The tertiary education system and the labour market in the Emirate of Qatar

Master Thesis

Submitted to

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1. Introduction

Qatar is a gulf state located on a small peninsula in the Persian Gulf, with the border to Saudi-Arabia being its only land border (Berrebi et al., 2009, p. 422) and maritime borders with Bahrain, the United Arab Emirates and Iran (Ahmed, 2018, p. 40). It became independent in 1971 and has since been ruled by the Al Thani family through an emirate governance structure (Berrebi et al., 2009, p. 422). Unlike the other gulf monarchies, it has seen certain forms of political liberalization, with the ratification of a constitution that came into effect in 2005 (Ahmed, 2018, pp. 41–42) and legislative elections that took place for the first time in October 2021, although the main power remains with the ruling dynasty. (Barrington & Ghantous, 2021, p. 1).

In recent years, the Saudi-led blockade since 2017 showed that despite Qatar's small size and geographical location, the country has a high degree of independence from its neighbours (Zweiri et al., 2021, p. 9). The blockade failed to cause a recession to the Qatari economy, which aimed to become more self-sustained, but also profited from its close integration in the global economy (Zweiri et al., 2021, pp. 7–8). At the same time, Qatar has gained attention for hosting the 2022 World Cup (Diop et al., 2020, p. 140). This led to an increasing debate about the situation of migrant workers in the state, on whom the Qatari economy relies heavily, even though their stay is intended to be short-term (Diop et al., 2020, p. 141).

Among the gulf states, such a reliance is not unusual. Like many other gulf states, Qatar developed an economy nearly entirely based on hydrocarbon resources a few decades ago (Ahmed, 2018, p. 39), and was able to rely on oil and natural gas exports to create strong economic growth and considerable wealth among the citizens (Berrebi et al., 2009, p. 421). However, compared to other nations, this system is developed so extensively in Qatar that Hertog coined the term 'super-rentier' to describe the extreme importance resource rent has for the Qatari state (Hertog, 2020, p. 5). Qatar became the wealthiest nation in the world by GDP per Capital in 2017 (Ahmed, 2018, p. 41).

But this system also relied heavily on migrant labour (Hvidt, 2013, p. 2) and left the economy dependent on oil and natural gas revenue (Berrebi et al., 2009, p. 422). The resulting susceptibility to changes in world market prices (Ahmed, 2018, p. 49; Langworthy & Warnecke, 2021, p. 326) was recognized as problematic by the state and led to a number of reforms with the aim to diversify the economy and to enhance

the role of the private sector (Berrebi et al., 2009, p. 424), of which the most comprehensive was the Vision 2030 program approved in 2008 (Ahmed, 2018, p. 42). The reforms conducted in Qatar included attempts to foster entrepreneurship, to diversify their local economy (Langworthy & Warnecke, 2021, p. 325) to employ more nationals in the private sector and increase their education (Gonzalez et al., 2008, p. 31) as well as to invest oil and gas revenues in assets which are supposed to generate employment (Hvidt, 2013, p. 38) This program is not unusual in regional politics, with similar proposals existing in Saudi-Arabia (Government of Saudi-Arabia, 2016, pp. 6–7), Bahrain (Hvidt, 2013, p. 18) and the United Arab Emirates (Hvidt, 2013, p. 31).

Currently, Qatar has about 2.7 million inhabitants, and the number of people living in the country increased sharply after the beginning of the strong economic growth due to the arrival of immigrant workers (Ahmed, 2018, p. 40), making it unique in the world in its high ratio of foreigners to nationals (Ahmed, 2018, p. 49). Only around 310.000 inhabitants of the state, around 11,6% of the population, are Qatari citizens (Ahmed, 2018, p. 40). Since the immigrants are mostly male, this led to the development of a very uneven gender ratio in Qatari society, with only 0.7 million women living in Qatar (Ahmed, 2018, p. 40). Arabic is the official language, but English is very commonly used (Ahmed, 2018, p. 40). Less than ten percent of the workforce are nationals, and they work almost exclusively in the public sector while migrants primarily find employment in the private sector (Hertog, 2020, p. 4). A major reason for the gender imbalance is that the Qatari system creates strong incentives for firms to hire primarily young men instead of attracting a more diverse migrant population (Berrebi et al., 2009, p. 431). Authors addressed the issues that most migrants in Qatar have low educational attainments (Berrebi et al., 2009, p. 423), and productivity in many Arabic countries remains low despite increases in education (Gonzalez et al., 2008, p. 4).

Although the first public schools were only founded in the 1950's and primary and secondary schools for girls were founded a few years after the corresponding institutions for boys, women had a strong presence in the tertiary education system since it was first established; the first college, the college of education established in 1973, already was attended by a cohort with a female majority in the year of its founding (Ahmed, 2018, p. 43). Qatar University was established in 1977 as national university and originally consisted of four colleges, it expanded since then to include

ten colleges at which over 20.000 students were taught by 2018 (Ahmed, 2018, p. 43). A second important institution in higher education is the Qatar Foundation for Education, Science and Community Development, which is a private non-profit organization, but founded by members of the royal family in 1995 (Ahmed, 2018, p. 43). The Hamad Bin Khalifa University, which was founded in 2010 (Ahmed, 2018, p. 44) belongs to this Foundation (Ahmed, 2018, pp. 52–53). Furthermore, eleven International Branch Campuses are currently operating in Qatar, under agreements they entered since 1998 (Ahmed, 2018, p. 44). Eight of these Branch Campuses and the Hamad Bin Khalifa University are located in Education City, (Ahmed, 2018, p. 44) a Quarter of Doha, together with several other institutions intended to foster research and economic development (Ahmed, 2018, pp. 44–45). For citizens, tertiary education at the undergraduate level is free at the Qatar University (Berrebi et al., 2009, p. 425; Qatar University, 2022).

Qatar is strongly affected by the 'MENA paradox', a phenomenon observed in the Middle East and North Africa where considerable achievements in female education are not accompanied by an increasing female labour market participation rate (Assaad et al., 2020, p. 818). Additionally, women are by far a majority of Qatari students, making up around 70% of the students enrolled in 2019. (World Bank, UNESCO Institute for Statistics, 2020b).

Although a gender imbalance in favour of women has persisted since the development of Qatar's tertiary education in the 1970's and has increased considerably during the 2010's, it has rarely been a topic discussed in dept in empirical or theoretical papers. It is worth noticing Qatar is no outlier among the gulf states, and causes of comparatively low educational achievements by men compared to women received some attention in the VAE (Abdulla & Ridge, 2011, p. 2). But in a sizeable number of papers, the issue was merely framed as one of low education among young people entering the workforce (Gonzalez et al., 2008, p. 30; Hvidt, 2015, p. 37); the question why women, who are far less likely to enter the labour market, still obtain degrees has received considerably less attention. While a sizeable number of papers is concerned with the challenges of reducing dependence on foreign labour in the gulf states and to bring their male youth into work, frequently addressing their comparably low educational attainments (Gonzalez et al., 2008, p. 30; Hvidt, 2015, p. 37), the question of female employment is often overlooked. This has considerable policy implications as female employment is still low in these

states, despite the opportunity poised by their university education to mitigate skill shortages.

This paper aims to address possible effects and causes of the significant gender education gap and the comparatively low female employment rates in Qatar in depth, discussing and aiming to explain them following a framework which builds on both the neoclassical theory of education and the rentier state theory. It aims to answer the questions why female and male participation in the tertiary education sector differ so strongly, how this relates to the labour market conditions and which implications it carries for Qatar's efforts to develop into a knowledge economy.

First, following Becker on the neoclassical education theory and Luciani and Beblawi on the rentier state theory, core aspects of both theories will be summarised. Their theories will be the primary frames of reference, though alternative explanations will also be discussed. Additionally, a literature review of empirical work undertaken so far in this area will be conducted.

