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GENDER DIVERSITY, PRODUCTIVITY, AND WAGES IN EGYPTIAN FIRMS

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Abstract

Women's employment is not evenly distributed across sectors and this variance in gender diversity can impact firms' productivity and wages. Using the newly available EC 2013 dataset, this paper explores the relationship between gender diversity, productivity, and wages. Our first finding is that gender diversity is positively associated with productivity and wages in the knowledge-intensive service sector. This result 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. 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 are robust across different industry classifications and measures of diversity.

JEL codes: J16, J23, L22, M51
Keywords: Gender Diversity, Firm productivity, Wages

ملخص

انطلقت الثورة الليبية منذ أكثر من سنة متوازية مع ثورات الربيع العربي الأخرى التي أطاحت ببعض حكام البلدان العربية، وما إن وافقت الجامعة العربية وأمريكا وأوروبا على ضرورة تدخللا يتم توزيع تشغيل النساء بالتساوي بين القطاعات المختلفة، ويمكن أن يؤثر هذا التباين في التنوع الجنسانى على إنتاجية وأجور الشركات. من خلال استخدام مجموعة بيانات الاتحاد الأوروبي 2013 المتاحة مؤخرا، تستكشف هذه الورقة العلاقة بين تنوع النوع الاجتماعي من ناحبة، والإنتاجية والأجور من ناحية أخرى. أول ما نخلص إليه هو أن التنوع بين الرجال والنساء يرتبط ارتباطًا إيجابيًا بالإنتاجية والأجور في قطاع الخدمات الذي يعتمد على المعرفة. وتتسق هذه النتيجة مع الفكرة القائلة بأن زيادة التنوع بين الجنسين تزيد من عدم تجانس المعتقدات والقيم، وبالتالي قد ترتبط بتفكير نقدي أكبر تشتد الحاجة إليه في الصناعات القائمة على المعرفة. والنتيجة الثانية التي خلصت إليها الورقة هي وجود ارتباط سلبي أو عدم وجود ارتباط بالإنتاجية والأجور وبين الخدمات الأقل كثافة في المعرفة والتصنيع الصناعي سواء كانت الشركات تستخدم تقنية عالية أو منخفضة ، فهذه العلاقات قوية عبر تصنيفات الصناعة المختلفة وعبر قياسات التنوع.

1. Introduction

Typically, women are not employed evenly across firms and sectors. This observation can be traced to different 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, wage and productivity patterns are possibly gender segregated. Unlike most of the existing literature on Egypt, this paper does not concentrate on supply side factors in studying this phenomenon. Instead, it utilizes firm-level data to focus on potential factors influencing demand for female labor by exploring the link between gender diversity and firms' productivity and wages across sectors. This exercise is carried out in the context of newly available establishment data for the Egyptian labor market from .2013

In recent years, examination of the negative economic consequences of gender inequalities has emerged (Cuberes and Teignier, 2014; Elborgh-Woytek et al., 2013; McKinsey, 2016). International organizations 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 forgo significant demand and growth effects hence advocating that policy makers act to increase employment among women. Because MENA and South Asian countries have the lowest female participation and employment rates in the world, these regions would therefore seem to have the most to gain from raising women's participation in the labour force. The simple tool of providing women more jobs in the public sector is fiscally costly. In Egypt, where the public sector is indeed the main provider of jobs for women, it would be a counterproductive move as it would negatively affect the nature of women's insertion in the labour market.

At the most basic level, employers are the agents of job creation, whether in state owned enterprises or the private sector. From an employers' perspective, encouragement to increase women's share in the workforce faces several objections and disincentives. The first is that the labour law may and in Egypt does require costly, special treatment for women workers, notably paid maternity leave (World Bank, 2015). Second, women workers tend to present 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 (World Bank, 2015)), 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 impact of gender diversity on productivity and wages of firms in the case of Egypt, using a novel firm-level dataset for Egypt. The data enable 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. Our hypothesis is that there will be differential effects of gender diversity

on productivity and wages depending on the sector, where labor force homogeneity can be advantageous in certain types of activities. More specifically, we expect that gender diversity would be associated with higher productivity and wages in knowledge-intensive service sectors where diversity in the workplace can allow firms to better provide for their clients and customers, and greater heterogeneity of employees can provide a greater diversity of skills, knowledge, and innovation.

Our results corroborate these expectations. They 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. These results remain valid when using alternative industry classifications and measures of diversity.

