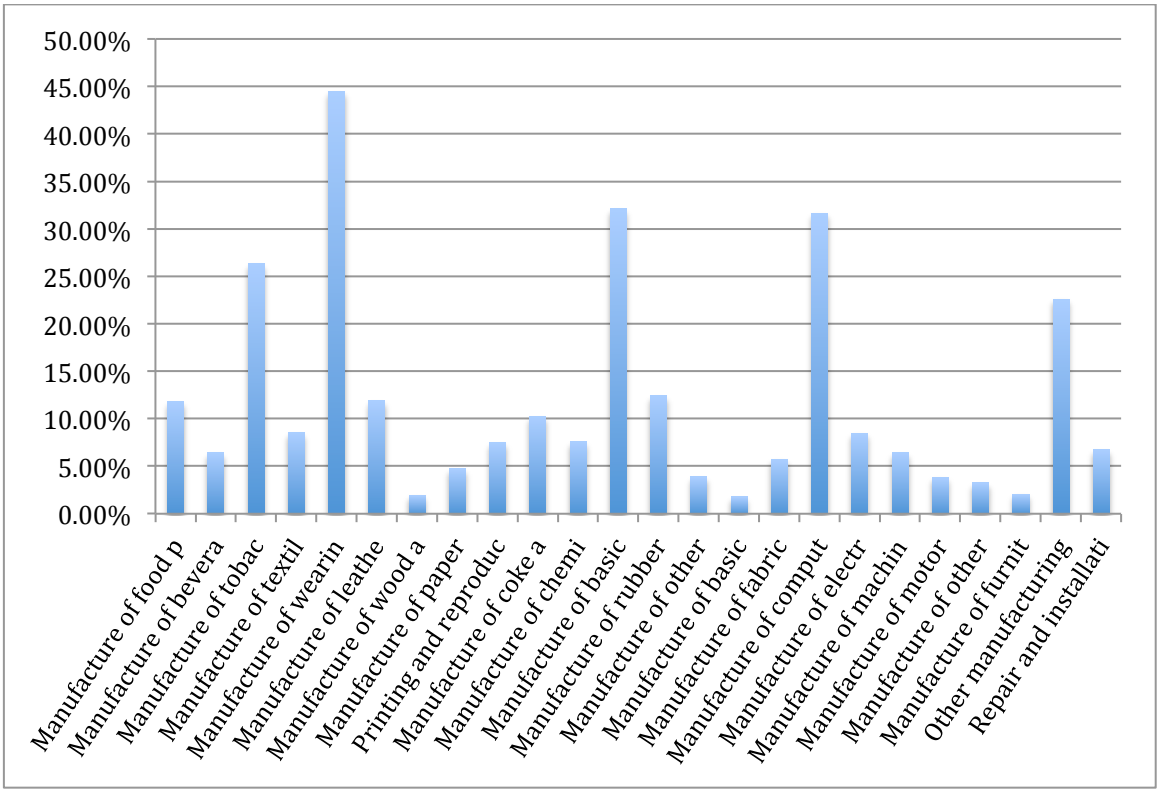

Figure 6: Percent of female workers by industry from total industry workers according to technological intensity of the industry