In the following step, the thesis will turn its attention to the comparably high propensity of women to attend university compared to men. The data on Qatari students and the Qatari labour market will be discussed and analysed. The thesis will show that the time series of the student numbers are different for both genders, and different models are adequate to describe them. The number of male students is more accurately predicted using an ARIMA (0,1,1) model with drift, while the number of female students can be modelled best by an ARIMA (1,1,0) model with drift.

Using a logit model, it will be shown subsequently that despite the overall low labour market participation rate and the relatively high unemployment rate compared to men, obtaining a tertiary degree is a rational strategy for women who wish to increase their labour market participation and employment prospects, and that the same does not hold for men.

Much research has been conducted on the Qatari economy and the education system from a rentier state theory perspective, and recently, an increasing number of people have addressed the gendered economics of Qatar and other gulf states, but the ways in which they intersect have rarely been addressed. This thesis aims to discuss in which ways rentier state structures and related local economic dynamics

shape the labour market situation and the decision-making with regards to tertiary education by Qataris and especially Qatari women.

2. Theory and current state of research

The aim of this chapter is to outline the current state of the literature on economic structures as they are commonly found in gulf states like Qatar, starting with some general and gender-specific economic theory and summarizing on empirical research undertaken in Qatar and other states of the Arabian Peninsula recently.

The chapter is divided into three subsections. The first section addresses the relationship between education and the economy as outlined in the neoclassical theory on human capital. The second section reviews the rentier state theory, which is still the dominant framework in economic analysis on the gulf states. It summarizes the key dynamics that are outlined in the theory and subsequently reviews some recent empirical research undertaken within a rentier state framework. The third part discusses a possible alternative motivation for people to attend higher education.

2.1.1. The neoclassic theory of education

The contribution of education to economic growth has long been considered an important factor in the role and significance attributed to education systems, including higher education (Lee, 2021, pp. 113–114). Gary Becker was the first person to outline a formal, general theory of the role of education as investment in human capital in economics (Becker, 1994, p. 29). Becker argued that persistent growth in income per capita, observed for at least 100 years in several countries, is caused by education and training (Becker, 1994, p. 24). He aimed to explain aspects like the negative relationship between education level and unemployment risk (Becker, 1994, p. 30). He empathized the close relationship of theory and empirical findings in research on human capital (Becker, 1994, p. 10) and argued that the rate of return on higher education has remained constant in the US from 1940 to 1970, despite the increasing number of people obtaining higher degrees, and attributes this to an increasing demand of more highly educated people in the labour market, in areas like Research and Development (Becker, 1994, p. 8). Around the same time, Machlup published an analysis in which he estimated knowledge-intensive sectors in the US to account for 28.7 % of the GNP, and found they had been growing faster than other parts of the economy (Machlup, 1962, p. 374). Machlup also introduced the term 'information economy' (Stehr & Mast, 2012, p. 22) to describe the increasing

importance of information in economics. In recent times, university education has been increasingly considered one of the key aspects of economic success, especially by the researchers who proposed the development of knowledge economies, economies, which are a following, more highly developed stage of the information society (Hvidt, 2015, p. 65). The idea itself can be traced back to a paper written by Peter Drucker in 1966, but it gained prominence only in recent decades (Hvidt, 2015, p. 27). While Hvidt noticed the differences in definitions of what exactly characterises such a knowledge economy, definitions like the one of The Work Foundation, which highlight the use of knowledge for economic success and as competitive advantage (Hvidt, 2015, p. 28) are common. Although their focus on competition shows its neoliberal background, it requires mass higher education (Hvidt, 2015, p. 29).

The development of such an economy is attractive for Qatar and many other countries in the region for a number of reasons: Currently, they have a strong economic dependence on natural resource prices and while they can increase production, production increases are often slower than increases in domestic consumption. Additionally, these economies face a challenge on the labour market as such resource uses usually create few jobs who often are taken by foreigners, while the youth population in many Middle Eastern countries is increasing and therefore youth employment is an important policy issue (Hendrix, 2019, p. 191). Additionally, with climate change being a pressing global issue and natural resources becoming depleted sooner or later, it has been clear for many decades that reliance on oil and gas incomes is unsustainable for these countries in the long run. Nearly all countries which highly rely on oil and gas in their economy and exports are therefore committed to diversifying their economy, and Qatar is no exception (Hendrix, 2019, p. 188). Attempts on economic diversification and the building of a knowledge economy have been a focus in many research projects on the gulf states and other countries currently depending on natural resources.

The idea that successful economies of the future will be knowledge based economies has been widespread for decades, as have suggestions that Arabic countries should try to expand their knowledge capital and built such economies for themselves (Gonzalez et al., 2008, p. 2). However, while the expectation exists that skills are necessary to build a successful economy (Gonzalez et al., 2008, pp. 2–3) certainly is based on reasonable assumptions, skills alone are not necessarily sufficient to build better economies, and exceptions to these assumptions are known. In several Arabic

states, increases in education were accompanied by higher unemployment rates and the workforce remained relatively unproductive, reducing positive economic effects from educational improvements (Gonzalez et al., 2008, pp. 3–4).

While education is positively correlated to a higher diversification in such resource-rich economies, as it is in line with the endogenous growth theory (Hendrix, 2019, p. 200) , it can also be linked to greater export concentration (Hendrix, 2019, p. 189), with fuel export dependence increasing the higher the education level of the population becomes (Hendrix, 2019, p. 200). A possible factor in this is the issue that countries who diversify tend to expand their services or construction sector, instead of manufacturing, and therefore, exports tend to remain concentrated on natural resources (Hendrix, 2019, p. 201) since services are mostly not tradeable (Hendrix, 2019, p. 202). While education appears to be a channel to further successful domestic diversification (Hendrix, 2019, p. 203), exports therefore appear to gain little from it. This has been the case in Qatar during the recent years: Even though Qatar saw a decrease of 12.5% in the share of its GDP that were oil and gas rents in a ten-year timespan from the 2000's to the 2010's, the corresponding decrease in exports was minimal, with fuel remaining the most important export good, making up still more than 88% of Qatar's export, at the end of the same interval (Hendrix, 2019, p. 193). However, the quality of education, if measured in years of schooling, has a significant positive influence on the diversification progress as was shown in a study of 40 oil and gas-exporting countries (Hendrix, 2019, p. 199).

Because of their good financial situation, the gulf states are able to import and to create many factors which are crucial for the development of a knowledge economy, like technology (Hvidt, 2015, p. 24) and a well-funded infrastructure system. However, they aim to expand the role of the private sector, since the states will be unable to continue funding their current economic structure in the long term (Hvidt, 2015, pp. 25–26). Hvidt argued that developing a knowledge economy may be preferable for them, compared to the attempt to create jobs in the industry, because many gulf states, including Qatar, are very small (Hvidt, 2015, p. 26). He also discussed that developing knowledge economies offers many possible advantages for gulf state countries. Among the possible benefits, he listened an increase in knowledge among the local population and more entrepreneurship (Hvidt, 2015, p. 25). He noticed that Qatar's attempts to develop into a knowledge economy are closely tied to efforts to diversify the Qatari economy and to increase the economic

importance of the private sector (Hvidt, 2015, p. 26). Despite the position of four gulf states, including Qatar, in the top 50 of the 182 countries analysed in the World Bank Knowledge Economy Index, Hvidt considered them to perform relatively weak in the index in the sense that countries with comparable economic strength do significantly better (Hvidt, 2015, p. 32). Issues of education that were addressed in a paper about the Arabic world were a neglect of research at universities, especially in the field of social science, a lack of academic freedom, comparatively low funding and a mismatch between qualifications taught in education and those demanded on the labour market (Hvidt, 2015, p. 33). As a major challenge for these states to become knowledge economies, Hvidt identified the necessity for certain cultural changes, the importance of citizens adopting a certain mindset, in which individuals not merely obtained a certain level of education, but also use their potential to participate in economic processes (Hvidt, 2015, p. 26). Hvidt argued that the framework used by the World Bank to estimate if a country is developing a knowledge-based economy is insufficient to analyse the case of the gulf states because, in his view, monetary incentives might be less efficient there since the states have such high incomes based on oil (Hvidt, 2015, p. 30). Hvidt believes that therefore, other motives such as culture play a more important role (Hvidt, 2015, p. 30). By World Bank measures, incentives for innovation in Qatar are below average, as is the quality of Qatar's education system, but it has increased in recent years and economic incentives and communication technology are well developed (Hvidt, 2015, p. 31).

