Economic Research Forum

Gender Diversity, Productivity, and Wages in Egyptian Firms

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October 2017
Work in Progress

[1] The authors acknowledge the financial support provided by the Economic Research Forum as well as invaluable comments from Ragui Assaad, Caroline Krafft, and the participants of the 2017 ERF Workshop. All errors remain with the authors.

1. Introduction

Typically, women are not employed evenly across firms and sectors. This observation owes to many causes ranging from demand side factors such as outright discrimination and low job growth in female-dominated sectors, to supply side factors like gendered educational attainment and social norms. The consequences are that employment and wage patterns are gender segregated. Unlike most of the existing literature on Egypt, this paper does not concentrate on supply side factors only in studying this phenomenon. Instead, it utilizes firm level-data to focus on potential factors influencing firm demand for female labor by exploring the link between gender diversity and firms' productivity and wages across sectors. This is carried out in the context of newly available establishment data for the Egyptian labor market.

In recent years, examination of the negative economic consequences of gender inequalities has emerged from unexpected quarters, such as McKinsey (McKinsey Global Institute 2016) and the IMF (e.g. Cuberes 2014, Elborgh-Woytek et al 2013, IMF 2016). These organisations are now promoting the idea that countries with low female (and hence total) labour force participation – more exactly, employment - rates experience reduced diversification and output and forego significant demand and growth effects and advocating policy makers to act to increase employment among women. MENA and South Asian countries have the lowest female participation and employment rates in the world. They would therefore seem to have the most to gain from raising women's participation in the labour force.

Increasing female labour force is not, however, a matter amenable to simple policy intervention. The only available direct measure is to provide more jobs in the public sector. Any such move is fiscally constrained. In Egypt, where the public sector is indeed the main provider of jobs for women, it has also to some extent counterproductive by negatively affecting the nature of women's insertion in the labour market (Assaad, various).

Employers are the agents of job creation, whether in state owned enterprises or the private sector. From employers' perspective, encouragement to increase women's share in the workforce faces several objections and disincentives. The first is that employment law may and in Egypt does require costly, special treatment for women workers, notably paid maternity leave (IFC 2016). Second, women workers tend to present with other kinds of costs, not legally prescribed, but to do with their social role as wives and mothers. Women may demand more time off, be less willing to work overtime, and insist on socially protective conditions within the workplace to reassure themselves and their families that they are not exposed to sexual

harassment. Even if these facilities are provided, and women are paid less than men to offset employers' costs in this regard (different wage payments being allowed by statute in Egypt (IFC 2016)), women lack commitment to employment and exhibit higher absenteeism and turnover rates than men (Hakim 1995). Third, greater gender equality in employment could be at the cost of production efficiency. Employers may believe that they are justified in not recruiting women in greater numbers because they are less productive workers than men, either because they are less dedicated to their work as a consequence of their social obligations or because they are less experienced and/or skilled and therefore less effective at their tasks. This paper examines the last of these hypotheses, i.e. the relative productivity and wages of enterprises in the private sector with respect to the gender diversity of their workforce for the case of Egypt. This of course, is done bearing in mind that it is very difficult to make claims of causality on this relationship, because women, as a result of discrimination, may face entry barriers to high-tech / high-wage firms, and hence, they may have no choice but to crowd in the labor intensive / lower-productivity jobs that are made available to them.

With this caveat in mind, the contribution of this paper is twofold. Firstly, we empirically measure the relationship between gender diversity, wages, and productivity using a novel firm-level dataset for Egypt. The data enables us to explore the relationship across sectors focusing on differential impacts of gender diversity in knowledge-intensive and less knowledge-intensive services, and high- and low-technology manufacturing. Secondly, the paper complements the prior work on women's labor force preferences for public sector employment, by looking at characteristics of firms that provide greater or lesser access to women's employment in the private sector.

Our findings indicate that greater shares of women's employment and greater gender diversity have a positive association with productivity and wages in the knowledge-intensive services sector, but a negative relationship in the less knowledge-intensive services and manufacturing sectors.

The rest of the paper is organized as follows. Section 2 presents a review of select relevant literature. Section 3 describes the data and methodology employed in our analysis. Section 4 presents the empirical findings. Section 5 discusses limitations and concludes.

2. Literature Review

Theory suggests that diversity can influence firm productivity both positively or negatively. Greater diversity of the workforce can on lead to improved productivity when employees hold complementary skills facilitating knowledge spillover effects (Lazear, 1999). Ethnic diversity can also improve decision-making and problem-solving (Hong and Page, 2001) and knowledge heterogeneity is an important part of the knowledge production process (Berliant and Fujita, 2008). However, greater diversity may hurt productivity due to co-worker discrimination (Becker, 1957) or from workers' preferences for ethnic homogeneity (Lazear, 1999), greater distrust among heterogeneous workers (Alesina and La Ferrara, 2002). If labor diversity has an impact on firm productivity, and if productivity is related to wages, then diversity may also influence wages.

Taking these theories to the test also produces competing results as well as differential impacts across sectors. Garnero et al., (2013) find educational diversity raises productivity and wages, age diversity does the opposite, and the effect of gender diversity is positive in high-technology and knowledge intensive sectors, but negative in more traditional sectors. Parrotta et al., (2014) find that diversity in ethnicity has a negative impact on productivity, while demographic diversity has no impact. The impact of skill diversity depends on the industry. Barrington and Troske (2001) find diversity has a positive impact on productivity. Iranzo et al., (2006) find a positive effect on productivity of skill dispersion within occupational groups. Skill diversity also has a positive effect on productivity in the manufacturing sector through human capital spillovers (Navon, 2009). Grund and Westergaard-Nielsen (2005) find an inverse u-shaped relationship between age diversity and productivity, with some differences across sectors and firm sizes. Few studies have included gender diversity in their analysis.

The literature on diversity broadly suggests different causal mechanisms between workforce diversity and productivity. Resource-based theory (Barney, 1991) states that there is a positive link between workforce diversity and firm productivity as psychological differences, experiences, and backgrounds can equip an organization with a diverse set of skills, knowledge, and perspectives. This could lead to better market insight, higher creativity, and innovation, which can lead to a higher rate of productivity. Social identity theory suggests that it is common for genders to have a tendency to group together, resulting in a male groups and female groups (Tajfel, 1982). Each gender group has a tendency to view themselves as superior (Tajfel and Turner, 1979). This phenomenon can result in decreased communication (Kravitz 2003), stereotype-based role expectations (Elsass and Graves 1997), a lack of cohesion

(Triandis, Kurowski and Gelfand 1997) and cooperation (Chatman and Flynn 2001), and increased conflict (Pelled 1996). These could in turn lead to lower firm productivity.

Empirical work on the link between female participation and gender diversity on firm outcomes has shown mixed results. Some have found that female-owned firms tend to have worse performance than male owned firms (Bardasi et al, 2011), possibly due to the fact that females face more constraints than males in securing credit, gender bias affects females adversely in legal treatment, and females are more affected by crime and corruption than their male counterparts. Others, though, have found that female-owned firms in Africa are at least as productive as their male counterparts (Bardasi et al 2007). Baliamoune & Lutz (2017) expand on this research by analyzing whether having female-owners and female managers has an effect on firms' productivity, specifically in the MENA region. Their work finds that firms that are managed by females, but do not have female owners have higher productivity. Conversely, firms who have female-owners and female managers have lower productivity.

