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Impact of Technological Progress on Economic Growth and Employment: A Case Study of Saudi Arabia

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Abstract

This research paper aims at examining the role of technology in boosting economic activity and employment, by adopting different research methodologies and taking the Saudi economy as a case study. The research results support the notion that technological progress is a key factor in achieving development goals pertaining to economic growth and employment level. The study suggests that the leaders and policy-makers in Saudi Arabia should pay a great attention on adopting technology as a medium for achieving the social and economic development goals.
Keywords: Technological Progress; Gross Domestic Product; Employment; Economic Development.

1. Introduction

Technology is immensely needed to prosper GDP growth and to lower unemployment rate. It helps in improving the education, the overall health, and to increase quality of life. An important measurement of the technology economy is observing the Worldwide IT spending volume, which is regarding the corporate spending for hardware, software, data centers, networks, and staff, both internal and outsourced IT services. Currently, this volume is close to $6 trillion per year. To put this number on a more illustrative perspective, if we were to consider the global technology economy a country and its yearly spending its GDP, it would be ranked as the world's third largest economy, between the economies of China and Japan and more than twice the size of the UK economy (Cavallo, 2016).

Technology spending, gross margins and economic growth have a strong relationship when measured by productivity and GDP. A good example is that executives can predict with some accuracy the impact on the overall economy of a decline in technology spending. Whenever companies cut back on discretionary spending in order to improve profits during a downturn, they slash their investments in technology. Soon afterward, GDP falls dramatically, and, within a few years, labor productivity across the economy falls, as technological innovation is an important component of productivity.

Singapore, China, and United States are examples for countries that are embracing technology in order to flourish their GDP growth and to lower unemployment rate. For United States, the total value-added GDP from software in 2017 was $1.14 trillion, which helped in creating 10.5 million jobs, thus contributed to the unemployment reduction, which is 4.1% as of December 2017 (Software Economic Impact Report, 2018) and (Bureau, 2018).

For Singpore, statistics show that the information and communication technologies sector has contributed by 20% in the overall GDP in 1996, and the unemployment rate is only 2.2% as of December 2017 (Singapore Department of Statistics Report, 2018) and (Singapore Ministry of Manpower, 2018). China, which is the second largest economy, has technology accounted for 30% of its GDP, and the unemployment rate is 3.95% as of September 2017 (World, 2017).

Section II: Research Objectives

As illustrated above, technology is required to prosper GDP growth and to lower unemployment rate. However, that is only a noticeable correlation. This research aims to investigate further and it has below objectives:

1) Examine the relationship between technology adoption and the GDP.
2) Investigate the relationship between technology adoption and the unemployment rate.
3) Understand how Singapore, China and United States are utilizing technology as a pillar to grow GDP and to lower unemployment rate.
4) Specify the challenges in adopting technology in Saudi Arabia to boost economic growth and to lower unemployment rate.

2. Research Problem and Questions

The problem that this research is trying to solve is to understand the impact of technology on GDP and employment. Through this research, the following questions are going to be answered:

1) What is the relationship between technology adoption and the GDP?
2) What is the relationship between technology adoption and unemployment rate?
3) Is there an impact of adopting technology in Singapore, China and United States on employment in general and employing females in particular?

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4) What are the challenges in adopting technology in Saudi Arabia to grow GDP and to lower unemployment rate?

3. Research Hypotheses

Below are three hypotheses that will be tested in this research, based on the specific objectives and questions that were identified:

1) There is impact for adopting technology on GDP and unemployment rate.
2) There is impact for adopting technology on employment in general and employing females in particular in Singapore, China, and United States.
3) The main challenges to adopt technology in Saudi Arabia are the unattractive environment for trading, poor infrastructure and the quality of education.

4. Literature Review

This research is going to study the impact of technology on GDP and employment in order to answer key questions related to utilizing technology to boost economic growth and lower unemployment rate. As a part of this study, a relevant literature review has been conducted to better understand published information around the topic.

Technology Impact on GDP and Growth: In a globalizing world economy, the explanation behind contrasts in financial development and between inter-country inequalities in income is clarified on the grounds of huge difference in technological implementation. The objective of science and innovation is to empower ventures and people to utilize advances all more effectively, as this yield diminished expenses and augmentation of productivity. The utilization of new advancements prepares for the generation of new affordable merchandise and for capital aggregation and, so far as that is concerned, for an improved global rivalry intensity of individual nations, and to an upgraded quality for science research establishments. Simultaneously, it also leads to the social and political advancement of various societies. The nature of development rates is as equally essential as their size.

Technology includes the use of science particularly for mechanical or business purposes and utilization of logical techniques and materials keeping in mind the end goal to accomplish business or industrial objectives and making "developments" to the manufacturing sector, manufacturing strategies and commodities so as to expand the volume of production or effectiveness all subsequently leading to a competitive edge and appreciation in profit margins. In this manner, technological innovation assumes a key part in economic expansion on the grounds that appropriate or inappropriate utilization of the innovative advances may have substantial positive or negative ramification on a particular firm, segment or country (Spence, 2011).

Hence, it has been presupposed that innovative improvement and digital data is an external factor which has economic implications. Innovation attains the generation of particular merchandise with less input with regards to resources and production factors.

Furthermore, innovation is not intricate, and it could be comprehended, sold and acquired effortlessly. Therefore, its exchange from one firm to the next does not necessitate excessive exertion and expenses and likewise, no issues emerge in its exchange from one country to the next. Technological improvement is a critical factor expanding the development rate of an economy at a macro level and gains in stock values at a micro level (Motohashi and Yuan, 2010).

The social improvement happens if a general public can generate technological advancements and implement them in their culture as well as social lives. It is apparent that economy has been directing innovations as the new technological developments also influence economic growth and ultimately the GDP. The countries that could productively disperse technological advancements and data to all regions in the global society can generate new employment opportunities in foreign nations. However, these new regions require a qualified task force. Therefore, important amendments ought to be made to the education-related policies to guarantee the advancement of human resources with such aptitudes underscoring the economic advancement.