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 and conducts robustness checks. 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 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, 2011; Roberge and Van Dick, 2010). In the female dominated sector (garments) in Morocco, male workers are kept as a small proportion of the shopfloor workforce. Social distance between the genders intensified gender-stereotypical behaviours in each group. Employers believed that on balance diversity in the workforce drove up productivity. Men worked faster and they drove up the work rate of women on the production line sufficiently to outweigh the costs of correcting relatively larger number of errors in the men's work (Joekes, 1987). This view of social dynamics is consistent with the social comparison or 'collective identity' model of Roberge and Van Dick (2010) and the intra-workforce rivalry productivity enhancing model of Lazear and Rosen (1981). Mixed gender groups have indeed been found elsewhere to foster the impact of group efficacy on performance (Lee and Farh, 2004). The argument is that gender diversity is likely to increase the heterogeneity in the values, beliefs and attitudes of the members of a group, which in turn may stimulate critical thinking and innovative decision making (Garnero et al., 2014). Diversity can improve creativity and innovation through the team members' greater variety of perspectives (Roberge and Van Dick, 2010).

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 Ferrara, 2005). The 'identity economics' model of Akerlof and Kranton (2011) predicts that diversity negatively affects productivity by introducing social frictions and misunderstandings within the workforce. If labor diversity has an impact on firm productivity, and if productivity is related to wages, then diversity may also influence wages.

Another way of thinking about how gender diversity influences labor market outcomes is

through 'soft skills', which refer to the personality traits, goals, motivations, and preferences that are valued in the labor market, in school, and in many other domains. Soft skills predict success in life and they causally produce that success (Heckman and Kautz, 2012). The contrast is with 'hard' or technical skills.

There is a large secondary literature on the differential gender distribution of 'soft skills' in a different sense, referring to social and interpersonal skills. It is generally claimed that women have superior competencies in this regard (for a review see Grugulis and Vincent (2009) and for a HR management analysis and policy brief see Korn Ferry Hays Group (2016)). It is also often asserted that, variously, soft skills complement hard skills, are greatest in people-centered, services jobs and are increasingly needed in other parts of industry. If these claims were verified, then by inference, increasing the share of women in the workforce would import greater 'soft skill' sets into the firm and support higher productivity and lend support to our finding. More research is needed to test out this possible explanation.

Taking these theories to the test also produces competing results as well as differential impacts across sectors. Garnero et al. (2014) 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 et al. (2001) find diversity has a positive impact on productivity. Iranzo et al. (2008) 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, 2010). Grund and Westergård-Nielsen (2008) 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, 1994) 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 and 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 interaction between the employee and the customer. Diversity in the workforce provides insights into the needs of male and female customers (Richard et al., 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-Lutz 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. (2014) finds that productivity rises by on average 5.2 percent to 6 percent following one standard deviation increase in gender diversity in high-knowledge, high-tech fields. In those fields, a higher share of jobs are in high skill occupations (professional and managerial), which include not only specialised technical knowledge but also complex problem-solving, decision -making and imparting knowledge to others (according to the definition of Level 4 skill occupations in the ISCO). Team work, necessarily involving complex intra-group communication, is required for problem solving and imparting knowledge to others. Communication and other interpersonal, non-cognitive (soft) skills have a causal relation to labour market and broader life outcomes (Kautz et al., 2014). There is some evidence that women have superior soft skills competencies to men, at least among those active in the labour market. In Bangladesh, across all industries, females report significantly higher scores than men in most non-cognitive skills, including decision making (Nordman et al., 2015). A study of 50,000 professional employees in 90 countries revealed differences by gender in the distribution of non-cognitive personal skills important in managerial and professional roles. Women outperform men in competencies including coaching and mentoring, influence, inspirational leadership, conflict management, organizational awareness, adaptability, teamwork and achievement orientation (Korn Ferry Hays Group, 2016). Women's soft skills are valued when combined with technical skills but not in isolation (Grugulis and Vincent, 2009).

In the manufacturing industry, however, gender-diversity hurts firm productivity. There may be cases where some (limited) gender diversity is used strategically to employers (as when a small minority of male workers are used to drive up the work rate on a production line of otherwise female workers (Joekes, 1987) but this is the exception. Prat (2002) and Jehn (1995) 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.

Thus different approaches from social psychology and economics generate apparently con-

tradictory hypotheses about the likely effects of gender diversity. Their relevance may depend on, for example, the relative gender shares within the workforce and on industrial context. Answers to research questions such as how and when diversity influences performance at work are still limited. In any event, empirical tests such as we carry out for this paper clearly need to control for enterprise and sector level factors, perhaps with novel classifications in terms of the nature of the production process.

3. Methodology and Data

To test the relationship between gender diversity, productivity, and wages, our 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 et al., 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 (2007) and van Ours and Van Ours and Stoeldraijer (2011). We use their same initial model where the estimated firm-level productivity and wage equations are as follows:

$$Log(laborproductivity)_j = \alpha + \beta_1 G_j^{\sigma} + \lambda X_j + \epsilon_j \tag{1}$$

$$Log(wagesperworker)_j = \alpha + \beta_1 G_j^{\sigma} + \lambda X_j + \epsilon_j \tag{2}$$

The dependent variables in the estimated equations are firms' value added per worker 1 and average wages on an hourly basis 2 in firm j. On the right-hand side of the equation, the main variable of interest is gender diversity, (G^{σ}). X is a vector of controls including capital and labor intensity, education of employees, and firm age, and ϵ is an error term.