The type of industry has an effect on the strength of the relationship between gender diversity and performance. Based on the empirical research, it was found that the gender-diversity provides a competitive advantage for the service industry, as there is an interrelationship between the employee and the customer. Diversity in the workforce provides insights into the needs of male and female customers (Richard 2002). On the other hand, the manufacturing industry's workforce has relatively low job interdependence (Dean and Snell 1991) and limited interaction (Frink et al. 2003). This limits the interactions between gender groups, which can cause the negative effects of the social identity theory to occur (Baliamoune and Lutz, 2017).

Also, complex industries that rely on innovation find workplace diversity to be an asset. A firm's likelihood to innovate increases when workers have various skills, information sets, and backgrounds. If the workforce is diverse, the firm increases its potential ideas and solutions to any given challenge. Garnero et al. (2013) finds that productivity rises by on average 2.5%-6% following one standard deviation increase in gender diversity in high-knowledge, high-tech fields. In the manufacturing industry, however, gender-diversity hurts firm productivity. Prat (2002) and Jehn et al. (1999) highlighted that industries such as manufacturing that require routine and rudimentary tasks find workplace diversity a net-loss. Workforce homogeneity is favorable when workers must coordinate a series of actions with various units. In this situation, homogeneity can increase communication, expectations, and therefore also increase productivity.

3. Methodology and Data

The empirical approach is based on the separate estimation of a value added function and a wage equation at the firm level. We use a linear econometric model with fixed effects that takes into account the heterogeneity across firms, sectors and governorates within Egypt (Garnero 2014, Melitz, 2003). The equations provide parameter estimates for the impact of labour diversity (with respect to education, age, and gender) on average productivity and wages, respectively. Both equations are estimated using the same sample with identical control variables. Because of this, the parameters for marginal products and wages can be compared. From this comparison, we can draw conclusions regarding how the benefits or losses of diversity are shared between employees and firms. As noted by Garnero et al. (2014), this technique was originally used by Hellerstein and Neumark (1995), Hellerstein and Neumark (2004) and van Ours and Stoeldraijer (2011). We use their same initial model where the estimated firm-level productivity and wage equations are the following:

$$\text{Log (Value added/hours)}j = \alpha + \beta_{1G}{}^{\sigma}{}_{j} + \lambda X_j + \varepsilon_j \qquad (1)$$

$$\text{Log (Total wages/hours)}_j = \alpha^* + \beta_{1}{}^{*}{}_{G}{}^{\sigma}{}_{j} + \lambda^* X_j + \varepsilon_j^* \qquad (2)$$

The dependent variables in the estimated equations are firms' value added per worker (1) and average wages on an hourly basis (2). The dependent variable in equation (1) is firm j's value added per worker. This was calculated by dividing the total added value of firm j by the total number of workers. The dependent variable in equation (2) is firm j's average hourly gross wage. Labor diversity indicators with respect to gender ($G\sigma$) are the main variables of interest.

As a segregation index of gender diversity, three main measures have been implemented in the regressions: average dissimilarity index, Herfindahl index and the share of females.
At a first stage, the share of females per firm has been included in the regressions.

Then, Following Rhoades (1993) normalized Herfindahl index[2] has carried out in our empirical estimations on the firm level[3]. The index is implemented as follows:

$$Herfindahl = 1 - \sum_{i=1}^{s} p_i^2$$

p_i^2 is the quadratic form of the share of each group. As we deal with only two groups (males and females), in our regressions we multiplied the index by two in order to simplify the interpretation of our coefficients. When the index is zero, one group dominates the firm. Finally, the average dissimilarity index has been implemented. It represents the shares of males and females, has been constructed on the firm level as follows:

$$Average\ Dissimilarity = S_{fj} \times S_{mj}$$

$S_{fj}\ and\ S_{mj}$ represent the share of females and males respectively within the firm j. The index ranges from zero (perfect dissimilarity of distribution between the two groups) to 0.25 (greatest similarity of distribution between the two groups). For simplification, especially in the interpretation of the empirical results, the index has been multiplied by four to range from 0 (dominance of one group) to 100 (no dominant group).

The dataset used is the Economic Census (EC) 2013. It is a 50% subsample of all establishments in Egypt. The data has been collected in 2013 by the Central Agency for Public Mobilization and Statistics (CAPMAS) and has been provided by the Economic Research Forum (ERF). The database provides substantial information on the firm level including economic. These include detailed information on the activity of the firm, location, age, number of employees by gender, and levels of labor and capital. Public sector establishments are not included in our analysis.

To assess the differential effects of gender diversity by sector we followed the classification of industries proposed by Eurostat that distinguishes the two-digit sector into two main sectors: Manufacturing and Services. Furthermore, each sector (Manufacturing, Services) has been dissected into two main sub-sectors according to technological intensity for the manufacturing sector and the knowledge intensity in the service sector. Regarding the manufacturing sector, two main industries can be distinguished according to the technological intensity: High,

[2] The normalized Herfindahl index is bounded between zero (diversity) and one (dominance of one group). In our regressions, we subtracted the index by one in order to have comparable results with the average dissimilarity index.

[3] This index can be used to measure diversity within firms. For more information, see Schneider and Eckl (2016) as well as Upadhyay and Zeng (2014).

Medium High technology (HT-MHT) and Low, Medium low technology (LT-MLT). Regarding the services sector, two sub-industries can be carried out according to the knowledge intensity: High Knowledge intensive Services (KIS) and Low Knowledge intensive Services (LKIS). Details of the aggregation are available in Appendix 1.

In order to incorporate employee characteristics within each sector, we merged the establishment survey with the "Egyptian Labor Market Survey 2012 (ELMPS). The ELMPS is a panel data survey compiled by Economic Research Forum (ERF) in cooperation with Central Agency for Public Mobilization and Statistics (CAPMAS). It covers substantial information on individuals covering employment and occupational characteristics, education, demographic information, and social background characteristics.

4. Empirical Findings

In this section we first present some descriptive analysis on the relationship between gender diversity, wages, and productivity, followed up by our regression results.

4.1 Descriptive Analysis

In Egypt, measures of diversity necessarily reflect the female share because women's presence in the private sector workforce is so low. The total share is 16 percent, and by industry, 19 percent of the workforce in services and 13 percent in manufacturing. By 2 digit sector, women constitute more than 40 percent in only four services industries (social work, human health, residential care and education). In several other, larger service activities women are almost entirely absent from the workforce. In manufacturing, women constitute more than 40 percent of the workforce in only one industry (wearing apparel) and more than 20 percent in only two (computer, electronic and optical products and pharmaceuticals products and preparations), with negligible shares in many other activities. The only 2 digit female-dominated (female workforce majority) industries in Egypt are education and residential care.

Women's employment in Egypt is segregated by occupational sector. The share of females in KIS is over 30%, compared to approximately 10% in LKIS, and only 6% and 5% in HT-MHT and LT-MLT respectively (Figure 4). The gender composition of firms across these sectors is also not even. Firms operating in KIS employ men and women together more so than other sectors, followed by HT-MHT, LKIS, and LT-MLT.

The distribution of female shares and gender diversity are also systematically different by firm size. Meanwhile, women's employment is greatest among medium-sized firms.