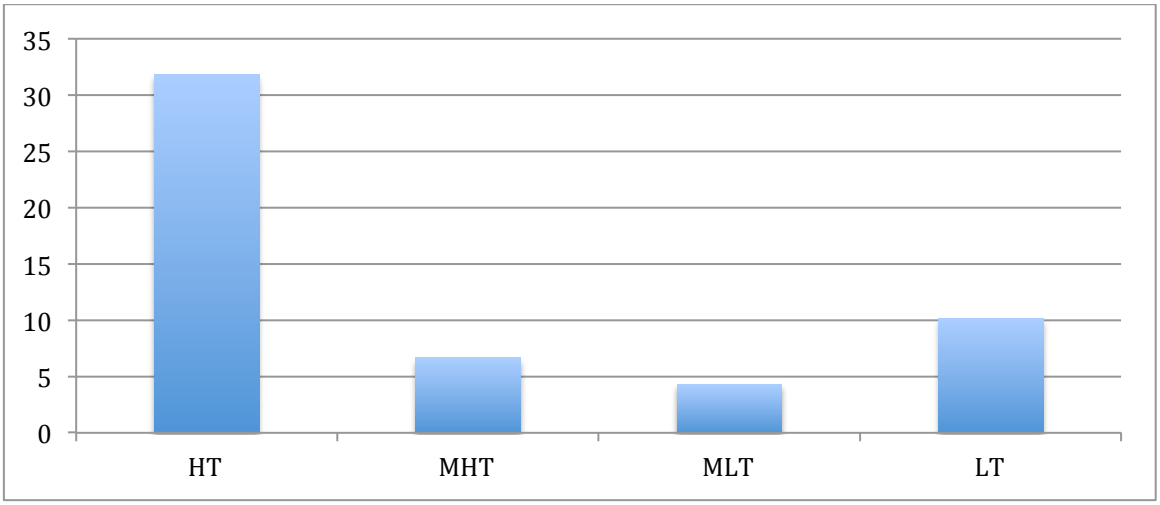

Table 1: Sample Descriptive Statistics

Variable	Mean	Std. Dev.
Number of Female workers	0.581	14.079
Number of Male workers	5.660	59.061
Total Number of workers	6.236	67.399
Log value added	10.651	1.290
Log Real Capital	9.721	1.931
Female hourly wage	1.080	0.669
Male hourly wage	1.344	0.217
Firm age	11.571	12.013
Firm Total Factor Productivity	0.000	0.845
Share of professionals and managers	51.578	31.285
Share of white collars	2.722	10.101
Share of blue collars	45.701	30.196
Observations	12476	

Table 2: Estimation results: Models of Female Labor Demand in Private Sector Manufacturing Firms as a function of firm and industry characteristics

VARIABLES	(1) log number of total female workers	(2) log number of total female workers	(3) log number of total female workers	(4) log number of total female workers
Log Value added	0.219***	0.336***	0.337***	0.332***
	(0.00456)	(0.0123)	(0.0474)	(0.0122)
Log Capital	0.0449***	-0.0382***	-0.0448***	-0.0383***
	(0.00319)	(0.00320)	(0.00675)	(0.00318)
Log Female hourly wages	-0.0656***	-0.0688***	-1.107***	-0.0458***
	(0.00992)	(0.00830)	(0.257)	(0.0104)
Log Male hourly wages	0.596***	0.467***	2.021***	0.508***
	(0.0286)	(0.0236)	(0.268)	(0.0243)
Formality (reference informal)				
Formal		0.0161	-0.0299*	0.00878
		(0.0139)	(0.0176)	(0.0136)
Firm size		0.00167***	0.00164***	0.00160***
		(4.95e-05)	(0.000173)	(4.91e-05)
Firm size square		-1.66e-07***	-1.54e-07***	-1.60e-07***
		(6.98e-09)	(3.13e-08)	(6.87e-09)
Region (reference Cairo Region)				
Alex Region		0.111***	0.146***	0.106***
		(0.0170)	(0.0483)	(0.0168)
Delta region		0.116***	0.0271	0.114***
		(0.0152)	(0.0370)	(0.0151)
Canal region		0.0715***	0.200***	0.0722***
		(0.0178)	(0.0472)	(0.0175)
North Upper Egypt		-0.0614***	-0.137***	-0.0585***
		(0.0212)	(0.0491)	(0.0210)
Middle Upper Egypt		-0.0139	-0.0428	-0.00482
		(0.0309)	(0.0476)	(0.0304)
South Upper Egypt		-0.0688***	-0.134***	-0.0777***
		(0.0218)	(0.0285)	(0.0214)
Firm age (reference 0-3 years)				
4-7 years old		-0.0233	-0.0107	-0.0263
		(0.0180)	(0.0120)	(0.0177)
8-12 years old		-0.0262	0.00323	-0.0255
		(0.0180)	(0.0205)	(0.0178)
12-20 years old		-0.0342*	-0.0156	-0.0376**
		(0.0176)	(0.0197)	(0.0174)
20-50 years old		-0.0381**	-0.0116	-0.0530***
		(0.0169)	(0.0229)	(0.0167)
Over 50 years		-0.163***	-0.0537	-0.177***
		(0.0308)	(0.0492)	(0.0303)
Log Total factor productivity		-0.383***	-0.354***	-0.357***
		(0.0135)	(0.0525)	(0.0134)
Firm exports: (reference: does not export)				

Export		0.830***	0.524***	0.812***
		(0.0368)	(0.0887)	(0.0363)
Firm Ownership (reference: others)				
Individual owned firms		0.0532***	0.0546**	0.0602***
		(0.0154)	(0.0232)	(0.0152)
Log share of workers in managers and professionals		-0.0928***	-0.0629**	-0.0903***
		(0.0121)	(0.0281)	(0.0120)
Log share of workers in white collars		-0.0129**	-0.0133	-0.0124**
		(0.00513)	(0.00848)	(0.00505)
4 digits industries dummies	No	No	Yes	No
Log Industry capital labor ratio				0.00110
				(0.00981)
Log Share of firms that export at four digits industry level				0.00373***
				(0.00129)
average productivity at four digits industry level				-0.415***
				(0.0249)
average firm size at four digits industry level				0.480***
				(0.0420)
Technological intensity (reference: High technology industries				
Medium high technology				-0.148**
				(0.0624)
Medium low technology				-0.159***
				(0.0609)
Low technology				-0.0409
				(0.0605)
Constant	-3.423***	-4.131***	-5.496***	-4.573***
	(0.0478)	(0.163)	(0.679)	(0.197)
Observations	12,476	12,476	12,476	12,476
R-squared	0.385	0.598	0.703	0.613

