Gender Wage Gap in Lebanon: Explorative Analysis

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The analysis of the gender wage gap has been an active subject within the socio-economic domains around the world. Much of this gap occurs at the upper rungs of the organizational ladder, even among females with credentials or achievements to their names. This research attempts to answer the gender wage gap questions related to Lebanon by utilizing an in-depth cluster analysis on gathered data pertaining to all the employees of two Lebanese financial institutions. The results indicate that Lebanon, as other countries of the world, suffers from serious discrimination as to the considerable differences between wages paid for classical "men's jobs" and those paid for classical "women's jobs". Moreover, this study shows that common factors for both genders, including years of experience, age, educational level and position, generally cannot be attributes to explain this significant wage gap; it may imply that the said gap is due to culture, traditions and weak governmental policies.

1. Introduction

Wage gap studies have extensively considered both sticky floors and glass ceiling effects. Bjerk (2008) found that the under-representation of females at higher managerial levels is more due to sticky floors than glass ceiling. While Yurtoglu and Zulehner (2009), using wages of top executive officers of publicly listed US firms, concluded that after controlling of individual and firm characteristics, the estimated pay gaps suffer a sticky floor effect and that females at top organizational jobs experience less discrimination than lower paid female managers. Also in India, Khanna (2012) contended that the sticky floor effect persists even after controlling personal and job attributes; thus, implying heavy discrimination of the poor women. As for Europe, Christofides, Polycarpou, and Vrachimis (2010) show that the wage gap in most of the nations of the EU is wider at the top of wage distribution; thus, implying a glass ceiling effect.

In Lebanon, A. Dah, Ben Sita and M. Dah (2009) concluded in their study of the Lebanese labor market that men earn 16% more than women do, after controlling factors such as education, experience and job category. In another study on the Lebanese labor market, A.

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Dah, Kassar and M. Dah (2009) showed that men have better odds to be promoted as compared to women as they move towards the top. In fact, the Gender Inequality Index score is 0.440 as measured by the Global Gender Gap Index, placing Lebanon at 76 out of 146 countries (OECD Development Centre, 2011).

This research paper aims at studying the gender wage gap problem by conducting a parametric analysis using a novel quantitative technique, that is, cluster analysis applied to two data sets extracted from two Lebanese financial institutions to identify clusters of Lebanese employees affected by either sticky floor or glass ceiling effects taking into consideration attributes, like years of experience, age, educational level and position. Outcomes of the research will fully explain the observed wage gap in order to more fully inform policymakers to change governmental policies and the public at large.

2. Literature Review

Blau and Kahn (2006) contended that even though the tendency to discriminate against women is decreasing, women continue to encounter discrimination in the labor market as evidenced by the fact that women's wages continue to be considerably less than those earned by men of similar qualifications. Similarly, Barreto, Ryan, and Schmitt (2009) stated that women's job status is still unclear, and that women continue to be underrepresented in key corporate positions, even after political and legislative reforms were undertaken within the large world's economy. While, Eagly and Sczesny (2009) based on a 2007 report by the European Commission, concluded that in each of the 27 nations of the European Union, women discrimination is apparent as they average only 4% of the presidents and 10% of the members of the highest decision making bodies. Correspondingly, Fitzpatrick (2010) stated that in 2008 women in the USA did earn 77 cents compared to a dollar earned by males; thus, indicating a gap of 23%. Moreover, in other parts of the world, like Pakistan, Channar (2010) asserted that females are discriminated more than males in the majority of the salary groups within job markets, and that females face discrimination not only from their superiors but also from their peer colleagues at the work place. Further, in Brazil, Madalozzo (2010) stated that even when both genders have similar characteristics, men earn better payments than women. More recently, in a Swiss study, Dacey (2012), using a sample of 1100 professionals, of which 85% were females, found that 79% of the women believed that gender is a determinant factor in their career advancement, while 73% of the women agreed that there are barriers to women advancement in upper management. The gender pay gap continues to persist as declared by Dugas (2012), referred to in the (American Association of University Women (AAUW) report; she reasons that among recent college graduates, women working full-time do earn 82% of what recent men graduates earn.

Likewise, in Australia, Vecchio, Scuffham, Hilton, and Whiteford (2013) asserted that there is a wage gap of 16.7% that remains unexplained, even after adjusting for endowments. And in Britain, according to Jobsite.co.uk (n.d.), cited in Hejase, Haddad, Hamdar, Massoud and Farha (2013, p. 30), a female working full-time earns just 82% of her male colleague's salary; a fee that for a part-time female worker sinks to 60%; as a consequence, the pay gap costs a woman with average qualifications about £250,000 during her lifetime. As such, it is worth mentioning that inequity in wages is usually found to be higher in developing nations as compared to that found in developed countries.

The gender wage gap, seen as wage discrimination, was considered by Velasco (2013) who highlighted the fact that important gender gaps are noticed within the Organization for Economic Cooperation and Development (OECD countries, where within labor markets,

females in 2009 continued to perceive significantly lower wages than men (16% less), with Korea having the maximum gap (38.9%) and Hungary the minimum gap (3.9%). Velasco referred to the wage differences as unadjusted pay gaps when attributed to the reality that women take more and longer career breaks, which reduce work and service time. Moreover, the less experience female negotiation power and their tendency to work in low paid industries also contribute to the unadjusted pay gap component. On the other hand, Velasco contended that the adjusted wage gaps are often tied to those unexplained parts which are considered as discriminatory. In his study, Velasco drew attention to the fact that some countries have high adjusted wage gaps: Cyprus (30%), Latvia (21%-24%), and Estonia (21%-22%). Velasco also highlighted the fact that there is a gap in representation that favors men, where women continue to be under-represented in top corporate jobs; for example, in 2009 on average, women occupied only 10% of board seats in listed companies. These percentages varied among the OECD countries from 3.4% in Germany to 38.0% in Norway.