Figure 1: Distribution by gender within firms in Egypt

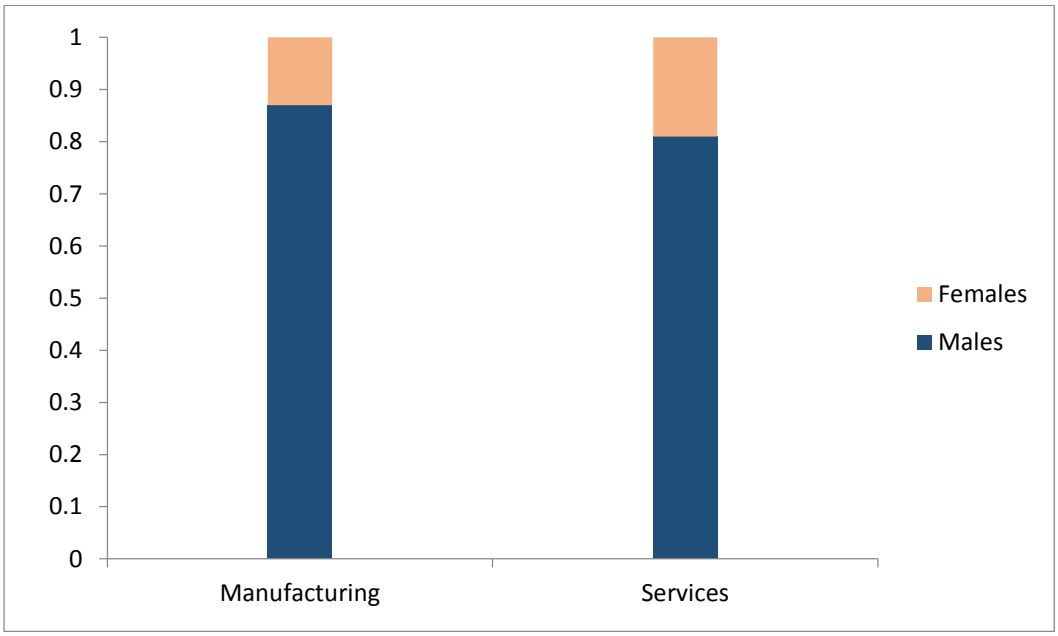


Figure 2: Sectors with highest and lowest shares of female employment - Manufacturing