It is widely acknowledged that innovative change is one of the most essential determinants for a quick increment in the income and volume of production and is an absolute necessity for accomplishing a global competitive edge. The competitive edge cannot only be considered from the aspect of enhancing societal wealth but also as the capacity to augment efficiency. In this respect, there is an indication that competitive rivalry is generated entirely among technology firms and cultivating the capacity to generate innovative components or systems in these organizations brings about both an expansion in the productivity and additionally offers corporations an upper hand on the global front.

Technological transformation does not merely mean an approach to expand the abundance and opulence of the countries, but it likewise enables the general population to achieve levels they could not attain previously. In this way, the novelty is a key determinant of whether an entire life quality will grow in a positive or negative manner. IT research indicates that in case a population has a greater ability for production as well as innovation, the GDP will grow exponentially due to increased circulation of money as well as increased international trade.

Technology Impact on Employment: The Information and Communications Technology (ICT) business has explicitly generated employment opportunities in the developed and the developing economies. In the OECD nations, for instance, the employment level of the ICT industry was at 5.74% of aggregate business industry employment. For the G20 member nations among this, the scope was within the bounds of 4.66 and 6.45%. Some developing economies have additionally profited. Brazil's IT industry accounted for 16 % of occupations made between the years 2010 and 2013 and had absorbed and excess of 1.3 million individuals by the years 2014. India's

IT-BPO industry presently accounts for more than 3.5 million laborers; a third of whom are women. The additional implications of the IT industry are likewise noteworthy (Bharati and Chaudhury, 2006). Different researches demonstrate that computerized occupations produce approximately two and four times the job openings in different divisions of the economy. These occupations additionally regularly pay higher-than-normal wages which are also noted to grow more rapidly in comparison to various other sectors.

Characteristic information from 2004-2005 for a group of G20 nations proposes that all things considered, PC software engineers gain net wages that are about a third higher in comparison with the national averages. As organizations and governments initiate integration of innovations into their procedures and undertakings, and people embrace these advances throughout various spheres of their lives, there is an expectation that the demand for digital laborers will appreciate. Specialists who have these (exceptionally high) aptitudes and can access these employment opportunities will profit substantially. Nevertheless, numerous nations are confronting a shortage in the number of qualified experts even as they may have individuals who are unemployed. Hence, having more individuals working in computerized jobs will require both the institution of the proper empowering conditions for organizations and also for people to embrace innovation.

Technology has also impacted employment through the introduction of computerized instruments. The propagation of affordable and highly capable technology worldwide has enabled more individuals to access digital devices that enable them to interface better with company resources and markets including the local and global labor markets. Three classes of these computerized devices have developed as essential empowering influences of labor markets. The first is transactional devices whereby a scope of computerized gadgets empower purchasers and vendors of different merchandise to execute their business operations with more proficiency and in a transparent manner. This incorporates the cell phone, which is acknowledged for enabling different specialists to retrieve data on costs better (for instance farmers). This additionally incorporates electronic payment services, for instance, that enhances the dependability of monetary exchanges regardless of area of the purchaser or vendor.

Web-based business has likewise started to have a noteworthy effect. In China, village economies have changed and started to generate job opportunities beyond farming due to the fact that SMEs could offer different items, for example, furniture or handcrafted art through Taobao, the consumer to-customer branch of Alibaba. eBay, an online commercial center initially began in the U.S., presently has an excess of 25 million merchants—a considerable number of them SMEs—and 155 million purchasers and operates in 190 nations. Currently, 90 % of business dealers on eBay ship goods to different nations; the proportion is below 25 % among conventional small enterprises. Additionally, in India, these commercial centers have generated numerous job openings for delivery personnel.

The second class is composed of complementary devices. These devices incorporate the different hardware and software components that numerous associations and specialists now utilize, including business programming, processing plant robots, PCs, and smart mobile phones. The McKinsey Global Institute asserts that "organizations that have completely incorporated [the Internet] and utilize it broadly generating more than twice the number of job opportunities as the typical average, while the Internet has a neutral to marginally negative implication on organizations utilizing it just sparingly or not at all (Etro, 2009). Additionally, it is likely that the advancement of these innovations is set to exponentially expand. Highly advanced robots or artificial intelligence-based PCs can perform numerous assignments presently that were formally viewed as difficult to implement automation. Robots are starting to complement specialists and could be utilized to perform remote surgeries. As 3D printing becomes affordable and less intricate, it is conceivable that it could change production, lessening the requirement for assembly line laborers, however, increasing the number of job openings for architects and experts in 3D printing.

The third class is matching devices. As the Internet and mobile networks have gradually become far-reaching, they have gradually transformed into a medium to link specialists with tasks or employment opportunities at various geographic levels. At the city level, these job matching services have opened unused rooms in homes (e.g. Airbnb), associated auto drivers with clients (e.g. Uber), and made markets for "gigs," where an individual executes particular and time constrained undertakings that are regularly non-tradable (e.g. getting basic supplies or conveying packages).

At the national and worldwide levels, these matching services have been developed that enable hiring companies and workers to link up with each other. In some instances, these online platforms center around occupations (for instance Monster.com or SoukTel Jobmatch), while in different cases, they center on short tasks. Certain platforms, for example, oDesk-Elance and Amazon Mechanical Turk enable individuals to work on the web. With regards to oDesk-Elance and comparable web-based contracting services, online specialists linkup with hiring companies who establish a one-on-one relationship for a specific undertaking, and where the supervision is done online.

There are various emerging issues linked to technology with some of them being that innovative concepts will complement employees in various tasks in the future. On the other hand, some of the present-day jobs will also be substituted by innovation. This translates to future jobs being either digital or utilizing digital tools. There is, nevertheless, minimal consensus concerning how these developments might establish themselves, at what pace they might manifest, and the degree of distribution of the gains and losses (Galí and Rabanal, 2004). Therefore, there are mounting concerns related to whether the implementation of lower-cost or augmented technology by organization and governments could have undesirable implications on employment of result to inequality, permitting some proportion of the populace to gain disproportionately, while other might end up with inadequate economic opportunities.