Hvidt also believed that well-educated expats significantly contribute to the gulf economies, and that their national economies would be at risk if they decided to leave (Hvidt, 2015, p. 44). This is a questionable assumption. As Hvidt himself showed earlier in the paper, the Gulf states lag significantly behind in innovation when taking their economic strength into account (Hvidt, 2015, pp. 31–32), which suggests that they also attract only relatively few well-educated expats. Furthermore, he reflected that wages in the private sector, in contrast to the to the public sector, are usually low. While he argued that this would discourage nationals from seeking employment there (Hvidt, 2013, 26-28), it additionally gives highly educated migrants who have better alternatives little incentive to come to Qatar. Additionally, research on the topic found that in general, private economic activities in Qatar and other gulf states are frequently associated by the inhabitants with a low social status of workers and bad working conditions (Gonzalez et al., 2008, p. 49), which are other aspects

giving well-educated people both from Qatar itself and from foreign countries little motivation to take jobs in the private sector. Diop et al. noticed that while in their sample of over 1000 migrant workers, 42% have completed secondary education, only a minority of 17% has obtained some form of post-secondary schooling (Diop et al., 2020, p. 143). Despite this, around 30% of them are employed as technicians, construction supervisors, machine repairers, assemblers, or operators (Diop et al., 2020, p. 143), which usually would require some specialised instruction.

Becker also already addressed the issue that returns on education depend on gender, social status and race, and that this can partly explain differences in the propensity of distinct social groups to obtain a college degree (Becker, 1994, p. 9). He furthermore assumed that women in the US, as long as their labour market participation was low, choose education based on perspectives in the marriage market and utility for the household (Becker, 1994, pp. 18–19), and argued that in the US and many other countries, irrespective of their culture, women started to prefer studying better-paying subjects when their labour market participation increased (Becker, 1994, p. 19).

Seguino and Braunstein conducted an empirical analysis which only partly supported Becker's theory. They addressed frequent obstacles women encounter when they are better educated and aim to receive better employment conditions: Although the employment rates of women compared to men have increased in many developing countries, the gap remains wider than the education gap (Seguino & Braunstein, 2019, p. 981). Firms may discriminate against women, partly because the employers themselves may believe in stereotypes, but also because they might gain economic benefits from occupational segregation (Seguino & Braunstein, 2019, pp. 976–977), for example through lowering their employees' bargaining power (Seguino & Braunstein, 2019, p. 999). The mechanisms of gender stratification their research is based on normalizing that women work for little or no income, and employers prefer men for better paid positions that require on-the-job training (Seguino & Braunstein, 2019, p. 979), creating conditions in which women, even if they have better education, cannot expect a higher income because of this. Such norms exist to different extents but have been observed in nearly all countries (Seguino & Braunstein, 2019, p. 978).

Additionally, the increase in the ratio of female to male employment rates among the countries they observed can partly be attributed to a declining male employment, implying it might, in some cases, be caused by general economic distress (Seguino & Braunstein, 2019, p. 984).The authors show that gender segregation is associated with a lower labour share of income (Seguino & Braunstein, 2019, p. 978), and therefore, through dampening aggregate demand, further lowers the number of good jobs (Seguino & Braunstein, 2019, p. 976). This lack of high-quality jobs in the developing countries, consequently, creates a barrier not only to gender equality, but also, through a lower labour share of income, lowers aggregate demand and therefore economic growth (Seguino & Braunstein, 2019, p. 1002). The authors suggest supporting women's access to better employment and increasing domestic demand through fiscal spending may help improve economic conditions in general (Seguino & Braunstein, 2019, p. 1003).

Unless the chances for women to obtain better jobs improve, it would, according to Becker, therefore not be rational for people in the countries analysed to invest much into female education. The reason why he did not observe a similar phenomenon in the US is likely the aspect that unlike some other countries, the US at the time of his analysis did not have a shortage of high-quality jobs (Becker, 1994, p. 8). It is worth noticing that Becker's framework implies people would invest more in educating women than men if they expected a higher return on it. To the best of the author's knowledge, no attempt has yet been made to identify possible causes of such a higher return for the gulf states, where this case of higher investments in female education compared to men can be observed. This thesis will aim to discuss possible causes based on available data.

2.1.2. The rentier state theory

Becker argued that his theory, in line with the typical economist approach of treating investments in education as decisions based on rational calculations, should be applicable in various cultures and countries, with increasing costs discouraging people from attending college and increasing benefits encouraging people to obtain a college degree (Becker, 1994, p. 17). He already pointed out and the importance of a well-educated labour force for national economic development. Additionally, he highlighted the mostly negative relationship of education and unemployment risk and the positive relation between income and education, which hold nearly universally

(Becker, 1994, p. 12). But his book only covered research based on US data (Becker, 1994, p. 13) and it has been doubted by many authors that Becker's theory can also be applied to Qatar and other gulf states.

The primary counterargument against the use of Becker's theory in the analysis of such economies is that because of the specific local structures, assumptions behind the neoclassical framework do not necessarily hold for these states and the countries therefore should be more accurately viewed under a separate paradigm that takes spatial features into account. Especially, the main argument of Becker that people earn money primarily from work and may earn more money by receiving better education may not hold in all systems, as individual activity and individual earnings may be disconnected (Beblawi & Luciani, 1987, p. 52).

The dominant paradigm in the analysis of the gulf states for three decades has been the rentier state theory, and until today, it remains the primary framework in the analysis of the gulf state economies, which has been noticed critically by Luciani himself (Yamada & Hertog, 2020, p. 1). While it certainly should not be understood as the only influence on their economics, its potential value lies in the ability to explain significant aspects of the economy with a parsimonious hypothesis (Yamada & Hertog, 2020, pp. 1–2). To account for this important distinction, this paper therefore will not try to verify or falsify the theory as such but analyse which aspects may potentially be explained by this theory and which not.

Despite the clarity of the main factors, several slightly different, though closely related concepts of a rentier economy exist. Adam Smith already introduced rent as a term separate from profit and wages. He characterized rent as the effect of a price, a causality that he argued pointed in the opposite direction compared to the usual relationship between wage and prices or profit and prices. Ricardo likewise defined rent as the effect of a high value of a product, which did not itself cause this high price (Beblawi & Luciani, 1987, p. 49). He also already noticed land and mines as source of rentier incomes (Beblawi & Luciani, 1987, p. 49). Following Marshall, rent is a "gift of nature", it can be said to be the gain from any natural endowments like, for example, locational advantages (Beblawi & Luciani, 1987, p. 49). A commonly accepted characteristic of rentierism is that unlike earned profit or wage, rent is obtained without effort (Beblawi & Luciani, 1987, p. 50). Rentier classes exist in nearly all economies, but some states are much more structurally shaped by the role

of rentier incomes than others (Beblawi & Luciani, 1987, pp. 51–52). A rentier state is a nation where the government receives some form of external rent and the state is primarily occupying itself with the distribution of this external wealth, not with productive activities (Beblawi & Luciani, 1987, pp. 51–52).