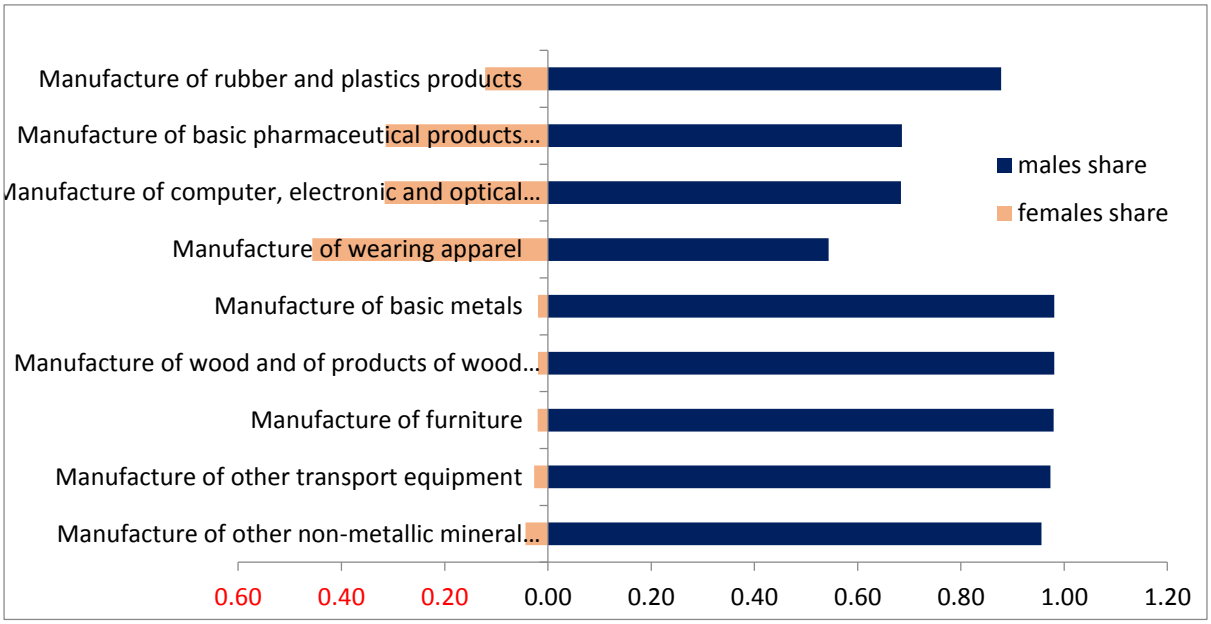


Figure 3: Sectors with highest and lowest shares of female employment - Services

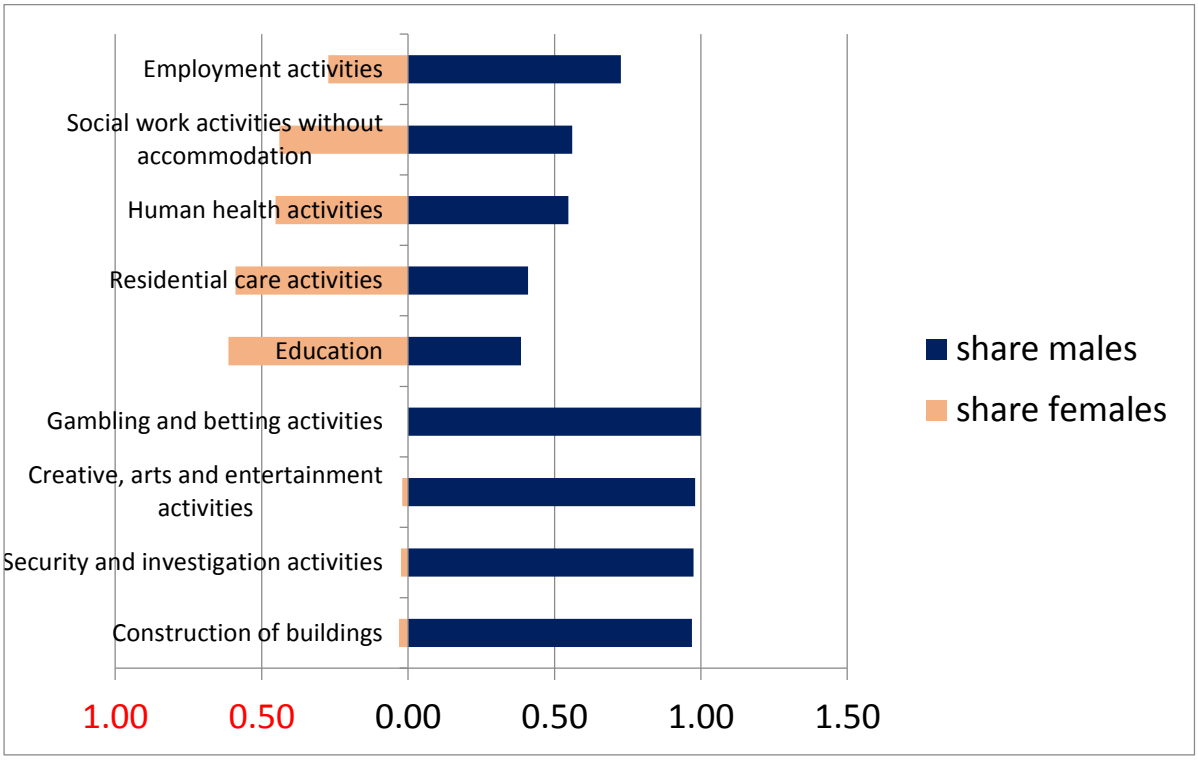


Figure 4. Distribution of Female Share and Gender Diversity by Sector

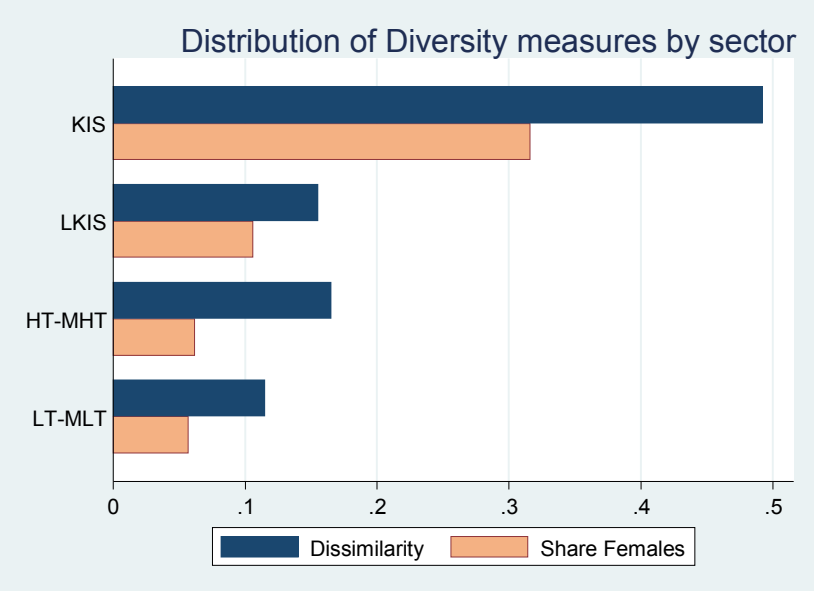
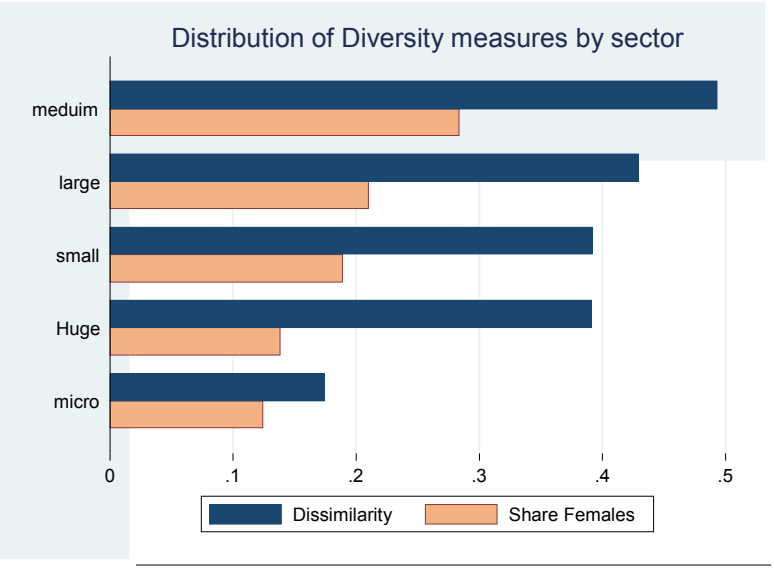


Figure 5. Distribution of Female Share and Gender Diversity by Firm Size



Note: Firm size is defined by number of workers such that huge >=1000), large 250-999, medium 50-249, small 10-49, and micro 0-9.

Combining the elements of firm size and sector classification provides a helpful visual representation of where women are engaging in the labor force. In Figures 6-7 vertical axes display the female share by firm and the horizontal axes display value added per worker and wages. The size of the markers denotes the firm size (5 categories) and the color denotes the industry classification (4 categories). There is a close association between firm size and both value added as well as wages. In Figure 6, the largest KIS and larger HT-MHT sectors have greater value added than the LKIS and LT-MLT. However, while the KIS as a whole has the largest share of female employees, female shares are highest among the smaller and lower value added firms within the industry. A similar pattern is apparent in the case of wages. The largest firms pay the highest wages with KIS paying the highest wages, followed by HT-MHT, LT-MLT and LKIS. The graphs reveal that women's employment is concentrated foremost in firms in the KIS sector, but in particular, among the small to medium sized firms within this sector.

Figure 6. Female Share and Value Added per Worker

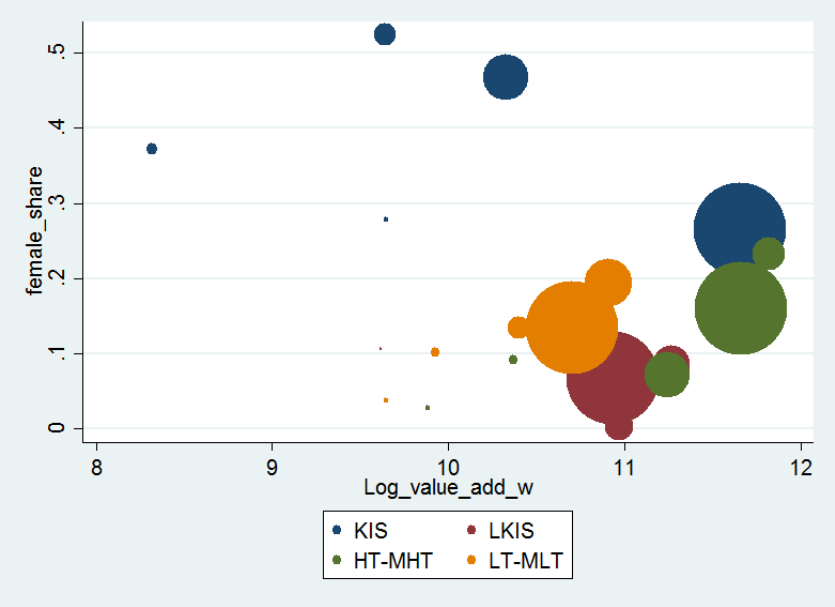
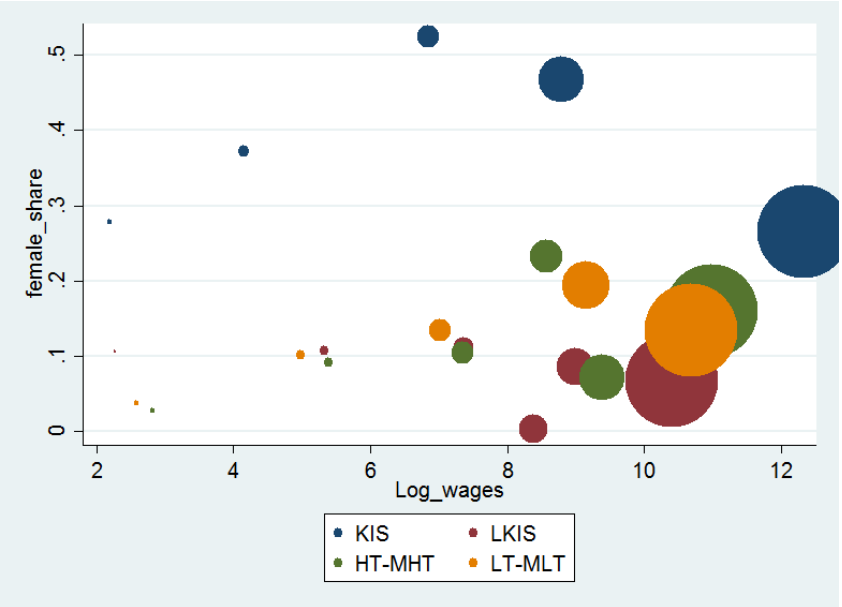