Challenges in Adopting Technology: There are many studies has been founded regarding the challenges facing countries in adopting technology. What follows is an analysis of the literature organized thematically around

Rogers's model of the diffusion of innovations. In his literature review for challenges of adopting technology, Jayson Richardson noted what has been published by Tiene and Hawkins that to increase adoption of ICTs in less developed countries, a focus must be placed on meeting the needs and addressing the limitations of the end user by demonstrating the advantages to adopting a given ICT innovation (Richardson, 2011). Tiene found that efforts to increase the adoption of ICTs in less developed countries often fail to improve educational efforts (Tiene, 2004). Tiene noted that "one critical mistake is to be overly ambitious and overly optimistic about what technology can accomplish".

It was found that schools in many developing countries fail to realize that ICTs are not constrained to simply having the right hardware. Tiene found that common challenges and barriers to technology adoption in less developed countries include a lack of ongoing support and a failure to include teachers in ICT planning. Many projects thus fail to capitalize on developing advantageous ICT solutions relative to the needs of the end user.

Cheng and Townsend cited four issues of compatibility with using ICTs in schools in the Asia-Pacific region. First, there is the difference between educational aims and the uses of ICTs. Second, there is a gap among hardware, software, and training. As Cheng and Tam have noted, the challenge for nations is to develop a comprehensive ICT package that includes "hardware, software, and training as well as an ICT platform to support and maintain the effective and efficient use of ICT in teaching and learning". Third, nations are challenged to bridge the gap between ICT and curriculum development. Since rapid ICT advancements are the norm, curriculum developers in most Asia-Pacific countries have difficulty keeping up. Finally, nations in the Asia-Pacific region are experiencing challenges bridging technological change and cultural norms. Failure to adjust to the paradigm shift has caused strong resistance from school practitioners (Cheng Y. C. and Townsend, 2000); (Cheng Y., 2001); and (Cheng Y. and Tam, 2007).

These four challenges each address unique aspects of an innovation's compatibility with a community's existing systems, norms, and beliefs. Pelgrum analyzed a worldwide survey of educational practitioners in primary and secondary schools in 26 countries at varying levels of development to understand the obstacles that hinder advancing ICT-related goals. Pelgrum compiled a list of 38 obstacles faced by school principals and technology experts (Pelgrum, 2001).

Out of the top-10 obstacles to successfully implementing ICT in Education initiatives, two dealt with the complexity of ICT. Pelgrum found that teachers often had a lack of knowledge and skills about ICTs and thus had difficulty integrating them in instruction. Further, Tiene noted that a main challenge of ICT adoption in less developed countries is the inability for the end user to troubleshoot hardware and software. This lack of troubleshooting ability increases the complexity of using the innovation.

In discussing ICT in Education initiatives, Law and Plomp noted that "staff development is the key element in the implementation plan for any education change" (Law and Plomp, 2003). Staff development hints at Rogers's characteristic of trialability (Rogers, 2003). Staff development gives potential users a chance to try the ICT innovation in a guided environment. Kozma et al. stated that the World Bank program, called World Links for Development, provided schools and ministries of education in less developed countries with "sustainable solutions for mobilizing the necessary technologies, skills, and educational resources to prepare students and teachers to enter the Networked World" (Kozma *et al.*, 2000). In analyzing this project, Hawkins found that one of the key failures of this and many past ICT in Education initiatives in less developed countries is the lack of professional development at the national as well as at the grassroots level (Hawkins, 2002).

Hawkins found that lessons learned from the World Links for Development program included the following: ongoing technical support is imperative; wireless technology is more effective than wired technology; community involvement is needed for both ongoing financial support and to understand the needs of the stakeholders; and both formal and informal sustained teacher training is needed. Many aspects of these lessons point to the need for end users to practice using the innovation in an ongoing and supportive environment. Pelgrum's list of the top-10 obstacles to implementing ICT innovations in less developed countries includes eight issues centered on the fact that end users could not practice using the ICT innovation and achieve observable results.

Pelgrum (2001) listed the following as obstacles: insufficient number of computers, difficulty scheduling computer time, insufficient peripherals, not enough copies of software, insufficient teacher time, not enough simultaneous access to the Internet, not enough supervision staff, and a lack of technical assistance. Likewise, Rodrigo conducted a cross-sectional survey of all schools in metro Manila and found that challenges tended to focus on the inability of the end users to practice using the innovation because of an inadequate number of computers, limited software availability, and limited Internet connectivity (Rodrigo, 2005).

5. Research Methodology

To achieve the research objectives, the research questions should be answered by testing the above-mentioned three hypotheses. As part of testing these hypotheses, the research methods to be utilized are qualitative and quantitative methods. To test the first hypothesis, that there is impact for adopting technology on GDP and unemployment rate, regression analysis will be used. To test the second hypothesis, that there is impact for adopting technology on employment in general and employing females in particular in Singapore, China and United States, secondary data analysis will be used. To test the last hypothesis, that main challenges to adopt technology in Saudi Arabia are the unattractive environment for trading, poor infrastructure and the quality of education, combination of secondary data analysis and primary data collecting through interview and questionnaire techniques are going to be used.

6. Data Collection Techniques

This research is going to study the impact of adopting technology on GDP growth and employment. Such study requires exploring the literature around this topic to understand all aspects related to technology, GDP growth, and employment rate. Therefore, exploring the literature will assist in identifying relative secondary data to this topic. That includes published historical information and statistics about technology, GDP and unemployment rate. Another technique that will be used is to collect primary data through interviews with technology executives in Saudi Arabia to understand their point of view on technology and economy. Moreover, a questionnaire is going to be published to gauge the answer of key questions developed in this paper related to challenges in adopting technology in Saudi Arabia.

7. Research Protocol

As illustrated in the previous sections, to achieve the research objectives, the research questions should be answered by testing all aforementioned 3 hypotheses. As part of testing these hypotheses, the research methods to be utilized are qualitative and quantitative methods. Collecting data is required to feed such methods.

To test the first hypothesis, that there is impact for adopting technology on GDP and unemployment rate, regression analysis will be used. Such analysis will require collecting historical secondary data. The first secondary data is Real GDP Growth Rate, which is the growth rate for the GDP adjusted for price changes (Federal, 2018). The second secondary data is Real GDP per Capita, which is the ratio of Real GDP to the average population of a specific year (European, 2018). The third secondary data is the unemployment rate. Moreover, as the independent variable, the team developed a model to gauge the technology adoption rate. More details about this is going to be discussed in later section.

