THE AMERICAN UNIVERSITY IN CAIRO
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Impact of ICT on Gender Gap in Egypt

Dina Atef Mandour

Working Paper #004

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Preface:

The concern for women economic empowerment has been a priority in the agenda of many national, non-governmental as well as international stakeholders in Egypt. Despite the various efforts that were carried on by the government and the different stakeholders concerned with the women economic participation in Egypt, it is evident that there are still various challenges and gaps that still hinder women full participation in the labor market and economic life. These main gaps include: The low women economic participation (around 20%), high unemployment rate (around three folds that of males), and the poor working conditions of women particularly in the informal sector.

Moreover globalization was found to bring a mixed bless and curse for women; trade liberalization, rapid developments of information and communication technology, increased roles of Multinational corporations and many other manifestations of the global economy we are living in pose positive well as negative results for working women depending on their vulnerability in the labor market. This created the need to pursue thorough research to tackle how all these challenges are affecting women ability to participate, work, progress and be empowered.

In the frame of the Consortium (RPC) on Pathways of Women's Empowerment, the Social Research Center- the American University in Cairo with the funding from the CIDA have initiated the **SRC/CIDA research program for research policy papers and policy briefs on gender and work.**

The project aimed at producing policy research papers and policy briefs on the various factors affecting women and work at the four levels: the household level, the enterprise level, the economy level and the global economy level.

The SRC/CIDA research program on gender and work aimed at:

- Issuing policy research papers and policy briefs on women and work
- Producing guidelines and recommendations that are supported by empirical knowledge, for policies and actions to support women work as a tool for women economic and social empowerment.
- Encouraging evidence based debate on needed policies for women economic empowerment.
- Contributing to an open environment of data access and effective use of field surveys in policy research papers.

The project produced two outputs:

- ***Four Research Papers*** tackling different important aspects of women work in Egypt. These included examining work and women economic empowerment in the Egyptian context, the relation between education, women empowerment and work in Egypt. Another important aspect the project looked at is the evolution of wage and job quality for men and women in the Egyptian labor market in the formal private and public sectors over the period (1998-2006). The fourth research paper examined an important new topic which has emerged recently as a result of the increased technological development which is the information and communication technology (ICT). It aims at assessing the impact of ICT on gender equality in Egypt focusing on differentials in wage rates and employment opportunities.

- ***Based on the results of the research papers; four policy briefs*** were prepared that aimed at providing the policy maker with clear and concrete policy advice. The briefs were prepared in Arabic.

The most important results stressed on by the papers and the briefs included that although the constitution and the Egyptian labour law stress on gender equality, however, it seems important to have an equal pay act, ensuring equal pay for equal work, in a broader sense, one which prohibits discrimination at the entry points into the labor market, in job titles, in job ranks and in pay scales, is yet to be passed.

The analysis indicates that there is a significant change in various views and social values regarding the right of women to participate, however, there is still a need to adopt labour market policies that support women's participation. These policies include: flexible working time (for example part-time jobs), designing macro and micro economic policies to better address women's employment problems especially in the private sector, and providing accessible and affordable daycare centers and other services which are important. Supporting an effective women's entrepreneurship policy could be an effective way to increase female labor force participation and to face female unemployment

Regarding the impact of education on women economic empowerment, it is evident that education is found to have a powerful influence on women's labor market pathways in Egypt. However, it is also found that raising female education level is not enough to boost young women's economic empowerment. To strengthen education as a path to enhance women's economic participation and opportunity in Egypt, there is an urgent need to focus on improving education quality, and targeting girls from secondary and technical education as they are more vulnerable to unemployment and engagement in the informal sector.

Information and Communication technology sector appears to be a promising field for improving women engagement in labor market and the community in general, however more efforts should be devoted to increase their engagement. To be able to reap from the benefits of ICT, women must be equipped with skills to prepare them for a range of roles not only as ICT users, but also as creators and designers.

In preparing the research papers and the policy briefs; the SRC/CIDA research program on gender and work have benefited from various consultative group meetings where participants from academia, research, donor organizations offered advice and guide to the researchers in designing their research work as well as in formulating the policy advice.

The project benefited from the Egypt Labor Market Panel Survey of 2006 (ELMPS 06). ELMPS 06 is a follow-up survey to the Egypt Labor Market Survey of 1998 (ELMS 98), which was carried out in November-December 1998 by the Economic Research Forum (ERF) in cooperation with the Egyptian Central Agency for Public Mobilization and Statistics (CAPMAS) – the main statistical agency of the Egyptian government . ELMS 98 was carried out on a nationally-representative sample of 4,816 households and was designed to be comparable to the special round of the Egyptian Labor Force Survey carried out in October 1988 (LFSS 88). The ELMPS 06 is the second round of what is intended to be a periodic longitudinal survey that tracks the labor market and demographic characteristics of the households and individuals interviewed in 1998, any new households that might have formed as a result of splits from the original households, as well as a refresher sample of households to ensure that the data continue to be nationally representative.

The final sample of 8,349 households is made up of 3,684 households from the original ELMS 98 survey, 2,167 new households that emerged from these households as a result of splits, and a refresher sample of 2,498 households. Of the 23,997 individuals interviewed in 1998, 17,357 (72 percent) were successfully re-interviewed in 2006, forming a panel that can be used for longitudinal analysis. The 2006 sample contains an additional 19,743 "new" individuals. Of these 2,663 individuals joined the original 1998 households, 4,880 joined the split households, and 12,200 were part of the refresher sample of households.

Impact of ICT on Gender Gap in Egypt

Dina Atef Mandour[1]

Working Paper #004

Abstract

The study addresses the interaction of gender and ICT. It aims at assessing the impact of ICT on gender equality in Egypt focusing on differentials in wage rates and employment opportunities. This aim is addressed by illustrating women's current status in Egypt regarding ICT related education and employment as well as their access to ICT. Further, the study employs two sets of panel regressions with different sector coverage on pooled data during 1996-2006 to test for the significance of gender employment gap in ICT related sectors and to identify factors affecting the gap in ICT and non-ICT related sectors.

The findings of the study identified that the current status of women in ICT related education, access and employment embeds many positive opportunities as well as considerable challenges. Among the positive trends in education is the increasing ratio of females to males in secondary and primary education as well as in scientific faculties during 1996-2006. Weakness lies in women's low enrollment rates and increasing gender gaps in ICT related higher scientific education specifically in technology and engineering. The study outlined a number of challenges that women face regarding employment in ICT sector, among which are; the relatively high concentration they experience in low skill demanding ICT sectors, their declining employment shares in all ICT related sectors as well as their relatively low productivity ratios on average in such sectors and the tendency to be more concentrated in temporary jobs. Regression results indicated a significant positive relationship between gender equality in employment and the level of ICT infrastructure in Egypt. A positive significant relationship was also found between the development of ICT sector and gender equality in employment indicating that economic growth of the ICT sector in Egypt could result in improving female to male employment ratios in the sector. Moreover, the results showed that encouraging female enrollment in scientific faculties would lead to significant improvements in their employment ratios compared to men in ICT sectors. Most importantly, the empirical findings have also illustrated that there is no significant difference between gender bias in employment in ICT sectors and non ICT sectors. This indicates that ICT sector is not one of the most highly gendered sectors in Egypt which gives a high potential for women to thrive from participating in this sector. Finally, the study proposed a number of policy implications including the need to adopt strategies that aim at addressing the supply side by generating female demand on ICT related education and training as well as devoting more efforts to encourage the engagement of women in novel areas as Tele-work and IT clubs which can significantly help in improving women intellectual and economic status provided that a proper institutional framework exists.

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1. Introduction

Globalization has brought in positive prospects for helping economies to be transformed to knowledge based economies. A knowledge based economy is defined to be one which can efficiently create, disseminate, and use knowledge to enhance its growth and competitiveness. Being a main catalyst for economic development, knowledge, can significantly contribute in raising the living standards of nations and individuals by narrowing different kinds of gaps (income, gender, education, etc.).

Information and communication technologies (ICT) represent one major pillar in forming a knowledge based economy through facilitating effective communication, disseminating, and processing of information. With the growing use of various forms of ICT, it is becoming a priority to utilize such technologies in serving socioeconomic developmental objectives (Kamel, 2007). ICT production and usage can significantly contribute to economic growth basically through gains in total factor productivity and increased flows of information and knowledge which are translated in reducing uncertainty and transactions costs. Such outcomes would help in overcoming market failures and asymmetric information. Moreover, with increased information flows, ICT availability and usage tend to allow greater transparency, accountability and accessibility in the delivery of public services, which in turn help in efficient allocation of resources (Chen, 2004). Thus, ICT embeds a high probability of exerting a positive impact on economic growth and human development.

Although the role of ICTs in promoting development is increasingly recognized, it is becoming clear that the benefits of ICTs are unevenly spread among and within countries, based on unequal access to technologies and knowledge skills needed to derive optimal benefit from them. This difference in the ability of countries to access, employ and develop knowledge through ICTs applies also on different regions, sectors and gender. This phenomenon has been typically coined as the "digital divide" (UNESCO, 2003).

The gender divide represents one important dimension of the digital divide. As the UNDP (2005) emphasized "Unless this gender digital divide is specifically addressed, there is a risk that ICT may exacerbate existing inequalities between women and men and create new forms of inequality. If, however, the gender dimensions of ICT—in terms of access and use, capacity-building opportunities, employment and potential for empowerment— are explicitly identified and addressed, ICT can be a powerful catalyst for political and social empowerment of women, and the promotion of gender equality". Lack of access and participation in the use and production of ICT, new technologies could become a significant factor in marginalizing women from the economic, social, and political mainstream of their countries and of the world (Hafkin and Taggart, 2001). Despite the importance of the gender dimension of ICT, many countries have, unfortunately, not included the gender considerations in their ICT national strategies (Daly, 2003).

ICT and gender inter-linkages gained their first international attention at the fourth World Conference on Women in Beijing in 1995. In 1998 gender issues in ICT was one major topic on the agenda of the World Telecommunications Development Conference as well as at Conference on Women and Economic Development (Hafkin, 2002). The issue was further heightened in 2003 at the World Summit on the Information Society (WSIS) where aligning the achievement of Millennium Development Goals (MDGs) with the goal of establishing an equitable information society was as a main objective.

This study addresses the interaction of gender and ICT. It aims at assessing the impact of ICT on gender equality in Egypt focusing on differentials in wage rates and employment opportunities. This aim is addressed by illustrating women's current status in Egypt regarding ICT related education and employment as well as their access to ICT. The existence of gender gaps in terms of employment and wage inequalities within ICT related sectors is examined. A crucial dimension in tackling the issue is to understand the factors affecting employment gaps in ICT related sectors and whether they differ between ICT and non-ICT related sectors. This is addressed in the study by estimating a panel regression. Identifying the mechanisms by which women can take advantage of the opportunities that ICT can provide is an important outcome of the study.

The study is divided into five sections following this introduction. Section 2 provides the conceptual framework of the study which encompasses the various definitions of ICT in the literature and a limited review of theoretical and empirical evidence on the relationship between ICT and gender. Section 3 provides a profile of ICT sector and women in Egypt to elaborate on the developments of ICT sector in Egypt as well as the status of women in the sector. Main efforts undertaken by various stakeholders to promote the use and production of ICT by women in Egypt are also reviewed in this section. Section 4 proceeds with elucidating the status of women in ICT sector by analyzing available national data through which the existence of wage and employment gender gaps in ICT related sectors are investigated. Section 5 presents a quantitative empirical assessment of the relationship between ICT and gender gaps in Egypt which is expected to help in understanding the significance of gender inequality in employment in ICT related sectors as well as its main determinants. Section 6 concludes and outlines main policy recommendations.

2. Conceptual Framework

2.1 Definition and Scope of ICT

There is no agreement in the literature on the definition and scope of the ICT sector and ICT employment. However, most definitions have adopted a wide view of the sector which included all industries and services that are directly and indirectly related to ICT. Some have regarded the sector to comprise a heterogeneous set of goods, applications and services used to produce, distribute, process and transform information. They are thus considered to encompass all information technology (IT) based industries whether producing IT products or depending on them in the production process. Such sectors are as diverse as telecommunications, television and radio broadcasting, computer hardware and software, electronics and other high-tech products, computer services and electronic media (e.g., the Internet, electronic mail, and electronic commerce) (Marcelle, 2000). A similar definition was adopted by the UNDP where ICT sectors are regarded to be tools that people use to share, distribute and gather information and to communicate with one another through the use of computers and computer networks. This includes computers, communication technologies (including radio, television, video, telephone, fax, mobile telephony, and internet), networking and data processing capabilities and software (ESCAP, 2004). Moreover, the World Bank defined ICT to consist of hardware, software, networks, and media for collection, storage, processing transmission, and presentation of information in the form of voice, data, text, and images. They also range from the telephone, radio and television to the internet. On the other hand, the OECD defined ICT sectors as a combination of manufacturing and service industries that capture, transmit and display data and information electronically (Chen, 2004). It is worth mentioning that the OECD represented the most

concise definition found in the literature and the study adopts it in the empirical assessment part. Table (A.1) in Appendix illustrates these sectors in detail. International Labor Organization (ILO) has differentiated between core ICT sectors and ICT related sectors where the former refer to sectors producing rather than using IT like software programming, software development, hardware consultancy, network management and so forth (Hafkin and Taggart, 2001).

Regarding ICT employment, the OECD (2007) has adopted a narrow and a broad definition of ICT employees and specialists. The narrow definition is basically related to ICT development and included ICT specialists, who have the ability to develop, operate and maintain ICT systems. In other words, ICT constitute the main part of their job (e.g. operation research analysists, computer programmers, software engineers, hardware engineers, electronic engineers, network analysts, database administrators). In line with the ILO sector classification mentioned above, this type of work could be referred to as core IT employment which is related to the production of IT (Hafkin and Taggart, 2001). On the other hand, the broad definition included, in addition to ICT developers, ICT advanced users encompassing competent users of advanced software tools and basic users of generic tools (e.g. Word, Excel, and PowerPoint). Due to unavailability of data on employment in ICT occupations in Egypt, the study adopts the broad definition of ICT employment which covers all employees engaged in all ICT related sectors as defined by the OECD (2007).

2.2 ICT-Gender Linkages: A Brief Literature Review

Globally, women's access to information has been a major concern. The United Nations places lack of access to information as the third most important issue facing women after poverty and violence (UNESCO, 2003). Theoretically, a large number of studies that analyzed the relationship between ICT and gender have focused on illustrating the enormous set of positive aspects that ICT could generate for women as well as the various constraints that could hinder women from an effective use of such benefits. Empirically, however, the number of studies analyzing the effects of ICT on gender is relatively meager especially for those applied on developing countries. This has led some researchers to conclude that the empirical foundation for understanding the issue is still not fully formulated (Marcelle, 2000). This section outlines ICT-gender linkages identifying the different channels through which ICT can affect gender as revealed by the existing literature.

A number of studies argued that ICT has a positive impact on gender gap through facilitating the engagement of women in the labor market and its contribution to women's empowerment and capacity building in numerous ways (Maier and Nair-Reichert, 2008). Since ICT related activities require essentially intellectual abilities rather than physical abilities and also allow for more flexible working conditions, women could enjoy comparative advantage when compared to men. Moreover, ICT has facilitated the transfer of information and knowledge around the world which could enable women to acquire education through distance learning and hence assist them in acquiring education in fields that they were previously deprived from. Thus, the relationship between ICT and education is a two-way relationship where education is arguably the most important prerequisite that enables women to take advantage of the opportunities offered by ICT, and ICT per se facilitates education attainment (Chen, 2004). Moreover, as Mitter (2006) underpinned, women entrepreneurs can benefit from better access to global information and markets which would enhance their competitiveness in the market.

Another positive aspect of ICT is strengthening women's political empowerment. ICT is a forceful tool to improve governance and strengthen democracy and citizen empowerment. It can help foster more transparency by enhancing interaction between government and citizens (United Nations, 2005). ICT has the potential of significantly increasing women's voice and enhancing their political participation where they employ technology to empower themselves politically and raise awareness, develop networks, and increase advocacy for women's causes. As a result, ICT can be used as a vehicle to pressure policymakers in order to respond to women's perspectives and concerns, leading to more gender-equitable policies and social services (World Bank, 2004).

ICT major essence falls in the broad spectrum of economic opportunities that widen the scope for women's engagement in the labor market in various novel areas like e-commerce, call centers, tele-centres and tele-work. Each area could potentially improve women status in the labor market and mitigate employment gender gaps, yet each has its relative limitations.

E-commerce offers many benefits for women entrepreneurs. It provides greater and wider market access, better information and cost-effective mean to promote businesses by eliminating the cost of middleman in the process of purchasing inputs and selling products[2]. Nevertheless, many factors in developing countries could constrain the dissemination of such type of work including lack of consumer confidence in the quality of the goods sold over the internet, insecure payment modes, and weak regulatory and legal framework. In addition, women would need to acquire far more qualifications other than traditional business skills to be able to engage in this field. This includes, among others, learning internet technologies and dealing with technical and regulatory problems for payment over the internet (Maier and Nair-Reichert, 2008).