Although the aforementioned facts present the negative aspect of the wage gap, there are researchers who present a brighter image. There is evidence that the gender gap seems to be declining over time but not eliminated. Blau and Kahn (2000) contended that, as of 1978 the wage disparities between men and women in the USA have been following a decreasing tendency, the declining rhythm of which is expected to continue during the years to follow. However, the US Department of Labor (2009) reported that despite the narrowing of the wage gap witnessed during the past years, this gap continues to be used in confusing ways to support public policy agendas, without fully clarifying the rationale behind the gap. Moreover, the report adds that there is no need to use the wage gap to justify corrective action since there would be nothing to correct if the wage gap arises from personal individual choices made by male and female workers. Similarly, Kolesnikova and Liu (2011) stated that the earnings gap between genders have dropped to around 16.5% in 2011, after being 23.75% in 1999 and 30% in 1989. Furthermore, Hejase et al (2013) contend that in a sample of 200 employees and managers, 73% of the respondents believe that managers of both genders are equally paid for the same managerial position.

If one admits that there is discrimination against women, then this act can occur at different stages of the latter career path. For example, Cotter, Hermsen, Ovadia, & Vanneman (2001), argued that the discrimination starts early in the career where there is a hidden barrier called a glass ceiling that prevents females from rising to the upper rungs of the organizational ladder, even if they prove their credentials or achievements. Likewise, Wirth (2001) stated that qualified females face glass ceiling, formed by attitude and organizational prejudices, but are not capable of breaking through the invisible artificial barriers. This view is reflected Barreto et al.'s (2009) point of view who asserted that men dominate the upper strata of the managerial pyramid. Furthermore, Channar (2010) contended that sticky floors arise as a result of the appointment of men and women of the same rank, but with men put at higher favorable scale. Moreover, Briefcaseessentials.com (2010; cited in Hejase et al, 2013, p. 31), reported that "every day, an average of 1,400 to 1,600 women leaders are leaving *Fortune 500* companies to start their own businesses or work for competitors, twice the rate of their male counterparts. This fact might imply that women are really feeling that glass ceiling in these companies is keeping them from fulfilling their ambitions, and that it is advisable to start up their own company."

The United States Government Accountability Office (GAO) reported that women have made progress in earning higher wages over the last three decades, but they remain overrepresented among workers who earn low wages (low wage workers are those earning an

hourly wage rate in the bottom quintile or 20% of wage across the workforce). In fact, this aforementioned statement did not change even with the reality that women have attained higher education levels than men since 1980: Young women now complete high school and college at somewhat higher rates than men; in 2010, 90% of young women compared to 87% of young men held at least a high school diploma (GAO, 2013).

A study done by the United Nations Economic and Social Commission for Western Asia (ESCWA) (2009) revealed that although there are wage gaps between genders in the ESCWA region, in general, and Lebanon, in particular, the statistical information that supports this claim lacks reliability. On the latter, Huff and Geis had long stated in their book 'How to Lie with Statistics 'written in 1954 that when interpreting poll and survey results there is always a tendency and desire to produce pleasing answers to the audience, forgetting that the results of any sample are as good as the sample itself. Thus, one can lie with statistics, especially when writers sacrifice the depth of a study for breadth, or when readers are not knowledgeable enough to capture the semantic nonsense of the presented results.

The aforementioned ESCWA report indicated that within the Arab region, women constitute 33.3% of the labor force but with significant disparities between one country and another. On one end of the spectrum is Kuwait with a rate of women in the labor force as high as 49%, and on the opposite end is Palestine with a rate as low as 10.3%. Lebanon falls somewhere in between with women forming 32.4% of the labor force.

In addition, the ESCWA report showed that there were wage gaps between men and women of the region that reach a high rate of 35.2% (average ratio of female to male income) in Bahrain while the lowest rate is 15.7% in the Kingdom of Saudi Arabia. Again, the report displayed a 31.5% wage difference in Lebanon. Moreover, the ESCWA report presented the results of a survey carried out in Lebanon by the World Bank on a sample of 615 workers (342 females and 273 males); some of the outcomes were:

- Percentage of female workers that have completed college education or above was 65% compared to 46% of males.
- Average age of female workers was 31 years compared to 35 years for males.
- The wage difference between male and female employees was around 27%.
- Wage gaps existed within the same section and occupation, even after adjusting for different levels of education.

Alieh (2012) in his study indicates that the percentage of wage difference within Lebanon vary significantly among the different age groups. This study shows that for ages 18 to 30 years, the wage gap is negligible; for ages 31 to 40 years, the gap reaches 20%; for ages 41 to 50 years, it reaches a maximum of 55%; and, finally for ages 51 to 70 years, the percentage is 36%. Also, Seitz-Wald (2012) affirms that women consistently earn less than men, even if they have had better education. In addition the study emphasizes that in the financial sector, females make less money than their male counterparts. Thinking outside the box, the question: *"Do Men Really Earn More Than Women?"* was raised and the concluding answer was that males earn more than females on average, but this gap figure diminishes and drops to lower levels when both genders perform the same job under similar experience and ability profiles (PayScale, 2012).