Figure 7. Female Share and Wages per Worker



4.2 A- Productivity and Wage Models

Table 1 presents means of the variables used in the regression analysis. The rest of the summary statistics are reported in Appendix 2. The majority of the sample is in the services industry, with 55.6 percent in the LKIS and 22.5 percent in the KIS. Most of the manufacturing firms are LT-MLT comprising 20.5 percent of the total, with only 1.4 percent of firms in HT-MHT.

This small percentage of high-tech manufacturing firms has the highest value added and wages per worker. These are followed by the LT-MLT and KIS, and the LKIS come at the bottom. As expected, there is a low concentration of women and low diversity in the manufacturing firms. The highest presence of women as well as diversity is in the KIS.

Table 1. Means of Dependent Variables and Diversity Measures

Mean	**KIS**	**LKIS**	**MT-MHT**	**LT-MLT**
Value add per worker	46186.81	95493.47	76356.51	35275.40
Wage per worker	6.12	5.52	12.2	6.85
Herfindahl[4]	0.24	0.07	0.08	0.05
Share Females	0.32	0.11	0.06	0.06
Average dissimilarity	0.49	0.15	0.17	0.11
Observations				
Total	13560	33502	841	12355

Regression results for value added per worker and wages across the four sector categories are displayed in Tables 2-5. The tables display the coefficients for capital, labor, education, and age, followed by our indicators on the female labor share and gender diversity. Fixed effects are included for firm size and firm geographic location. The tables are organized by sector and in each case the first four columns display results for value added per worker and the latter four columns wages per worker.

Taken as a whole, the regression results paint a consistent and expected picture that a larger female share and greater labor force diversity is positively associated with productivity and wages in some sectors, but negatively in others. Results are largely across different specifications and gender diversity measures. In the case of KIS, there is a positive association between the share of women and greater gender diversity, and value added per worker and wages. This relationship becomes negative for both value added and wages in LKIS and LT-MLT sectors. The effect is essentially insignificant for HT-MHT.

[4] These are summary stats of the normalised Herfindahl index.

Table 2. Knowledge-Intensive Services Value Added and Wages per Worker

VARIABLES	(1) VA per worker KIS	(2) VA per worker KIS	(3) VA per worker KIS	(6) wage per worker KIS	(7) wage per worker KIS	(8) wage per worker KIS
lcap	0.224***	0.219***	0.293***	0.102***	0.0952***	0.113***
	(0.0174)	(0.0170)	(0.00747)	(0.00986)	(0.00958)	(0.00391)
llabor	-0.393***	-0.422***	-0.431***	0.801***	0.778***	0.585***
	(0.0542)	(0.0537)	(0.0230)	(0.0328)	(0.0318)	(0.0134)
educ_person	0.363***	0.347***	0.588***	0.204***	0.180***	0.262***
	(0.0392)	(0.0385)	(0.0194)	(0.0260)	(0.0248)	(0.0111)
age_person	-0.0730***	-0.0714***	-0.0502***	-0.0480***	-0.0456***	-0.0386***
	(0.0137)	(0.0141)	(0.00531)	(0.00891)	(0.00916)	(0.00328)
share_females	0.153**			0.257***		
	(0.0694)			(0.0424)		
Herfindahl		0.232***			0.279***	
		(0.0537)			(0.0317)	
av4_diss			0.180***			0.209***
			(0.0249)			(0.0143)
Constant	9.613***	9.743***	6.704***	-1.712***	-1.570***	-1.625***
	(0.652)	(0.656)	(0.284)	(0.415)	(0.411)	(0.162)
Observations	13,118	13,118	13,118	13,357	13,357	13,357
R-squared	0.243	0.248	0.371	0.530	0.538	0.479
Firm Size FE	YES	YES	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3. Less Knowledge-Intensive Services Value Added and Wages per Worker

VARIABLES	(1) VA per worker LKIS	(2) VA per worker LKIS	(3) VA per worker LKIS	(4) wage per worker LKIS	(5) wage per worker LKIS	(6) wage per worker LKIS
lcap	0.114***	0.117***	0.166***	0.0176***	0.0185***	0.0319***
	(0.0138)	(0.0139)	(0.00432)	(0.00576)	(0.00578)	(0.00240)
llabor	0.0314	0.119***	0.107***	1.082***	1.158***	1.078***
	(0.0424)	(0.0451)	(0.0118)	(0.0137)	(0.0144)	(0.00656)
educ_person	0.344***	0.341***	0.374***	0.0562*	0.0488	0.100***
	(0.0640)	(0.0629)	(0.0199)	(0.0339)	(0.0337)	(0.0108)
age_person	-0.0397***	-0.0349***	-0.00805**	-0.0428***	-0.0345***	-0.0243***
	(0.0109)	(0.0111)	(0.00359)	(0.00532)	(0.00535)	(0.00215)
share_females	-0.641***			-0.317***		
	(0.0488)			(0.0247)		
Herfindahl		-0.541***			-0.419***	
		(0.0440)			(0.0235)	
av4_diss			-0.354***			-0.253***
			(0.0193)			(0.0123)
Constant	9.720***	9.266***	6.892***	-0.681***	-1.159***	-1.796***
	(0.564)	(0.578)	(0.156)	(0.237)	(0.241)	(0.0911)
Observations	32,750	32,750	32,750	33,370	33,370	33,370
R-squared	0.161	0.163	0.244	0.571	0.586	0.659
Firm Size FE	YES	YES	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4. High Technology Manufacturing Value Added and Wages per Worker

VARIABLES	(1) VA per worker HT-MHT	(2) VA per worker HT-MHT	(3) VA per worker HT-MHT	(4) wage per worker HT-MHT	(5) wage per worker HT-MHT	(6) wage per worker HT-MHT
lcap	0.223***	0.225***	0.247***	0.0630	0.0637	0.0888***
	(0.0426)	(0.0425)	(0.0280)	(0.0410)	(0.0410)	(0.0168)
llabor	-0.153	-0.180	-0.0470	0.489***	0.481***	0.495***
	(0.134)	(0.134)	(0.0749)	(0.165)	(0.166)	(0.0530)
educ_person	0.193	0.117	0.443*	0.233	0.209	0.576***
	(0.390)	(0.385)	(0.231)	(0.298)	(0.304)	(0.156)
age_person	-0.0649**	-0.0604**	-0.0439***	-0.0704***	-0.0690***	-0.0710***
	(0.0306)	(0.0304)	(0.0143)	(0.0226)	(0.0223)	(0.0110)
share_females	-0.258			-0.0637		
	(0.335)			(0.252)		
Herfindahl		0.101			0.0406	
		(0.201)			(0.144)	
av4_diss			0.0295			-0.178**
			(0.129)			(0.0814)
Constant	9.915***	10.13***	7.052***	1.288	1.354	-0.642
	(1.306)	(1.293)	(0.817)	(1.301)	(1.327)	(0.548)
Observations	828	828	828	835	835	835
R-squared	0.390	0.389	0.329	0.545	0.545	0.597
Firm Size FE	YES	YES	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5. Low Technology Manufacturing Value Added and Wages per Worker