For the measure of diversity, we use two different measures in the regressions: the share of females and Herfindahl index. The share of females is simply the ratio of female employees to total employees. The share of females is not synonymous with diversity as a firm composed entirely of female employees would not be diverse. We therefore also use the normalized Herfindahl index as a measure of gender diversity estimated following the Rhoades (1993)1:

$$Herfindahl = 1 - \sum_{i=1}^{S} p_i^2 \tag{3}$$

where p_i^2 is the quadratic form of the share of each group. As we deal with only two

1The normalized Herfindahl index is bounded between zero (diversity) and one (dominance of one group).

groups (males and females), in our regressions we multiplied the index by two in order to simplify the interpretation of our coefficients.2

The dataset used is the Economic Census (EC) .2013 It is a 50 percent random 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 at the firm level. 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, 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 the Appendix.

In order to incorporate employee characteristics within each sector, we merged establishment survey data with the Labor Force Survey (LFS), to include age and education variables. Age represents the average age of employees within the sector and education represents the share of employees, per sector, that have university or post graduate degrees. The LFS is one of the main sources of labor market statistics in Egypt. It is conducted annually by the Egyptian national statistical agency the Central Agency for Public Mobilization and Statistics (CAPMAS). The survey targets more than 90,000 households every year and follows the methodology and harmonized definitions defined by the International Labor Organization (ILO). The survey is nationally representative and contains information including individuals' education, employment, occupation, gender, and geographic residence.

4. Empirical Findings

In this section, we first present some descriptive analysis on the relationship between gender diversity, wages, and productivity, followed by our regression results. The results are disaggregated by sector. We then test the robustness of our results by using an alternative measure of gender diversity as well as a different industry classification. The results remain valid.

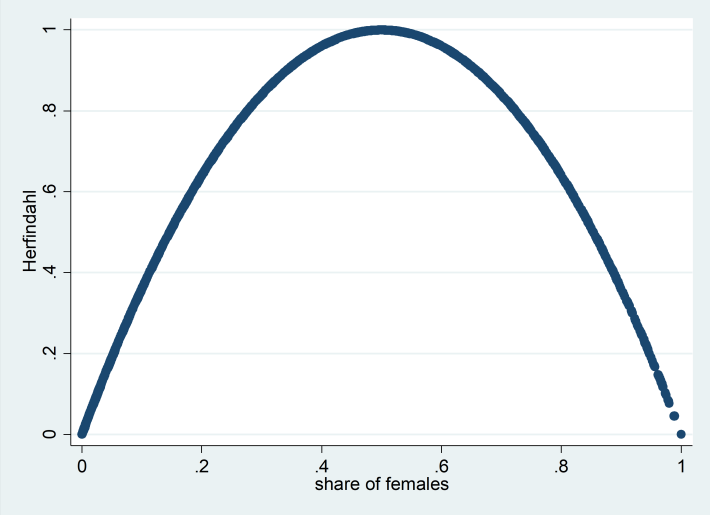
2This index can be used to measure diversity within firms. For more information, see J. and Eckl (2016) as well as Upadhyay and Zeng (2014).

4.1. Descriptive Analysis

In Egypt, the data reveal a low level of gender diversity largely because the participation rates of women is low in the private sector. Overall, the total share of women workers is 16 percent of the total employed, with 19 percent of the female 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.

Higher shares of females do not necessarily imply greater diversity in the firms. The relationship between the female share and Herfindahl index is apparent in the spline in Figure 1, showing an inverted U-relationship between with a spearman correlation of .67.0 As the inverted U-shape reaches its maximum, the Herifindahl index approaches 1 and as the share of females reaches 1, the Herfindahl index approaches .0

Figure 1: Relationship female share and Herfindahl index



Women's employment in Egypt is segregated by occupational sector and firm size (2-6). The share of females in KIS is over 30 percent, compared to approximately 10 percent in LKIS, and only 6 percent and 5 percent in HT-MHT and LT-MLT respectively. 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. Women's employment is greatest among medium-sized firms.