The aforementioned studies are a small subset of similar studies that demonstrate the existence of wage gaps between genders with Lebanon being just another location where

females suffer from wage discrimination (Blau and Kahn, 2006; Barreto, Ryan and Schmitt, 2009; Channar, 2010; Dacey, 2012; Dugas, 2012; Eagly and Sczesny, 2009; Fitzpatrick 2010; Madalozzo 2010; Vecchio, et al., 2013; and Hejase and Dah, 2013). In fact, Lebanese information provider Infopro (2013) contends that Lebanese females' contribution to the economic activity has been increasing over the last few decades. Nevertheless, their collected data indicates that men still earn more than women, meaning that female workers continue to face wage discrimination.

In parallel with the presented evidence on wage gap existence, others have concluded that these gaps are steadily diminishing with time (Blau and Kahn, 2000; Kolesnikova and Liu, 2011; and U.S. Department of Labor, 2009); while others continue to rely on basic material to criticize the sampling studies utilized; thus, raising questions related to the reliability and understanding of research projects (Huff and Geis, 1954).

Finally, one of the most recent studies, the Global Gender Gap Index of 2014 (World Economic Forum, 2014) presents national gender gaps on economic, political, education and health-based criteria for 142 different countries around the globe. This Global Gender Gap Index was first introduced by the World Economic Forum in 2006 as a frame for assessing the extent of gender-based gaps. One distinguishing feature of this Index is that it ranks countries according to their proximity to gender equality rather than to women's empowerment. Thus, the main goal is to focus on whether the gap between women and men has dropped, rather than whether women are "winning" the "battle of the sexes". The report indicates that no country among the selected 142 countries in the world has fully closed the gender gap; however, it is noticeable that all five of the Nordic countries (Iceland, Finland, Norway, Sweden, and Denmark) have closed more than 80% of it. Yemen came to be the lowest ranking country by having closed just over 51.45% of the gender gap. Lebanon's rank was135 among 142 countries with a score of 59.23%; while Syria ranked 139 and its score was 57.75%. For a country like Lebanon, such scores imply that compared to the rest of the world there is still a long track to cover in order for it to be considered among the leading top ranks.

3.   Method
3.1. Previous Work

CONSAD (2009) asserted that the approach used in reported economic research on the gender wage gap involved "performing multivariate statistical analysis to estimate the degree to which the raw gender wage gap is related to an array of possible explanatory factors. Then, results have been used to decompose the raw wage gap into estimated proportions for which specific explanatory variables account statistically, and a residual proportion, commonly called the adjusted gender wage gap. The adjusted gap is attributed, to unknown degrees, to other explanatory factors that have been omitted from the analyses or to overt discrimination against female workers" (p. 15), knowing that previously, Blau and Kahn (2007a) had asserted that empirical studies using the aforementioned approach provide evidence consistent with both human capital differences and labor market discrimination in explaining the gender pay gap (p. 11). To achieve what Blau & Kahn and CONSAD had described, several methodologies have been used which have been consolidated in Table 1. The authors of the current paper constructed Table 1 which shows a summary of methodologies and techniques used for the last four decades.

The current paper builds on the most recent Hejase, Hejase, and Hejase's (2014, p. 434) study in which they used Wooldridge's (2009) proposed econometric model which depicts a linear regression that relates the natural logarithm of the earnings to the explanatory variables

of experience, education and gender. This approach matches similar approaches reported in Table 1; however, Hejase et al.'s study is related to the assessment of the impact of "Sticky Floors" and "Glass Ceilings", where experience plays a major role in the regressions, and where non-linear relationships with experience, the inclusion of a squared experience term was considered as suggested by Wooldridge (2009).

Furthermore, different regression equations using subsets of the original data, based on the individual years of experience, were compared in an attempt to study the value of the gender coefficient in each subgroup. Accordingly, this research concluded that women in the Lebanese banking sector suffer more from intermediate discrimination while being in the intermediate years of service. Therefore, both the "sticky floors" and "glass ceiling", although present, are not the dominant discrimination factors (p. 442).

Table 1: Summary of methodologies and techniques used for the last four decades

Citation	Model	Type of Research
Oaxaca (1973)	Descriptive Statistics Decomposition Technique	Quantitative
Bowler (1999) Blau & Kahn (2000) Blau, Ferber, & Winkler (2007) Johnson (2008)	Descriptive Statistics	Quantitative
Albelda (1986)	Descriptive Statistics Dissimilarity Index Calculations Regression Analysis	Quantitative
Morrisey (2001) Levine (2003) WFD Consulting (2006) Blau & Kahn (2007a)	Literature Review	Qualitative
Joy (2006)	Descriptive Statistics Dissimilarity Index Calculations Multinomial Logit Regression Analysis	Quantitative
Mulligan & Rubenstein (2008)	Descriptive Statistics Ratio Analysis Probit Analysis Logit Regression Analysis	Quantitative
Sanborn (1964) DiNatale & Boraas (2002) Rose & Hartmann (2004) Hartmann, Sorokina, & Williams (2006) Weinberg (2007)	Descriptive Statistics Ratio Analysis	Quantitative
Cortes & Tessada (2008)	Descriptive Statistics Ordinary Least Squares – OLS Regression Analysis	Quantitative
Blau & Kahn (2000) Plasman & Sissoko (2004) Blau & Kahn (2006)	Descriptive Statistics Decomposition Technique Logit Regression Analysis	Quantitative
Johnson & Solon (1986) Boraas & Rodgers (2003) Anderseon, Binder & Krause (2003) Bayard, Hellerstein, Neumark, & Troske (2003) Gabriel (2005)	Descriptive Statistics Decomposition Technique Regression Analysis	Quantitative
Budig & England (2001)	Descriptive Statistics Ordinary Least Squares – OLS Regression Analysis Logit Regression Analysis	Quantitative
McCrate (2005) Dey & Hill (2007) Correll, Benard, & Paik (2007)	Descriptive Statistics Ratio Analysis Regression Analysis	Quantitative