VARIABLES	(1) VA per worker LT-MLT	(2) VA per worker LT-MLT	(3) VA per worker LT-MLT	(1) wage per worker LT-MLT	(2) wage per worker LT-MLT	(3) wage per worker LT-MLT
lcap	0.122***	0.122***	0.164***	0.0149	0.0155	0.0439***
	(0.0111)	(0.0112)	(0.00570)	(0.0101)	(0.0101)	(0.00415)
llabor	-0.0117	-0.00400	-0.0228	1.167***	1.182***	0.951***
	(0.0298)	(0.0304)	(0.0148)	(0.0216)	(0.0219)	(0.0105)
educ_person	-0.0681	-0.0790*	-0.0156	-0.0325	-0.0282	-0.0303**
	(0.0452)	(0.0451)	(0.0203)	(0.0383)	(0.0386)	(0.0154)
age_person	-0.00482	-0.00457	-0.00225	7.61e-05	0.000511	0.0134***
	(0.00801)	(0.00804)	(0.00364)	(0.00711)	(0.00712)	(0.00276)
share_females	-0.665***			-0.649***		
	(0.112)			(0.0913)		
Herfindahl		-0.296***			-0.459***	
		(0.0673)			(0.0589)	
av4_diss			-0.275***			-0.398***
			(0.0319)			(0.0234)
Constant	9.602***	9.583***	8.371***	-2.340***	-2.413***	-2.451***
	(0.395)	(0.398)	(0.158)	(0.313)	(0.311)	(0.111)
Observations	12,204	12,204	12,204	12,264	12,264	12,264
R-squared	0.148	0.142	0.199	0.599	0.601	0.606
Firm Size FE	YES	YES	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

B- Results using dissimilarity by dominance group

The previous regressions show the effect of dissimilarity by gender without taking into account whether the dominant group is males or females.

For the purpose of distinguishing the dissimilarity by dominant group, two main variables should be included in the econometric specification: dissimilarity for females dominated firms ($Diss_{females}$) and dissimilarity for males dominated firms ($Diss_{males}$).[5] The specification of those variables can be written as follows:

$$Diss_{females} = Majority_{females} \times \text{Herfindahl}$$

$$Diss_{males} = (1 - Majority_{females}) \times \text{Herfindahl}$$

$Majority_{females}$ is a dummy variables that takes one if the firm is dominated by females and zero otherwise.

The results based on this alternative measure of diversity are reassuring. Table 6 shows results for the impact of diversity on value added per worker across different sectors. In KIS, greater diversity, whether in male or female dominated firms, has a positive effect on value added, which is consistent with the results in Table 2. In the LKIS, the results are also consistent, where diversity has a negative effect on value added with a stronger degree in female dominated firms. In the case of manufacturing, diversity still has a negative effect on value added, especially in female dominated firms in the case of LT-MLT. The results are neither significant in male dominated firms nor in the female dominated ones in the case of HT-MHT. As expected, based on other dissimilarity indices results, the results for wages are very similar to the productivity outcomes also here , as presented in Table 7 below.

[5] Results should be investigated and extended in the next draft

Table 6. Value Added per Worker across Sectors

VARIABLES	(1) VA per worker LT-MLT	(2) VA per worker HT-MHT	(3) VA per worker KIS	(4) VA per worker LKIS
Lcap	0.164***	0.246***	0.218***	0.117***
	(0.00570)	(0.0281)	(0.0169)	(0.0139)
Llabor	-0.0267*	-0.0494	-0.435***	0.108**
	(0.0149)	(0.0749)	(0.0569)	(0.0463)
educ_person	-0.0160	0.446*	0.339***	0.339***
	(0.0203)	(0.231)	(0.0383)	(0.0628)
age_person	-0.00253	-0.0441***	-0.0711***	-0.0355***
	(0.00364)	(0.0143)	(0.0142)	(0.0111)
diss_males	-0.179***	0.0606	0.329***	-0.377***
	(0.0404)	(0.140)	(0.113)	(0.0865)
diss_females	-0.408***	-0.0584	0.205***	-0.571***
	(0.0449)	(0.243)	(0.0479)	(0.0443)
Constant	8.394***	7.058***	9.819***	9.265***
	(0.158)	(0.817)	(0.669)	(0.578)
Observations	12,204	828	13,118	32,750
R-squared	0.201	0.329	0.249	0.164
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 7. Wage per Worker across Sectors

VARIABLES	(1) Wages per worker LT-MLT	(2) Wages per worker HT-MHT	(3) Wages per worker KIS	(4) Wages per worker LKIS
lcap	0.0435***	0.0892***	0.0950***	0.0181***
	(0.00414)	(0.0168)	(0.00947)	(0.00576)
llabor	0.948***	0.496***	0.770***	1.149***
	(0.0105)	(0.0530)	(0.0337)	(0.0146)
educ_person	-0.0307**	0.574***	0.175***	0.0469
	(0.0154)	(0.156)	(0.0243)	(0.0337)
age_person	0.0132***	-0.0709***	-0.0455***	-0.0348***
	(0.00275)	(0.0110)	(0.00925)	(0.00534)
diss_males	-0.322***	-0.201**	0.333***	-0.284***
	(0.0289)	(0.0925)	(0.0684)	(0.0539)
diss_females	-0.501***	-0.114	0.264***	-0.445***
	(0.0334)	(0.148)	(0.0291)	(0.0243)
Constant	-2.433***	-0.645	-1.527***	-1.159***
	(0.110)	(0.547)	(0.418)	(0.239)
Observations	12,264	835	13,357	33,370
R-squared	0.606	0.597	0.539	0.586
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

5. Conclusion

Using the newly available EC 2013 dataset, this paper has explored the relationship between gender diversity and firms' productivity and wages. The results suggest that gender diversity is positively associated with productivity and wages in the knowledge-intensive service sector. This finding is consistent with the notion that higher gender diversity increases heterogeneity of beliefs and values, and thus may be linked to greater critical thinking required in knowledge-based industries (Lee and Farh, 2004). Our second finding is that there is a negative or no association with productivity and wages among less knowledge-intensive service and both high- and low-tech manufacturing firms. These relationships with diversity and productivity are maintained when we control for whether the firm is male or female

dominated and are robust to changing the productivity measure from value added per worker to TFP. The results for wages are very similar to those for productivity

In future drafts of this paper, we will explore additional dissimilarity indices that take into consideration potential non-linearities in the relationship between gender diversity and firm outcomes. Secondly, we will also investigate the possibility of using other classifications of firms that take into account more explicitly gender-specific occupational preferences and roles within the firm (perhaps by merging information from the ELMPS 2012). Thirdly, other firm characteristics, such as informality, and interactions between diversity and firm characteristics could be incorporated in the analysis.