Tele-work is another growing employment field that has opened up new opportunities for women using ICT to enable them to work from their homes utilizing flexible working hours and location. Nevertheless, compared to work in organized sector, tele-working may lead to lower wages, less secure working conditions and difficulty in engaging in any kind of collective action to achieve dignity at work. It also deprives women from rights and benefits associated with regular employment like promotion, pensions, training, unionization and paid leave (Gillard et al., 2007). Thus, such type of work, in spite of the flexibility it provides, can deepen existing gender inequalities unless proper policy measures are implemented. Moreover, to engage in this type of work, women will need to make substantial investments, including purchase of computers, payment for internet connectivity and acquiring technical skills to be able to deal with technical problems (United Nations, 2005; Mitter, 2006).

ICT has also facilitated outsourcing which opened up new areas for women employment. Among the most significant outsourcing applications is the establishment of call centers[3]. Such new field offers job opportunities for low educated and low skilled segments. Recent

[2] An example for this is El-souk (the market), an e-commerce website set up with World Bank assistance, which helps women artisans from Morocco, Egypt, Jordan, Tunisia and Lebanon sell their products abroad and develop B2B direct relations (Maier and Nair-Reichert, 2008).

[3] Call centers is one type of IT Enabled Services (ITES) which resulted from Business Process Outsourcing (BPO). These centers are being globally located via outsourcing to take advantage of different time zones and lower wages. They combine front-office (voice) and back-office work. Back-office work can range from low skilled jobs, like data entry, to sophisticated high skilled jobs like technical consultancy and web design and management (Mitter, 2006).

qualitative case studies indicated that women are concentrated in front office jobs (voice) and areas related to back-office work that require routine or discretionary skills (Gillard et al., 2007). Nevertheless, this type of work represents insecure employment where employees can be easily dismissed. Like tele-work, call centers could result in a form of non-unionized workforce which may jeopardize the quality of work and the sustainability of these jobs (Mitter, 2006). Being tied to shifts that match peak call times in other countries, this type of work deny women from benefiting from the flexibility ICT is supposed to provide (United Nations, 2005).

Tele-centers[4] represent one of the strategies adopted to increase public access to ICT in remote areas and marginalized groups. Such centers provide new means for education, public awareness and business opportunities. Through tele-centers women can benefit by receiving information on their legal rights, on-line government services, general and specialized ICT training to upgrade their job qualifications and job opportunities as trainers in such centers (Wanas and El-Tokali, 2007). Moreover, Tele-centers present promising opportunities to small and micro women entrepreneurs, particularly to those who cannot afford to buy their own computers and associated networking technologies. Tele-centers can be part of existing institutions such as health centers, schools and community centers (United Nations, 2005). Long term sustainability of these centers is a crucial issue. It depends on the income generating capacity of the users, which in turn, depends on the ability of the tele-center to meet specific needs and demands of the community it serves (Maier and Nair-Reichert, 2008). Inappropriate opening times, security issues and lack of transport could hinder women from benefiting from these centers. The availability of women support staff and trainers in these facilities can facilitate women's and girls' use of ICT resources. Allocating certain times and/or spaces solely for women in such centers could also help in this regard (United Nations, 2005). IT Clubs in Egypt is a successful example of tele-centers that could significantly help women to attain the benefits from ICT (See section 3.2).

Opposing such positive aspects that ICT provides which could ultimately mitigate gender gaps, many studies, as cited in Maier and Nair-Reichert (2008), have emphasized that ICT sector remains one of the most gendered sectors (Archibald, et al., 2005; Mitter and Rowbotham, 1997). There is an agreement in the literature that ICT gender gap is not a country specific phenomenon as it exists in developing as well as developed countries (Sorenson, 2002).

A number of studies have identified a set of constraints that could deprive women from enjoying the potential benefits of ICT. Some scholars have argued that ICT could tend to exacerbate the returns on human capital which could lead to an increase in the gender gap, given the already existing gender gap in terms of education in many developing countries. Women relative to men, especially in developing countries, have frequently fewer years of schooling, lower enrollment rates in science and technology education and less work experience. Additionally, they often lack access to skills training that would enable them to gain specialized ICT related jobs. Thus, with respect to men, women's wages are likely to relatively deteriorate if a premium is dedicated to human capital (Moreno-Galbis and Wolff, 2007). Moreover, socially and culturally constructed gender roles and relationships remain a

[4] Tele-centers can take different forms; public call offices providing access to public phones, community tele-centers providing basic information based services like data processing , multi-purpose community tele-centers offering tele-education, facilities and support for local small business and tele-workers, IT general and specialized training and finally mobile tele-centers which bring ICT to rural and under developed areas (Wanas and El-Tokali, 2007).

vital element in constraining the capacity of women and men to participate on equal terms in the ICT related activities. Conventional views of women's skills and abilities have imprisoned them in the category of low-skilled, low-paid and temporary jobs in ICT related sectors whereas men are more likely to be found in the high-paying, creative work of software development (UNESCO, 2003). That is why some scholars have argued that without appropriate policy measures, the pattern of the status of women in the traditional so- called old economy is likely to appear in the ICT based new economy (Mitter, 2006). In addition to such gender specific constraints, women as well as men face other limitations including technical infrastructure, connection costs, computer literacy and language skills (United Nations, 2005).

Another major constraint that hinder women from benefiting from ICT is the fact that the majority of the newly created technology and telecommunication jobs in developing countries are in the private sector, where women-specific related benefits remain minimum when compared to public sector. As a result, women are expected to opt for public sector work that is more likely to offer childcare provision, flexible hours and maternity leave, but lagging behind in ICT related aspects (Gillard et al., 2007).

Regarding use and access, some studies have tried to test the hypothesis that issues of gender will disappear since the internet is a virtual environment. However, it was found that there is little evidence that proves this hypothesis after sustained case study analysis. On the contrary, most studies confirmed that males have dominated internet use (Boafo, 2003). As aforementioned, levels of literacy and education, language, time, cost, geographical location of facilities, social and cultural norms, and insufficient computer and information management skills were constantly mentioned as the major obstacles that limit women's access to ICT. On the other hand, Hafkin and Taggart (2001) pinpointed that there is no strict correlation between internet usage, a main indicator of accessibility to ICT, and a set of gender related variables including female literacy, female technical and professional employment as well as per capita GNP for women. This was justified by the fact that women internet users in many developing countries are concentrated within the small percentage of educated women in urban areas. Accordingly, Hafkin and Taggart (2001) argued that women internet users are not representative of women in the country as a whole.

Among the issues that most of the empirical studies did confirm were the high usage of ICT to enhance political advocacy among women and the high correlation between education and production of ICT. This implies that women's lower representation in the production and design of IT could be a result of reduced access to education, and socio-cultural norms discouraging women from studying science and technology and limiting their engagement in ICT jobs (Hafkin and Taggart, 2001). In other words, educational status and socio-cultural norms are likely to have a higher weight within factors affecting women as producers of ICT more than as ICT users.

Research on gender and ICT is highly constrained by the lack of macro and micro data classified by gender, and the scarcity of surveys that document all the uses women make of ICT in developing countries. Chen (2004) and Moreno-Galbis and Wolff (2007) followed different methodologies to assess the impact of ICT on gender gap. Both have tried to overcome data limitations by taking proxies for ICT indicators whether on the macro or micro level as well as for employment and wages. Chen (2004) focused on analyzing the impact of ICT on gender equality in education and employment by undertaking a panel regression among 209 countries during the period 1960-2002 using macro level data. The

analysis showed that increases in the level of ICT infrastructure tend to improve gender equality in education and employment and that gender equality in education is an important factor for improving gender equality in employment. Moreno-Galbis and Wolff (2007) focused on studying the impact of ICT on the gender pay gap along the wage distribution building their econometric analysis on micro level data. The study came up with the conclusion that the gender gap is higher among ICT users than among non-ICT users at the middle and upper part of the wage distribution. Thus they concluded that ICT tends to widen the gender gap. They also found that discrimination explains a high percentage of the wage gap among non-ICT users whereas the gap depends more on objective differences in the labor market characteristics between men and women among ICT users.

Liff and Sheperd (2003) investigated a number of additional determinants that could have an impact on the gender digital divide. They undertook a limited survey in the UK to investigate the impact of a number of determinants on gender digital divide including technical access; ability to use access; take-up of access; and impact of access[5]. Their data results showed that a gender divide continues to exist, not simply at the level of whether or not a person is an internet user but also in terms of utilization of such technology and the usefulness it provides for men versus women (Liff and Sheperd, 2003).

Consequently, this limited literature survey showed that there is no agreed upon clear-cut impact of ICT on gender gap. On theoretical and empirical levels, the issue remains inconclusive. There are several determinants which influence the impact of ICT on women, many of which are related to social and cultural aspects. However, the most evident element that remains influential is educational attainment. Moreover, the literature survey pointed out that a clear distinction should be drawn between women as ICT producers and ICT users. The gender gap in terms of ICT producers is likely to be more affected by the educational level and socio-cultural aspects compared to ICT users.

3. Development of ICT and Women's Status in Egypt

3.1 ICT Developments and Diffusion in Egypt

ICT sector in Egypt is amongst the largest in the Arab region including computing services, equipment and software development. The sector is regarded as a major engine of economic growth in the country. ICT sector contribution in real GDP reached 3.6% in (October-December) 2007 compared to 3.3% in (October-December) 2006. Moreover, the sector is one of the fastest growing sectors in Egypt where the quarterly growth rate of ICT sector reached 15.5% in (October-December) 2007(MCIT, 2008a). In 2007 the number of ICT companies reached 2,262 going up from about 300 companies in 1999, a growth that is significantly higher than growth in other traditional economic sectors (UNCTAD, 2007; Kamel, 2007).

[5] *Technical access*: where men and women can and do get access to an Internet-ready device; the type of device involved; and the quality of the connectivity.• *Ability to use access*: the extent to which men and women know other people who use the Internet and can provide help; the skill levels they perceive they have reached; their comfort/discomfort with ICT-based systems; and worries about potential negative consequences of access (e.g. fraud or viruses).• *Take-up of access*: whether men and women are Internet users; any variation in length of use; how much use they make of access; and what range of activities they use it for.• *Impact of access*: the degree to which Internet use has changed patterns of activities; any views as to the significance of this, in this context focusing on the extent to which access is being used in ways that challenge or reinforce gender stereotypical behavior (Liff and Sheperd, 2003).

Additionally, Egypt has a high personal computers (PCs) growth rate and is considered the fastest growing market for PCs in the Arab region. Nevertheless, the number of PC installations as compared to the total population is minimal where only 3.7 PC were available per 100 inhabitants in 2005. However, this number represented a 223% increase compared to the figure of 1999 (World Bank, 2008). Use of ICT exists in almost all sectors of the economy with highest percentage in manufacturing sector (50.9%) followed by hotels and restaurants and financial intermediation in 2007. Number of ICT employees increased in 2007 to reach 162.5 thousand compared to 147.8 thousand in 2006 with an annual growth rate of 9% (MCIT, 2008a) [6].

Since 1985, Egypt has heavily invested in its ICT infrastructure to become the platform for the economy's development and growth. In 1999, ICT was identified as a priority at the highest policy level and a new ministry was established, Ministry of Communications and Information Technology (MCIT), leading to more investments and infrastructure build-up (Kamel, 2007). Furthermore, Egypt's Information Society Initiative (EISI) was launched in 2001 to provide a broad perspective on the strategic plan for ICT's diffusion in Egypt. In 2003 the EISI was amended to cater for the changing local and global market needs through a public-private partnership (PPP). The government continued with its efforts and adopted many strategies and initiatives to increase ICT diffusion in the country. Initiatives included "free internet", establishment of IT clubs and reduction of ADSL installation fees by more than 100% in 2 years. In 2006, the price basket for internet (US$ per month) in Egypt was 58% lower than its figure at the world level and 45% lower than the prevailing level in the MENA region (World Bank, 2008). The industry was further boosted in 2004 with the establishment of the Egyptian Information Technology Industry Development Authority (ITIDA), a governmental entity aiming at paving the way for the diffusion of the e-business services and supporting an export-oriented IT sector. A number of other initiatives have also helped in increasing ICT access across a wide spectrum of the community. These included "PC for every home" initiative and its successor "Nation On-line", broadband diffusion, mobile penetration, electronic government institutionalization and software incubation and development (Kamel, 2006).

The ICT industry has flourished as revealed by different indicators among which is the significant increase in internet users from 0.65 million users in 2000 to 9.17 million in March 2008. This has put Egypt as the second highest country in Africa regarding internet usage (Internet World Stats, 2008). Internet penetration (% of population) increased from 1.01% in 2000 to 12.3% in March 2008 (MCIT, 2008a).

Moreover, the number of ICT multinationals coming to Egypt to expand their businesses and penetrate the local and regional markets has been growing. Further, as emphasized by UNCTAD (2007), Egypt has the potential to become a competitive international location for outsourced services. Based on the level of ICT infrastructure, government support, training programs available and the country's multilingual workforce, in 2005 Egypt was ranked the 12th on the world level in terms of competitiveness in outsourced services (MCIT, 2009). In 2006, the ICT market in Egypt generated around 2.9 billion US dollars of annual revenue (delete 2 previous sentences). Starting from 2002 onwards, investments in telecommunications have approached their equivalents in the MENA region and exceeded those at the world level. Similarly, telecommunications revenue in Egypt has surpassed its

[6] The criteria that the MCIT adopts in classifying ICT employees and ICT sectors were not clear.

figures in the MENA region since 1996 and the world since 1999 and represented almost 4% of GDP in 2006 (See Table (A.2) in Appendix) (World Bank, 2008).

Egyptian ICT exports have almost doubled during the period 2005 till 2007 (MCIT, 2008a). Egypt was the second largest African ICT services exporter in 2007. A survey conducted jointly by the MCIT, ITIDA and UNCTAD[7] in 2007 revealed that exports sales were concentrated in services whereas domestic sales were equally distributed between ICT goods and services. Nevertheless, Egyptian ICT goods exports increased at faster rate of 22 % annually from 2000-2006 compared to ICT services which expanded by 9% during the same period. Telecommunication, audio and video equipments accounted for the majority of ICT goods exports (UNCTAD, 2007).

In spite of the significant achievements in the sector, Egypt still lags behind the MENA region and the world in many ICT access indicators among which are the numbers of internet users and personal computers as well as the number of fixed line and mobile subscribers. Regarding the infrastructural aspects, information and communication technology expenditure in Egypt represented only 46% and 20% of its level in the MENA region and world respectively. The very low percentage of high technology exports within manufactured exports reveals weak productive aspects in this field.
As emphasized in Egypt Human Development Report (2008), the economy suffers from digital divide at all economic levels. From a social perspective and despite efforts of the government to lower the access price to the internet, the society suffers from unequal opportunities to take advantages of such progress. In 2008, only 6.8% of the lower income households (income below LE 1000) use the internet whereas about 74% of higher income groups (more than LE 3000) do. Regarding gender, there is a gap in internet usage between males and females where the percentage of males using the internet reached 61% while the percentage of females reached 39% out of total internet users in 2008 (MCIT, 2008a).

In general there are typically three dimensions to ICT policies – infrastructural, vertical, and horizontal – where:

- Vertical information policies address sectoral needs like education, health and industry;
- Infrastructural information policies address issues related to national communications infrastructure; and
- Horizontal information policies are those that affect broader social concerns like freedom of information, security, tariffs and pricing (UNESCO, 2003; Hafkin, 2002).

It could be inferred that ICT development in Egypt was more biased towards the infrastructural and horizontal aspects whereas the vertical aspect has been relatively lagging behind. Though there have been several initiatives undertaken by the MCIT as well as by Information and Decision Support Center to deliver specific training to graduate students in ICT, they were still insufficient (Kamel, 2006).

3.2 ICT and Gender Trends in Egypt

This part provides an overview on the status of women in Egypt regarding ICT related education and training, accessibility, and employment in ICT sector. Regarding employment, this part reviews the status of women based on the outcomes of previous studies and surveys.

[7] The survey interviewed 151 Egyptian ICT companies representative of the ICT sector (UNCTAD, 2007).