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Appendix 1

Eurostat High-tech classification of manufacturing industries: Based on NACE Rev. 2 2-digit level

Technological group	NACE Rev. 2 2-digit level	
High-technology (HT)	21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
	26	Manufacture of computer, electronic and optical products
Medium-high technology (MHT)	20	Manufacture of chemicals and chemical products
	27 to 30	Manufacture of electrical equipment, machinery and equipment n.e.c., motor vehicles, trailers and semi-trailers, other transport equipment
Medium-low technology (MLT)	19	Manufacture of coke and refined petroleum products
	22 to 25	Manufacture of rubber and plastic products; Manufacture of other non-metallic mineral products; Manufacture of basic metals; Manufacture of fabricated metals products, excepts machinery and equipment
	33	Repair and installation of machinery and equipment
Low technology (LT)	10 to 18	Manufacture of food products, beverages, tobacco products, textile, wearing apparel, leather and related products, wood and of products of wood, paper and paper products, printing and reproduction of recorded media
	31 to 32	Manufacture of furniture; Other manufacturing

Appendix 2

Variables Definition and Construction

Variable	Definition	Construction
Log number of females' workers Dependent Variable (l_{fij})	Total female workers paid and unpaid per firm at end of year	Measured by dividing total number of females' workers per firm by total number of workers. Then taking the log.
Log Value added (y)	Consists of the value of finished products and by-products, value of semi-finished products and byproducts, receipts for work done for others and other receipts.	Computed by subtracting Intermediate inputs cost (Fuel oils, lubricants+ Purchased electricity+ Other commodities + Other expenses) from total output. Then taking the log. The value added is expected to have positive impact on employment due mainly to nature of derived demand for labor.
Log Capital (*K*)	Capital stock	Measured as log of the net book value of fixed assets after depreciation at the end of the year (fixed assets comprise machinery, vehicles, and equipment as well as land and buildings).
Log Female hourly wages (w_{fij})	Predicted female hourly wage	Measured as log value
Log Male hourly wages (w_{mij})	Predicted male hourly wage	Measured as log value
Formal	Firms are considered formal if holding accounting statement and/or commercial Registration-License Number	Dummy variable equal 1 if formal zero other wise
Firm size		Number of total workers by firm
Firm size square		Square of Number of total workers by firm
Firm exports:	Whether the firm export or not during the survey period	Dummy variable equal 1 if the firm is exporting, zero other wise
Region	7 geographical regions as per the ministry of planning classification	Categorical variable of 7 groups: "Cairo region" "Alex region" "Delta region" "Canal region" "North upper Egypt region" "Middle upper Egypt region " "South upper Egypt region " With the Cairo region group as reference.
Firm age	Firms age classified in 6 groups	Firms age is Computed by subtracting date of beginning to practice current activity from 2013. Then a Categorical variable of 6

		groups is created “0-3 years” “4-7 years old” “8-12 years old” “12-20 years old” “20-50 years old” “Over 50 years”
Log Total factor productivity	Total factor productivity at the firm level	Computed as the predicted residual of the cobb Douglas production function in log value
Firm legal form	Whether the firm is individually owned or not	Dummy variable equal 1 if the firm is individually owned, zero other wise
Log share of workers in managers and professionals	The share of workers in the managers and professionals’ occupation from total workers of the firm	Measured by dividing number of workers in this occupation by the total number of workers in this firm then taking the log
Log share of workers in white collars	The share of workers in the white collars’ occupation from total workers in this firm	Measured by dividing number of workers in this occupation by the total number of workers in this firm then taking the log
Log Industry capital labor ratio	The log of the capital labor ratio at the four digits industry level	Measured by dividing total capital by total labor at the 4-digit industry level then taking the log
Log Share of firms that export at four digits industry level	The share of firms that exports from total firms at the 4 digits industry level	Measured by dividing number of firms hat export by the total number of firms at the 4-digit industry level then taking the log
average productivity at four digits industry level	The mean of the firm total factor productivity at the 4 digits industry level	Measured as the mean value of firms’ total factor productivity obtained from the cobb Douglas production function for each 4 digits industry
average firm size at four digits industry level	The mean of firm size at four digits industry level	Measured as the mean value of firms’ total employment for each 4 digits industry