There are a number of important caveats. These findings should not be interpreted causally. There are a number of characteristics that this analysis was not able to control for due to data limitations. Typically studies that endeavor to measure the causal link between employee characteristics and firm outcomes use matched panel employee-employer data. This type of data would allow us to examine another host of hypotheses such as types of discrimination, factors influencing crowding of women in particular occupations and industries, and more generally the interaction of supply side and demand side determinants of wage and productivity outcomes.

References:

Alesina, Alberto, and Eliana La Ferrara. 2005. "Ethnic Diversity and Economic Performance." Journal of Economic Literature 43(3): 762-800.

Ali, M., Kulik, C. T., & Metz, I. (2011). The gender diversity–performance relationship in services and manufacturing organizations. The International Journal of Human Resource Management, 22(07), 1464-1485.

Assaad, R., & Krafft, C. (2015). The Structure and Evolution of Employment in Egypt: 1998-2012. The Egyptian Labor Market in an Era of Revolution, 27-51.

Baliamoune-Lutz, M., & Lutz, S. Gender and Firm Performance in Middle Eastern and African Economies.

Bardasi, E., Blackden, C. M., & Guzman, J. C. (2007). Gender, Entrepreneurship, and Competitiveness. The Africa Competitiveness Report.

Bardasi, E., Sabarwal, S., & Terrell, K. (2011). How do female entrepreneurs perform? Evidence from three developing regions. Small Business Economics, 37(4), 417.

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of management, 17(1), 99-120.

Barrington, L., & Troske, K. (2001). Workforce diversity and productivity: An analysis of employer-employee matched data. Economics Program Working Papers, (01-02).

Becker, Gary S. 1957. The Economics of Discrimination. Chicago: University of Chicago Press.

Berliant, M., & Fujita, M. (2011). The dynamics of knowledge diversity and economic growth. Southern Economic Journal, 77(4), 856-884.

Breen, R., & Garcia-Penalosa, C. (2002). Bayesian learning and gender segregation. Journal of Labor Economics, 20(4), 899-922.

Brown III, U. J., Knouse, S. B., Stewart, J. B., & Beale, R. L. (2009). The relationship between unit diversity and perceptions of organizational performance in the military. Journal of Applied Statistics, 36(1), 111-120.

Cataldi, Alessandra, Stephan Kampelmann, and François. Rycx. 2012. "Part-time Work, Wages, and Productivity: Evidence from Matched Panel Data." Brussels: unpublished manuscript.

Chatman, J. A., & Flynn, F. J. (2001). The influence of demographic heterogeneity on the emergence and consequences of cooperative norms in work teams. Academy of Management Journal, 44(5), 956-974.

Cuberes, D. and M. Teignier. 2014. "Gender Inequality and Economic Growth: A Critical Review." Journal of International Development 26: 260-276.

Dean, J. W., & Snell, S. A. (1991). Integrated manufacturing and job design: Moderating effects of organizational inertia. Academy of Management journal, 34(4), 776-804.

Dwyer, S., Richard, O. C., & Chadwick, K. (2003). Gender diversity in management and firm performance: The influence of growth orientation and organizational culture. Journal of Business Research, 56(12), 1009-1019.

Elborgh-Woytek, K., M. Newiak, K. Kochhar, S. Fabrizio, K. Kpodar, P. Wingender, B. Clements, and G. Schwartz. 2013. "Women, Work, and the Economy: Macroeconomic Gains from Gender Equity." Staff Discussion Note, SDN/13/10, (Washington: International Monetary Fund).

Elsass, P. M., & Graves, L. M. (1997). Demographic diversity in decision-making groups: The experiences of women and people of color. Academy of Management Review, 22(4), 946-973.

Foster, L., J. C. Haltiwanger, AND C. J. Krizan (2001): Aggregate Productivity Growth. Lessons from Microeconomic Evidence, chap. 9, pp. 303–372, New Develop- ments in Productivity Analysis. National Bureau of Economic Research, Inc.

Frink, D. D., Robinson, R. K., Reithel, B., Arthur, M. M., Ammeter, A. P., Ferris, G. R., ... & Morrisette, H. S. (2003). Gender demography and organization performance: A two-study investigation with convergence. Group & Organization Management, 28(1), 127-147.

Garnero, A., Kampelmann, S., & Rycx, F. (2014). The heterogeneous effects of workforce diversity on productivity, wages, and profits. Industrial Relations: A Journal of Economy and Society, 53(3), 430-477.

Göbel, Christian, and Thomas Zwick. 2012. "Age and Productivity: Sector Differences." De Economist 160 (1): 35-57.

Grund, C., & Westergård-Nielsen, N. (2008). Age structure of the workforce and firm performance. International Journal of Manpower, 29(5), 410-422.

Hakim, C., 1995, Five Feminist Myths about Women's Employment. The British Journal of Sociology, 46(3), 429-455.

Haltiwanger, J. Eric Bartelsman and Stefano Scarpetta "Cross-Country Differences in Productivity: The Role of Allocation and Selection" , American Economic Review, Vol. 103, Issue 1 (February 2013) , pp. 305-334

Hellerstein, J. K., & Neumark, D. (1995). Are earnings profiles steeper than productivity profiles? Evidence from Israeli firm-level data. Journal of Human Resources, 89-112.

Hellerstein, J. K., & Neumark, D. (2007). Production function and wage equation estimation with heterogeneous labor: Evidence from a new matched employer-employee data set. In Hard-to-measure goods and services: Essays in honor of Zvi Griliches (pp. 31-71). University of Chicago Press.

Hong, L., & Page, S. E. (2001). Problem solving by heterogeneous agents. Journal of economic theory, 97(1), 123-163.

IFC, 2016, Women, Business and the Law: Getting to Equal, World Bank, Washington DC

IMF, 2016, Gender Equality and Economic Diversification, by R. Kazandjian, L.Kolovich, K. Kochhar, and M. Newiak. Working Paper WP/16/140, African Department, Human Resource Department, and Strategy, Policy, and Review Department

Iranzo, S., Schivardi, F., & Tosetti, E. (2008). Skill dispersion and firm productivity: An analysis with employer-employee matched data. Journal of Labor Economics, 26(2), 247-285.

Jehn, Karen. 1995. "A Multimethod Examination of the Benefits and Detriments of Intragroup Conflict." Administrative Science Quarterly 40(4): 256–82.

Kiendrebeogo, Youssef "Export Activity and Productivity: New Evidence from the Egyptian Manufacturing Industry"

Kinda, Tidiane, Patrick Plane and Marie-Ange Vaerganzos-Varoudakis (2011) "Firm Productivity and Investment Climate in Developing Countries: How does Middle East and North Africa manufacturing perform?" Developing Economics

Kravitz, D. A. (2003). More women in the workplace: is there a payoff in firm performance?. The Academy of Management Executive, 17(3), 148-149.

Lazear, Edward P. 1999. "Globalisation and the Market for Team-Mates." Economic Journal 109(454): C15-40.

Lee, Cynthia L., and Jiing-Lih Farh. 2004. "Joint Effects of Group Efficacy and Gender Diversity on Group Cohesion and Performance." Applied Psychology 53(1): 136-54.

McKinsey Global Institute 2016, Delivering the Power of Parity: Toward a more gender- equal society, Working Paper, May

Melitz, M. J. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity. Econometrica, 71(6), 1695-1725.