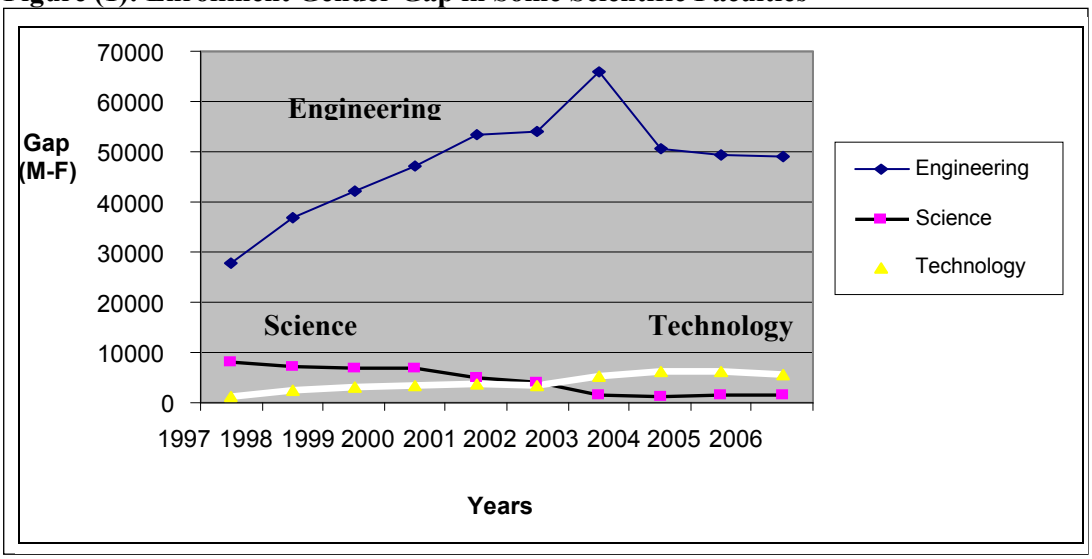
Women employment in ICT related sectors is further investigated in Section 4 based on analyzing data at the national level.

Education and Training

Modest figures, but improving trends are revealed by the statistics of ICT graduate and postgraduate education as well as the attainment of technical training and contribution in scientific research centers.

- Women scientists represent more than one third of the total number of scientists and engineers (MCIT, 2007).
- The ratio of females to males in secondary and primary education has increased significantly from 84% in 1996 to 97% in 2006. This is attributed to the number of females enrolled in secondary education which exceeded that of males starting from the year 2001 onwards.
- Number of females in scientific faculties is significantly lower than that of men. However, the ratio of the number of female to male students enrolled in scientific faculties has increased significantly from 53.4% in 1995/96 to 89.8% in 2005/06. Within scientific faculties, female enrollment reached its lowest rates in faculty of engineering (CAPMAS, 2007b). As Figure (1) reveals, the gender gap in terms of the difference between the number of male and female students enrolled reached its highest levels in faculty of engineering though experienced a decreasing trend starting 2004. The gap in technology and science faculties is significantly lower, yet it started to increase in the former staring 2003 and has been experiencing a continuously decreasing trend in the latter. It is worth mentioning that the percentage of female engineers who applied for High Diplomas in ICT increased from 10% in 2001/2002 to 30% in 2002/2003. Moreover, percentage of females as ICT graduates ranged from 15% to 28% in various universities in Egypt (MCIT, 2005).

Figure (1): Enrollment Gender Gap in Some Scientific Faculties



Source: CAPMAS (2007b)

- In 2004, women as faculty members in scientific faculties of national universities constituted 38%. Again, faculty of engineering had the lowest percentage reaching 15% in 2005 while women represented around 35% in

faculty of computing and information and 32% in faculty of science in the same year.

- Women represented about 50% of researchers at the National Research Center and 46% in centers affiliated to Ministry of Scientific Research (MCIT, 2008d; Hassan, 2005)
- The number of women in leading positions in scientific institutions is relatively low. In 2004, females represented only 3% of total number of employees in leading positions and decision makers in National Research Centre and 4% in Mubarak City for Scientific Research. As directors of research projects in Academy of Scientific Research, women represented only 16% in 2003 (Hassan, 2005). On average during 2001-2005 women accounted for only 11% of research projects directors in field of basic sciences research for the fifth 5-year research plan. However, there are signals of improvement in this respect. In 2005, women as departments' directors in research institutions represented 25%, 71% and 51% in Mubarak City for Scientific Research, Electronics Research Center, and National Research Centre respectively (CAPMAS, 2006).
- In the year 2004/2005, women working in the governmental sector in Cairo and Alexandria represented 49% of trainees on the use of high technology and computers in Leaders Management Development Center. Furthermore, in the same year women accounted for around 40% of employees working in various ministries and local municipalities who received specialized training on computer use and languages. Employees at Ministry of Education working in pre-university stages have received training on the use of high technology which included training on the use of computers, advanced scientific labs, use of internet, e-learning, e-government and managerial digitization. On average women represented 39% of those who received such type of training during 1997-2005. Highest percentage of women was found in those programs related to e-learning and e-government (48%). Lowest rate of women participation were at the secondary and preparatory stages. Moreover, 30% of those working at pre-university educational stages who attained the International Computer Driving License (ICDL) were women (CAPMAS, 2006).

Access

Due to data limitations, access to ICT is mainly gauged by internet usage which is considered a standard indicator of the use of ICT (Hafkin and Taggart, 2001). As previously mentioned, in 2008 women in Egypt represented 39% of total internet users, showing that males are more likely to use internet compared to women. Internet penetration among women reached 10% in 2008 which comes close to the penetration rate at the country level (12%) yet is still lower that that of men which reached 15% in the same year[8].

MCIT reported several indicators measuring different dimensions for internet usage by gender. In general, internet usage by females followed the same pattern as that of males classified by reasons for use, regions, or educational status as shown in Figures (2-4). Concerning the various internet activities, females compared to men employ the internet with a higher degree of usage for educational and learning reasons (a gap of 10 percentage points) and to some extent for issues related to health (a gap of 0.12 percentage points). This

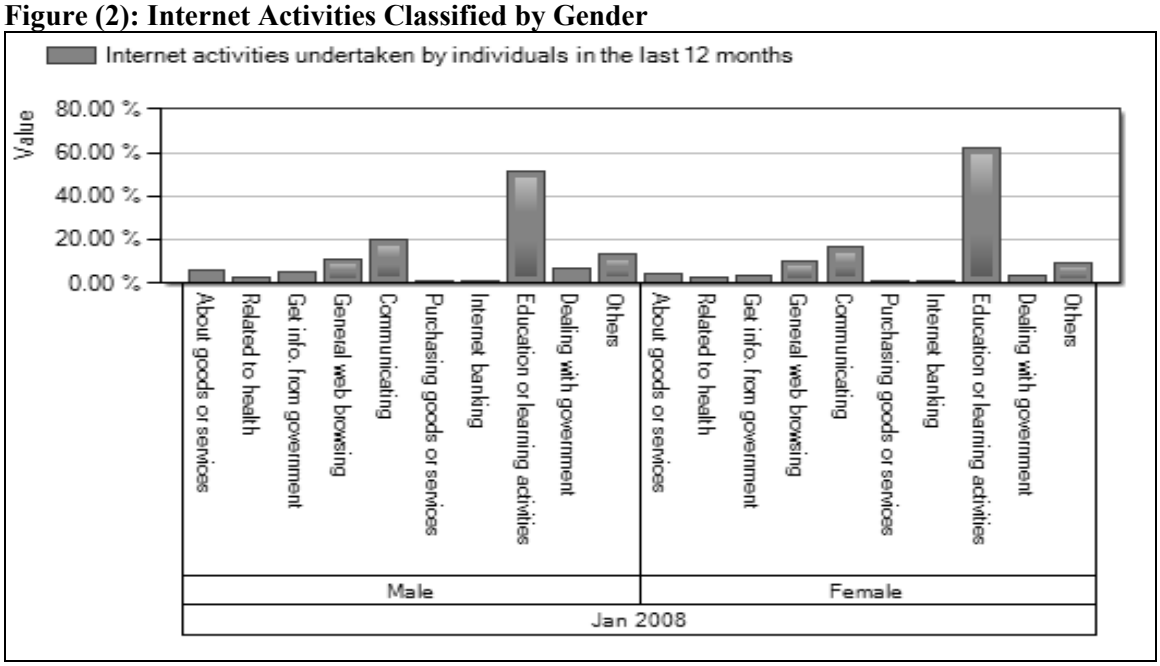
[8] Internet penetration was calculated by the author as the number of women internet users divided by the total number of women based on data of MCIT and projected population figures based on data from the census of 2006 published by CAPMAS (2007b).

indicator shows the flexibility that ICT provides women with in attaining distant education. On the other hand, females use the internet with a lower degree compared to men in all other activities (See Figure (2)). This was most evident in the case of activities related to communication followed by dealing and getting information from the government.

Classifying internet usage by region reveals the discrepancy between ICT diffusion in rural and urban areas (regional digital divide) where urban internet users accounted for the majority of internet users in the country in 2008 reaching 62% of total users. Females constituted 25% of internet users in urban areas as opposed to only 15% in rural areas. Nevertheless, the gender gap from this respect was higher in urban compared to rural areas forming a difference of 15 and 9 percentage points respectively. This stresses on the importance of devoting greater attention to rural ICT development that would benefit men and women equally and following more gender oriented ICT policies in urban areas especially that women represent around 49%[9] of total urban population.

Regarding education, the highest degree of discrepancy between females and males in internet usage falls in the upper or post secondary and tertiary education where the gap reached around 8 percentage points in each category compared to 2 and 4 percentage point gaps in the primary and lower secondary respectively. Though the percentage of internet users for females and males is much lower at earlier education stages, yet the gender gap is much lower. Hence, policies integrating IT in the education system in Egypt should focus more on increasing the inclusion of IT in general at primary stages of education and dedicate more attention to the gender aspect at upper secondary and tertiary stages trying to address the reasons behind the gender gap.

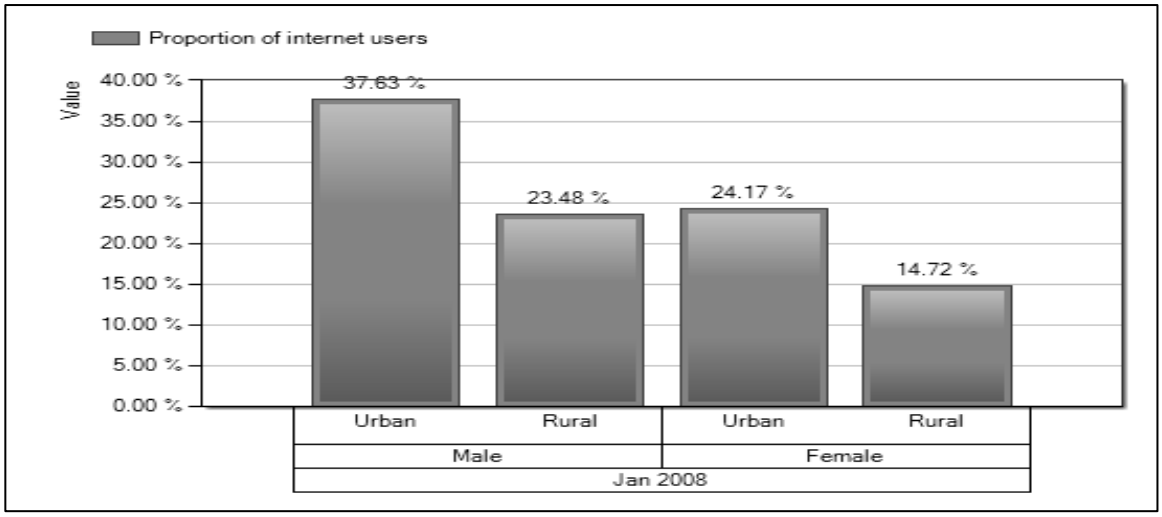
Figure (2): Internet Activities Classified by Gender



Source: MCIT (2008c)

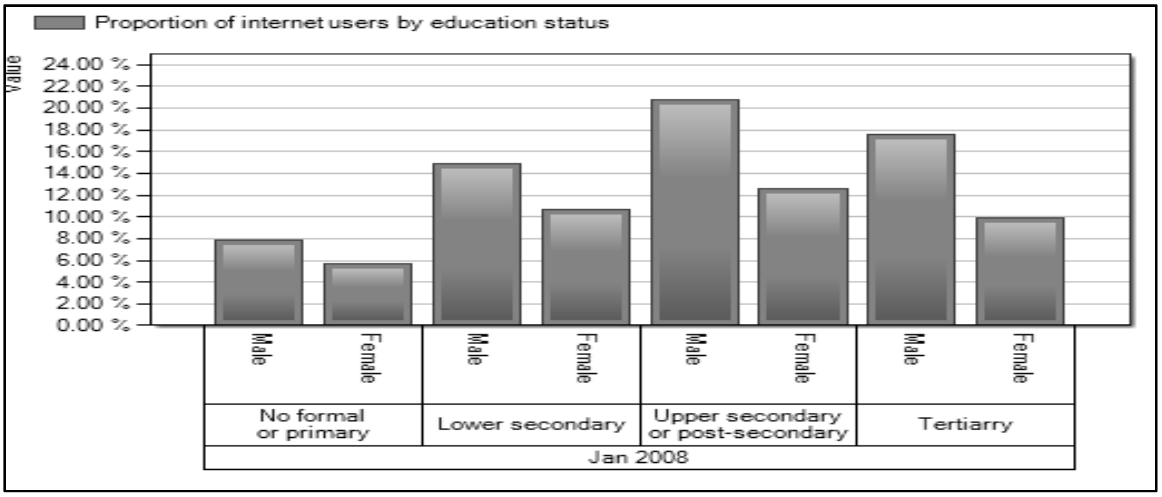
[9] The same figure applies also for rural areas (CAPMAS, 2007b)

Figure (3): Proportion of Internet Users by Region and Gender



Source: MCIT (2008c)

Figure (4): Proportion of Internet Users by Education Status and Gender



Source: MCIT (2008c)

Employment

Despite weak employment rates that women experience in ICT sector, Egypt is still recognized as one of the few African countries where women have high potential in significantly participating in the sector. In 2001 the number of women working in telecommunications reached 22% out of the total number of employees in this sector[10]. According to the previously mentioned MCIT/ITIDA UNCTAD study, women working in the surveyed ICT firms reached 23% out of total employees a figure that surpasses their average participation rate of 15%[11] in total workforce at the economy level in 2006[12] (UNCTAD, 2007).

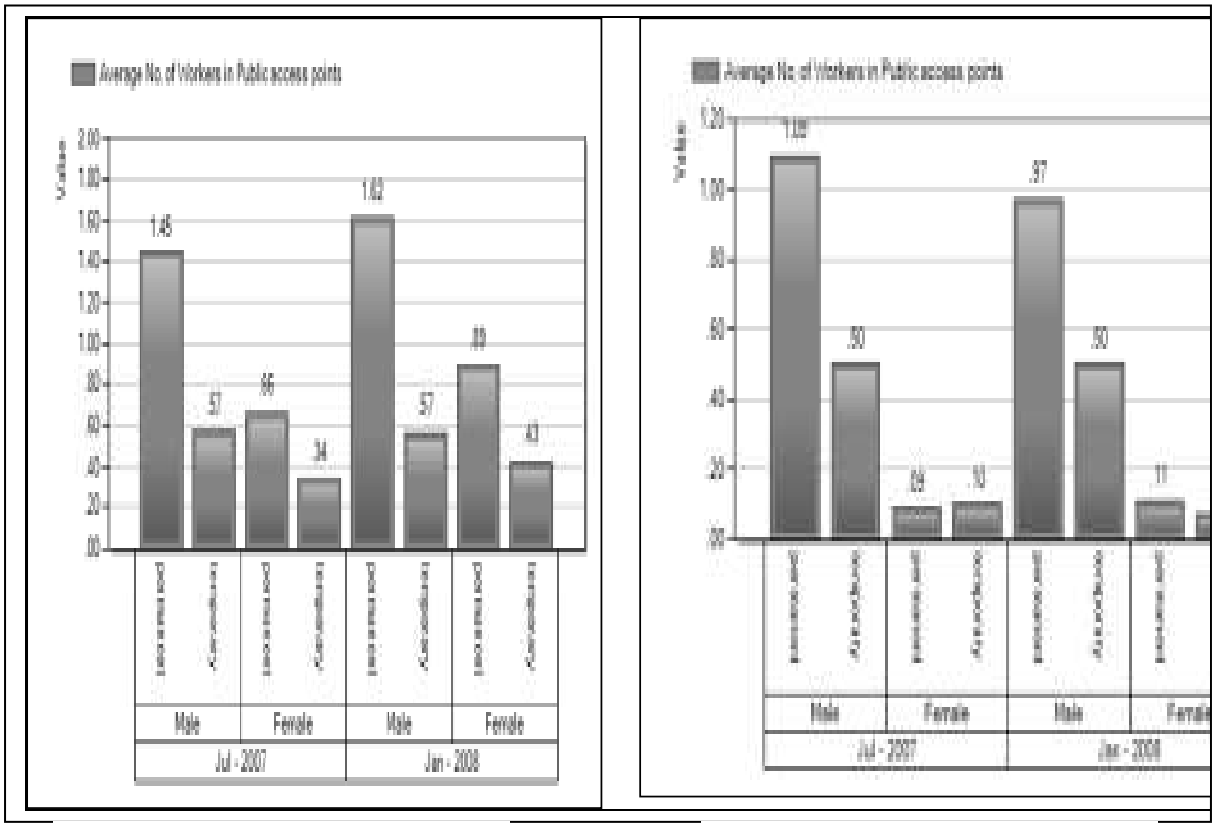
[10] In 2006 women participation in telecommunications sector declined to 15% as illustrated in Section 4.2 (CAPMAS, 2007a).