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 7-8 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)[3] and

3Firm size is defined by number of workers such that huge >=1000), large 250-999, medium 50-249, small 10-49, and micro .0-9

Figure 2: Distribution of female share and gender diversity by sector

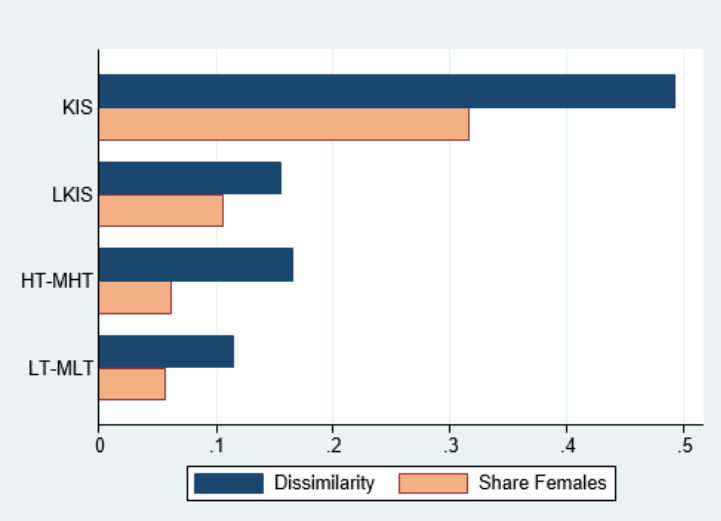


Figure 3: Distribution by gender within firms in Egypt

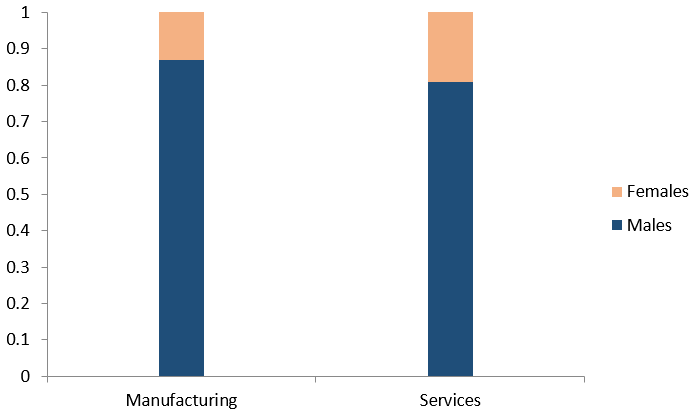
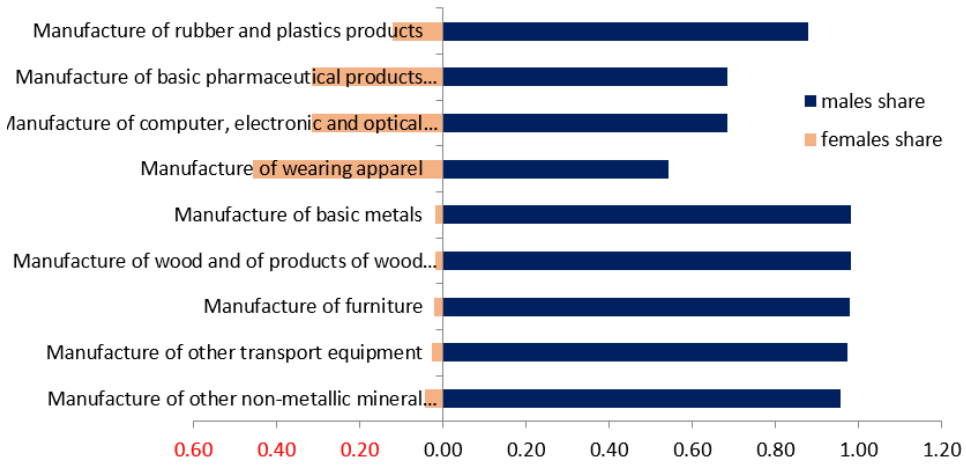


Figure 4: Sectors with highest and lowest shares of female employment - Manufacturing



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 7, 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