To test the second hypothesis, that there is impact for adopting technology on employment in general and employing females in particular in Singapore, China and United States, secondary data analysis will be used. The research team is going to rely mainly on collecting facts and statistics to help performing descriptive analysis to test the hypothesis and answer the question.

As for the third hypothesis, that main challenges to adopt technology in Saudi Arabia are the unattractive environment for trading, poor infrastructure and the quality of education, combination of secondary data analysis and primary data collecting through interview and questionnaire techniques are going to be used. The research team is going to conduct interviews with technology executives in Saudi Arabia to understand their point of view on technology and economy. Moreover, a questionnaire is going to be utilized to gauge the answer of key questions developed by this study related to challenges in adopting technology in Saudi Arabia. This should help in testing the hypothesis and answering the research question.

The literature review section shed the light on the importance of technology and innovation to prosper the GDP growth and lower the unemployment rate as well as explored the challenges for adopting technology. This section is going to explore in more depth the importance of female participation in the workforce to increase the GDP, challenges in achieving that, and how technology can help with increasing female participation in the workforce.

Importance of Female Participation in The Workforce: Gender equality has the effect of attracting better talent since a male-dominated job market is in general unappealing to women. This has a detrimental since women generally have greater educational achievements in comparison to their male counterparts. Essentially, a perceived shortage or absence of equality makes an economy highly susceptible of missing out on a large pool of talent (Barnett and Hyde, 2001). Other than skills and talent, a variety of perspectives that accompany diversity — and it's not merely about the female perspective, but perceptions sourced from the divergent cultures and socioeconomic backgrounds that they grew up in. For instance, in the United States, since the year 2000, labor force participation among American females, unfortunately, has begun reversing course from generational advancements.

Presently, approximately 57% of females in the U.S labor force are employed away from home, a drop from 60% at the dawn of the millennium. Particularly, the prime-age women rate of participation stood at 74% in the year 1990, at number 7 among the OECD nations. As that figure has stagnated in the U.S., the GDP of other developed economies have experienced significant gains, plummeting the United States to position 20 among the 22 OECD nations by the year 2016 with regards to the contribution of women to the GDP.

In 2012, a report conducted by one of the women's advocacy groups, it was projected that a boost in female workforce participation by approximately 6% (matching it with that of Canada) would bolster the size and output of the Australian economy by approximately $25 billion annually. This would be specifically true for the technology sector. It is widely acknowledged that innovative change is one of the most essential determinants for a quick increment in the income and volume of production and is an absolute necessity for accomplishing a global competitive edge (Bloom *et al*., 2009).

The competitive edge cannot only be considered from the aspect of enhancing societal wealth but also as the capacity to augment efficiency. In this respect, there is an indication that competitive rivalry is generated entirely among technology firms and cultivating the capacity to generate innovative components or systems in these organizations brings about both an expansion in the productivity and additionally offers corporations an upper hand on the global front.

Technological transformation does not merely mean an approach to expand the abundance and opulence of the countries, but it likewise enables the general population to achieve levels they could not attain previously. In this way, the novelty is a key determinant of whether an entire life quality will grow in a positive or negative manner.

Challenges Facing Increasing Female Participation in The Workforce: The participation of females in line and staff roles exemplifies some of the firmly established hindrances to advancement to top-level positions. Females are extensively under-represented inline job positions in the Energy, Mobility, Basic and Infrastructure and Information and Communication Technology sectors, with line roles having a greater likelihood of equipping women with the skills and experience that are pertinent to these fields and that would thoroughly prepare them for senior positions (Jaumotte, 2003).

Research indicates that with regards to the barriers hampering the participation of women in the workforce diverge based on industry and typically mirror various industry cultures in addition to the predominant societal and economic factors. Despite the fact that in almost all geographies and industries there has been a notable move away from the intentional marginalization of females from the workplace, there persist to be cultural beliefs that result in unconscious biases. This incorporates opinions that prosperous, competent females are less desirable, that solid performance by the female gender is attributable to hard work as opposed to skills. Additionally, there have been assumptions that females are less dedicated to their careers.

There has been noted trend that, particularly in well-established, older corporations, workplace structures that were intended for a past age still, typically inadvertently, show favoritism for men. In addition to this, women's historically low labor market participation translates to fewer role models for them to venture into all industries. Research also specifies that females typically have a very negative perception of top roles and also lack a perfect line of sight as the manner in which positions of senior leadership might assist them to attain their objectives, in the absence of role models who can demonstrate the benefits and trade-offs they convey.

In the United States, for example, Women's aspirations and confidence are considered to be another obstacle. Women have a lower probability of desiring a top job – noting the pressure or stress of the job description as a key deterrent. A normally noted obstacle is the absence of qualified incoming women talent in particular fields, particularly in STEM (Science, technology, engineering, and mathematics) education, where females presently comprise a mere 32% of all graduates all over the world.

Finally, where each industry stands particularly is typically influenced by how recently and industry has enhanced its gender balance. Owing to the fact that career selections are disproportionately influenced by prior bias and experience, conventionally men dominated fields normally find it challenging to appeal to women. Across all industries, industries, unconscious prejudice among company executives and the absence of a work-life balance are notes as the two main hindrances to female workforce integration over the next few decades. Some managers state that there is a concern with regards to the availability of competent talent, particularly, employers in the Energy and ICT industries.

How Technology Helps Increasing Female Participation in Workforce? As illustrated in the previous sections, increasing female participation in the workforce will be beneficial in increasing the GDP and lowering the unemployment rate. This section is going to explore a study done to explain how women working in technology can be a drive for economic growth.

In the paper "Women in Tech as a Driver for Growth in Emerging Economies", It is explained how the world is transitioning to a more of a digital economy, where many low- and middle-income countries are having the challenge of lacking qualified workers to fill the information and communication technology (ICT) jobs. Moreover, low representation of females in this sectors is an additional factor for such shortage. It is explained that the gap between the demand for ICT workers and the supply of job seekers with the necessary technical skills threatens the ability of those countries to participate in a powerful driver of growth in the twenty-first century—the digital economy. It is claimed that increasing the participation of women in the ICT labor force would help bridge this gap.