The reasons for such a phenomenon may vary. Fossil fuels and development aid have been listed as possible sources of rentier incomes (Beblawi & Luciani, 1987, p. 10). One of the core hypotheses of the rentier state theory is that therefore, the relationship between work and reward is discontinued in rentier states (Beblawi & Luciani, 1987, p. 52). This implies that workers do not necessarily get paid more for obtaining a higher education or working more hours, and therefore a rentier system would remove any incentive for the workers to engage in such effort.

The classification enters issues concerning foreign labourers and their remittances: Remittances are explicitly noted to be a source of income that may create rentier economies by Beblawi and Lucario, with states like Jordan mentioned to be influenced (Beblawi & Luciani, 1987, p. 124). Furthermore, in case they are paid from external sources of income, like oil, as it is commonly the case in the gulf states, both the host and the beneficiary countries are rentier economies. However, this does not make them comparable. The rentier mentality in the gulf states is usually attributed to citizens, not migrants. This shows one of the issues in this definition: "Rent" is broadly characterized as difference between the earnings of a person and the net value their activities generate (Beblawi & Luciani, 1987, p. 14).

However, this leads to the question what a proper baseline characteristic to determine this "net value" would be. By common economic theory, the people have an incentive to move to places and accept jobs that are paid best, and as a firm can pay the more the more productive it is. By this logic, that migrants can earn more in certain countries is no rentier characteristic, but might just, on the contrary, show their labour is used more effectively there. The issue may be that the original definition is too broad: By this definition, nearly all countries have, at least in some respects, rentier characteristics. Not only would the migrant pay gap, which can be considerable in economies that are not primarily seen as rentier economies, like many European states (Amo-Agyei, 2020, p. 99), be a rent on citizenship, but also, practically every other profit would be a rent on certain conditions that must be met for the person to obtain the profit but are not determined by the effort of the person

alone. Beblawi already addressed this issue that distinguishing rent and profit by looking at the origin of the value is nearly impossible, because nearly all forms of income combine rentier and non-rentier characteristics (Beblawi & Luciani, 1987, p. 50). For most states, the cause-effect relation is therefore less clear, but few people doubt that the Arab oil states fall in the category of rentier economies, since it is the case there that only a small number of people are involved in wealth creation while most people engage in distribution and utilisation of the rentier income, (Beblawi & Luciani, 1987, pp. 51–52).

The difficulty in distinguishing between rentier and non-rentier economies may also explain why the rentier mentality is such a popular concept because it is one of the more observable parts than can be attempted to be verified or disproved. As it is doubtful whether a clear and logical distinction between profit and rent as value that does not come from labour is even possible, the people who own such capital can instead be analysed with respect to the question how they use it. The rentier, Beblawi argued, is less an economic than a social category. He is perceived as an individual with unproductive behaviour. In a sense, this distinction can be traced back at least to Schumpeter and some other economists: His model, with the focus on the "creative destruction process", contains an entrepreneurial figure that is investing in productive uses and risk-taking, and this figure therefore is no rentier (Beblawi & Luciani, 1987, p. 50). Hertog, based on the work of Beblawi and Luciani, listened two key points which may be used to describe a rentier mentality: A lack of relationship between work and reward which might create high material expectations, but simultaneously undermine work ethic, and an indifference to politics since the government is not tax-based (Hertog, 2020, p. 1).

The extent to which such a mentality is indeed prevalent in present-day gulf states like Qatar has been subject to research. Quantitative research has only relatively recently addressed this question if a rentier mentality was indeed prevalent in economies that fulfil characteristics of rentier states (Hertog, 2020, p. 1). Some recent studies attempted to research if such a rentier mentality was indeed prevalent in the gulf states, which have been considered some of the most clear cases of rentier economies already at the time when Beblawi and Luciani discussed the concept (Beblawi & Luciani, 1987, p. 53).

But empirical evidence on the question if such a mentality is indeed prevalent in the gulf states showed mixed and sometimes conflicting results. Hertog argued in a paper analysing the World Value Survey (1999 to 2014) and the 2014 YouGov Survey (Hertog, 2020, p. 8) that there is a noticeable discrepancy between the abstract values people from Saudi Arabia exhibit, which are strongly in favour of competition and hard work and also include, contrary to the rentier mentality thesis, a high interest in politics, and their concrete life preferences when searching for a job, which are much closer to what the rentier state theory predicts (Hertog, 2020, p. 6).

Puranen and Widenfalk also analysed the World Value survey and pointed out that people in rentier economies put more emphasis on work and money and less on leisure than people of non-rentier states, though they noticed Saudi Arabia was an outlier with less emphasis on work in this survey (Puranen & Widenfalk, 2007, pp. 171–172). A closer analysis, however, still subverted expectations from the rentier theory in Saudi-Arabia's case: It were the non-Arabs of the country, likely primarily migrant workers, who scored low for both leisure and work when asked what was important to them. Arabs in Saudi Arabia, regardless of their nationality, placed more emphasis on work than people in Morocco, and received similar values for leisure (Puranen & Widenfalk, 2007, p. 175). They furthermore found the appreciation not of democratic ideals, but of democratic performance (which was a separate variable) and trust in big companies to be higher in rentier than non-rentier-economies, and while Egypt was a positive outlier for views on democracy, non-rentier-states still had less appreciation for democratic performance than rentier states (Puranen & Widenfalk, 2007, pp. 169–170). All in all, the authors argued that it might not be export of oil as such, but the general wealth in a country combined with certain state structures such as the networks used to distribute resources and the very influential leadership that lead to the phenomenon commonly observed and described as "rentier mentality", implying non-rentier states may theoretically develop such structures as well (Puranen & Widenfalk, 2007, p. 177)(Puranen & Widenfalk, 2007, p. 177). They agreed with Hertog in the aspect that they think a rentier mentality can be observed more strongly in a society which is richer and where wealth distribution is stronger developed (Hertog, 2020, p. 7; Puranen & Widenfalk, 2007, pp. 175–176), and therefore, if a rentier mentality exists, it is very likely to occur in Qatar.

Diwan et al. argue they found no evidence for a rentier mentality hypothesis among oil exporters in general but noticed low values for thrift and little support for female employment among Arab oil producing countries as problematic (Diwan et al., 2018, p. 57). Their data about Qatar, however, implied this may be less of an issue there, as support of female employment is higher, Qataris are on average more economically motivated and show more confidence in the state and a higher tolerance of income inequality compared to other Arabic countries (Diwan et al., 2018, p. 40). This is in line with Hertog's finding that while there is no clear pattern for oil states, Qataris tend to believe in success through work, to tolerate income differences and have a positive attitude towards competition (Hertog, 2020, pp. 10–12). However, Hertog doubted that such abstract ideals influence concrete life choices for the people in the gulf states (Hertog, 2020, p. 1).

The effect of a rentier state structure has been given by several authors as reason why the educational systems of the gulf states show specific shortcomings: Lee questioned to which extent the expansion of higher education systems in small gulf states like Qatar and the UAE can be attributed to labour market demands, as these countries import a significant part of their labour force and therefore might be able to rely on alternative ways of recruiting and building human capital (Lee, 2021, p. 114). On the other hand, it is uncertain to which extent the gulf states will continue to be an attractive place of immigration for highly educated migrants. Lee empathized that while the initiatives to expand university education also attract some international students, to develop the skills of Qatari citizens is an important political target (Lee, 2021, p. 117). However, he also pointed out that many nationals are not qualified to enrol at the international (primarily American) branch campus universities and little effort has been invested in changing that or rising the education quality of the state universities most locals are enrolled in (Lee, 2021, pp. 117–118).

Two of the key traits of recent developments of higher education institutions in this area have been noted to be internationalization and privatisation (Lee, 2021, p. 114). Lee argued the education system offered essentially two tracks, an internationalized, private, English-speaking one and a national, public track where Arabic is the primary language (Lee, 2021, p. 125). He also pointed out that despite the rentier nature of the state, education achievements matter and for several reasons, people who attended international universities have advantages on the labour market: They speak better English, which is a necessity as the economy, with its large dependence

on expatriates, is dominated by English as primary business language, and they also are more likely to have acquired prior experience of international environments (Lee, 2021, p. 126). If people acquire such traits may highly depend on their cultural and ideological background (Lee, 2021, p. 127).