[11] See Table (A.3) in Appendix.

[12] A much lower rate was found based on national data which reveals the need for consistent databases (see Section 4)

According to MCIT (2005) report, women working in large ICT firms have experienced positive developments in terms of employment. Telecom Egypt has witnessed a steady increase in its qualified women engineers from 2000-2005. Moreover, the number of women holding leadership positions was continuously rising during the same period except for the year 2001 as many of them reached the retirement age. The percentage of women engineers ranged between 64 to 68 % out of the total number of engineers in the National Telecom Institute. However, in 2004 women constituted about 36% of total workforce specialized in scientific and technological fields in various ministries (Hassan, 2005). On the other hand, women represented about 54% of total employees at the Academy for Scientific Research in 2005. Women employed in jobs related to engineering, science and mathematics and statistics in the Academy represented 43%, 51%, 68% of total employees in each specialization respectively (CAPMAS, 2006). At the national level, females constituted 31% of technical and professional workers in 2005 (UNDP, 2005). Regarding the private sector, a remarkable increase in the number of women engineers took place in Mobinil between 2002 and 2003. The percentage of women working for the different company departments ranges from 35% to 38%, including women who held non-engineering posts (MCIT, 2005).

Figure (5): Number of Workers in IT Clubs and Internet Cafés in Egypt

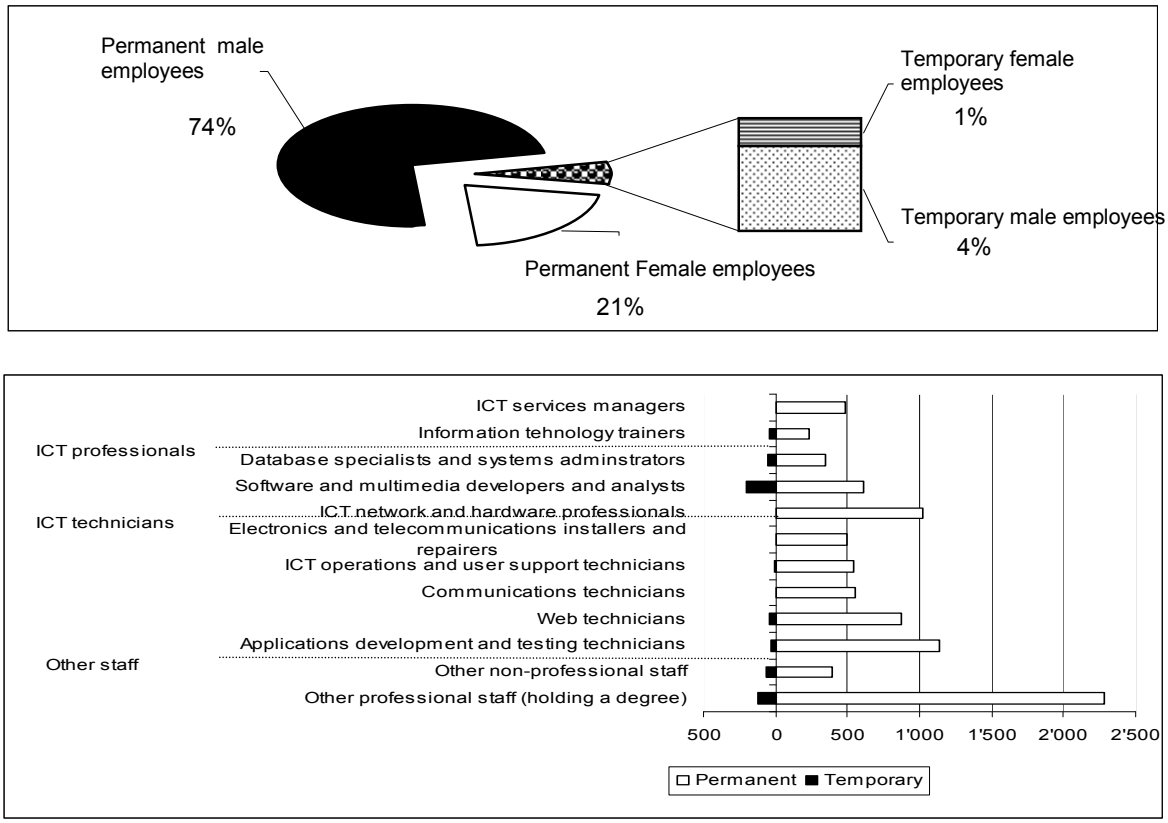


IT Clubs **Internet Cafés**

Further, tele-centers represented in IT clubs and internet cafés in Egypt have opened a novel work opportunity for men and women. As Figure (5) depicts, jobs in such tele-centers are highly dominated by men accounting for 62% and 64% of total labor force in IT clubs and internet cafés respectively in 2008. Yet the average number of women has increased in 2008 at a higher rate compared to men. In IT clubs women increased in permanent jobs by 35% in 2008 compared to 2007 surpassing the rate of growth of men's employment in the same category which increased by only 12%. Similarly, in internet cafés women employment in

permanent jobs experienced a growth rate of 22% in 2008 compared to 2007 whereas men witnessed a decrease by 11%. Women in IT clubs and internet cafés have experienced a relative increase in temporary jobs compared to men who did not experience any increase in this category in 2008. This resulted in a decline in the gender employment gap in 2008 compared to 2007 for both temporary and permanent jobs in such tele-centers. It is worth mentioning that women's share in temporary jobs in IT clubs and internet cafés is much higher than their share in permanent jobs. In 2008 they constituted 43% and 58% of total labor in temporary jobs in IT clubs and internet cafés respectively opposed to 35% and 10% in permanent jobs.

Figure (6): Permanent and Temporary Workforce in a Sample of ICT Companies in Egypt

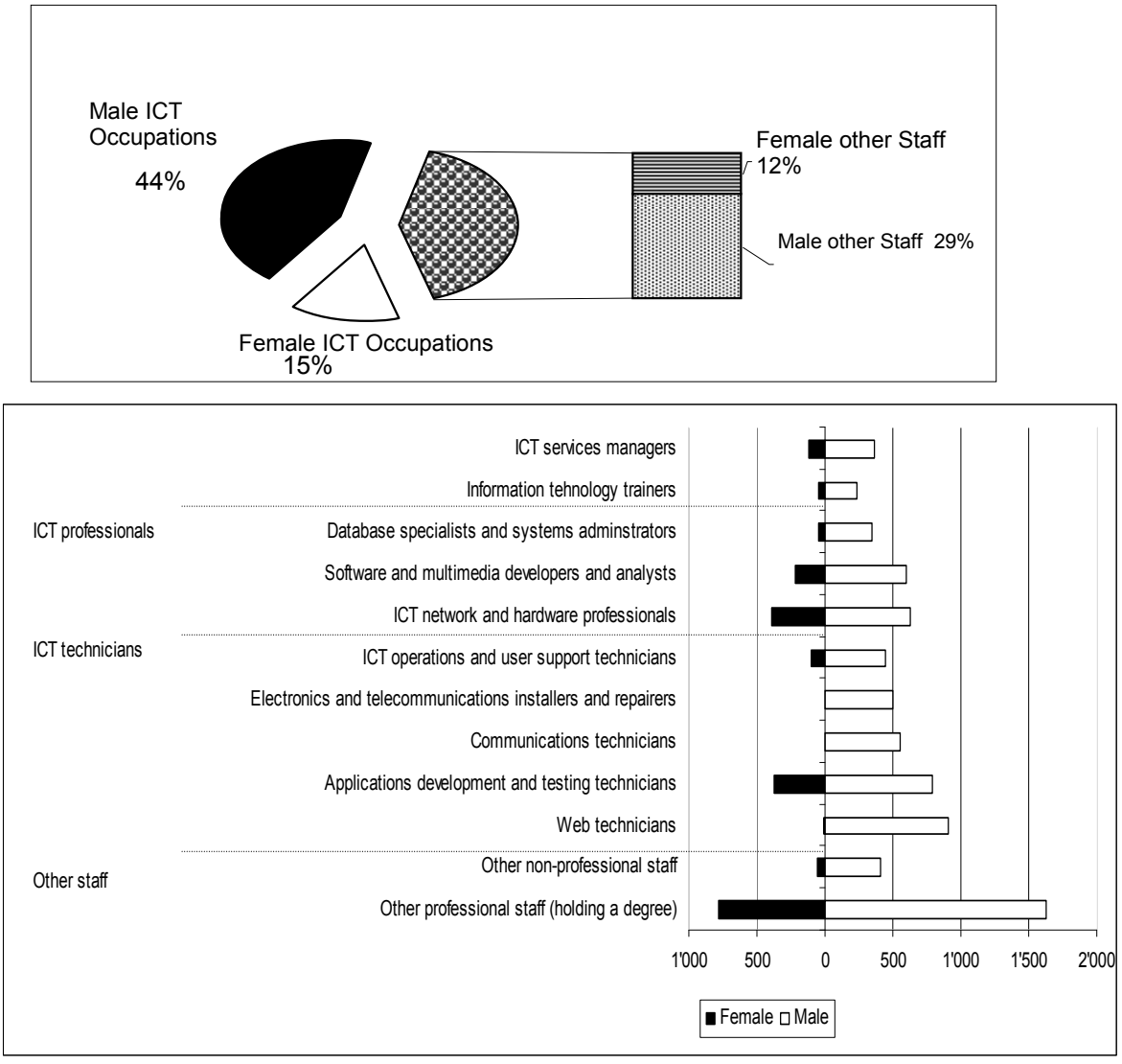


Source**:** Helmy (2008); UNCTAD (2007)

MCIT/ITIDA UNCTAD study revealed that in the ICT sector there are relatively more women employed in temporary positions and in non-ICT related occupations (see Figure (6)). On average, for all types of ICT occupations there is a ratio of 3 male to 1 female employee, while among the other staff members the ratio is closer to 2 to 1. Also, for every 4 male permanent staff members, there is 1 permanent female staff member, while among temporary staff members this ratio is 3 to 1 (see Figure (6)). The results showed further that there were more women working as ICT professionals than as ICT technicians. As figure (7) illustrates, women are more commonly employed as ICT network and hardware professionals and as applications development and testing technicians. As emphasized by UNCTAD (2007), these same jobs with a high participation of women coincide with positions most in demand among specialized ICT occupations in Egypt. This indicates that women can contribute to increasing numbers of specialized ICT employees to match labor demand in ICT sector provided that the sector development in Egypt is sustainable.

The study has also revealed useful insights on the job employers and their preference regarding women employment. Foreign firms or joint ventures prefer hiring more men when compared to domestic firms in ICT sector which employ relatively more women. Moreover, firms with longer experience in the market (more than 10 years) have a higher tendency of hiring women when compared to new entrants or young firms. Such observations are of paramount importance when designing a gender targeting policy where it identifies areas which have relatively larger gender gaps. (UNCTAD, 2007)

Figure (7): Male and Female ICT Occupations in a Sample of Companies in Egypt



Source: Helmy (2008); UNCTAD (2007)

Based on a study undertaken by the World Bank[13], ILO (2008) has emphasized another positive aspect for women employment which lies in the field of entrepreneurship. Women's entrepreneurship has considerable positive aspects on women's level of employment as well as total level of employment and most importantly on women's job qualities towards a better representation at the managerial and skilled labor level.

[13] World Bank (2007), The Environment for Women's Entrepreneurship in the Middle East and North Africa Region, cited in International Labor Organization (ILO) (2008), Global Employment Trends, Geneva.

The World Bank study identified that female-owned firms in a number of Arab countries including Egypt[14], have a relatively higher propensity when compared to those owned by men of using ICT and hiring more women as employees in their firms. Female-owned firms are more likely to regularly use email and websites in their interactions with clients. In Egypt, 19 % of workers in female-owned firms have professional competencies, compared with just 16 % in male-owned firms. Women make up about 25 % of the workforce in these firms, compared with 22 % in male-owned firms. They also offer a better quality of work where they employ a higher share of female workers at professional and managerial levels compared to jobs offered by male-owned which fall in unskilled positions. Despite that the percentage of women entrepreneurs remain relatively low (which as argued by ILO (2008) can be a result of social and cultural reasons), enhancing women entrepreneurship can achieve the dual goal of increasing women participation in the economic sphere in general and increasing ICT usage by businesses (ILO, 2008).

3.3 Role of Stakeholders: On-going Efforts

A number of initiatives were explicitly dedicated to strengthen inter-linkages between ICT and women. They have been mostly undertaken by the government of Egypt represented in the National Council for Women (NCW) and MCIT, and international donors with the collaboration of the private sector and the civil society. In addition, various stakeholders have pursued other programs that have indirectly benefited women from this respect. Efforts undertaken have tackled different ICT related aspects which in turn have had a positive impact on women employment, ICT access and diffusion, education and legal awareness. This section reviews a number of such efforts[15].

Employment and Training

Several initiatives have been undertaken aiming at enhancing the role of ICT in job creation, acquiring and upgrading of skills. The projects have mainly targeted Small and Medium Enterprises (SMEs).

Support Centre for Women in Small and Medium Enterprises: The NCW and USAID have financed the establishment of the Support Centre for Women in SMEs. The centre aimed at developing management, research, marketing, and accounting skills for women entrepreneurs. Target groups of the project were university graduates, project owners and employees.

E-commerce Support Centre: The NCW signed an agreement supporting an e-commerce and IT project, funded by USAID. In cooperation with the Scientific Authority for Egyptian Women, the council is carrying out a project aiming to help equip female SME owners with the necessary skills. In addition, the agreement offers guidance to help women entrepreneurs to utilize e-commerce in increasing local and international sales.

IBM Occupational Training Centres: An agreement was signed between the NCW and IBM in early 2004 to establish a regional centre for occupational training for women. The project aimed at providing technical assistance in shifting to use e-government services and developing the council's website by providing technical advice, electronic translations, and a security system along with services for women on the website. Moreover, within this program a geographic information system was planned to be established to provide information on women regarding education and illiteracy, political participation, and

[14] The other Arab countries were Morocco and Jordan.
[15] This part heavily draws on MCIT (2005).

registering for voting and social security. A database is also currently being compiled at the National Administrative Authority of all women in senior managerial positions.

A very recent initiative was taken by the Ministry of State for Administrative Development that encourages both men and women to get engaged in one of the novel employment opportunities provided by ICT, tele-work. The initiative *"Your Home Your Office"* calls for undertaking work from home and earning an equal salary for similar jobs conducted at traditional working places. This applies for specific jobs where its nature allows for work from home and also where productivity measurement is feasible to ensure work discipline and commitment. The ministry announced its readiness to provide support for other administrative parties that need to apply this new working system (AL Ahram, 2009). According to the Minister, currently four women affiliated to the Ministry joined this new mode of work.

Access and Diffusion: Several efforts were devoted to enhance access and diffusion of women to ICT. Vulnerable women in rural and remote areas were the main targets of such efforts. The government has recently pursued disseminating the use of ICT in various fields at a country-wide scale through the establishment of IT clubs. Moreover, Egypt has joined existing regional initiatives facilitating the use of ICT in serving various interests of Arab women.

IT clubs have a high potential in facilitating ICT affordability, accessibility, and awareness. Services in IT clubs in the form of providing hardware, software and internet connections are offered for minimal fees reaching about US$ 0.20 per hour. Being mostly based in deprived and rural areas, IT Clubs provide opportunities for those with the greatest need. Users receive guidance through instructors as well as training for basic skills, such as software applications, and web design. IT clubs are a result of collaboration between the civil society, government and private sector. The civil society organizations are involved in the process of planning and managing IT-Clubs. Civil organizations that have IT-Clubs can be youth centers, non-government organizations offices, schools, community centers, media centers, cultural palaces, or libraries. The government provides all equipment and hardware necessary for each club's launch, including computers, printers, peripherals, internet access, a network, and a server. The private sector provides the internet connection, technical support and the tools and utilities for proper management and organization of IT-Clubs. The government has encouraged partnering with Egyptian and international entrepreneurs to accelerate the rate of expansion of these clubs throughout the country (MCIT, 2005; Wanas and El-Tokali, 2007).

IT clubs create job opportunities as trainers for university graduates who join the Training of Trainers program. To improve the engagement of such trainers within their relevant community, it is conditioned that they live in the same governorate where the club is located, utilizing their familiarity with the needs and interests of the local community. Till the second quarter of 2008 1747 IT clubs were established all over the country recruiting around 33 thousand trainees. Since 2005, serving people with special needs and reducing illiteracy among women have been a major aim within newly established IT clubs (MCIT, 2005; MCIT 2008b). As mentioned in Egypt's ICT strategy 2007-2010 "IT Clubs, of which there are now over 1,500 nationwide managed by partnering local NGOs, continue to be successful as educational and ICT access centers in outlying areas, particularly for women" (MCIT, 2009). Moreover, mobile IT clubs are vital upcoming tool to increase accessibility in remote and deprived areas and are highly expected to have positive impacts on women, especially in rural areas, who lack the flexibility of moving to fixed IT clubs.