Figure 5: Sectors with highest and lowest shares of female employment - Services

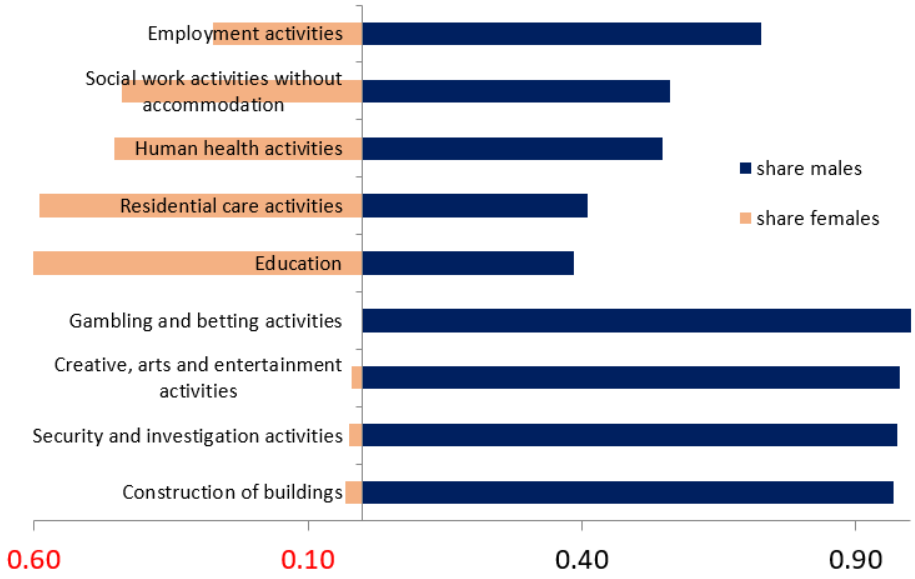
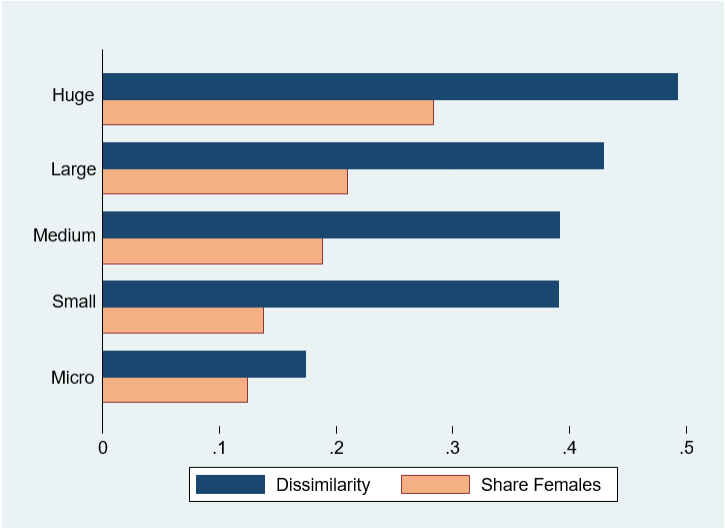


Figure 6: Distribution of Female Share and Gender Diversity by Size



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. It is known that around half of all employment is in low productivity microenterprises (Sahnoun et al., 2014). Opinion surveys suggest that working conditions are important to women in deciding whether to accept job offers, particularly regarding exposure to gender based violence or harassment (Dougherty, 2014; Assaad and Arntz, 2005). There is little or no legal protection for women in microenterprises, and consequently they are less likely to accept employment in such cases.

In summary, women are disproportionately employed in the knowledge-intensive services sectors compared to manufacturing sectors. Women are employed in these knowledge-intensive service firms together with men, not in single firms dominated by women. Conversely women's employment in manufacturing firms finds more women concentrated in

Figure 7: Female Share and Value Added per Worker

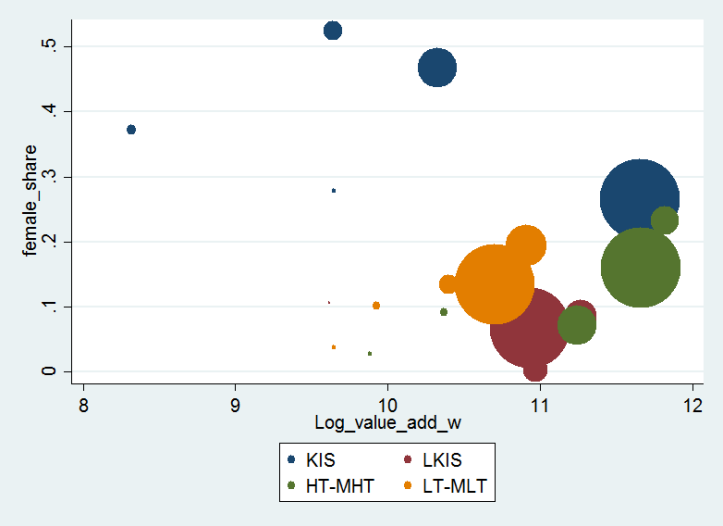
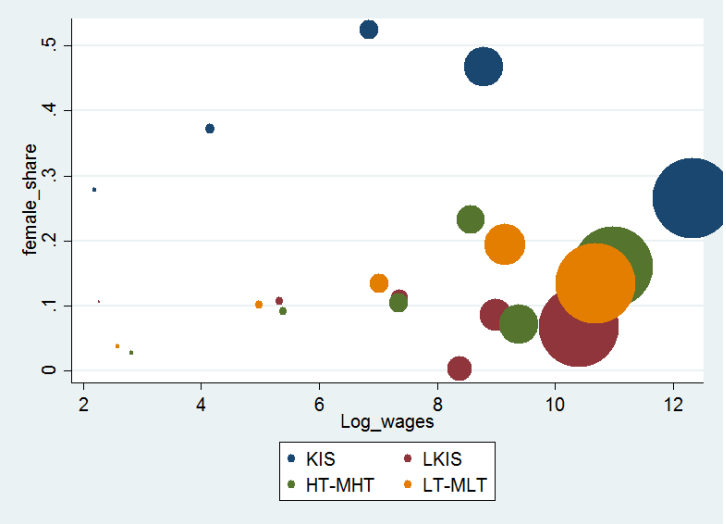


Figure 8: Female Share and Wages per Worker



the same firms. Women are also systematically employed in small and medium-sized firms, which exhibit lower wages and productivity than larger firms.