Mincer, J., & Polachek, S. (1974). Family investments in human capital: Earnings of women. Journal of political Economy, 82(2, Part 2), S76-S108.

Navon, G. (2010). Human capital spillovers in the workplace: Labor diversity and productivity.

Parra, Maria and Inmaculada Martínez-Zarzoso (2015) " Imported Inputs and Egyptian Exports: Exploring the Links" Economics

Parrotta, P., Pozzoli, D., & Pytlikova, M. (2014). Labor diversity and firm productivity. European Economic Review, 66, 144-179.

Pelled, L. H. (1996). Demographic diversity, conflict, and work group outcomes: An intervening process theory. Organization science, 7(6), 615-631.

Prat, Andrea. 2002. "Should a Team Be Homogeneous?" European Economic Review 46(7): 1187–207.

Richard, O. C., Kochan, T. A., & McMillan-Capehart, A. (2002). The impact of visible diversity on organizational effectiveness: Disclosing the contents in Pandora's black box. Journal of Business and Management, 8(3), 265.

Schneider J. and V. Eckl (2016), "The difference make a difference: Team diversity and innovative capacity", OECD conference proceedings, Belgium, September 16, 2016

Solberg, E. J. (2005). The gender pay gap by occupation: A test of the crowding hypothesis. Contemporary Economic Policy, 23(1), 129-148.

Tajfel, H. (1982). Social psychology of intergroup relations. Annual review of psychology, 33(1), 1-39.

Tajfel, H. E. (1978). Differentiation between social groups: Studies in the social psychology of intergroup relations.

Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. The social psychology of intergroup relations, 33(47), 74.

Triandis, H. C., Dunnette, M. D., & Hough, L. M. (1994). Handbook of industrial and organizational psychology, Vol. 4.

Upadhyay and Zeng (2014), Gender and ethnic diversity on boards and corporate information environment, Journal of Business Research 67(11):2456–2463.

Van Ours, J. C., & Stoeldraijer, L. (2011). Age, wage and productivity in Dutch manufacturing. De Economist, 159(2), 113-137.

Vandenberghe, V. (2013). Are firms willing to employ a greying and feminizing workforce?. Labour Economics, 22, 30-46.

World Bank. 2004. World Development Report 2005: A Better Investment Climate for Everyone. New York: Oxford University Press.

Appendix 1

Manufacturing Industry Classification - NACE Rev. 2 codes – 2-digit level
High and medium-high are combined. Medium-low and low are combined.

High-technology	21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
	26	Manufacture of computer, electronic and optical products
Medium-high technology	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	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	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

Service Industry Classification - NACE Rev. 2 codes – 2-digit level
Knowledge Intensive Services

Knowledge intensive services (KIS)	50 to 51	Water transport; Air transport;
	58 to 63	Publishing activities; Motion picture, video and television programme production, sound recording and music publish activities; Programming and broadcasting activities; Telecommunications; computer programming, consultancy and related activities; Information service activities (section J);
	64 to 66	Financial and insurance activities (section K);
	69 to 75	Legal and accounting activities; Activities of head offices, management consultancy activities; Architectural and engineering activities, technical testing and analysis; Scientific research and development; Advertising and market research; Other professional, scientific and technical activities; Veterinary activities (section M);
	78	Employment activities;
	80	Security and investigation activities;
	84 to 93	Public administration and defence, compulsory social security (section O); Education (section P), Human health and social work activities (section Q); Arts, entertainment and recreation (section R).
Knowledge intensive market services (excluding high-tech and financial services)	50 to 51	Water transport; Air transport;
	69 to 71	Legal and accounting activities; Activities of head offices, management consultancy activities; Architectural and engineering activities, technical testing and analysis;
	73 to 74	Advertising and market research; Other professional, scientific and technical activities;
	78	Employment activities;
	80	Security and investigation activities;
High-tech knowledge intensive services	59 to 63	Motion picture, video and television programme production, sound recording and music publish activities; Programming and broadcasting activities; Telecommunications; computer programming, consultancy and related activities; Information service activities;
	72	Scientific research and development;
Knowledge intensive financial services	64 to 66	Financial and insurance activities (section K).
Other knowledge intensive services	58	Publishing activities;
	75	Veterinary activities;
	84 to 93	Public administration and defence, compulsory social security (section O); Education (section P), Human health and social work activities (section Q); Arts, entertainment and recreation (section R).

Less Knowledge Intensive Services

Less knowledge intensive services (LKIS)	45 to 47	Wholesale and retail trade; Repair of motor vehicles and motorcycles (section G);
	49	Land transport and transport via pipelines;
	52 to 53	Warehousing and support activities for transportation; Postal and courier activities;
	55 to 56	Accommodation and food service activities (section I);
	68	Real estate activities (section L);
	77	Rental and leasing activities;
	79	Travel agency, tour operator reservation service and related activities;
	81	Services to buildings and landscape activities;
	82	Office administrative, office support and other business support activities;
	94 to 96	Activities of membership organisation; Repair of computers and personal and household goods; Other personal service activities (section S);
	97 to 99	Activities of households as employers of domestic personnel; Undifferentiated goods- and services-producing activities of private households for own use (section T); Activities of extraterritorial organisations and bodies (section U).
Less knowledge intensive market services	45 t6 47	Wholesale and retail trade; Repair of motor vehicles and motorcycles (section G);
	49	Land transport and transport via pipelines;
	52	Warehousing and support activities for transportation;
	55 to 56	Accommodation and food service activities (section I);
	68	Real estate activities (section L);
	77	Rental and leasing activities;
	79	Travel agency, tour operator reservation service and related activities;
	81	Services to buildings and landscape activities;
	82	Office administrative, office support and other business support activities;
	95	Repair of computers and personal and household goods;
Other less knowledge intensive services	53	Postal and courier activities;
	94	Activities of membership organisation;
	96	Other personal service activities;
	97 to 99	Activities of households as employers of domestic personnel; Undifferentiated goods- and services-producing activities of private households for own use (section T); Activities of extraterritorial organisations and bodies (section U).

Appendix 2 – Summary Statistics of Variables by Sector

KIS sector	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	13560	46186.81	1987115	-1310864	230000000
Wage per worker	13560	6.12	29.52	0	1970
Herfindahl[6]	13560	0.24	0.14	0	1
Average dissimilarity	13560	0.49	0.44	0	1
Share Females	13560	0.32	0.31	0	1

LKIS	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	33502	95493.47	3457844	-7499976	600000000
Wage per worker	33502	5.52	15.56	0	2076
Herfindahl	33502	0.07	0.16	0	1
Average dissimilarity	33502	0.15	0.33	0	1
Share Females	33502	0.11	0.24	0	1

HT-MHT	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	841	76356.51	281509	-2056509	4167452
Wage per worker	841	12.20	15.18	0	276
Herfindahl	841	0.08	0.14	0	1
Average dissimilarity	841	0.17	0.29	0	1
Share Females	841	0.06	0.13	0	1

LT-MLT	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	12355	35275.40	226872	-235485	14900000
Wage per worker	12355	6.85	8.80	0	385
Herfindahl	12355	0.05	0.14	0	1
Average dissimilarity	12355	0.11	0.28	0	1
Share Females	12355	0.06	0.16	0	1

[6] These are summary stats of the normalised Herfindahl index