Empirical research by Behar outlined the ways in which gulf state citizens respond very differently to economic situations than the migrants living in these states. He was able to show, with a seemingly uncorrelated error correction model, that changes in nonoil GDP have a significantly stronger positive employment effect on migrants compared to gulf state citizens (Behar, 2017, pp. 704–706). The results that the elasticity of migrants is stronger both in the short and in the long run are robust to weighting the regressions with nonoil GDP or excluding Qatar (Behar, 2017, p. 704) suggesting Qatar is not a significant outlier in these aspects among the gulf states. In his interpretation, he argued that this may signal higher adjustment costs caused by skills mismatches or high private-sector reservation wages as many citizens prefer to work for the state (Behar, 2017, pp. 706–707). In his study, Behar furthermore argued that changes in the employment of citizens in the private sector are unlikely to have large effects on the GDP and that firm's employment would be demand-driven, as he assumes no supply constraint on foreign labour (Behar, 2017, p. 704).

Another recent paper concerning the situation of migrants in Qatar came to a more nuanced conclusion. It pointed out that while there is a demand for jobs in Qatar in many common countries of origin of migrant workers, these migrants, despite Qatari Law and international standards prohibiting it, frequently face recruitment costs (Diop et al., 2020, p. 145) and that, given their often low expected wage, these costs can be very high, but tend to become less frequent and lower among nationalities that earn higher wages (Diop et al., 2020, pp. 145–146). Therefore, while supply of foreign labour appears not to face very tight constraints in general, it might be more constrained for very low-paid workers, as the lower their wage becomes, the larger is the probability that they face recruitment costs they are unable to afford.

Furthermore, the paper showed that Qatari firms are not generally confident in their ability to hire workers whenever convenient, nor in their ability to keep hired workers employed through contracts. A frequently voiced criticism of employment practices is that many firms withhold passports of their employees. 59% of blue-collar workers in a 2014 survey reported their employers did so against their will, and 16% still were in

this situation in 2018 even though this practice had been prohibited since 2015 (Diop et al., 2020, p. 147). Additionally, while the number of workers who felt their contracts were not being completely honoured fell, between 2017 and 2018, from 36% to 20%, it remained relatively high (Diop et al., 2020, p. 145) suggesting a significant number of workers in Qatar did not consider their firms to offer and honour sufficiently attractive contracts.

Diop et al. do not discuss possible reasons or theoretical implications of these findings. There are several possible factors which may explain this form of insecurity. One possible reason may be that the international labour market for blue-collar workers may be dysfunctional in general. A lack of basic information was observed in many areas, with 49% of all workers not owning – against Qatari law – a copy of their contract and a third of the workers stating that their employment details were not very clear in 2016 (Diop et al., 2020, p. 145), and in 2018, around 30% did not understand their contracts completely (Diop et al., 2020, p. 144). These and other information deficits offer one possible explanation for persisting structures like recruitment fees the workers face from intermediaries (Diop et al., 2020, pp. 145–146). Firms may also rely on such intermediaries to hire workers, and not trust worker's abilities to judge correctly if they are good employers or not, therefore lacking another motive to keep contracts. Another aspect is that, as the paper shows, a significant number of foreign workers, even among those which have lived in Qatar for more than five or ten years, is still housed in collective accommodations. 22% of the people in the sample which was analysed, which only contained people from such forms of housing, have been in the country for more than 10 years and half of the people questioned for at least five years (Diop et al., 2020, p. 143). Despite the growth of the construction sector, they do not own apartments or rent them for a longer period and do mostly not live with their family, even though over 70% of the people in the sample are married and around 60% have children below the age of 18 (Diop et al., 2020, p. 143). Migrants in Qatar rarely acquire Qatari citizenship and the state does not fund them or their children university education. Therefore, they have little incentive to stay in Qatar in case another, better job offer elsewhere is given to them. Diop and his colleagues notice their stay is intended to be temporary and they are not targets of an integration policy as in many European countries (Diop et al., 2020, p. 141), even though in practice, they often stay for a long time.

Like many other gulf states, Qatar is a state where most citizens work for the government and work in the private sector is primarily done by migrants (Hertog, 2020, p. 4). This phenomenon is so common that the tendency of citizens to prefer working for the state has sometimes been used as measure of a rentier mentality. Since many rentier states use state employment as a primary source for the redistribution of their rentier income (Hertog, 2020, p. 4), this may initially appear to be a good measure. However, it cannot be concluded that in reverse, a preference to work for the state among the population is specifically something primarily occurring in rentier states. As Diop et al. recently highlighted several issues with the Qatari labour market in the private sector such as a lack of law enforcement (Diop et al., 2020, pp. 145–147), it is questionable if specific reasonings like those typical for a rentier state mentality are required as explanation why people might avoid the sector.

Similarly, the 2014 YouGov specifically asked how interested private sector employees would be to accept a job at the government with similar payment and working hours to their current position, but higher job security (Hertog, 2020, p. 6). For a person who does not have a specific reason to dislike working for the government, this way of formulating the question makes preferring the government position the rational choice, regardless of the prevalence or absence of a rentier state system. This is reasonable for a risk-averse agent, unless they attribute specific advantages to the private sector that government positions cannot offer, which does not appear to be the case in this survey. Hertog likewise reported that in aspects like working hours, wages and pension age, the public sector generally offered better conditions (Hertog, 2020, p. 4). As Diwan et al. noted, the high preference for state employment is not limited to the gulf states within the Arabic world: While many people in Saudi Arabia and even more in Qatar indeed prefer work for the governmental sector, even if asked for their preferences in case the other conditions of the jobs were similar, it is worth noting that this does not make them outliers among Arabic countries. Saudi Arabia with slightly more than 25% preferring the private sector and Qatar with less than 15% are close to both ends of the span of preferences collected in the sample: Only people of three countries prefer the private sector more than inhabitants of Saudi Arabia, among 17 included in the survey. Four countries have a population with an even larger preference for the state as employer than Qatar, and in Yemen, which is one of the poorest countries in the world, not even 10% would prefer the private sector (Diwan et al., 2018, p. 51). The authors

also note critically that comparable data is not available for other parts of the world, and notice that on average, young people are more in favour of getting a job in a firm, while women have particularly high tendency to prefer working for the state (Diwan et al., 2018, pp. 51–52), implying that the effects of the rentier system, to the extent to which they cause such preferences, are not homogenous within societies.

This heterogeneity is very briefly addressed by Hertog who considered the additional responsibility that is often placed on women to take care of their family an aspect why so few of them were ready to work longer hours in the private sector (Hertog, 2020, p. 7), but the extent to which personal traits like gender may interact with the characteristics of a rentier state economy largely remains under-researched. Many analyses based on the rentier state framework only briefly consider that women often calculate labour market decisions differently from men because they face different expectations and constraints. It should be noticed, for example, that there are countries whose economic systems make it a rational decision especially for women to work for the state without being rentier economies. The idea that people might prefer private sector employment to working for the state usually rests on beliefs such as that the wages paid within the private sector are less equal and more based on merit. However, in a study of Macedonia, Angel-Urdinola found results implying that at least for women, the opposite was the case there: Women in this country could expect a significant increase in their wage with higher education primarily because higher educated women found better employment in the public sector, where the returns on education were especially high, while the private sector showed a large gender pay gap especially among lower education levels (Angel-Urdinola, 2008, pp. 7–8). She argued this may be caused by a monopsonist labour market especially affecting women, who, as they have often low mobility, are in some regions employed by a low number of textile firms who may pay them below their marginal product of labour and therefore worker's earnings may remain below the optimal level (Angel-Urdinola, 2008, p. 2), encouraging women to stay out of the labour market. This private sector, with its production of clothing, would not be classified as rentier-based by its mode of production, but with how little perspectives it offers to highly educated women, it still discourages incentive to invest in education for a job in the private sector and makes the public sector the more attractive option for highly educated women. Similar tendencies are prevalent in non-oil-states in the Arabic world, where the formal private sector offers insufficient working opportunities to compensate for

the decrease in public sector employment and work in the private economy therefore frequently implies informal, low-quality work (Assaad et al., 2020, p. 831).