4.2. 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 the Appendix. The majority of the sample is in the services industry, with 6.55 percent in the LKIS and 5.22 percent in the KIS. Most of the manufacturing firms are LT-MLT comprising 5.20 percent of the total, with only 4.1 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.

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,

Table 1: Means of Dependent Variables and Diversity Measures

Mean	KIS	LKIS	MT-MHT	LT-MLT
Value add per worker	46,187	95,493	76,357	35,275
Wage per worker	12.6	52.5	2.12	85.6
Herfindahl	24.0	07.0	08.0	05.0
Share Females	32.0	11.0	06.0	06.0
Observations	13,560	33,502	841	12,355

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

	(1)	(2)	(3)	(4)
VARIABLES	VA per worker KIS	VA per worker KIS	wage per worker KIS	wage per worker KIS
Capital	***218.0	***213.0	***0958.0	***0898.0
	(0197.0)	(0190.0)	(0116.0)	(0110.0)
Labor	***433.0-	***483.0-	***771.0	***737.0
	(0548.0)	(0545.0)	(0322.0)	(0317.0)
Education	**239.0	**259.0	0216.0	0184.0
	(106.0)	(105.0)	(0774.0)	(0734.0)
Age	***0676.0	***0642.0	***0454.0	***0416.0
	(0164.0)	(0168.0)	(0102.0)	(0104.0)
share_females	0164.0		***167.0	
	(0711.0)		(0449.0)	
Herfindahl		***235.0		***276.0
		(0579.0)		(0361.0)
Constant	***234.6	***497.6	***038.4-	***772.3-
	(638.0)	(659.0)	(390.0)	(397.0)
Observations	13,116	13,116	13,356	13,356
R-squared	203.0	210.0	506.0	518.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<,01.0 ** p<,05.0 * p<1.0

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 as expected paint a consistent picture that a larger female share and greater labor force diversity is positively associated with productivity and wages in the knowledge intensive services sector, but negatively in others. 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.

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

	(1)	(2)	(3)	(4)
VARIABLES	VA per worker LKIS	VA per worker LKIS	wage per worker LKIS	wage per worker LKIS
Capital	***115.0	***119.0	***0194.0	***0199.0
	(0136.0)	(0138.0)	(00574.0)	(00574.0)
Labor	0221.0	**110.0	***082.1	***156.1
	(0411.0)	(0435.0)	(0138.0)	(0146.0)
Education	***388.2	***440.2	**388.0	***407.0
	(260.0)	(256.0)	(157.0)	(158.0)
Age	***0942.0-	***0908.0-	***0622.0-	***0537.0-
	(0118.0)	(0118.0)	(00736.0)	(00736.0)
share_females	***642.0-		***314.0-	
	(0483.0)		(0249.0)	
Herfindahl		***548.0-		***417.0-
		(0432.0)		(0236.0)
Constant	***56.12	***13.12	197.0	320.0-
	(613.0)	(623.0)	(305.0)	(309.0)
Observations	32,718	32,718	33,338	33,338
R-squared	166.0	169.0	571.0	587.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<,01.0 ** p<,05.0 * p<1.0

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

	(1)	(2)	(3)	(4)
VARIABLES	VA per worker HT-MHT	VA per worker HT-MHT	wage per worker HT-MHT	wage per worker HT-MHT
Capital	***227.0	***229.0	0635.0	0643.0
	(0403.0)	(0397.0)	(0422.0)	(0421.0)
Labor	168.0-	203.0-	***478.0	***465.0
	(138.0)	(136.0)	(178.0)	(178.0)
Education	00839.0	240.0-	518.0-	611.0-
	(775.0)	(770.0)	(738.0)	(759.0)
Age	**0958.0-	**101.0-	0341.0-	0356.0-
	(0453.0)	(0443.0)	(0582.0)	(0580.0)
share_females	150.0-		0323.0	
	(379.0)		(306.0)	
Herfindahl		192.0		121.0
		(214.0)		(177.0)
Constant	***00.12	***32.12	229.1	325.1
	(795.1)	(769.1)	(427.2)	(428.2)
Observations	769	769	776	776
R-squared	395.0	396.0	474.0	475.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<,01.0 ** p<,05.0 * p<1.0