Other efforts have also focused on enhancing ICT use to serve common interests of Arab women. For example, a website "Arab Women Connect" was launched by United Nations Development Fund for Women (UNIFEM) as part of a regional strategy to increase Arab women's use of new information and communication technologies. Egypt, among other Arab countries like Lebanon, Syria, Palestine, Jordan, Yemen, United Arab Emirates and Qatar has joined this initiative. Moreover, the UNDP/Japan Women in Development Fund has supported programs in Egypt to increase rural women's access to ICT. For example, model health clinics have been set up in rural areas and provided access to and training in health related information with extensive use of ICT (United Nations, 2005).

Education: Using ICT to enhance education and eradicate illiteracy include the most advanced projects that have been applied in Egypt. Several projects have been initiated in this regard aiming at employing ICT by both teachers and students to improve the educational process. Among the virtues of such projects is the increased interaction of students and teachers and the positive spillover effects on the local community.

The Smart School Network (SSN) project was launched in 2003 to allow students to achieve computer literacy after completing preparatory school, enhance student creativity, and enable them to cope with the new requirements of the labor market. The project aimed at developing the educational system through integrating ICT in preparatory schools. The components of the project included equipping schools with computers and several software applications that assist in school management. The project has also focused on building the capacity of school teachers and administrators to use ICT tools effectively. SSN is a multi stakeholder partnership where benefits are distributed among the Ministry of Education, private ICT companies, and the schools and students. NGOs played a vital role in managing smart schools especially in remote areas where there are no incentives for the private sector.

An important outcome of the Smart School that was established in Siwa, was illiteracy eradication classes which were conducted in schools and homes for women using special multimedia CDs. Use of high speed internet connections enabled new teaching methods to be employed, and the project gradually motivated the community to take an interest in opportunities for socio-economic development using ICT (MCIT, 2005).

Moreover, the e-Learning Competence Centre initiative between MCIT and Cisco was set up to create a national e-Learning Program, establishing an organization to lead and coordinate all e-Learning projects in Egypt. The initiative aimed at enhancing the workforce performance through high quality e-Learning and human resources development activities to match the government and businesses evolving needs. Private and public organizations collaborate to achieve the goals of the initiative. Within this initiative, women empowerment through e-learning was among the projects that have been implemented.

The civil society has a seminal role in diffusing ICT among the community. Some NGOs have worked in the field of illiteracy eradication through the use of ICT tools. It was noted that women participating in such kinds of projects showed enthusiasm and interest by their commitment to attend classes and achieving high scores. Other NGOs have targeted employing ICT for development by contributing in its diffusion at low educational segments of the community (MCIT, 2005; Hassan, 2005)[16].

[16] Examples of such NGOs included Ressala and the Scientific Association for Egyptian Women.

Legal awareness

The most well-known project in this area was concerned with digitizing women's legal rights. UNDP and Information and Communication Technology for Development in the Arab Region (ICTDAR), with funding from the EU with collaboration with NCW, have launched a regional project for women's rights in Egypt, Lebanon, and Tunisia. The objective of the project was to automate data retrieval and create a database which would help women in knowing and understanding their legal rights. The project has aimed to eradicate the legal illiteracy of women by providing legal information regarding their social status related to issues such as dowry, divorce, marriage, and custody rights in a simple form of questions and answers on CDs, video cassettes, or on the internet in Arabic[17]. Rural women with low educational levels are a main target group of the project. Women are not only beneficiaries of the project but also interact to form one of its data sources, among others, represented in NGOs defending women rights as well as legal clients.

As evident from the above, several efforts have been undertaken by the government, the private sector, international organizations and the civil society to enhance inter-linkages between women and ICT where several achievements have been recognized in various areas of interest. Such areas included disseminating awareness regarding the use of ICT in improving women's job qualification, intensifying the role of female owned SMEs, illiteracy eradication, and enhancing legal awareness.

4. ICT and Women in Egypt: Empirical Evidence

This section investigates the significance of ICT gender gap in Egypt employing a descriptive approach utilizing the available relevant national data[18]. The study adopts the definition of OECD in classifying ICT related sectors (see Table (A.1) in Appendix). Female to male employment and wage ratios are taken as measures for the gender gaps. The section studies the status of women in ICT related sectors from an absolute perspective focusing on their sectoral distribution within ICT sectors and a relative perspective comparing wage and employment gaps in ICT sectors to those prevailing at the country level as well as to those in non-ICT related sectors.

4.1 Women in ICT Sectors

Distribution of females working within ICT related sectors revealed high degree of concentration. Manufacturing sectors constituted the lion's share especially the manufacture of television, radio and communication equipments which accounted for 62% of total number of females working in all ICT related sectors (See Figure (8)). The nature of their occupation in such sectors is quite vague. It is not clear whether they are engaged in low (low skilled workers, administrative employees) or high skilled (engineers, technicians…etc) jobs[19]. However, it is more likely that women in this sector are ICT users than producers. In fact, jobs in such sectors are usually defined to be low technology jobs (Gillard et al., 2007).

Highly ICT related sectors (the so-called core ICT sectors) as computer and related activities had a relatively low concentration ratio where only 7% of women working in ICT related sectors were engaged in them. Sectors of weak attraction for females working in ICT related sectors were telecommunications, research and development, and wholesale and renting of

[17] See http://217.52.27.150/legal/

[18] The study analyses wage and employment data classified by gender registered in the Annual Reports of Employment, Wages and Hours of Work from 1996 till 2006 published by CAPMAS.

[19] This needs classification by occupation which CAPMAS does not publish for ICT related jobs.

machinery where the degree of concentration did not exceed 1%. Research and development forms one of the most important sectors for capacity building in ICT. Women suffered from very low and declining rate of participation in this sector which could be partly explained by their low engagement in scientific education as mentioned in Section 3.2.

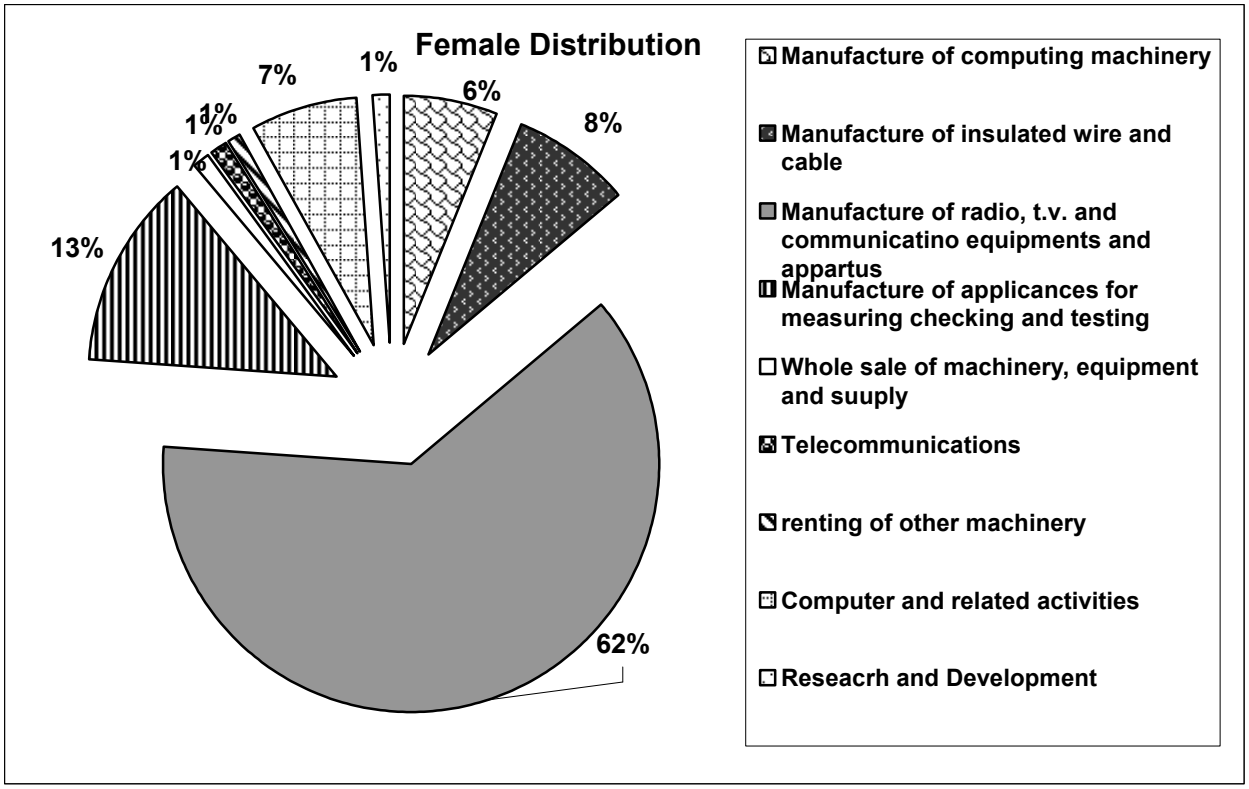
Men had a highly similar distribution across ICT related sectors as apparent from Figure (8). They had also experienced relatively high concentration in manufacturing ICT related sectors with a higher percentage in manufacture of insulated wires and lower in manufacture of television, radio and communication equipments compared to women. Slightly higher concentration for men existed in manufacture of computing machinery, telecommunication and wholesale of machinery.

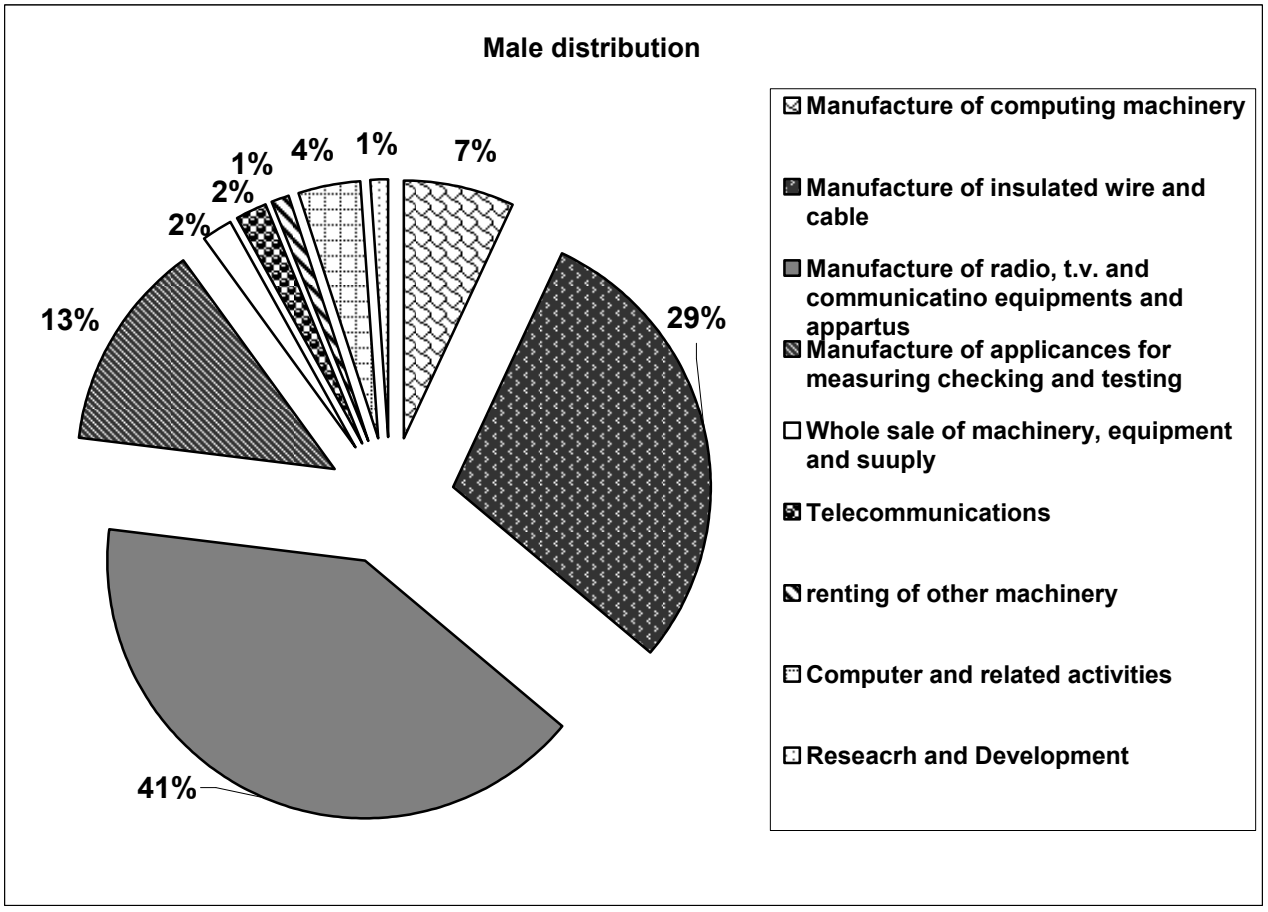
Women witnessed a higher degree of concentration in computer and related activities of 7% of total women workforce in ICT related sectors compared to men of which only 4% were engaged in such activities during 2000-2006. Within this sector women compared to men were more concentrated in software consultancy, database activities and data processing; whereas men were more concentrated in hardware consultancy, repair of computing machinery and other computer related activities (See Table (1)). Referring to Figure (8), women and men experienced exactly similar distribution in all other ICT related sectors.

Women's distribution within ICT related sectors revealed that they are more attracted to fields where they act as users (advanced and basic users[20]) compared to low concentration in developers' fields. This, however, comes at odds with the results of the MCIT/ITIDA UNCTAD 2007 survey which revealed high concentration in hardware related professions and low concentration in database activities. This could be attributed to differences in sampling techniques and in the adopted definition of ICT related sectors. Female distribution within computer and related activities sector according to CAPMAS (2001-2007a) does not necessarily imply positive prospects for women's specialization to match labor demand in the sector. Nevertheless, having higher participation in software consultancy could still provide women with a professional advantage in the field.

[20] Refer to Section 2.1 for elaboration on this classification.

Figure (8): Female and Male Distribution within ICT Related Sectors (2000-2006)





Source: Adapted from CAPMAS (2001-2007a)

Table (1): Male and Female Distribution within Computer and Related Activities (Core ICT Sectors) during 2000-2006 (%)

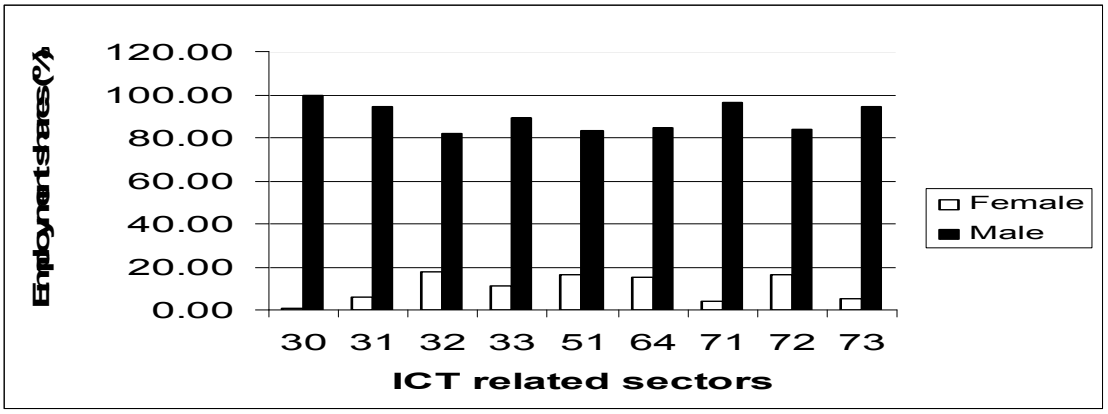
	Male	Female
Hardware consultancy	2.3	1.4
Software consultancy and supply	18.7	28.1
Data processing	16.3	22.6
Data base activities	8.8	13.2
Maintenance and repair of office, accounting and computing machinery	37.2	26.8
Other computer related activities	16.6	7.9
Total	100	100

Source: Author's Calculations from CAPMAS (2001-2007a)

4.2 Wage and Employment Gender Gaps in ICT Related Sectors

ICT related sectors are highly dominated by men with a 10% average employment share for women in 2006, a figure that is lower than average employment share at the country level of 15% in the same year. Moreover, this figure revealed a declining trend in women's participation in the sector where their employment share reached 17% in 2000 and 14% in 2003 (see Figure (9)). However, from an economy-wide perspective, female weak employment participation is not confined to ICT sectors in specific, but rather it is a widely spread phenomenon in the majority of economic activities. Women suffer from weak employment shares in all other sectors among which many were even lower than those prevailing in ICT related sectors. Education, health and social work and manufacture of wearing apparel and dressing are the only exceptions where women employment share exceeded 50% of total employment levels on average during 1996-2006 (CAPMAS, 1997-2007a).