Table 1: Summary of methodologies and techniques used for the last four decades (**cont'**)

Citation	Model	Type of Research
Blau & DeVaro (2006)	Descriptive Statistics Probit Analysis Multiple Linear Regression Analysis	Quantitative
Phelps (1972) Groshen (1991) Brooks (1999) Pannenberg (2002) Trejo (2003) Mandel & Semyonov (2005)	Descriptive Statistics Regression Analysis	Quantitative
Hausman & Taylor, 1981 Rhine (1987) Trejo (1991) Light & Ureta (1995) Fields & Wolff (1995) Olson (2002) United States General Accounting Office (2003) Spivey (2005) Lowen & Sicilian (2008) Wooldridge (2009) Hejase & Dah (2013) Pastore, Sattar, & Tiongson (2013) Hejase, Hejase & Hejase (2014)	Descriptive Statistics Logit Regression Analysis	Quantitative
Gruber, 1994 Costa (2000)	Descriptive Statistics Differences-in-differences-in-differences Regression Analysis	Quantitative
Sheiner (1999)	Descriptive Statistics Ratio Analysis Logit Regression Analysis	Quantitative
Even & Macpherson (1990)	Descriptive Statistics Decomposition Technique Logistic Regression Analysis Multiple Linear Regression	Quantitative
Solberg & Laughlin (1995) Amuedo-Dorantes & Mach (2003)	Descriptive Statistics Multivariate Statistical Analysis Regression Analysis	Quantitative
Bauer & Zimmermann (1999)	Descriptive Statistics Tobit Analysis of Determinants Multinomial Logit Regression Analysis	Quantitative
Bell & Hart (1999) Bell, Hart, Hubler & Schwerdt (2000)	Descriptive Statistics Regression Analysis Logit Regression Analysis	Quantitative
Hamermesh & Trejo (2000)	Descriptive Statistics Difference-in-difference Regression Analysis Difference-in-difference-in-difference Regression Analysis	Quantitative
Trejo (1993)	Descriptive Statistics Probit Analysis Tobit Analysis of Determinants Multinomial Probit Analysis of Determinants	Quantitative
CONSAD Research Corp (2009)	Literature Review Descriptive Statistics Decomposition Technique Multivariate Statistical Analysis Logit Regression Analysis	Quantitative

Note: Table constructed by the authors based on reported review in CONSAD Research Corp (2009), pp. 41-92. In addition to references used in this paper.

3.2. Current Paper Model

Based on the aforementioned facts, the purpose of this paper is to perform an exploratory research for the Lebanese market where the banking sector is considered for two principal reasons: First, because the Lebanese banking sector is **"one the best performing regionally** and internationally, as it managed to weather the economic slowdown stemming from the regional turmoil as well as local sporadic instabilities. Banking activity in Lebanon, measured by total domestic assets of banks operating in the country, grew by 8.5% from December 2012 till December 2013 to reach USD 164.8 billion. Lebanon has one of the **highest ratios of assets to GDP in the world standing at 379.0%,** compared to averages of 161.9% for the world, 277.3% for the European Union, and 106.0% for Emerging Markets" (IDAL, 2015, Para 4); and, secondly, because previous studies have shown that the maximum gender pay gap occurs within the financial sector (Seitz-Wald, 2012). Consequently, to increase reliability and avoid sampling biases and error, this study relies on two main sources of data that was collected from the Lebanese banking sector. The first source involves all the personnel of a medium- size bank with a work force of 633 persons, and covering all business authority levels, while the second source corresponds to a smaller banking business with 323 employees, also at all levels. The data extracted for each employee from the respective human resource departments show the following:

- Earnings: Annual earnings of an individual in USD.
- Experience: Years in the field of work.
- Education: One of the six levels of education: illiterate, primary and intermediate, secondary, diploma, university, or graduate.
- Gender: Female or male.
- Age.
- Occupation level within the bank.

3.3. Cluster Analysis: K-Means Clustering Algorithm

This paper follows a completely new approach in identifying wage gaps among different groups of employees by using cluster analysis. Table 1 delineated all the methodologies used showing common methodologies among researchers but non used cluster analysis to identify groups of employees reflecting similar charcateristics which help to explain gender wage gaps. The idea of cluster analysis is to use data related to each employee to devise a scheme for grouping the employees into classes so that similar employees are in the same class (Manly, 2005). The resulting classes are relatively homogeneous within themselves and heterogeneous among each other.

In building the clusters, the Euclidean distance between two objects "i" and "j", where the six attributes of object "i" are (x_{i1}, x_{i2}, x_{i3}, x_{i4}, x_{i5}, x_{i6}) and the six attributes of object "j" are (x_{j1}, x_{j2}, x_{j3}, x_{j4}, x_{j5}, x_{j6}) respectively, is defined by (Fomby, 2010):

$$d = \sqrt{(x_{i1} - x_{j1})^2 + (x_{i2} - x_{j2})^2 + (x_{i3} - x_{j3})^2 + (x_{i4} - x_{j4})^2 + (x_{i5} - x_{j5})^2 + (x_{i6} - x_{j6})^2}$$

Now considering a set of "n" bank employees, each employee "i" is denoted by a vector **X_i** whose components are the six attributes: x_{i1} = gender, x_{i2} = yearly salary, x_{i3} = years of experience, x_{i4} = age, x_{i5} = education level code, and x_{i6} = occupation level code. Then, for "k" clusters, the "n" employees are sub-optimally (K-means can't generate optimal results. This is why the k-means was run multiple times and the cluster results that minimizes the Sum of

Squares due to Errors- SSE were used) distributed among the "k" sets (S₁, S₂, S₃, …, Sₖ) by minimizing the Within Cluster Sum of Squares - WCSS defined as:

$$\text{WCSS} = \sum_{p=1}^{k} \sum_{X_i \in S_p} \left\| X_i - \mu_p \right\|^2$$

Where, "μ_p" represents the vector of the means of the attributes for all the members of cluster S_p, also called the centroid of the cluster, and the quantity enclosed between the squared double vertical lines represents the Euclidian distance between the vector X_i and the vector μ_p. Notice that the components of vector μ_p are the six means of the six attributes corresponding to employees of cluster S_p. Moreover, it should be noted that modes replace means when categorical variables are present.