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

	(1)	(2)	(3)	(4)
VARIABLES	VA per worker LT-MLT	VA per worker LT-MLT	wage per worker LT-MLT	wage per worker LT-MLT
Capital	***118.0	***118.0	0124.0	0128.0
	(0113.0)	(0114.0)	(0100.0)	(00996.0)
Labor	0184.0-	00978.0-	***167.1	***183.1
	(0320.0)	(0327.0)	(0230.0)	(0232.0)
Education	606.0-	*686.0-	339.0-	268.0-
	(404.0)	(408.0)	(383.0)	(383.0)
Age	0293.0	*0330.0	**0268.0	*0255.0
	(0199.0)	(0199.0)	(0131.0)	(0132.0)
share_females	***666.0-		***593.0-	
	(117.0)		(0901.0)	
Herfindahl		***296.0-		***445.0-
		(0686.0)		(0614.0)
Constant	***250.8	***078.8	***378.3-	***378.3-
	(649.0)	(646.0)	(445.0)	(446.0)
Observations	11,815	11,815	11,873	11,873
R-squared	147.0	142.0	604.0	606.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<,01.0 ** p<,05.0 * p<1.0

4.3. Robustness Checks

The previous regressions show the effect of dissimilarity by gender without taking into account whether the dominant group is males or females. Low diversity may imply that the firm is dominated by either women or men, and that these may have differential impacts on productivity and wages. For the purpose of distinguishing the dissimilarity by dominant group, two variables are included in the econometric specification: dissimilarity for female dominated firms ($Diss_{females}$) and dissimilarity for male dominated firms ($Diss_{males}$). The specification of those variables can be written as follows:

$$Diss_{females} = Majority_{females} * Herfindahl \tag{4}$$

$$Diss_{males} = 1 - Majority_{females} * Herfindahl \tag{5}$$

where $Diss_{females}$ 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

Table 6: Value Added per Worker across Sectors

	(1)	(2)	(3)	(4)
VARIABLES	VA per worker LT-MLT	VA per worker HT-MHT	VA per worker KIS	VA per worker LKIS
Capital	***162.0	***254.0	***212.0	***118.0
	(00578.0)	(0299.0)	(0185.0)	(0138.0)
Labor	**0335.0-	0377.0-	***507.0-	**0999.0
	(0153.0)	(0774.0)	(0584.0)	(0446.0)
Education	00874.0	**0562.0-	***0642.0	***0911.0-
	(00649.0)	(0274.0)	(0167.0)	(0118.0)
Age	185.0	**951.0	**222.0	***429.2
	(199.0)	(475.0)	(102.0)	(256.0)
diss_males	***177.0-	0301.0	***423.0	***393.0-
	(0413.0)	(142.0)	(123.0)	(0854.0)
diss_females	***423.0-	122.0-	***181.0	***577.0-
	(0462.0)	(241.0)	(0491.0)	(0437.0)
Constant	***987.7	***100.9	***596.6	***12.12
	(236.0)	(066.1)	(673.0)	(622.0)
Observations	11,815	769	13,116	32,718
R-squared	201.0	326.0	212.0	170.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<,01.0 ** p<,05.0 * p<1.0

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.

It may also be possible that results are sensitive to the classification of sectors, as perhaps Eurostat definitions do not suit the Egyptian context characterized by a dominance of lower-skilled activities. We therefore perform our analysis using an alternative classification, derived from the LFS based on the levels of education and occupational skill level of different sectors. We define KIS if two conditions are fulfilled: firstly, if the number of workers within the 2-digit sector, that have a University or Post-graduate degree is above the average of their number for the whole sector; secondly, if the number of professionals, technicians and associate professionals, within the 2-digit sector is above the average of the whole sector. As can be seen from tables 8 and 9, there is still a significant and positive association between gender diversity and both value added and wages in the KIS industries. As for female share, the relationship becomes insignificant in the value added equation, but positive and significant once we interact the variable with occupation. Hence, the results on the relationship between female share and diversity are maintained even if we vary the basis for the classification for knowledge-intensity based on the proposed endogenous empirical strategy.

Table 7: Wage per Worker across Sectors

	(1)	(2)	(3)	(4)
VARIABLES	Wages per worker LT-MLT	Wages per worker HT-MHT	Wages per worker KIS	Wages per worker LKIS
Capital	***0393.0	0642.0	***0891.0	***0196.0
	(00417.0)	(0748.0)	(0107.0)	(00572.0)
Labor	***939.0	***428.0	***723.0	***147.1
	(0109.0)	(148.0)	(0341.0)	(0148.0)
Education	***0295.0	175.0-	***0416.0	***0539.0-
	(00466.0)	(170.0)	(0104.0)	(00735.0)
Age	***496.0		00422.0-	**397.0
	(160.0)		(0700.0)	(158.0)
diss_males	***320.0-	365.0	***392.0	***283.0-
	(0293.0)	(261.0)	(0763.0)	(0541.0)
diss_females	***491.0-	349.0	***243.0	***443.0-
	(0347.0)	(228.0)	(0315.0)	(0244.0)
Constant	***089.3-	132.6	***711.3-	328.0-
	(167.0)	(270.6)	(409.0)	(307.0)
Observations	11,873	108	13,356	33,338
R-squared	609.0	682.0	519.0	587.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<,01.0 ** p<,05.0 * p<1.0