It is shared that expanding women's access to ICT jobs would not only advance economic opportunities for women, their families, and their communities, but it would also help address the shortage of skilled workers for these jobs and grow the digital economy. As women become increasingly active users of technology, their participation in designing and developing tech products and services will help to enhance technology's relevance for women as consumers, further boosting innovation and economic growth. Working together, the public and private sector should address the multiple barriers women and girls face, particularly in low- and middle-income countries whose economies stand to gain the most from greater participation of women in vital ICT jobs (Powell and Chang, 2016).

8. Qualitative Research

In this study, qualitative research methods have been applied. Interviews and questionnaires were used to conduct an interpretative study. Questionnaires are self-report data collection tools which, answered at a distance from the researcher, eliminate personal influence. The technique used in the interviews was to utilize a single open-ended question to give the opportunity for the interviewee to express his view about challenges in adopting technology in Saudi Arabia. More details about responses for the interviews and the questionnaire are going to be discussed in later section.

Questionnaire Target Audience: Rigorous questionnaire design was undertaken to provide the research reliable measures that have been validated for this application also ensuring participants can understand the questions and answer accurately with the most appropriate response. Our target population are employees within private and public sector and students in university. Both have direct relationship with technology every day.

Questionnaire Sampling Size: This study has chosen 200 responses as a target number of questionnaires responses with 95% confidence level and 5% margin error. The total number os responses was161 responses.

Data Analysis: In order to achieve the research objectives, the research team relied on collecting secondary data through studying the literature related to the topic of technology impact on GDP growth and employment, as well as looking into historical published statistics related to Real GDP, Real GDP per Capita, and unemployment rates. Moreover, the team has also collected primary data related to the challenges for adopting technology in Saudi Arabia, through utilizing interviews with technology executives in Saudi Arabia as well as a questionnaire. This sections is going to discuss in further details the data that have been collected, why such techniques have been used, and interpretation for reached results.

Descriptive Data: The questionnaire's goal was to determine what employees and students perceived as obstacles and challenges facing Saudi Arabia to adopt technology in effective manner. At the beginning of the questionnaire the researcher explained the purpose of the survey and directions for filling out the questionnaire. The first section of the questionnaire was designed to capture demographic information such as age, occupation educational background. The second section was designed to obtain information on their understanding of technology and if there is relationship between technology and unemployment rate. The last section was designed to find out what respondents felt were the challenges and barriers facing Saudi Arabia to adopt technology in effective manner.

Interviews Overview: Interviews were conducted with executives in Saudi Arabia, in private and public sectors, to understand their point of view on technology and economy in general, and on challenges adopting technology in Saudi Arabia. The first interviewee was the IT Audit Director in AlRajhi Bank, which is the largest Islamic bank (Islamic, 2015).

The second interviewee was with the IT Audit Director in STC, which is the second largest internet and telecommunication company in the middle east, and ranking 18 on the world in telecommunication category (Forbes, 2018).

The third and last interviewee was with the CEO of Saudi Industrial Development Fund, which contributes effectively to the realization of the goals, policies and programs of the Kingdom's industrial development, by providing the finance and advisory services needed to support the growth and development of the local industrialization and upgrading the level of the industry performance (Saudi, 2018).

Interviews Results: To utilize the strategic position of all interviewees, being executives leading their well performing organization, the decided to ask only one open ended question "What are the challenges that faces Saudi Arabia to adopt technology". Such question will allow each interviewee to express his answer in as much desired details, based on his experiences and point of view.

The IT Audit Director in AlRajhi Bank expressed his view as following: "Actually, I think that there many challenges facing Saudi Arabia. One of the main challenges is the infrastructure, which I consider is partly ready, but I feel that major enhancement is needed to our infrastructure in order to adopt those new technologies such as smart cities. Also, in the network level, there is a need for more enhancement since the integration part is not well established, Also in policies and procedure level, we need to have applicable policies which reflect the intent of management toward adoption of technology in systematic manner. Another factor is the human resources within the kingdom that is not matured enough, as they might need consultants to facilitate the implementation of technology. The kingdom should have a look for the long term as well by having proper education for Saudi candidate to be leaders in this sector. Another concern is most of our government entities have their own ICT, and in order to face this challenge as well, we need to have consistency in all government technology by adopting the same technology patterns like banks, which are using almost the same technology."

The IT Audit Director in STC expressed his view as following: "Implementing technology in general and automation is considered as transformation, and we have less experience in transformation in corporate culture history. Experience is one factor which can be considered as a challenging factor in Saudi Arabia. Another factor is the legal factor. Yes, we have some regulation and laws defining violations regarding the misuse of technology, however there are some gaps that will require legal infrastructure to be developed in the country to overcome those challenges as well. The last thing is the technology itself, which keeps changing in nature and no matter how you follow up with technology, a new technology will come. We need to be agile to keep in pace with change in technology, so we need change in mindset as well. This might help us to face those challenges in our country."

The CEO of Saudi Industrial Development Fund, he expressed his view as following: "One of major challenges is that the nature of technology itself has been changed. We can define three areas where the change of technology is happening. The first one is the artificial intelligence and automation, which will change the nature of the jobs these days. The second factor is customization, were it allowed the customer to design and choose the material as he wants. The third one is the logistic services, which has been moved from global level to domestic level. So, you might ask me how is that affecting Saudi Arabia? I will say that customization has become more valuable than mass scale. Thanks to technology, the automation and artificial intelligence has become a competitor to humans. Even the countries with low pay jobs has been effected. China as example, in one of their factories, has replaced the humans with machines, which was more effective in doing the job and less costly compare to people work there and the efficiency has increased as a result. So what Saudi Arabia should do to faces those challenges or opportunities? First, they have to support domestic companies to adopt those technologies from financial perspective. Also, create a positive environment by supporting academic research and encourage student toward these researches. Second, facilitate the regulation part regrading technology."

Questionnaire Overview: The survey questionnaire was divided into three parts: demographic information, information technology knowledge, and perceived challenges and barriers facing Saudi Arabia to adopt technology in effective manner.