In this research, cluster analysis is used to identify the homogeneous groups of bank employees and their corresponding grouping parameters, mainly aiming at identifying the wage gaps among these groups. The clustering procedure used is the partitional K-means, where the computational algorithm performs the following steps:

1. Predefining the number "k" of clusters.
2. Selecting randomly "k" data points as centroids.
3. Assigning the different bank employees to the nearest centroid. Closeness to the nearest centroid is measured using the Euclidian distance measure.
4. Re-computing the centroid for each formed cluster.
5. Repeating steps 3 and 4 until convergence (i.e. until the centroids cease to change).

According to Hijazi and Chan (2013), K-means clustering with a simple distance measure, such as the Euclidian distance, can achieve high classification performance. Moreover, for this research's case, in order to determine the most suitable (near optimal) number of clusters, the *Within Cluster Sum of Squares* (WCSS) measure has been adopted; Table 2 presents the WCSSs for the different number of clusters applied to Bank1 (small-size bank), Bank2(medium-size bank), and to the combined data of both Bank1 and Bank2.

Kasparis, Charalampidis, Georgiopoulos and Rolland (2001) claim that a main disadvantage of the K-means algorithm is that the selection of centroids can lead to a relatively local minimum. Therefore, to avoid falling in a local minimum, one has to apply the above algorithm to different selections of initial centroids; thus, decreasing the probability of being confined to a single location, and increasing the chance of achieving a global minimum. Similarly, to avoid falling into a local minimum, the researchers ran K-means algorithm with different initial centroids and have chosen the partitions that lead to the smallest WCSS.

Table 2: Within Cluster Sum of Squares (WCSS) values for different numbers of clusters

k=Number of Clusters	Bank1 WCSSx10⁹	Bank2 WCSSx10⁹	Bank1+Bank2 WCSSx10⁹
4	20.3	32.7	53.9
6	8.92	14.2	23.5
8	5.31	8.71	14.4
10	3.72	6.12	9.68
12	**1.81**	**2.75**	**4.56**
14	2.44	2.84	5.19
16	1.83	2.76	4.93
18	1.98	2.96	4.65

Table 2 shows that the minimal values of the WCSS measures are achieved at K=12. Thus, clustering using twelve clusters is the most appropriate grouping mechanism. In choosing the test numbers for clusters, only even numbers are selected due to the existence of the dichotomous gender variable for each employee that forces the clusters to be always divided into two halves, where each half corresponds to one of the genders. Again, in this study's results, the search converges always into six male clusters and another six female clusters.

3.3. Results

Table 3 shows the results obtained from the application of the K-means clustering algorithm using MATLAB software to the three sets of data corresponding to Bank1 (small-size bank), Bank2 (medium-size bank), and to the combined data of both Bank1 and Bank2. Table 3 shows for each cluster: The gender together with the number of employees included, the average of yearly salary in USD, the average years of experience inside the bank, the average employees' age, the mode of the occupation code (1= office boy, 2= teller/secretary, 3= supervisor, 4= manager and 5= senior manager), and the mode of the educational code such that 0 represents an illiterate employee, 1 represents primary or intermediate studies, 2 stands for secondary studies, 3 denotes university education without a degree, 4 corresponds to university bachelor degree, and 5 typifies master and doctoral degrees.

The following observations can be deduced from the data depicted in Table 3:

- The percentage of women in the small-size bank is 39.44% of the total working force (322 employees); while for the medium-size bank, this percentage is 40.60% (total 633 employees).
- Within the lowest paid clusters in both banks which are dominated by females who hold university degrees, females collect relatively better average wages than males. Moreover, one has to observe that within the two banks under consideration and under the lowest paid clusters, ages of males on the average exceed ages of females by around 4 years, and males do have higher years of experience.
- The top most paid clusters in both banks are dominated by males: no females occupy any high paid position in the small-size bank; while, in the medium-size bank, the number of male senior managers is 23 compared to 5 females only. Within these clusters, the females' salaries are on average 81.67% of their male counterparts. Many researchers attribute this aspect to what is known as Glass Ceiling! In fact, Cotter, Hermsen, Ovadia, & Vanneman (2001) stated that there is an unseen barrier called a Glass Ceiling that will prevent females from rising to the upper rungs of the organizational ladder even when they acquire credentials or achievements. While, Barreto et al (2009) inferred the existence of the Glass Ceiling is due to the fact that men dominate the upper strata of the managerial pyramid. Furthermore, Hejase, Haddad, Hamdar, Massoud and Farha (2013, p. 48) reported that 28% of the Lebanese females are in the labor force with women comprising 90% of the workforce in Lebanese banks, but account for only 19% of these banks' general and assistant general managers.
- The second top most clusters, i.e. the clusters labeled "5" have the number of males well above that of the number of females (15 males to 9 females, and 38 males to 10 females); thus, enforcing the idea of a Glass Ceiling. Average experience years for females are way above those corresponding to males; similarly, females mark higher experience years than their male colleagues. Even though females have all the

aforementioned advantages, and with similar gender education backgrounds as that of males as indicated in Table 2, the average males' wage still exceeds that of females. In fact, within these clusters, the females' salaries are on the average 91.19% of their male counterparts in the small-size bank, while, education and occupation modes are relatively the same; however, sharp wage gaps are observed: it is noticed that a female average salary is around 73.35% of a male average salary in the small-size bank and 96.26% in the large-size bank.