Table 8: Value added per worker

	(1)	(2)	(3)	(4)
VARIABLES	VA per worker KIS-new	VA per worker KIS-new	VA per worker KIS-new	VA per worker KIS-new
Capital	***204.0	***197.0	***203.0	***194.0
	(0177.0)	(0171.0)	(0174.0)	(0171.0)
Labor	***569.0-	***610.0-	***579.0-	***620.0-
	(0635.0)	(0602.0)	(0617.0)	(0592.0)
Education	0271.0-	0149.0	00363.0-	0149.0
	(110.0)	(105.0)	(109.0)	(104.0)
Age	***0771.0	***0736.0	***0730.0	***0658.0
	(0165.0)	(0170.0)	(0169.0)	(0174.0)
share_females	0852.0			
	(0950.0)			
Herfindahl		***285.0		
		(0634.0)		
Share_females*occupation			*260.0	
			(135.0)	
Herfindahl*occupation				***501.0
				(0839.0)
Constant	***641.6	***867.6	***796.6	***197.7
	(717.0)	(724.0)	(724.0)	(737.0)
Observations	10,733	10,733	10,733	10,733
R-squared	248.0	257.0	250.0	263.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

Note: Robust standard errors in parentheses *** p<,01.0 ** p<,05.0 * p<1.0

Table 9: Wage per worker

	(1)	(2)	(3)	(4)
VARIABLES	Wage per worker KIS-new	Wage per worker KIS-new	Wage per worker KIS-new	Wage per worker KIS-new
Capital	***0949.0	***0873.0	***0924.0	***0841.0
	(00983.0)	(00941.0)	(00970.0)	(00921.0)
Labor	***660.0	***635.0	***657.0	***629.0
	(0374.0)	(0346.0)	(0365.0)	(0341.0)
Education	124.0-	*128.0-	118.0-	*134.0-
	(0765.0)	(0738.0)	(0769.0)	(0720.0)
Age	***0584.0	***0534.0	***0508.0	***0456.0
	(00976.0)	(00998.0)	(00993.0)	(0101.0)
share_females	***237.0			
	(0501.0)			
Herfindahl		***313.0		
		(0370.0)		
Share_females*occupation			***434.0	
			(0733.0)	
Herfindahl*occupation				***515.0
				(0493.0)
Constant	***123.4-	***815.3-	***822.3-	***488.3-
	(405.0)	(404.0)	(409.0)	(404.0)
Observations	10,956	10,956	10,956	10,956
R-squared	489.0	504.0	492.0	513.0
Firm Size FE	YES	YES	YES	YES
Governorate FE	YES	YES	YES	YES

5. Conclusion

Using the newly available Economic Census 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. 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. As a robustness check, we investigated other classifications of the industries that take into account the educational and occupational characteristics of the workers in Egypt for the knowledge intensive service activities. Using this new classification, our results remain robust.

However, 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 including, for example, views of unacceptable working conditions which risk exposure to harassment, and more generally the interaction of supply side and

demand side determinants of wage and productivity outcomes.

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Appendix

Table A.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

Table A.2: Service Industry Classification - NACE Rev. 2 codes – 2-digit level 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).
Market KIS	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;
KIS High-tech	59 to 63	Television Production, Telecommunications, Information services
	72	Scientific research and development;
KIS Financial	64 to 66	Financial and insurance activities (section K).
Other KIS	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).

Table A.3: 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).
LKIS (Market)	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;
LKIS (Other)	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).

Table A.4: Summary Statistics of Variables by Sector

KIS sector	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	13,560	46,187	1,987,115	-1,310,864	230,000,000
Wage per worker	13,560	6	30	0	1,970
Herfindahl	13,560	0	0	0	1
Share Females	13,560	0	0	0	1

LKIS	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	33,502	95,493	3,457,844	-7,499,976	600,000,000
Wage per worker	33,502	6	16	0	2,076
Herfindahl	33,502	0	0	0	1
Share Females	33,502	0	0	0	1

HT-MHT	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	841	76,357	281,509	-2,056,509	4,167,452
Wage per worker	841	12	15	0	276
Herfindahl	841	0	0	0	1
Share Females	841	0	0	0	1

LT-MLT	Obs	Mean	Std. Dev.	Min	Max
Value add per worker	12,355	35,275	226,872	-235,485	14,900,000
Wage per worker	12,355	7	9	0	385
Herfindahl	12,355	0	0	0	1
Share Females	12,355	0	0	0	1

Figure A.1: Female share and Herfindahl index (4-Digit level)