The questionnaire was accessed through the online survey website google survey. It was available online for 10 days. The total number of participants who responded to online survey to identify important challenges that faces Saudi Arabia to adopt technology was 161 respondents. All of them were classified as Saudi citizens and as Internet users who have the basic knowledge about Internet, websites and its usage. The majority of participants are employees and that gave the research a clear view about their knowledge about technology.

Questionnaire Results: The questionnaire results can be classified into 10 categories, where each category represents a set of answers on a particular question. Detailed survey information are available upon request.

Demographical Information: The data showed that the majority of respondents are between the ages of 20-30 years, which is about (50.3%) of the total number of respondents. (24.2%) were above 30 years of age, (13.%) were between ages 50-70 years old, and (12.4%) were between 41-50. Participants were mostly male employees and students with percentage about (53.2 %) and rest were female employees and students with (46.8 %). This section also identified the educational level of the respondents; it revealed that the majority of these participants held a bachelor degree that is (66.5%). (19.9%) of the respondents had higher than bachelor degree, (10.6%) had a high school degree, (3%) had doctorate degree. This explanation of section one of the research questionnaires will help in the interpretation of the following sections to answer the research questions.

Technology as a Driver for Economic Growth: Response for this question was (97 %) who think technology has improved the business and (3 %) were between saying No and to some extent. For sure technology has improved business in almost every process.

Technology as a Driver for Decreasing Unemployment Rate: Result of the survey shows that (55.3 %) believing that technology decrease the unemployment rate while (34.2 %) think that technology increase the unemployment rate. Other responses were split between No relationship and "don't know".

Saudi Human Resources as a Challenge in Adopting Technology: One of the main challenges that faces countries to adopt technology is having skilled capabilities to handle this technology in effective manner. The question was about is Saudi Arabia having skilled and enough resources to handle new technology. Our result shows that (46%) believe that Saudi Arabia has enough resources while (50.3 %) disagree, and (2%) doesn't know.

Awareness as a Challenge in Adopting Technology: Awareness is one of the main challenges that faces Saudi Arabia as per our survey result were (68 %) believe that it's a real challenge while the rest have different opinion by (28 %) who believe it's not real challenge. And the rest doesn't know.

Level of Interest in Technology as a Challenge in Adopting Technology: As business become more demanding and competition increases between nation and private firms. there is level of interest in technology and this is what our survey shows. (84 %) believe that there is increase in technology interest within private and public sector. While (13 %) think there is no interest in technology aspect within private and public sector. And (3%) don't have answer for the question.

Information Technology Infrastructure as a Challenge in Adopting Technology: One of the main challenges face any county is the infrastructure, especially in IT infrastructure. As per our survey result, (67.7 %) believe that Saudi Arabia IT infrastructure is modern and scalable for long term while (30.4 %) think it's not scalable nor modern and it should be rebuilt again and the rest (2%) doesn't know.

Privacy as a Challenge in Adopting Technology: As technology evolve, concern toward privacy are increased. This is what our survey shows that there are (80.1%) think that privacy is real challenge that face Saudi Arabia, while (17.4%) don't see it as a challenge, and others don't have answers.

Society Culture as a Challenge in Adopting Technology: Resistant to new technology is a challenge by its own, and society culture is main factor to determine to which extent this factor could affect the new technology adopted. Based on our survey result. (82 %) believe that Saudi Arabia society are encourage the use of technology while (15.5 %) believe that society culture is challenge that face Saudi Arabia to implement or adopt new technology.

Policies and Procedure as a Challenge in Adopting Technology: In order to facilitate the management intent toward technology and other aspect within organization policy and procedure is one of these tools that could help. Our question was about policies and procedure and either they mentioned and inspire the use of technology or not. Based on survey result we found that (57.1 %) believe that policies and procedure covering the technology aspect and inspire the use of it. While (19 %) think that polices and procedure don't support the use of technology and as result it's not mentioned. And the rest of the survey (23.6 %) don't have answer for this question.

Financial Support as a Challenge in Adopting Technology: Companies and R&D departments in collage and public sector they all need financial support in order to adopt the new technology and to discover how to improve it as well, our survey was about if enough financial support are exist in our companies and our public sector offices and the result was (44 %) think that there is enough financial support from both public and private sector. While (35.4 %) believe that there is no enough support in technology improvement. And the rest (20.5 %) don't' have answer for the question.

9. Regression Analysis

Adopting technology is immensely useful to prosper GDP growth and to lower unemployment rate. It helps in improving the education, the overall health, and to increase quality of life. As stated in previous sections, regression analysis is going to be utilized to understand the relationship between technology adoption and GDP and employment. Regression analysis is a set of statistical procedures for estimating the relationships among different variables. It includes many techniques for modelling and analyzing several variables, when the focus is on the relationship between a dependent variable and one or more independent variables. More specifically, regression

analysis help in understanding how a value of the dependent variable changes when any one of the independent variables is varied, while the other independent variables are held fixed.

Technology Adoption Index as Independent Variable: In order to test the first hypothesis, that there is impact for adopting technology on GDP and unemployment rate, regression analysis is identified to be the right method. This study modelled the Technology Adoption Index, which is the independent variable, as the summation of number of fixed telephone subscriptions, number of mobile-cellular subscription, number of individuals using the internet, and number of fixed broadband subscriptions in Saudi Arabia. All relevant and required data were collected for the period 2000 and 2016. Consequently, Technology Adoption Index has been calculated for each year. This paper examines the impact of technology on three domains of development trajectory, namely GDP growth, unemployment, and GDP per capita.

Technology Adoption Impact on Real GDP Growth Rate: Gross Domestic Product (GDP) is defined as the aggregate measure of production equal to the sum of the gross values added of all resident institutional units engaged in production (plus any taxes, and minus any subsidies, on products not included in the value of their outputs). The sum of the final uses of goods and services (all uses except intermediate consumption) measured in purchasers' prices, less the value of imports of goods and services, or the sum of primary incomes distributed by resident producer units.