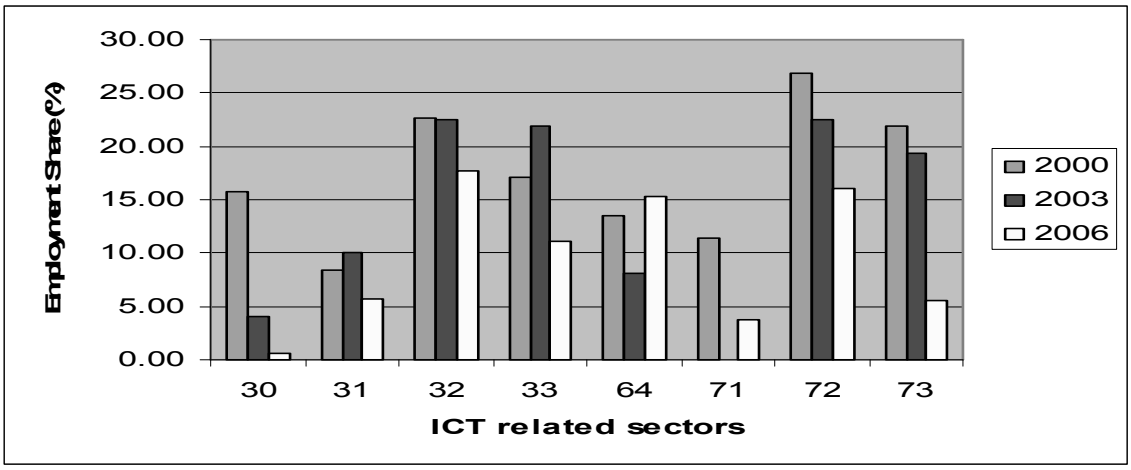
Figure (9): Employment Shares in ICT related Sectors in 2006



Source: CAPMAS (2007a)

As Figure (10) depicts, female employment share out of total employment in almost all ICT related sectors has been decreasing over the period 2000-2006. The only exception for this was post and telecommunications (64) in which the percentage of females increased in 2006, however looking at the main ICT related sector in this category, namely telecommunications (642), the same decreasing trend is observed. In fact, female employment in this sector decreased by 53% over the period 2000-2006. This implies that the potential for a gender gap in employment in ICT sectors might be increasing over time.

Figure (10): Female Employment Shares in ICT Related Sectors in Selected Years



Source: CAPMAS (2001, 2004, 2007a)

On average during the period 1996-2006, women employment shares out of total employment in ICT related sectors reached its highest values (though still relatively low, not exceeding 27%) in sector of computer related activities (72) like software consultancy, database activities, data processing (negligible shares prevailed in hardware consultancy), research and experimental development on natural sciences and engineering (73) as well as in manufacture of television, radio and communication equipments (32), see Figure (11). The decreasing trend reveals that women face a problem in retaining employment shares in such sectors. Moreover, taking relative hours of work as a proxy for productivity, it appears that female to male productivity on average in ICT related sectors was lower than its equivalent on the country level during 1996-2006 (See Table (A.3) in Appendix). It is worth mentioning that female to male productivity ratios reached their highest values in manufacturing ICT related sectors whereas lowest values were found in telecommunications, computer and related activities as well as research and development[21].

Referring to female distribution within ICT related sectors discussed in the previous section, Table (2) reveals that women enjoyed lowest wage gaps (highest female to male wage ratios) in manufacturing ICT related sectors where they experienced high degree of concentration yet are most likely engaged in low technology jobs. Women, however, enjoyed lowest employment gaps (highest female to male employment ratios) in core ICT sectors from which they tend to deviate as shown by their relatively low degree of concentration. This applies to the case of computer and related activities sector as illustrated in Table (2).

Table (2): Average Employment and Wage Ratios in ICT Related Sectors (2000-2006)

	Employment ratio	Wage ratio
30 Manufacture of office, accounting and computing machinery	0.27	1.10
31 Manufacture of electrical machinery and apparatus	0.04	1.05
32 Manufacture of radio, television and communication equipment and apparatus	0.29	1.05
33 Manufacture of medical, precision and optical instruments, watches and clocks	0.23	0.79
51 Wholesale trade and commission trade	0.08	0.96
64 Post and telecommunications	0.11	0.71

[21] This is based on calculations done by the author based on CAPMAS (1997-2007a).

71 Renting of machinery and equipment	0.08	0.52
72 Computer and related activities	0.32	0.83
73 Research and development	0.21	0.81

Source: Author's Calculations Based on CAPMAS (2001-2007a)

Taking average female to male wage ratio on the economy level as a benchmark of comparison reveals that women, on average, have enjoyed relatively high wage ratios compared to men in ICT related sectors. During the period 1996-2006, wage ratio exceeded its equivalent on the economy level in all ICT industries except data processing, hardware consultancy and maintenance and repair of office, accounting and computing machinery.

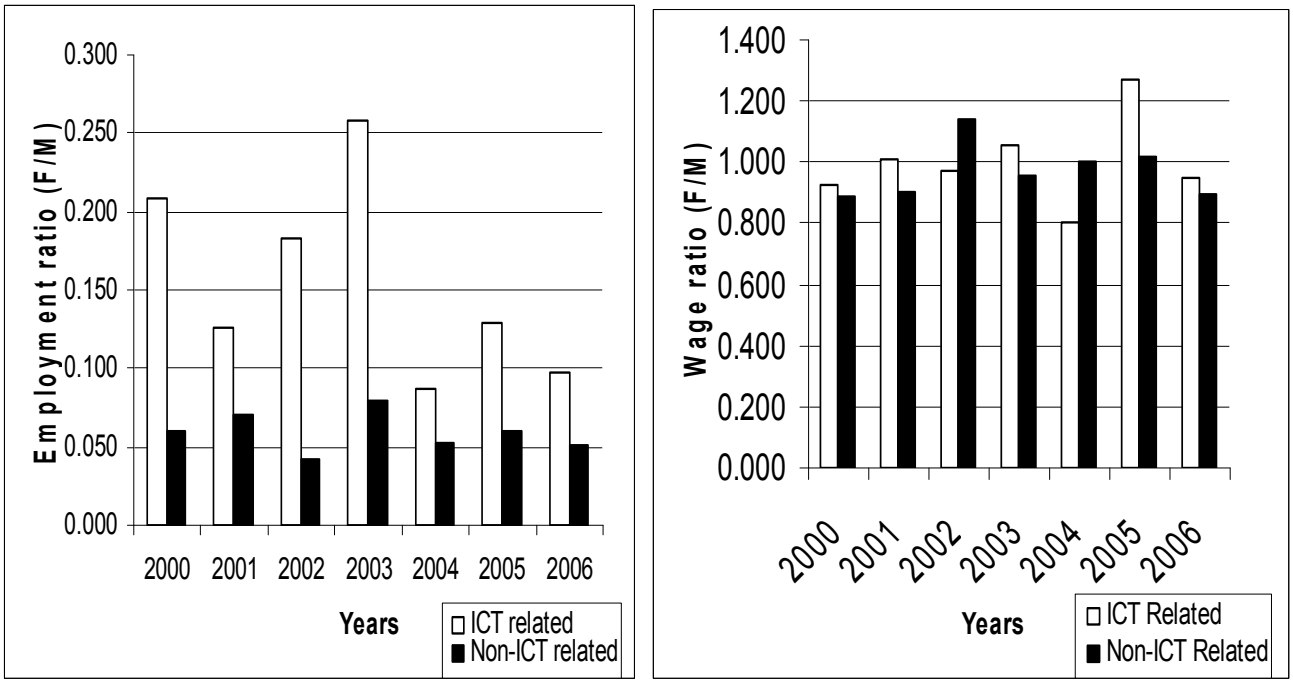
On average women enjoyed higher employment ratios (lower employment gaps) in ICT related sectors compared to their equivalent on the economy level until 2004. However, in 2005 and 2006 employment gap in ICT related sectors started to increase compared to those prevailing at the economy level. On a sectoral level, employment female to male ratios in software consultancy, data processing and data base activities exceeded that of its counterpart at the economy during 1996-2006. Other sectors have witnessed relatively high employment ratios for a number of years during the whole period. Those included manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy (till 2003), research and experimental development on natural sciences and engineering (between 1997-2003), maintenance and repair of office, accounting and computing machinery (between 2000-2004 and in 2006) and other computer activities (1996-2004). Women suffered from lower employment ratios in all other ICT sectors (manufacture of computing machinery, telecommunications, wholesale and renting of machinery), compared to their counterpart on the economy level during the whole period.

To understand the significance of digital gender gap in Egypt, wage and employment gaps in ICT sectors were compared to those in non-ICT related sectors[22]. On an aggregate economy level, during 2000-2006 (as well as during 1996-2006) women enjoyed higher average wage ratios while suffered from lower average employment ratios in ICT related sectors compared to non-ICT sectors. On a sectoral level, women enjoyed on average higher employment and wage ratios in ICT related sectors compared to those prevailing in non ICT related sectors in manufacturing sector while suffered from lower ratios in the case of transport, storage and communication sector (see Figures (11) and (13)). In other sectors women suffered from either an employment or a wage gender bias. For example, within the category of real estate, renting and business activities sectors[23] women enjoyed higher employment ratios in ICT related sectors compared to non-ICT whereas they suffered from lower wage ratios (see Figure (14)). Opposite results were found in the category of wholesale and retail trade, repair of motor vehicles and personal and household goods (see Figure (12)). Thus, it could be argued that gender gaps are of lower degree of severity in ICT related sectors in manufacturing and higher degree of severity in transport, storage and communications (telecommunications) where both wage and employment gaps followed similar trends. Nevertheless, the comparison did not lead to a clear-cut conclusion regarding the significance of gender gaps in ICT related sectors compared to non ICT related sectors as the results were highly sector specific. Assessing the relationship econometrically, as illustrated in the coming section, is expected to aid in this regard.

[22] The analysis in this part was done at a highly aggregated level (ISIC version 3 at a 1-digit level), see Table (A.1) in Appendix.

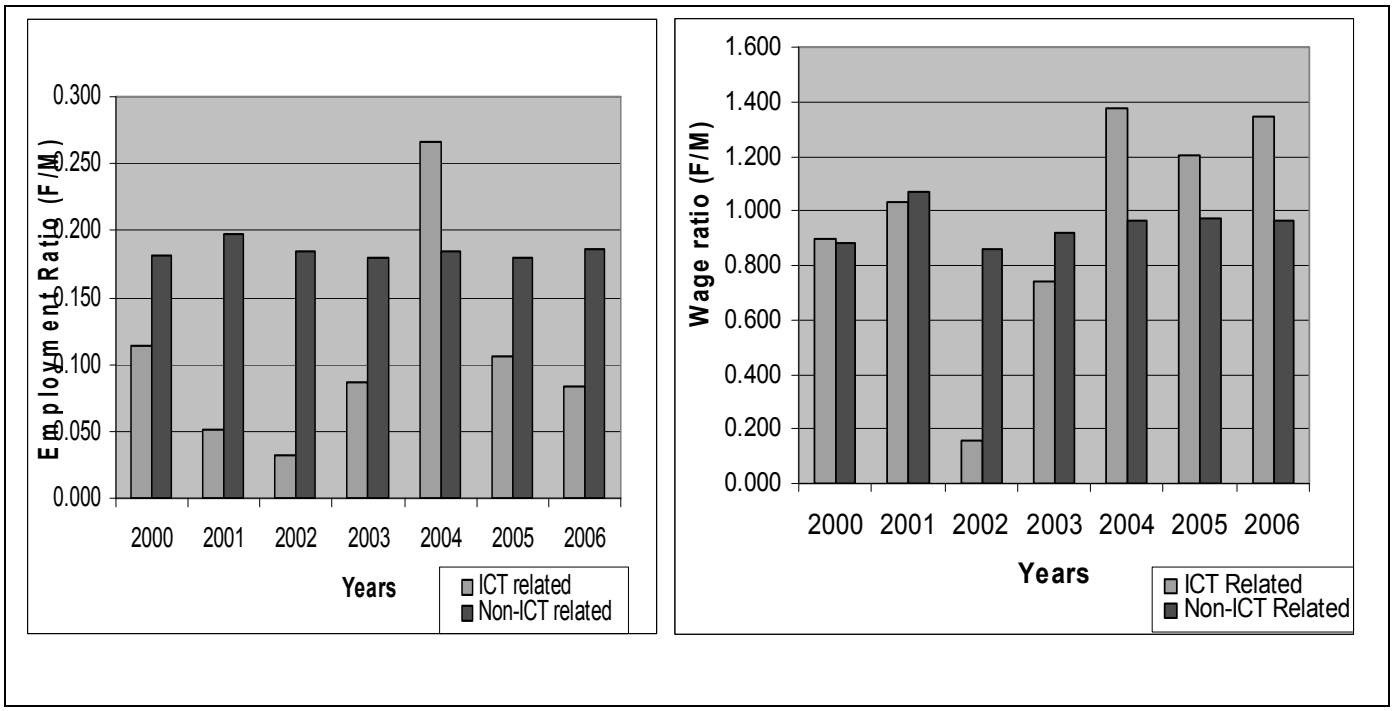
[23] It is worth mentioning that core ICT sectors (computer and related activities) are a subset of this category.

Figure (11): Employment and Wage Ratios in Manufacturing (300-381)



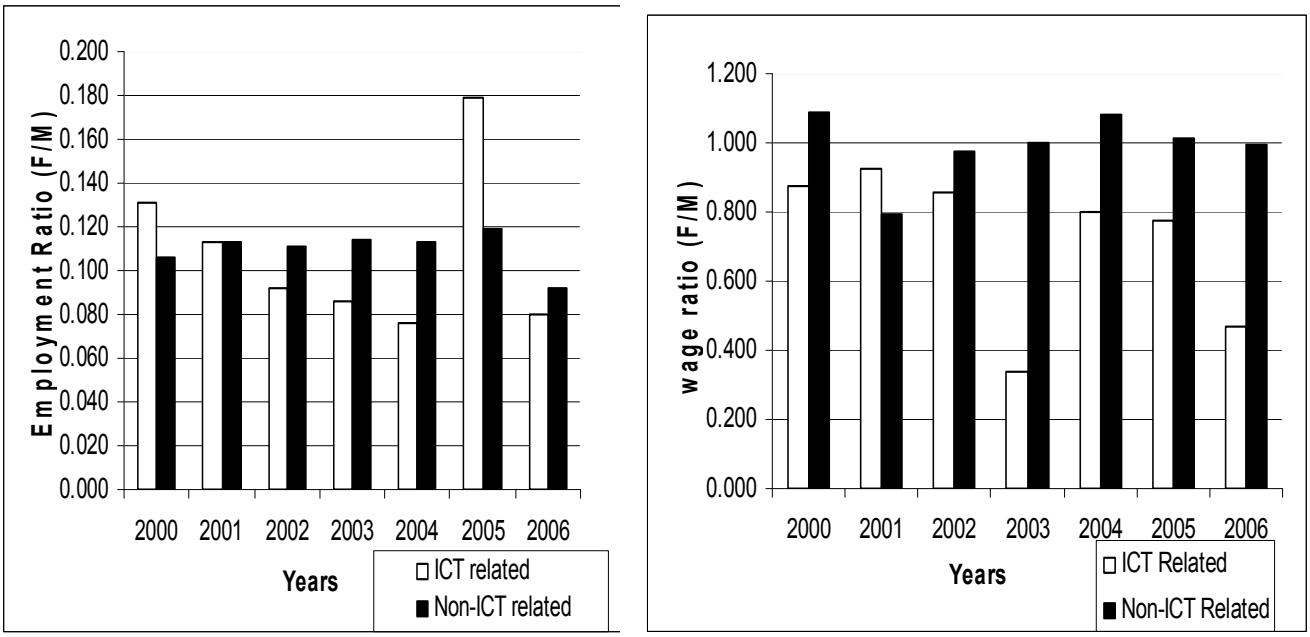
Source: CAPMAS (2001-2007a)

Figure (12): Employment and Wage Ratios in Wholesale and Retail Trade; Repair of Motor vehicles, Motorcycles and Personal and Household Goods (501-526)