- The groups of clusters that correspond to wages in the middle range of the scale do exhibit some minor consistent trends for the wage gaps. For example, in Table 3 and in the group labeled "2", the reader can observe that average salaries are relatively the same, even though females' average ages and years of experience are lower than those that correspond to their male counterparts. Likewise, the clusters carrying label "3" do exhibit similar average wages for both genders, even with the variations related to years of experience and age.

Table 3 The results of the clustering algorithm applied to the three sets of data

Cluster	Attribute	Bank1		Bank2		Bank1+Bank2	
		35 Males	**13 Females**	**111 Males**	**97 Females**	**228 Males**	**167 Females**
1	Salary	5,209.00	6,467.30	7,171.40	7,424.90	7,733.90	8,071.50
	Experience	6.0857	5.9231	6.7748	4.433	9.4649	6.3653
	Age	36.829	32.538	33.126	28.784	36.465	31.419
	Occupation	1	2	2	2	2	2
	Education	1	4	4	4	4	4
		58 Males	**46 Females**	**98 Males**	**75 Females**	**146 Males**	**119 Females**
2	Salary	9,653	9,647	11,332	11,780	13,544	13,439
	Experience	13.483	9.7391	18.082	15.707	18.267	17.378
	Age	41.5	35.717	42.092	41.933	43.274	43.303
	Occupation	2	2	2	2	2	2
	Education	1	4	2	2	2	4
		41 Males	**33 Females**	**51 Males**	**44 Females**	**88 Males**	**52 Females**
3	Salary	14,680	14,702	17,195	16,903	22,131	21,257
	Experience	18.927	14.939	18.176	22.159	21.227	22.115
	Age	44.659	42.606	44.333	46.455	46.955	47.981
	Occupation	2	3	3	3	3	3
	Education	2	4	4	4	4	4
		28 Males	**26 Females**	**55 Males**	**26 Females**	**44 Males**	**9 Females**
4	Salary	23,612	24,555	24,294	26,238	32,756	30,564
	Experience	22.286	21.038	21.182	23.038	20.045	22.771
	Age	50.143	46.346	45.491	48.385	48.841	48.114
	Occupation	3	3	3	3	3	3
	Education	2	4	4	4	4	4
		15 Males	**9 Females**	**38 Males**	**10 Females**	**35 Males**	**9 Females**
5	Salary	40,632	37,053	38,221	36,793	46,539	45,776
	Experience	12.467	22.111	19.737	27.3	16.4	17.556
	Age	47.467	50.111	49.395	52.6	50.143	50.556
	Occupation	5	4	4	4	4	4
	Education	4	4	4	4	4	4
		18 Males	**0 Females**	**23 Males**	**5 Females**	**30 Males**	**2 Females**
6	Salary	64,347		61,061	54,159	66,317	59,500
	Experience	15.556		18.652	9	16.933	14
	Age	58.333		54.696	47.4	57.5	48
	Occupation	4		5	5	5	5
	Education	4		4	5	4	5

3.3.1. Cluster Validity

In order to evaluate the feasibility of the resulting clusters and, thus, have confidence in the credibility of the results, it is important to prove the existence of a non-random structure in the employees' data; hence, showing that there is a correct number of clusters that embodies the gathered data.

A criterion that is applied to judge the validity of clusters is based on the internal measures of the data itself and is accordingly called an *Internal Validity Criterion*. Here, both cluster cohesion and cluster separation are considered: cluster cohesion refers to how closely related are the objects in a cluster and is measured by the aforementioned WCSS; and, cluster separation measures how distinct is a cluster from other clusters, and is measured by the *Between Cluster Sum of Squares* (BCSS) measure which can be defined as the *Total Sum of Squares* (TSS) minus the *Within Cluster Sum of Squares* (WCSS) (Kasparis, et al., 2001),

$$\mathbf{TSS} = \sum_{p=1}^{k} \sum_{X_i \in S_p} \left\| \mathbf{X_i} - \boldsymbol{\mu} \right\|^2$$

Where, "$\boldsymbol{\mu}$" represents the vector of the means of the attributes for all the members of all data (also called the centroid of the total data), and the quantity enclosed between the squared double vertical lines represents the Euclidian distance between the vector $\mathbf{X_i}$ and the vector $\boldsymbol{\mu}$. Notice that the components of vector $\boldsymbol{\mu}$ are the six means of the six attributes corresponding to all the employees of all clusters. Moreover, it should be noticed that modes replace means when categorical variables are present.

$$\mathbf{BCSS} = \mathbf{TSS} - \mathbf{WCSS} = \sum_{p=1}^{k} \sum_{X_i \in S_p} \left\| \mathbf{X_i} - \boldsymbol{\mu} \right\|^2 - \sum_{p=1}^{k} \sum_{X_i \in S_p} \left\| \mathbf{X_i} - \boldsymbol{\mu_p} \right\|^2$$

From the above expression, it is seen that minimizing WCSS is equivalent to maximizing BCSS. Thus, one way of identifying cluster validity is to analyze the within-between group variance, giving special attention to the parameter "k", and the number of clusters (Zaho, Xu and Franti, 2009). On this basis, Zaho et al. proposed a simple validation index: the sum-of-squares based method or the WB-index whose minimal value serves as a validity measure for the number of clusters. This WB-index is defined as:

$$\mathbf{WB} = \frac{k \times \mathbf{WCSS}}{\mathbf{BCSS}}$$

The WCSS and BCSS results included in Table 2 and Table 4 respectively may be used in conjunction with the number of clusters "k" to obtain the WB indices for the aforementioned sets of data corresponding to Bank1, Bank2, and both Bank1+Bank2. Table 4 shows the resultant outcome.