Real GDP is used to adjust the GDP for price changes resulted from inflation or deflation. Therefore, Real GDP Growth Rate is identified as a key dependent variable. The research team developed the regression model between technology adoption and Real GDP growth as follows:

$$RGPDGROWTH_t = \beta_1 TECHAD_t + U_t$$

where, $RGDPGROWTH_t$ represents Real GDP Growth Rate and $TECHAD_t$ represents technology adoption index. The constant parameter (intercept) is not entered into the regression equation because the growth rates depend mainly on the lagged values of GDP and, therefore, it counts for the effect of other unspecified independent variables. Regression results are shown as in Table 1.

Table-1. Regression Results: Dependent Variable: Real GDP Growth Rate ($RGPDGROWTH_t$)

Explanatory Variable	Coefficient	t-value	p-value	R^2	Significance F
$TECHAD_t$	0.0006	3.2***	0.005	0.39	0.00061

Source: Author's computations.

Results can be interpreted as technological progress had a positive and statistically significant (at 99 percent confidence level) impact on economic growth, yet this effect is still modest (+0.06%) due to the fact that Saudi economy is still oil-driven economy.

Technology Adoption Impact on Real GDP per Capita: As explained in previous section, Real GDP is used to adjust the GDP for price changes resulted from inflation or deflation. To further adjust such number on the population growth, Real GDP per Capita is used. This study develops a regression model between technology adoption and Real GDP per Capita as follows:

$$RGPDPC_t = \alpha + \beta_1 TECHAD_t + U_t$$

where $RGPDPC_t$ represents Real GDP Per Capita in time t. The constant parameter (intercept) is now entered into the second regression equation because the growth rates of GDP are not included in the second equation and have been replaced by absolute values of GDP per Capita, which is not absolutely a function of time and the effects of other variables and, therefore, it should be counted for the effects of other unspecified independent variables. Table 2 shows the regression results.

Table-2. Regression Results: Dependent Variable: Real GDP per Capita ($RGPDPC_t$):

Explanatory Variable	Coefficient	t-value	p-value	R^2	Significance F
Constant α	67376.3	48.4***	0.000007	0.67	0.00006
$TECHAD_t$	140.6	5.54***	0.006		

Source: Author's computations.

The results support strongly the results of Table 1. That is, the Economic Activity adjusted for population growth and the price effects ($RGPDPC_t$) is strongly and significantly affected by Technological progress.

Technology Adoption Impact on Unemployment Rate: As explained previously, employment rate can be defined as a measure of the extent to which available labor resources (people available to work) are being used. They are calculated as the ratio of the employed to the working age population. The working age population refers to people aged 15 to 64. This indicator is seasonally adjusted, and it is measured in terms of thousand persons aged 15 and over; and as a percentage of working age population. People who are retired from work, full-time students in an education system, or full-time housewives are excluded from the labor force.

This study also develops a regression model to examine the impact of technology on unemployment where the following model was estimated:

$$UNEMPL_t = \alpha + \beta_1 TECHAD_t + \beta_2\ SAUDIZE_t + U_t$$

where, $UNEMPL_t$ represents unemployment rate, and $SAUDIZE_t$ represents Saudization Index. To examine the effect of technology on unemployment and since a new independent variable ($SAUDIZE_t$) has been entered into regression equation, the intercept is included in the model because the initial growth rates of unemployment were not entered into the regression equation and also maintain the significant level of goodness of fit of the model. Since

unemployment in Saudi Arabia is strongly affected by government policy of Saudization, we should control for that intervention. Therefore, a proxy for Saudization index is entered into the model as a dummy variable taking an increasing value from 1 till 16. The regression results are summarized as in Table 3.

Table 3. Regression Results: Dependent Variable: Unemployment Rate ($UNEMPL_t$):

Explanatory Variable	Coefficient	t-value	p-value	R^2	Significance F
Constant α	6.46	21.48***	0.000	0.92	0.000
$TECHAD_t$	-0.014	-0.74	0.47		
$SAUDIZE_t$	0.45	3.93***	0.002		

Source: Author's computations.

The result of the regression supports the theory that says technology has a positive impact on employment, i.e., negative impact on unemployment where the technology coefficient has a value of -0.014 yet this value is statistically insignificant, which might be attributed to lack of accurate measures for technological progress.

10. Findings and Discussion

As illustrated in previous sections, in order to answer all the of research questions to achieve the research objectives, this paper reviewed the literature by performing a holistic literature review for topics related to GDP, employment, and technology. Therefore, a secondary data analysis has been performed to understand the impact of technology on GDP and employment, and the challenges associated with adopting technology. To expand the secondary data analysis further, this paper looked into the importance of female participation in the workforce, the challenges for female to participate in the workforce, and how technology helps overcoming such challenges.

Moreover, the team collected primary data to help in identifying challenges for adopting technology in Saudi Arabia. Set of interviews have been done with executive leaders from public and private sectors. Additionally, a questionnaire has been developed and shared to analyze the public opinions about such topic. This section is going to have detailed presentation of the research findings.

Technology is immensely needed to prosper GDP growth and to lower unemployment rate. It helps in improving the education, the overall health, and to increase quality of life. Technology includes the use of science particularly for mechanical or business purposes and utilization of logical techniques and materials keeping in mind the end goal to accomplish business or industrial objectives and making "developments" to the manufacturing sector, manufacturing strategies and commodities so as to expand the volume of production or effectiveness all subsequently leading to a competitive edge and appreciation in profit margins. In this manner, technological innovation assumes a key part in economic expansion on the grounds that appropriate or inappropriate utilization of the innovative advances may have substantial positive or negative ramification on a particular firm, segment or country.

Technology has impacted employment through the introduction of computerized instruments. The propagation of affordable and highly capable technology worldwide has enabled more individuals to access digital devices that enable them to interface better with company resources and markets including the local and global labor markets. Three classes of these computerized devices have developed as essential empowering influences of labor markets.

This study found through analyzing secondary data using literature review and performing regression analysis that there is a positive impact on GDP when adopting technology. When there is more utilizing for technology, there has been an increase in GDP. Moreover, it has been also found there is a positive impact on employment when adopting technology. When there is more utilizing for technology, there has been a decrease in unemployment rate. Such proven information is crucial for leaders and policy makers to take strategic decisions that strongly supports adopting technology in order to increase GDP growth, lower unemployment rate, and increase female participation in the workforce.