The aim of this paper is not to verify or to falsify the theory of rentier states or the existence of a rentier mentality as such. Instead, it will attempt to analyse the explanatory power of the rentier state theory and its limits for the Qatari education system as well as the economy in light of the recent reform and diversification attempts undertaken by the Qatari government. In a standard rentier state economy, since factors like closeness to the ruling elite and citizenship replace work and ability as determinants of income (Puranen & Widenfalk, 2007, p. 161), people have no incentive to undergo tertiary education. Qatar clearly is a rentier state where most of the working citizens are employed by the state and distributing incomes generated from hydrocarbon resources is one of the state's main functions (Hertog, 2020, p. 4). Despite that, a significant number of Qataris, especially women, obtain academic degrees. The next section will briefly discuss a theory why people might undergo higher education, even if it does not help them improve their labour market perspectives.

2.1.3. The theory of education as consumption good

A perspective which might explain why people engage in university education which offers no monetary benefits was suggested by Pseiridis et al., whose paper noted that university education is frequently not only an investment, but simultaneously acts as a consumption good (Pseiridis et al., 2018, pp. 277–278). In their analysis on Greece, whose university graduates they argue to be overeducated (Pseiridis et al., 2018, p. 278), Pseiridis et al. researched the motives of students to attend university and concluded that expected financial benefits are not usually the main reason students give to attend courses. They were able to show that while the exact distributions of motives varied depending on the type of university and the subjects people received their degree in, financial benefits usually were given as secondary and, in some cases, played only a marginal role (Pseiridis et al., 2018, p. 273). Social benefits such as a higher status within society also rarely were the most important motive, with psychic benefits being given the highest weight among the three categories by the students that were surveyed, though status was also a factor for many students (Pseiridis et al., 2018, p. 273). In such a case, firms might highly profit from the readiness of their potential employees to invest in education without expecting a monetary return, but this also implies that the potential workers might be

more unwilling to choose specific forms of education that are more advantageous to the firm's productivity over alternatives they have a personal preference for.

There are some authors whose findings imply this may be a factor in Qatar and other gulf states. It was argued by several papers that a number of people continue to obtain academic degrees in these countries although this does not appear to improve their situation on the labour market (Berrebi et al., 2009, pp. 428–429), and utility they derive from the degrees directly instead from earnings obtained on the labour market is a possible explanation why they do so.

3. Data and Methodology

The aim of this paper is to discuss the current and possible future developments in the tertiary education sector in Qatar and the labour market. The ambitions of the Qatari government to transform the country into a knowledge economy led to significant developments in areas like tertiary education and the composition of the economy in Qatar throughout the recent years.

The first part of the analysis will forecast the development of the number of students in Qatar by gender. Additionally, the analysis will present and discuss some data on the nationalities and subjects of the people who study at Qatari universities. Second, the situation of the Qatari economy and the Qatari labour market will be discussed referring to data on the labour market participation and unemployment rates by education and gender as well as the composition of the Qatari GDP and specifically the industrial sector.

3.1. Data

3.1.1. Data of the tertiary sector in Qatar

The data used for the analysis and the forecast of the number of students in Qatar are originally from the UNESCO Institute of Statistics, taken for this paper from the World Bank database. The number of female and male students that will be analysed are, as defined by the World Bank: "The total number of male students enrolled at public and private tertiary education institutions" and "The total number of female students enrolled at public and private tertiary education institutions", respectively (World Bank, UNESCO Institute for Statistics, 2020a).

Additionally, data from the Qatari government is available for recent years and for public universities only, containing more details, including the nationality of the students (Qatari nationals or non-nationals) and the subject of their studies (Planning and Statistics Authority, 2019, pp. 27–28).

3.1.2. Data of the Qatari labour market and the economy

Variables that will be referred to in the discussion on the Qatari economy are the labour force participation rate by education and gender, the unemployment rate by education and gender, the GDP, the percentage of natural resource rent in the GDP and the economic value generated by the services, industry, and manufacturing sector.

The labour force participation rate is taken from the year 2013, as this is the only year in the data where values are available disaggregated by gender and education level. The labour force participation rate is defined by the UNESCO as: "proportion of the population ages 15 and older that is economically active: all people who supply labour for the production of goods and services during a specified period". Their levels of education are reported in the data based on the International Standard Classification of Education 2011 (ISCED 2011): People with basic education attended primary or lower secondary education, people with intermediate education obtained upper secondary or post-secondary non tertiary education and people with advanced education finished short-cycle tertiary education, obtained a bachelor's degree or equivalent education level or a higher degree (World Bank, UNESCO Institute for Statistics, 2020c). Similarly, the unemployment rate by education and gender is only available from 2013 in detail and taken from the same database, giving the percentage of the labour force, female or male, that is unemployed, by education level (World Bank, UNESCO Institute for Statistics, 2020c). The education levels are defined as above, based on the ISCED 2011 classification.

Data on the valued added by the economic sectors is also taken from the World Bank. The classification of the sectors services, manufacturing and industry are based on the ISIC revision 3 (World Bank, UNESCO Institute for Statistics, 2020c). Industry is defined as a sector containing mining and quarrying, manufacturing, water and waste management, electricity, gas, steam and air conditioning supply and construction (World Bank, UNESCO Institute for Statistics, 2020c). Services include all forms of trade, transport, government services and administration and financial,

professional, and personal services (World Bank, UNESCO Institute for Statistics, 2020c). Total natural resource rents combine rents from oil, gas, coal, minerals and forests (World Bank, UNESCO Institute for Statistics, 2020c).

All values in the data are given in constant local currency units in the database, with the exception of natural resources rent, which is given as percentage of GDP (World Bank, UNESCO Institute for Statistics, 2020c). Therefore, for the analysis, its value will be calculated in constant local currency units using the GDP data.

Finally, data on the employment by sector is also taken from World Bank, with sector definitions that are in line with the classifications of industry, services and agriculture of the ISIC revision 3 (World Bank, UNESCO Institute for Statistics, 2020c).

3.2. Methodology

This paper aims to analyse existing data on the Qatari economy and higher education system. For the analysis, this paper employs the open-source programming language R (R Core Team, 2021) and within it, the readxl package to import the data (Wickham & Bryan, 2019), the tidyverse package for data cleaning and graphic design (Wickham et al., 2019), the scales package to rescale the axis on the graph of the Qatari Economy by sector (Wickham & Seidel, 2020), the LM package for performing the Breusch-Godfrey-test and the likelihood ratio test (Achim Zeileis & Torsten Hothorn, 2002) and the fable package for the forecasting (O'Hara-Wild et al., 2021).

3.2.1 Methodology for the time series analysis

First, the tertiary education sector data on the number of students will be analysed. To obtain a more nuanced view of the student population than most previously published papers, the data is generally analysed separately for men and women. This serves two key purposes: First, it allows to identify the role of some gender specific effects in the developments that are observed. Second, in case such effects exist, a model that is well suited to analyse and forecast the time series of one gender may not be optimal for the data on the other gender, and a separate analysis allows to create the models independently of each other. A graphical analysis will first be performed to provide some insights into the general development of the variables and to allow the discussion of some noticeable trends. Since they follow

approximately exponential patterns, the logarithm of the student numbers will be taken for of the following analysis.