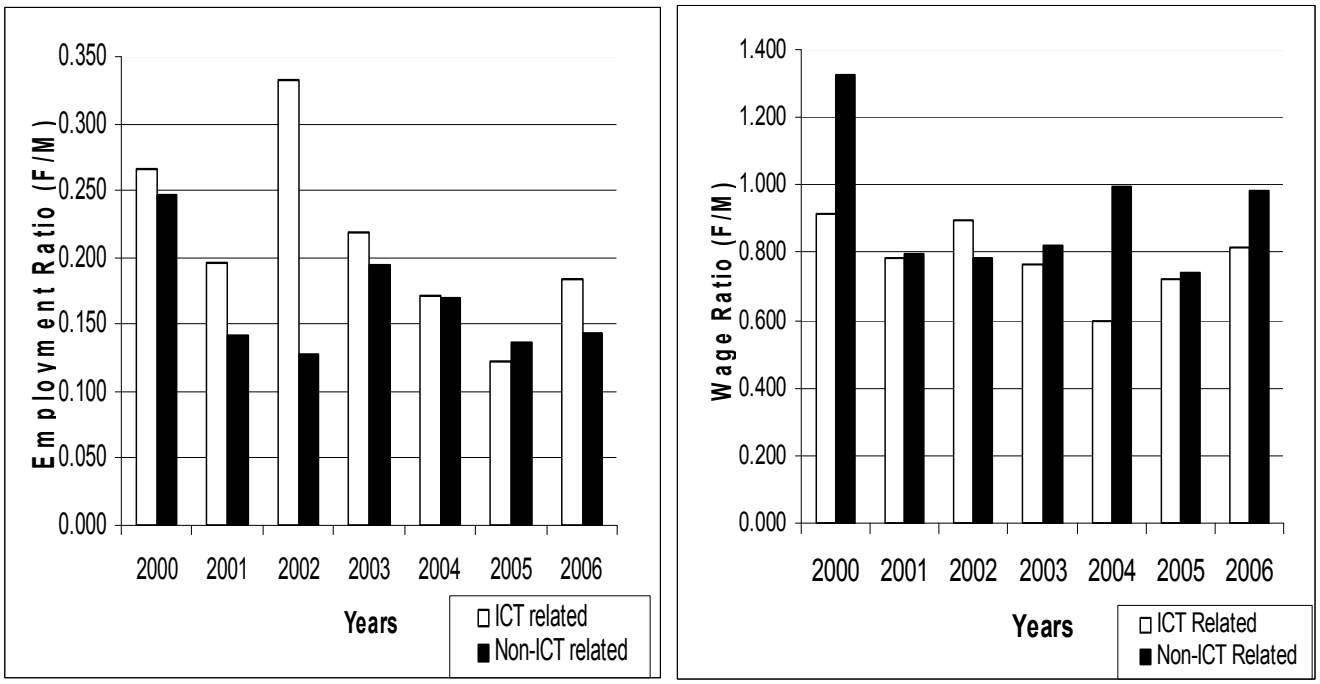
Source: CAPMAS (2001-2007a)

Figure (13): Employment and Wage Ratios in Transport, Storage and Communications (601-642)



Source: CAPMAS (2001-2007a)

Figure (14): Employment and Wage Ratios in Real Estate, Renting and Business Activities (701-749)



Source: CAPMAS (2001-2007a)

5- Impact of ICT on Gender Equality in Egypt: Econometric Analysis

This section focuses on the econometric analyses to test the impact of ICT infrastructure on employment gender gap. The analysis is conducted to test for the significance of gender employment gap in ICT related sectors and to identify factors affecting the gap in ICT and non ICT related sectors. A panel regression is performed on pooled data of the variables during 1996-2006 across the various sectors in the economy. Economic sectors are classified into ICT-related and non-ICT as previously done. A brief description of the variables, data sources and the adopted methodology is first presented then a discussion of the results follows.

The data set included all sectors in the economy (14 sectors) following SITC revision 3 at a highly aggregated (1-digit) level for the years 1996-2006[24]. According to the OECD definition, some sectors were disaggregated into ICT and non ICT related sectors. The definition applied on four sectors, namely; manufacturing, wholesale and retail trade, transport, storage and communications and real estate, renting and business activities.

Female to male employment ratios at sectoral levels were used as the dependent variable. ICT variables, along with other control variables, acted as independent variables in each equation. Generalized least squares (GLS) was estimated using constant coefficient model where it is assumed that there are no significant time nor sector effects. White's heteroskedasticity consistent standard errors were employed and AR(1) term was added to account for autocorrelation.

Dependant variable (measure of gender gap):

1. Ratio of female to male employment in ICT and non-ICT related sectors. Source: CAPMAS (1997-2007a).

Independent Variables (ICT variables and other control variables):

1. ICT variables: To determine the effects of ICT on gender inequality, four different indicators are used to proxy for the level of ICT infrastructure and availability within the economy. These indicators are the number of computers per 100 persons, the number of telephones per 100 persons and telecommunication revenues (% of GDP). Source: World Bank (2008).
2. Control Variables: these included other variables that are believed to exert effects on gender gaps in employment.
    a. Sectoral wage per capita taken as a proxy for the economic development of the sector. Source: CAPMAS (1997-2007a).
    b. Productivity variables reflecting labor productivity as expressed by ratio of hours of work of females to males in various sectors. Source: CAPMAS (1997-2007a).
    c. Education Variables: Two measures for gender inequality in education were considered, namely ratio of females to males in primary and secondary education and ratio of females to males enrolled in scientific faculties (namely; engineering, technology and science). Source: CAPMAS (2007b).

[24] Those included agriculture, fishing, mining and quarrying, manufacturing, electricity, construction, wholesale and retail trade, hotels and restaurants, transport, storage and communications, financial intermediation, real estate, renting and business activities, health and social work, education and other community, social and personal service activities.

To investigate the possibility that gender gap in employment significantly differs across ICT and non-ICT related sectors, the following regression specification was estimated. Two regressions were performed where a dummy was added in each to account for the nature of the sector, whether ICT or non-ICT related.

$$Gendergap_{it} = \beta_0 + \beta_1 Hoursofwork_{it} + \beta_2 Wagepercapita_{it} + \beta_3 Scientificfacultiesratio_t + \beta_4 primary\,\text{sec}\,ondaryratio_t + \beta_4 ICTproxy_t + \beta_5 D_i$$

Where $Gendergap$ is measured by employment female to male ratios across the sectors and years, i refers to sectors, t refers to years, and D refers to the dummy variable.

To understand the factors determining gender gaps in ICT and non-ICT related sectors, the estimation was done for the group of non-ICT related sectors and ICT related sectors separately. This was done by including a dummy variable taking value 1 when it is an ICT related sector and zero otherwise, but in an interactive manner with the independent variables.

As for the first set of regressions applied on all sectors the results showed that the nature of the sector whether ICT related or not did not have any significant impact on employment gaps. In other words, employment gender gaps in ICT related sectors are not significantly different from their equivalent in other sectors[25].

For regressions confined only to ICT-related sectors, the ratio of females in scientific faculties seemed to be the most highly significant variable exerting a positive impact on employment female to male ratios. This reveals the importance of encouraging women's enrollment in scientific education which would significantly contribute in improving their participation in ICT workforce.

All ICT infrastructure proxies had a significant positive impact on employment ratios in both ICT and non ICT related sectors (Table A.6 and A.7 in Appendix)[26]. Such an outcome shows that improvements in levels of ICT infrastructure would tend to have positive spillover effects on gender gap in terms of employment ratios that is not only limited to ICT sectors but extends to non-ICT related sectors as well.

The estimated coefficient of sectoral wage per capita, taken as a proxy for sectoral economic development, was positive and statistically significant in the case of ICT related sectors. This indicates that ICT economic development tends to have a positive influence on gender equality in employment within ICT related sectors. This outcome is inline with the UNCTAD (2007) emphasis that women's participation in ICT workforce would flourish if demand conditions led to economic growth of the sector provided they receive appropriate training and gender-balanced use of ICTs prevails.

As for the hours of work ratio (measuring productivity of females to males) and primary and secondary enrollment ratios, the results were quite counterintuitive. Hours of work was insignificant in the case of non ICT related sectors and statistically significant in ICT sectors,

[25] For ICT dummy, t-statistic was -0.738022 with probability 0.4617 and for non-ICT dummy, t-statistic was 0.802549 with probability 0.4235.

[26] With the exception of telecommunication revenue in the case of non-ICT related sectors.

yet had a negative sign. This result might be due to the higher concentration of women in temporary jobs in ICT related sectors which could indicate higher hours of work yet lower employment ratios. Estimated coefficients of school enrollment ratios had a negative sign and were significant for both ICT and non-ICT related sectors. This indicates that improvement in gender equality in school education is not sufficient to exert a positive impact on gender equality in employment in both ICT and non-ICT related sectors[27].This could be attributed to the fact that a large percentage of female school graduates do not join the workforce either due to their own choice or due to lack of quality attributes. This leakage variable was not explicitly taken in consideration which could have resulted in such counterintuitive relationship.

6- Conclusion and Policy Implications

The findings of the study identified that the current status of women in ICT related education, access and employment embeds many positive opportunities as well as considerable challenges. Among the positive trends in education is the increasing ratio of females to males in secondary and primary education as well as in scientific faculties during 1996-2006. Women also constitute a promising percentage among university staff members in scientific faculties and research institutes, technical and professional staff at the country level, and as recipients of training on the use of high technology. The main weakness lies in women's low enrollment rates and increasing gender gaps in ICT related higher scientific education specifically in technology and engineering. Their minimal engagement in the design of IT national strategy where women suffer from relatively low representation in leading decision making positions is another major challenge.

Regarding ICT access, men constituted the majority of internet users in the country exceeding 60% of total users. However, women enjoyed a 10% internet penetration rate in 2008 which is close to the average rate at the country level, yet is still lower that that of men which reached 15% in the same year. Internet usage by females followed the same pattern as that of males classified by reasons for use, regions, and educational status. Nevertheless, data underpinned special areas of focus where women experienced relatively low rates, among which is the weak use of e-government services and wide gender gaps in urban compared to rural areas as well as at higher secondary and tertiary educational stages.

Analyzing national data revealed that ICT related sectors are highly dominated by men, with a 10% average employment share for women in 2006 declining from 17% in 2000. During 2000-2006, women and men have experienced similar pattern of distribution across various ICT-related sectors being more concentrated in low technology sectors. Compared to men, women witnessed a higher degree of concentration in core ICT sectors namely computer and related activities. Nevertheless, women faced a number of challenges regarding employment in ICT sector. First, women working in computer and related activities were more employed in low skill demanding sub-sectors, namely in database activities and data processing, whereas men were relatively more concentrated in hardware consultancy, repair of computing machinery and other computer related activities. The major exception is women's higher concentration in software consultancy which is classified as a high skill demanding field. Second, women faced declining employment shares in all ICT related sectors during 2000-

[27] Chen (2004) found an insignificant relationship between gender inequality in education and gender inequality in employment using instrumental variables estimation.

2006 which reveals that the problem lies in attracting and retaining female employment in such sectors. Third, female to male productivity on average in ICT related sectors was lower than its equivalent on the country level during 1996-2006. Fourth, women tend to deviate from ICT related sectors in which they enjoy relatively low employment gaps as observed in the case of core ICT sectors.

Taking average employment and wage female to male ratios at the country level as a benchmark for comparison revealed positive aspects for women working in ICT related sectors. During the period 1996-2006, female to male wage ratio exceeded that at the economy level in all ICT sectors except in data processing and, hardware consultancy and maintenance and repair of office, accounting and computing machinery. Moreover, women enjoyed higher employment ratios in ICT related sectors compared to their equivalent on the economy level, yet until 2004. On the other hand, taking non-ICT related sectors as the benchmark of comparison revealed that during 1999-2006 women in ICT sectors enjoyed higher wage ratios while suffered from lower employment ratios. Accordingly, one could conclude that women in general held a relatively better situation in ICT sectors regarding the wage gaps they faced while still experienced negative trends regarding employment gaps.

The study outlined several existing efforts initiated by different society stakeholders to integrate women as an important beneficiary from ICT. A number of projects aimed to enhance the role of women in labor market by introducing the implementation of e-commerce and making use of it in increasing sales for female SME owners as well as improving women's job qualifications in general. Other projects focused on empowering women politically by increasing their awareness regarding their legal rights and providing technical assistance in learning how to use e-government services. Moreover, women appeared to be important beneficiaries of other general projects aiming at illiteracy eradication and integrating ICT into the Egyptian education system. Recently gender has gradually risen as one of the important issues that need to be tackled by MCIT. The ministry has started to publish ICT indicators classified by gender, though still at a very limited scale (only one indicator concerning ICT access starting from 2007).

Nevertheless, the gender dimension of the ICT adopted strategies and policies remain modest with neglected several areas of potential support. In general, there was no announced specific strategy relating ICT and women in specific in Egypt. Women appeared as a side dimension within many of the various efforts. Further, the projects have focused mainly on enhancing the role of women as ICT users and not as producers. To be able to reap from the benefits of ICT, women must be equipped with skills to prepare them for a range of roles not only as ICT users, but also as creators and designers. Therefore, policies should focus on generating demand for ICT related education. For example, campaigns could be implemented by the government as well as civil society organizations (CSOs) to increase the level of awareness of families and teachers on the importance of encouraging girls in science and math, building girls' confidence to study scientific subjects. The UNIFEM-supported research project in Brazil which brought women scientists and engineers as role models to girls in secondary schools could be replicated in the case of Egypt (Hafkin and Taggart, 2001). In addition to social barriers, scientific education is more costly compared to theoretical one. This should also be addressed knowing that poverty is the primary reason affecting gender gap in education and accordingly is one of the key factors affecting family choices for education of their children. Financing scientific education could be partially met by the private sector as part of their corporate social responsibility.

Although integrating ICT at early education stages is invaluable, more attention should be given in integrating ICT at secondary and post secondary educational stages with special focus on gender equality. MCIT data have shown that the share of students in such educational categories in total internet users is relatively high, yet they suffer from a relatively high gender gap compared to other educational stages. Thus, policies integrating IT in the education system in Egypt should focus more on increasing the inclusion of IT in general at primary stages of education and give more attention to the gender aspect at upper secondary and tertiary trying to understand the reasons behind the gender gap at such stages. As United Nations (2005) emphasized, gender-sensitive planning of ICT interventions in education is a prerequisite to ensure equal access and effective ICT learning for both genders. Within higher education, the possibility of scholarships helps encourage women to apply to ICT related academic programs or training. This could be financed by the government and the private sector. Other possibilities could include reserving certain percentages of higher education seats for female students at public universities in scientific and technological faculties, a trial that was implemented in India and was considered to have a positive impact of women's access to education needed for IT related jobs (Hafkin and Taggart, 2001).

On the other hand, training and upgrading women skills is crucial in this novel area of employment which should not be confined only to current employees but extend to include university graduates, housewives and unemployed women. As an example for this was the initiative undertaken by Government of the Republic of Korea which established several projects for the economic empowerment of women among which was Kyonggi Province Program for women providing training for women as IT professionals. The program included women in different situations; unemployed women, women heads of households and handicapped women who want to enter the work force. Two thirds of those who completed the course were employed or established their own business (United Nations, 2005). Moreover, the Ministry of Gender Equality has organized programs at 12 Korean universities for women who want to work in an e-business or to start Small Office Home Office businesses (SOHO). Rural females with low level of education should be another target group of training initiatives. The Ministry of Agriculture and Forestry in Korea encouraged the use of ICTs by women farmers through mobile computer education and technical support services. Women benefited from updated information on market prices also the use of internet to market their products (Thas et al., 2007). The same experience existed in Senegal where the Senegalese telephone company provided cell phones with internet access to rural women agricultural producers. This technology helped women obtain information about market prices of the inputs for their food processing activities and for the sale of their products (United Nations, 2005).

Since capital is an essential input in ensuring women's ability to take advantage of the opportunities presented by ICT, disseminating awareness about the viability of women's ICT related businesses and the importance of using ICT tools to strengthen existing businesses among financial institutions is a crucial issue (Hafkin and Taggart, 2001). The best known model in this regard is that of the Grameen Bank and Grameen Phone operation in Bangladesh, which combined lending to women's IT-enabled micro-enterprises with social and economic assistance and training in entrepreneurial skills. In 1996, the Bank launched the project of Grameen Phones, Bangladesh's first cell phone network. The project has been frequently cited for the economic empowerment that it has brought to poor, largely uneducated women. The Bank management selected Village Phone Operators to whom phones were provided as an in-kind loan. Women represented 75% of operators and worked in reselling wireless phone service to fellow villagers. The project aided in generating a

significant level of income accounting for 30 to 40 % of household income resulting in a higher than average per capita income at the country level. Most Grameen-provided phones represented the first telecommunications service in the respective villages. The main privileges of the project are the minimal educational (simple mechanical skills) and capital requirements. In addition to providing income and employment for the entrepreneurs, a major positive externality for the project was that it accelerated development in areas where telecommunications were scarce or non-existent (Hafkin and Taggart, 2001).

Disseminating similar kind of awareness among ICT related private enterprises and integrating them in different support programs would consequently help in improving women's image as active actors in the field. This would ultimately increase their employment as users and developers in ICT related activities. Accordingly, there is a need to adopt strategies that aim at addressing the supply side by generating female demand on ICT related education and training and the demand side on part of employers in association with developing the suitable institutional framework. This could ultimately help women join the high value added jobs including those at managerial and leading positions so that their participation is not confined to low value added jobs.