Table 4: Between Cluster Sum of Squares (BCSS) values for different numbers of clusters

k=Number of Clusters	Bank1 WCSSx10^{11}	Bank2 WCSSx10^{11}	Bank1+Bank2 WCSSx10^{11}
4	4.72	6.3	11.4
6	8.45	12.7	20.8
8	11.3	16.2	28.1
10	12.4	19.3	36.6
12	**11.2**	**19.1**	**34.7**
14	15.73	30.6	47.1
16	19.5	32.4	50
18	24.9	33.9	58.1

Table 5: The WB indices for the different proposed numbers of clusters

k=Number of Clusters	WB Bank1	WB Bank2	WB Bank1+Bank2
4	17.20	20.76	18.91
6	6.33	6.71	6.78
8	3.76	4.30	4.10
10	3.00	3.17	2.64
12	1.94	1.73	1.58
14	2.17	1.30	1.54
16	1.50	1.36	1.58
18	1.43	1.57	1.44

On plotting the results of Table 5, one obtains the curves shown in Figures 1, 2 and 3, where it can be observed that the three sets of data corresponding to Bank1, Bank2, and both Bank1+Bank2 attain their first significant minimum WB at k=12. In fact, at k=12, the WB indices exhibit the major descent jumps as "k" increases after beginning at k=4.
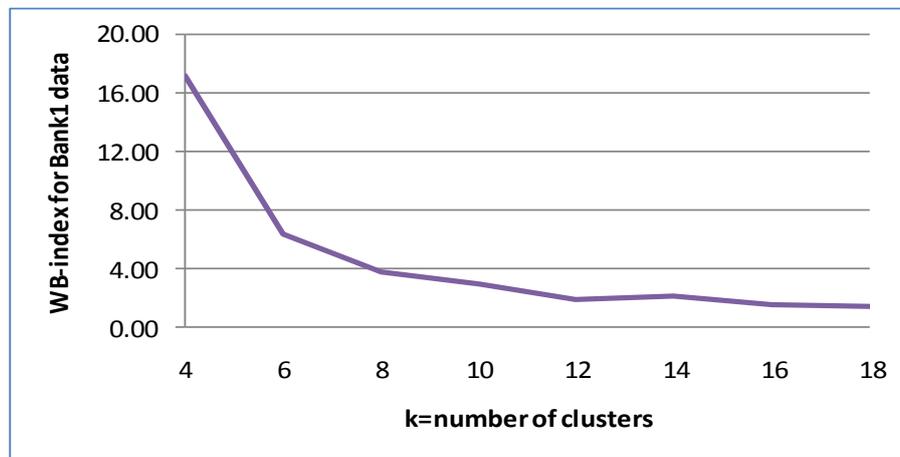
Figure 1 The WB-index behavior for Bank1 data as number of clusters increases
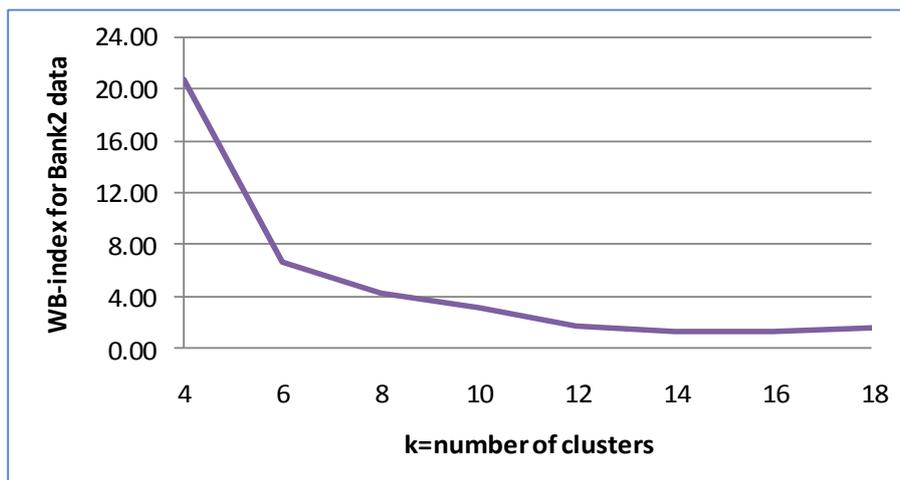
Figure 1: The WB-index behavior for Bank2 data as number of clusters increases
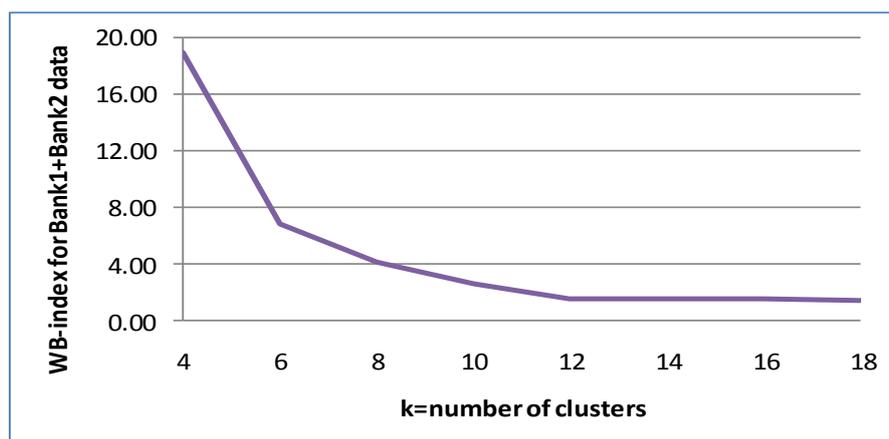
Figure 2: The WB-index behavior for Bank1+Bank2 data as number of clusters increases