Missing values are an issue that needs to be addressed. The dataset only contains sporadic values from before 1980, so only datapoints from this year on are used. In the remaining dataset, there is a missing value for male students in 2006. As this is the only value missing for this specific year, it can be reconstructed as the number of students minus the number of female students in Qatar for this year. Other missing values are included in the dataset for the year 2000, for both time series. An ARIMA model will be used to estimate them. The estimates will them be used for further analysis steps which sometimes require complete datasets without any missing values.

The steps to achieve a good forecast follow the workflow outlined by Hyndman: After the data is prepared by bringing it into the correct format and estimating missing values, the data will be visualised in a graph. This should give a first impression about which models may fit and which models can be discarded immediately as unfitting.

Fitting a model is a critical step to produce forecasts of a good quality. When fitting a model, values are estimated as precisely as possible using a certain model. Afterwards, for different fitted models, it can be compared how accurate their estimations are (Hyndman & Athanasopoulos, 2021, 5.3).

The model with the best fit is a model where the residuals are uncorrelated and have zero mean. These conditions are required to hold for the forecast to be optimal. It can be tested empirically to which extent these properties hold. The mean of the residuals can be computed, as it will be done in the analysis. A one-sample t-test will be used afterwards to test that the result should not be significantly different from 0.

Likewise, Autocorrelations can be plotted, and it can also be tested if they are likely to come from a White Noise process or not. The Box-Pierce and Ljung-Box-tests are frequently used to test for autocorrelation. However, both of them have been shown to have low power, and are generally not appropriate to be used for testing autoregressive models, since they, like the Durbin-Watson-statistic, require the model not to contain any lagged dependent variables as explanatory variables, which is not the case when the model is autoregressive (Maddala, 1992, pp. 540–541).

Therefore, to analyse the autocorrelation of the residuals, this paper instead employs a Breusch-Godfrey-test. As this test requires homoscedasticity, which might not be given for all models, a modified version that is robust to heteroscedasticity, following Wooldridge, will be used in case heteroscedasticity is detected (Wooldridge, 2013, p. 422).

Homoscedasticity and normal distribution are also useful properties for the error term to have because they simplify the creation of confidence intervals (Hyndman & Athanasopoulos, 2021, 5.4). If the values of the error term are not normally distributed or heteroscedasticity is detected, then bootstrapping, which only assumes a constant variance and the residuals to be uncorrelated with it, may be used to create confidence intervals (Hyndman & Athanasopoulos, 2021, 5.5). Additionally, it will be verified that the error term is normally distributed using a Shapiro-Wilk-test (Royston, 1982).

This thesis will create and compare ARIMA and ETS models. The best models from the class of ARIMA and ETS models, respectively, will be determined using the algorithms of the fable package and the tests outlined above.

The algorithm to determine the best fitting ARIMA model is a version of the Hyndman-Khandakar algorithm (Hyndman & Athanasopoulos, 2021, 9.7), whose general procedure is as follows: First, it uses KPSS tests to determine the appropriate number of differences to take that are required to make the data stationarity (Hyndman & Athanasopoulos, 2021, 9.7). The KPSS test is different from most unit root tests in that it tests for a unit root with the null hypothesis of stationarity, while others such as the Dickey-Fuller test and its varieties have the presence of a unit root as null hypothesis (Kwiatkowski et al., 1992, pp. 159–160).

In the next step, the algorithm compares different values for the number of lags on the autoregressive and the moving average parts, the p and q, respectively. It does so by fitting a small number of models whose p and q values are 0, 1 or 2 and checking their AICc, the corrected Akaike Information criterion. The model with the smallest AICc is chosen to continue from there. Afterwards, the algorithm tests if the model can be improved by increasing or decreasing p or q by one or by removing or adding a constant by comparing the AICc values until it minimized them (Hyndman & Athanasopoulos, 2021, 9.7). This allows to find an ARIMA model that is at least

locally optimal, but not yet to assess the accuracy of the forecast they produce, nor does it allow for a comparison between the ARIMA and the ETS class models.

Likewise, the ETS function of the fable uses the minimization of the AICc to find the most appropriate model for the data (Hyndman & Athanasopoulos, 2021, 8.6).

The accuracy tests will also be done following a framework outlined by Hyndman: The data will be divided into a large training data subset and a smaller test dataset. A forecast for the values of the test dataset will be created using the models and the training data subset.

In the next step, models will be specified and trained using training data. This thesis will compare an ETS and an ARIMA model on the data for both genders. Two different training and test datasets will be used to account for the issue that depending on the datasets, results on model quality may be different.

First, a training dataset containing data from 35 years, from 1980 to 2014, with the respective test dataset using the last five of the 40 observations. This follows a suggestion that the test dataset should contain about the most recent 20% of the observations (Hyndman & Athanasopoulos, 2021, 5.8).

After the models produced forecasts using the training datasets, their forecast quality can be analysed comparing various indicators. The indicators that will be used in this thesis will be the mean absolute error, root mean squared error and mean absolute percentage error for the point forecast accuracy (Hyndman & Athanasopoulos, 2021, 5.8) and the Winkler Score and CRPS for distribution forecast accuracy (Hyndman & Athanasopoulos, 2021, 5.9).

In the final step, the model that has the best values will be used to create a forecast for the next years. It will be shown that for the present data, the ARIMA model generally outperforms an ETS model based on most standard measures of error minimisation. A forecast based on ARIMA models will be created for female and male students.

3.2.2 Methodology for the analysis of the labour market and the Qatari economy

The current literature of the gulf states includes a broad range of theories that carry a great number of implications for the expected developments and structures within gulf states like Qatar. After performing the time series analysis, the thesis will present

further available data and discuss how the empirical findings can be related to the theory. Data on nationality and the subjects in which people obtain degrees in the Qatari public education system will be presented and discussed with regards to the differences in academic education between migrants and nationals as well as men and women and their possible causes and consequences. A second aspect of the discussion will be the situation at the labour market. Possible implications and causes of patterns in the Labour market participation rates and unemployment rates will be addressed.

Unfortunately, no direct data on the number of people by gender and the educational attainment in the labour force is available. However, data from the World Bank allows to calculate these numbers for the year of 2013. Available are the numbers of people of different age cohorts as well as the number of people in the labour market, and the percentages of each gender in these cohorts. This allows to calculate the number of Qatari women and men of working age and, using the labour market participation rate, the number of those people who are in the labour force. In the year for which the most precise data is available, 549,807 women lived in Qatar. Of those, according to the data, 148,189 were children up to the age of 14, so 401,618 were 15 or older, which is classified as working age by the World Bank. The labour market participation rate averaged across all women was 48,6% according to the national estimate, but 55,81% according to the modelled ILO estimate. This thesis uses the ILO estimate for further calculations since the number given there implies 224,143 women were in the labour market force, which is consistent with the number of women in the Qatari labour force as calculated from the total labour force of 1,758,736 people and the percentage of women in it, which is given as 12,74455%. The national estimate would imply 195,186 women to be in the labour force, a considerably lower number.

Finally, 1,6% of the women in the labour force were unemployed in 2013, according to the ILO estimate again, though the national estimate differs little in this respect. By the ILO estimate, 3,586 women were unemployed in Qatar in 2013.

These figures, combined with the labour market participation rate and unemployment rate by educational attainment allow to reconstruct the numbers of women by educational status. A linear equation system is set up where the first equation is based on the aspect that the number of all Qatari women above 15 must be 401,618.

The second line is calculated based on the labour market participation. The number of all women in the labour market must be 224,143. The third line is calculated relying on the aspect that the numbers of unemployed women in the labour force (hence why the unemployment rate is multiplied with the labour force participation rate since unemployment is given as rate among women who are in the labour market) must add to be 3,586. Solving the equation system, around 157,894 Qatari women above the age of 15 have high education, around 94,538 are at an intermediate educational level and 149,186 completed basic education. Using the data on labour market participation and unemployment, two full datasets can be created. The first one includes observations of the educational status and labour market participation of all Qatari women. The second model is including information only on women who are active in the labour market and contains the educational status and the employment status. In both datasets, women of intermediate education are compared to those who completed higher education to assess the effect receiving an academic degree has on labour market participation and unemployment.