In 2008, e-government services were one of the fields which witnessed very low use by women compared to men. Thus, increasing the awareness regarding the use of e-government services on a wider scale is of special importance as women, especially poor ones, can profit greatly from having access to government information and services online. Experiencing highest degree of internet usage for educational and learning reasons draws the attention on e-learning as a major tool to upgrade women's educational levels.

Since tele-work is a growing employment field that has opened up new opportunities for women utilizing flexible working hours and locations, establishing a convenient institutional framework that minimizes its main drawbacks is an important pillar of its success. Ensuring that legal frameworks oblige employers in enforcing contracts in such new mode of work is one mean to do that. An example that could be referred to in this field is the set of policy and collective agreement clauses on telework developed by the Public Service Alliance of Canada, a union of federal government employees in which they emphasized the need to have a clear and strong contract with their employers to be able to enjoy all the benefits of working from home. Among these clauses were; telework must be voluntary, teleworkers must remain members of their respective bargaining unit, offering telework must not replace the employers' legal and social obligations to promote employment equity within the workplace, telework must not be used by management as a long-term solution to health and safety problems, or to avoid its responsibility to provide and maintain a quality, safe and healthy workplace, training for teleworkers must be provided, training for managers must be provided from the point of view of learning how to supervise teleworkers, and hours of work for teleworkers must follow a consistent pattern that maintains similarity with those expected of non-teleworking colleagues (Gordon, 1999).

NGOs could also direct more efforts to encourage tele-work by enhancing women's awareness regarding its main advantages and arranging workshops to provide women with the needed technical capabilities that would allow them to undertake such type of work. While the incidence of teleworking is more common in developed countries, women in many developing countries still prefer institution-based jobs and employers are still not acquainted with this new mode of work (Huyer, 2005). One of the influential CSOs in developing countries that boosted awareness about telework and provided technical support as well as

consultancy for existing and potential women teleworkers is the "e-Homemakers". This is a community group that was founded in 1998 in Malaysia aiming at improving the lives of homemakers through the innovative use of ICT. The project targeted marginalized woman aiming at encouraging them to use ICT to generate income from home. The project has been designed to enable homeworkers and homemakers to teletrade, network, and support each other through creative problem-solving and idea-sharing. Among the activities offered by the group are training sessions and conferences for lifelong learning and community outreach and contests for home-based business ideas[28]. The main partners of the network that supports their continuous efforts are the Ministry of Women, Family and Community Development as well as the Ministry of Science, Technology and the Environment (http://www.ehomemakers.net/en/index.php). A replication of such a model would be beneficial in the case of Egypt.

As previously indicated, a recent initiative has been undertaken by the Ministry of State for Administrative Development to encourage telework with equivalent salaries for similar jobs conducted at traditional working places. The initiative is a good start, but needs to be widened to cover the private sector as well.

Regarding political awareness, efforts have been mostly limited to strengthening legal awareness. More efforts should be dedicated to disseminating political awareness among women to help in understanding their political duties and rights and strengthening their participation in the political process. Such type of projects is expected to enhance democracy and other political rights in the country in general.

IT clubs form another potential tool that can significantly help in improving women intellectual and economic status through facilitating access to ICT generic services, general ICT and specialized job training and as employers and trainers at such centers. To date, in Egypt men seem to be the main beneficiary from employment opportunities that such initiative provides, with weak women engagement. Nevertheless, there are signs for improvements in women employment growth rates in such centers in the last two years. Being such a promising field for improving women engagement in labor market and the community in general, more efforts should be devoted to increase their engagement. Increasing women's awareness about availability of IT clubs and the various types of training and job opportunities they offer is crucial for women to help in developing needed skills outside the formal education system. The availability of women support staff and trainers in these facilities can facilitate women's use of ICT resources. Allocating certain times and/or spaces solely for women in such centers could also help in this regard.

As surveys and macro data have revealed, women working in ICT sector in Egypt tend to be more concentrated in temporary jobs. This could give women an edge in the market being a flexible employee provided that effective enforcement of Labor Law is taking place to prevent any abuse from the employers' side. It could also form a major drawback where women lack stable and secure jobs in the sector. Moreover, additional efforts should be devoted to encourage young and foreign firms in ICT sector to employ women where studies showed that they tend to hire lower number of females relative to men compared to domestic and old firms.

[28] Among the successful contests were "The Best Teleworking Moms" in and "Volunteers Mothers Unite" in 2009 2004 to raise awareness about teleworking allowing mothers to be active economic contributors and to encourage women to women support.

Regarding access, MCIT data revealed the existence of lower women shares of total internet users in rural areas and higher gender gaps in urban areas. This stresses on the importance of devoting greater attention to rural general ICT development that would benefit men and women equally and following more gender oriented ICT policies in urban areas.

Regression results indicated a significant positive relationship between gender equality in employment and the level of ICT infrastructure in Egypt. Such an outcome underpins the importance of improving ICT infrastructure and diffusion which would lead to positive repercussions on improving employment gender equality in ICT and non-ICT related sectors. A positive significant relationship was also found between the development of ICT sector and gender equality in employment indicating that economic growth of the ICT sector in Egypt could result in improving female to male employment ratios in the sector. This is in line with the fact that women job description matches labor market demand in ICT sector as emphasized by UNCTAD (2007). Further, results showed that encouraging female enrollment in scientific faculties would lead to significant improvements in their employment ratios compared to men in ICT sectors. Most importantly, the empirical findings have also illustrated that there is no significant difference between gender bias in employment in ICT sectors and non ICT sectors. This indicates that ICT sector is not one of the most highly gendered sectors in Egypt which gives a high potential for women to thrive from participating in this sector.

Finally, more efforts and finance should be devoted to build up a complete and consistent database covering gender classified indicators regarding access and use, employment and entrepreneurship in various IT fields. This would facilitate more rigorous research and serve in identifying the areas of strength and weakness regarding gender and ICT which would ultimately have its feedback on the design of the IT policy. Collaboration between MCIT, CAPMAS and international organizations like ITU is needed to achieve this aim. Moreover, assessing and evaluating the outcomes of the on-going projects on different actors of the community is a needed effort that is crucial for future IT policy design.

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Appendix

Table (A.1): ICT Related Sectors (ISIC Revision 3)

One-Digit Level	Two-Digit Level	Three-Digit Level
D. Manufacturing	30 Manufacture of office, accounting and computing machinery	300 Manufacture of office, accounting and computing machinery
	31 Manufacture of electrical machinery and apparatus n.e.c.	313 Manufacture of insulated wire and cable
	32 Manufacture of radio, television and communication equipment and apparatus	321 Manufacture of electronic valves and tubes and other electronic components, 322 manufacture of television and radio transmitters and apparatus for line telephony and line telegraphy 323 Manufacture of television and radio receivers, sound or video recording or reproducing apparatus, and associated goods
	33 Manufacture of medical, precision and optical instruments, watches and clocks	3312 Manufacture of instruments and appliances for measuring, checking, testing, navigating and other purposes, except industrial process control equipment, 3313 Manufacture of industrial process control equipment,
G. Wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods	51 Wholesale trade and commission trade, except of motor vehicles and motorcycles	515 Wholesale of machinery, equipment and supplies
I. Transport, storage and communications	64 Post and Telecommunications	642 Telecommunications
K. Real estate, renting and business activities	71 Renting of machinery and equipment without operator and of personal and household goods	712 Renting of office machinery and equipment (including computers)
	72 Computer and related activities	721 Hardware consultancy, 722 Software consultancy and supply, 723 Data processing, 724 Data base activities, 725 Maintenance and repair of office, accounting and computing machinery, 729 Other computer related activities
	73 Research and development*	731 Research and experimental development on natural sciences and engineering

Source: OECD (2007) and Chen (2004)

*This sector was not included in the definition of the OECD, however was considered in the study to be ICT related.

Table (A.2): Main ICT Indicators in Egypt, Middle East and North Africa (MENA) and the World

ICT Indicators		1996	1998	2000	2002	2004	2006
High-technology exports (% of manufactured exports)	Egypt	0.49	0.17	0.29	0.76	0.64	0.54
	MENA	NA	2.22	3.31	2.88	2.66	4.72
	World	18.94	21.01	22.96	21.96	20.89	20.55
Information and communication technology expenditure (% of GDP)	Egypt	NA	NA	1.05	1.18	1.32	1.36
	MENA	NA	NA	NA	2.66	2.98	2.94
	World	NA	NA	7.30	6.78	6.77	6.72
Internet users (per 100 people)	Egypt	0.06	0.16	0.68	2.75	5.45	8.09
	MENA	0.03	0.18	0.90	2.90	6.40	13.75
	World	1.35	3.16	6.54	9.97	13.67	21.41
Personal computers (per 100 people)	Egypt	0.57	0.94	1.20	1.62	3.21	
	MENA	1.31	1.94	2.55	2.98	4.79	
	World	4.79	6.01	7.99	6.80	12.33	
Telecommunications investment (% of revenue)	Egypt	NA	NA	18.82	29.78	17.19	NA
	MENA	28.42	40.51	39.16	30.72	18.37	NA
	World	35.57	30.26	26.78	24.79	NA	NA
Telecommunications revenue (% GDP)	Egypt	1.14	1.62	2.78	2.94	3.46	3.84
	MENA	0.74	0.96	1.13	0.95	1.26	NA
	World	1.85	1.95	2.31	2.61	2.87	NA
Telephone mainlines (per 100 people)	Egypt	4.90	6.19	8.24	11.26	13.23	14.57
	MENA	5.98	7.19	8.65	10.80	12.64	16.87
	World	12.86	14.21	16.08	17.42	18.99	19.51
Fixed line and mobile phone subscribers (per 100 people)	Egypt	4.91	6.34	10.29	17.73	23.91	38.84
	MENA	6.14	7.74	10.96	16.91	25.45	52.58
	World	15.38	19.59	28.25	36.05	46.72	59.47
Computer, communications and other services (% of commercial service exports)	Egypt	34.07	34.22	26.99	26.95	**27.01**	16.22
	MENA	NA	NA	NA	NA	**NA**	NA
	World	37.23	38.98	38.512 31	40.06	**40.97**	41.69
International Internet bandwidth (bits per person)	Egypt	NA	NA	0.46	9.35	**22.29**	126.38
	MENA	NA	NA	1.21	7.80	**19.76**	125.96
	World	NA	NA	101.77	355.17	**746.23**	NA

Source: World Bank Development Indicators (WDI), 2008

Table (A.3): Average Employment and Hours of Work Female to Male Ratios (1996-2006)

	Wage ratio (female/male) Economy Wide	Wage ratio (female/male) ICT related Sectors	Employment ratio (female/male) Economy Wide	Employment ratio (female/male) ICT related Sectors	Female % of total Employment Economy Wide	Hours of Work (female/male) ICT related Sectors	Hours of Work (female/male) Economy Wide
1996	0.81	0.92	0.25	0.25	20.13	0.54	0.83
1997	0.86	1.00	0.16	0.29	14.12	0.55	0.67
1998	0.85	0.92	0.17	0.20	14.52	0.53	0.67
1999	0.78	0.78	0.17	0.23	14.47	0.51	0.75
2000	0.81	0.88	0.17	0.22	14.28	0.62	0.70
2001	0.85	0.85	0.17	0.28	14.14	0.48	0.71
2002	0.83	0.85	0.16	0.28	14.40	0.25	0.67
2003	0.83	0.86	0.18	0.18	15.05	0.49	0.72
2004	0.87	0.86	0.17	0.25	14.81	0.27	0.65
2005	0.78	1.13	0.20	0.16	16.30	0.27	0.65
2006	0.80	0.88	0.18	0.15	15.30	0.26	0.57

Source: Author's Calculations based on CAPMAS (1997-2007a).

Table (A.4): Female/Male Wage Ratios in ICT Related Sectors

	2000	2001	2002	2003	2004	2005	2006
Manufacture of office, accounting and computing machinery	0.77	1.76	1.22	1.04	0.85	1.10	0.96
Manufacture of insulated wire and cable	0.90	1.13	1.20	1.16	0.83	1.18	0.95
Manufacture of electronic valves and tubes and other electronic components	NA	0.44	0.75	1.71	0.98	2.03	NA
Manufacture of television and radio transmitters and apparatus for line telephony and telegraphy	0.81	1.09	0.91	1.71	0.56	1.49	0.89
Manufacture of television and radio receivers, sound or video recording or reproducing apparatus	1.08	0.96	0.97	0.76	1.00	0.97	1.08
Manufacture of appliances for measuring, checking, testing, navigating and other purposes	0.95	0.56	0.66	0.39	0.92	0.99	1.04
Wholesale of machinery, equipment and supplies	0.90	1.03	0.15	0.74	1.38	1.20	1.35
Telecommunications	0.88	0.92	0.86	0.34	0.80	0.78	0.47
Renting of other machinery and equipment	1.13	0.92	NA	0.00	NA	0.53	0.00
Hardware consultancy	NA	0.00	NA	NA	NA	NA	0.93
Software consultancy and supply	0.93	0.68	1.18	0.97	NA	0.99	1.00
Data processing	0.54	0.77		0.85	0.68	NA	NA
Data base activities	NA	NA	NA	0.88	NA	NA	NA
Maintenance and repair of office, accounting and computing machinery	0.86	0.86	1.06	0.83	0.52	1.15	1.13
Other computer related activities	NA	0.74	0.00	NA	0.93	1.14	0.92
Research and experimental development on natural sciences and engineering	0.84	0.85	1.26	0.73	0.82	NA	0.72

Source: Author's Calculations based on CAPMAS (1997-2007a).

Table (A.5): Female/Male Employment Ratios in ICT Related Sectors

	2000	2001	2002	2003	2004	2005	2006
Manufacture of office, accounting and computing machinery	0.19	0.17	0.36	0.04	1.00	0.12	0.01
Manufacture of insulated wire and cable	0.09	0.04	0.03	0.04	0.03	0.04	0.02
Manufacture of electronic valves and tubes and other electronic components	NA	1.62	0.83	0.08	0.05	0.01	NA
Manufacture of television and radio transmitters and apparatus for line telephony and telegraphy	0.24	0.15	0.25	0.08	0.13	0.04	0.16
Manufacture of television and radio receivers, sound or video recording or reproducing apparatus	0.31	0.22	0.28	0.39	0.07	0.42	0.29
Manufacture of appliances for measuring, checking, testing, navigating and other purposes	0.19	0.03	0.38	0.34	0.07	0.19	0.12
Wholesale of machinery, equipment and supplies	0.11	0.05	0.03	0.09	0.27	0.11	0.08
Telecommunications	0.13	0.11	0.09	0.09	0.08	0.18	0.08
Renting of other machinery and equipment	0.21	0.11	NA	0.00	NA	0.23	0.00
Hardware consultancy	NA	0.00	NA	NA	NA	NA	0.33
Software consultancy and supply	0.36	0.77	0.39	0.33	NA	0.40	0.55
Data processing	0.48	0.28	NA	0.35	0.63	NA	NA
Data base activities	NA	NA	NA	0.39	NA	NA	NA
Maintenance and repair of office, accounting and computing machinery	0.18	0.22	0.50	0.18	0.18	0.11	0.19
Other computer related activities	NA	0.33	0.00	NA	0.46	0.07	0.08
Research and experimental development on natural sciences and engineering	0.18	0.13	0.16	0.19	0.06	NA	0.06

Source: Author's Calculations based on CAPMAS (1997-2007a).

Table (A.6): Regression Results Applied on ICT sectors

	Coefficient	Std. Error	t-Statistic	Prob.
Hours of work	-0.018163	0.002171	-8.367964	0.0000
Average Wage per Capita	3.65E-05	2.37E-06	15.37962	0.0000
Scientific faculties ratios	1.918961	0.074717	25.68288	0.0000
School enrollment ratios	-9.166121	1.022494	-8.964475	0.0000
PCs/100 inhabitant	0.109742	0.009687	11.32881	0.0000
Telephone lines/100 inhabitant	0.083789	0.006420	13.05191	0.0000
Telecommunications Revenue (% of GDP)	0.217660	0.014159	15.37232	0.0000
R-squared	0.980521	Durbin-Watson stat	2.508899	
Adjusted R-squared	0.979612	F-statistic Prob	1078.638 0.000000	

Source: Author's Calculations

Table (A.7): Regression Results Applied on Non-ICT Sectors

	Coefficient	Std. Error	t-Statistic	Prob.
Hours of work	0.002576	0.001801	1.430805	0.1546
Average Wage per Capita	-1.93E-05	4.61E-06	-4.190890	0.0000
Scientific faculties ratios	-0.052131	0.015135	-3.444320	0.0007
School enrollment ratios	-0.289998	0.095985	-3.021292	0.0030
PCs/100 inhabitant	0.007335	0.001026	7.145771	0.0000
Telephone lines/100 inhabitant	0.004969	0.001496	3.322435	0.0011
Telecommunications Revenue (% of GDP)	-0.002673	0.002749	-0.972149	0.3325
R-squared	0.991727	Durbin-Watson stat	2.640597	
Adjusted R-squared	0.991341	F-statistic Prob	2568.714 0.000000	

Source: Author's Calculations