Singapore, China, and United States are examples for countries that are embracing technology in order to flourish their GDP growth and to lower unemployment rate. For United States, the total value-added GDP from software in 2017 was $1.14 trillion, which helped in creating 10.5 million jobs, thus lowered the unemployment rate to be 4.1% as of December 2017.

For Singapore, statistics show that the information and communication technologies sector has contributed by 20% in the overall GDP in 1996, and the unemployment rate is only 2.2% as of December 2017. China, which is the second largest economy, has technology accounted for 30% of its GDP, and the unemployment rate is 3.95% as of September 2017.

After it has been proven that adopting technology can positively impact GDP growth and lower unemployment rate, this research performed secondary data analysis to identify the general challenges in adopting technology. Moreover, primary data collection techniques such as interviews and a questionnaire were performed to understand the challenges in adopting technology in Saudi Arabia. Such technique allowed to understand the global challenges in adopting technology, and how far Saudi Arabia has the advantage and the flexibility in overcoming them, and what are the unique challenges in Saudi Arabia.

It has been found that there are many general challenges that Saudi Arabia is already in good position against. Challenges such as absence of the right hardware, lack of professional support and training, absence of formal technical education, absence of wireless technologies, relatively too expensive software and hardware prices compared to the individual income, and the limited internet access, are general challenges that are not existing in Saudi Arabia compared to other less developed countries.

Saudi Arabia is one of the largest technology consumers in the middle east and in the world. This paper found that in 2015, out of the Saudi Arabia population of ~ 31 million, there were ~ 50 million active mobile subscriptions. That number reflects the strong stance for the digital society that Saudi Arabia already have compared to other countries.

However, there are other challenges identified after conducting the interviews and analyzing the questionnaire that Saudi Arabia need to solve in order to have a stronger position in adopting technology. The first challenge is related to overcoming the complex nature of technology. Technology is constantly changing, and such characteristic requires highest attention to avoid problems and to seize opportunities. One technology identified to be promising by our executive interviewees is the Artificial Intelligence. As explained by our interviewees, artificial intelligence can introduce automation, which lowers costs and improve productivity, which in turn increases GDP and improve jobs quality. Another challenge is related to infrastructure. Although Saudi Arabia is already in good stance in spreading 3G and 4G wireless cellular networks, major enhancements are required to the infrastructure in order to be ready to adopt new technologies such as smart cities.

Another challenge raised by executive interviewees is the absence of the policies and the legal framework that clearly define service level agreements and constraints of using technology. Another challenge is related to the culture and awareness. Our questionnaire showed that 68% of the total participants think that Saudi Arabia's culture and awareness is a challenge for adopting technology. For example, drones are banned since 2015 until today (Saudi, 2018). Another challenge raised by both the interviewees and the questionnaire participants is the skilled Saudi human resources. Although such challenge is getting faded by the Saudi government initiatives to up-skill Saudis, and by the presence and operation of international companies such as Cisco, Microsoft, and soon Apple, Saudi human resources are still in need for strategic training in leading the formulation, implementation, and evaluation of the technology in the country.

Studying and applying economics concept is paramount in order to ensure the best utilization of scarce resources such as time, money, labor, and land in the process of production, distribution, and consumption of goods and services. Macroeconomics is a branch of economics that examines major areas with a mission such as increasing national income growth, decreasing unemployment rate among the population, and controlling the inflationary increase in prices by using different fiscal and monetary instruments.

There are many indicators to determine the level of economic activity in a country, to understand how many goods and services a nation is producing, and to know how many and what are the kinds of jobs actually available. Gross Domestic Product (GDP) is a measure for the monetary value for final goods and services purchased by consumers. It an indication of the value creation in the country. The other indicator to gauge the health of economy is the unemployment rate. Employment rate can be defined as a measure of the extent to which available labor resources (people available to work) are being used.

Technology is immensely needed to prosper GDP growth and to lower unemployment rate. It helps in improving the education, the overall health, and to increase quality of life. The objective of science and innovation is to empower ventures and people to utilize advances all the more effectively, as this yield diminished expenses and augmentation of productivity. The utilization of new advancements prepares for the generation of new affordable merchandise and for capital aggregation and, so far as that is concerned, for an improved global rivalry intensity of individual nations, and to an upgraded quality for science research establishments. Technological transformation does not merely mean an approach to expand the abundance and opulence of countries, but it likewise enables the general population to achieve levels they could not attain previously.

In this way, the novelty is a key determinant of whether an entire life quality will grow in a positive or negative manner. IT research indicates that in case a population has a greater ability for production as well as innovation, the GDP will grow exponentially due to increased circulation of money as well as increased international trade.

The Information and Communications Technology (ICT) business has explicitly generated employment opportunities in the developed and the developing economies. In the OECD nations, for instance, the employment level of the ICT industry was at 5.74% of aggregate business industry employment. For the G20 member nations among this, the scope was within the bounds of 4.66 and 6.45%. Some developing economies have additionally profited. Brazil's IT industry accounted for 16 % of occupations made between the years 2010 and 2013 and had absorbed and excess of 1.3 million individuals by the years 2014. India's IT-BPO industry presently accounts for more than 3.5 million laborers; a third of whom are women. The additional implications of the IT industry are likewise noteworthy.

There are various emerging issues linked to technology with some of them being that innovative concepts will complement employees in various tasks in the future. On the other hand, some of the present-day jobs will also be substituted by innovation. This translates to future jobs being either digital or utilizing digital tools. There is, nevertheless, minimal consensus concerning how these developments might establish themselves, at what pace they might manifest, and the degree of distribution of the gains and losses. Therefore, there are mounting concerns related to whether the implementation of lower-cost or augmented technology by organization and governments could have undesirable implications on employment of result to inequality, permitting some proportion of the populace to gain disproportionately, while other might end up with inadequate economic opportunities.

In conclusion, the research has proven the positive impact for adopting technology on GDP growth and employment. The research also identified the key challenges that are facing Saudi Arabia to increase technology adoption. Such information is crucial for leaders and policy makers to take strategic decisions that strongly supports adopting technology in order to increase GDP growth, lower unemployment rate, and increase female participation in the workforce.

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