Looking carefully at the plots of Figures 1, 2 and 3, the whole process of the cluster validity is settled; whereas, at k=12, the WB indices exhibit the major descent jumps as "k" increases after beginning at k=4. It is worth mentioning that in their work, Zaho et al. provided evidence to prove the certainty of their index when compared to other sum-of-squares based indices like those proposed by Ball and Hall (1965), Calinski and Harabasz (1974), Hartigan (1975) and Xu (1997).

4.   Conclusions and Implications

Knowing that the banking sector in particular is considered the key sector of the Lebanese economy, the data corresponding to the total number of employees of two banks have led to twelve clusters, divided equally between the two genders. The results obtained from applying the k-means clustering algorithm exhibit two major findings that do coincide with previous works.

The first major finding that reflects on the whole Lebanese employees is the Glass Ceiling syndrome, where the top most paid clusters are mainly dominated by males, and the presence of females is minimal and the latter salaries on average are around 81.67% of their male counterparts. Hejase et al (2013) found that 26.6% of Lebanese respondents claim that women are not paid as well as men when occupying the same position. Yet, when asked about the number of females on the Board of Directors (BOD), the results revealed that only 1 of 6 BOD members are females (p. 46); hence reflecting Blau and Kahn (2007b) assertion that states that "discrimination can affect employer hiring and promotion policies and decrease women's employment in highly-paid occupations and industries" (pp. 2-3).

The second major finding relates to the lowest paid clusters in both banks (Bank1 and Bank2) which are dominated by females that hold university degrees and are paid with relatively better average wages than males. For many, this is considered a Sticky Floor since females in the low paid clusters are better educated; their ages are on average less than those of their male counterparts (average males age is higher than average female age by around 4 years). Similarly, within these clusters, males do have as an average higher years of experience. These findings are not a surprise in an economy like that of Lebanon. In fact, males in these lower levels of wages do hold very basic classical male-jobs (e.g., office boys, guards, and office keepers). Thus, it is apparent that males within this cluster remain attached to their jobs while females who enter at similar low level jobs (e.g., teller) have better future opportunities to advance both along the job and wage ladders. Mulligan and Rubinstein (2008) contended

that women's wages rose due to their behavior in the labor market (cited by CONSAD, 2009, 51). Findings match those found by Hejase et al (2013) who contended that "women in Lebanese institutions seem to be able to reach acceptable levels of seniority, but they are still way behind when it comes to top managerial positions which involves strategic planning and decision making" (p. 47). The aforementioned findings conform to Blau and Kahn's (2007a) findings which asserted that "gender differences in occupation and industry are substantial and help to explain a considerable portion of the gender wage gap. Men are more likely to be in blue-collar jobs; they are also more likely to be in unionized employment. Women are more likely to be in clerical or professional jobs and to work in the service industry, previously confirmed by Bowler (1999, 20) and Joy (2006, 221). Taken together, these variables explain 53% of the gender wage gap—27% for occupation, 22% for industry, and an additional 4% for union status" (p. 12). However, Blau and Kahn (2007a) warn that "the proportion of the wage differential that is not explained by these types of productivity-related characteristics includes the impact of labor market discrimination, the effects of gender differences in unmeasured productivity levels or non-wage aspects of jobs. In this case, 41% of the gender gap cannot be explained even when gender differences in education, experience, industries, occupations, and union status are taken into account" (p. 12).

The results of this paper have implications for staff and managers in organizations as well as for policymakers. The relationship that has been proved to exist between gender, occupation, and wages, indicates the importance of considering such factors as prerequisites to the success of describing the wage gap in the Lebanese banking sector, and to identifying possible problems like "Glass Ceiling" and "Sticky Floors". Therefore, managers may pay more attention on the development of career plans which are fair and correlated to performance and policymakers may take these attributes into consideration while formulating labor policies.

The current paper serves as an eye opener to researchers who are interested in studying wage gaps and discrimination in a Middle Eastern country, while studying the case where government does not have a clear policy or regulation of work discrimination in its formal legal system. Moreover, this paper emphasizes the fact that universities and other institutions of higher education have the responsibility for creating awareness of the job market's realities so as to enable their students to survive the existing hostile and difficult market's conditions, especially for future female workforce, and be ready to face hostile situations with responsibility and ethical behavior. Finally, this paper contributes and adds value to the literature, characterized as highly lacking, of the current Lebanese job-market.

5.   Limitations

This research is limited to the data of the small- and medium-size financial institutions in the banking sector; it did not take a sample from all types of banks of the sector into consideration. Statistics is usually needed to identify possible differences in small-, mid- and large- sized firms. Also, findings of the current research cannot be generalized because it was mainly conducted within one specific business field. However, considering the current research as an exploratory study, one may use the results as possible indicators that are needed to be addressed to improve the status of females at work in general terms.

6.   Future Research

The Lebanese literature on recorded wage discrimination involving female leaders within the various economic business sectors is poor. Therefore, this research should be expanded to include other economic sectors in order to provide a realistic view of female wage

discrimination across the ladder of jobs within the Lebanese organizations. The aforementioned future research is needed to furnish recommendations to the Lebanese Government to implement new policies to mitigate any discrimination in wages.

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