A logistic regression will be performed with them, following the framework outlined by Wooldridge (Wooldridge, 2013, pp. 584–585).

The regression formula for employment with a logistic link function that will be used is:

(1)
$$P(Y = 1 \mid X) = \frac{\exp\left(\beta_0 + \beta_1 * X\right)}{1 + \exp\left(\beta_0 + \beta_1 * X\right)}$$

In function 1, Y denotes the Employment status, with Y = 1 indicating employment and Y = 0 indicating unemployment. X is also a binary variable, with X = 1 implying a tertiary degree was obtained and X = 0 denoting it was not.

The regression formula for labour market participation, depicted in equation 2, likewise includes Z, with Z = 1 denoting labour market participation and Z = 0 denoting no labour market participation. The explanatory variable X again indicates ownership of an academic degree.

(2)
$$P(Z = 1 \mid X) = \frac{\exp(\beta_0 + \beta_1 * X)}{1 + \exp(\beta_0 + \beta_1 * X)}$$

The significance of the models compared to a baseline model which only contains a constant will be tested using a likelihood ratio test (Wooldridge, 2013, p. 589).

Unlike many other research projects, which rely on samples, the data obtained covers all women who lived in Qatar in 2013, so the results should have a high external validity. Due to limitations in the dataset, it is not possible to account for third variables that may impact the relationship between education, gender, and the employment rate. On the other hand, since the data covers all women who lived the state of Qatar in 2013, possible sample bias is not an issue. And since the vast majority of Qatari people who are employed work for the state (Hertog, 2020, p. 4), it is a valid assumption that the decision to employ them is made based on their degree (Hvidt, 2015, p. 39), even though other, unobservable characteristics may play a role as well. However, omitted variable bias is unlikely to pose a significant problem because traits like intelligence, while certainly being of advantage during the studies, are unlikely to be relevant in the hiring process of the public sector except through their influence on the process of receiving a degree. Personal connections are more likely to influence the hiring process is much more difficult to evaluate, but since public education is freely available to all Qatari citizens, personal relationships should not affect the ability of a Qatari to study. While this model can therefore not account for all real influences on their employment chances, for Qatari women who are faced with the decision to obtain a degree or not, it gives a reasonably good approximation of the effect they can expect on average from attending university and therefore still gives valuable insights into possible decision processes.

Finally, the analysis will turn to the demand side of the Qatari labour market and give an overview of the current economic structure and the ways in which it might impact young people's decision to attend higher education or not. For the analysis of the Qatari economy, data on the size and growth of the industry, manufacturing, services, and natural resources rents will be presented and put into relation to the size and growth of the Qatari GDP. Additionally, the development of the employment by sector during the recent decades will be discussed. Furthermore, the implications

the empirical findings have for the current research will be addressed and some possible theoretical explanations for those findings will be provided.
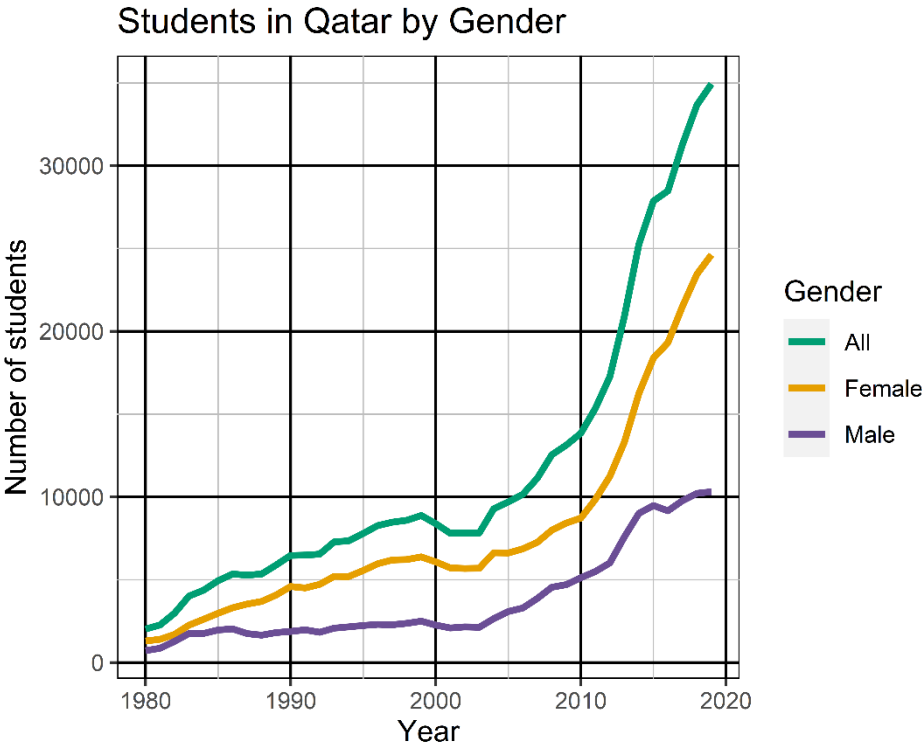
4. Analysis

4.1. Qatari Students

Figure 1: Students in Qatar by Gender

The number of Qatari students has increased rapidly over the last forty years. Figure one shows the development of the number of people currently studying in Qatar for all genders and separated into female and male students. It can be seen that since 1980, women were the majority among the students in all years, but the gender divide widened in recent years. Not only did women more often attend university or college at the beginning of the timeline, but their number also tended to increase until the late 90's, while at the same time the number of male students was mostly stagnating. In the 2000's and early 2010's, the number of students increased overall, the reasons behind change appeared to encourage both genders to pursue tertiary education at first. However, over time, this effect appeared to accelerate for women while it faded out for men. Since 2015, the number of male students was nearly constant again while the number of female students continued to increase rapidly,

widening the gap until in 2019, nearly 25.000 women attended classes while only around 10.000 men did so.

An increase in the overall number of students is unsurprising, considering that comparable developments in the extension of tertiary education have been observed in many other countries and that Qatar has invested heavily in its university system. Reasons for the increase since the 2000's might have been the expansion of the Qatari education system as it is evident in projects like Education City, an increase in population, a shift in the labour market towards increasing demand for highly skilled workers or improvements in secondary education, which might have made tertiary education feasible for a larger group of people.

However, the data shows clearly that it are women who make up the vast majority of the increasing number of students since the 2000's. This is surprising, especially considering that women already were a majority among the students in the decades before, meaning that if there was a 'catching-up'-process taking place, it would have to be observed among the male gender. Possible reasons for this observation will be discussed during the Interpretation.

Since the numbers of students in the data appear to be following an exponential growth process, the analysis in the next part will take the logarithm of the number of students and evaluate it. First, ARIMA and ETS models for the male and female number of students, respectively, will be selected according to their fit and accuracy. Furthermore, they will be used to forecast the expected future development of the number of people attending tertiary education in Qatar. Afterwards, some facts on the Qatari labour market and economy will be presented, to be taken into account in the following discussion, which aims to give some insight into why tertiary education is attended so much more frequently by women in Qatar.

4.1.1. Model evaluation

The first model to be evaluated is the ARIMA model for the female students. The algorithm suggested the following ARIMA (1,1,0) model with drift, where y is the natural logarithm of the number of female students:

(3) $$\Delta y_t = 0.0357 + 0.5218\Delta y_{t-1} + \varepsilon_t$$

The mean of its residuals is not significantly different from zero, which is confirmed by a one-sample t-test (see Table 1). A Breusch-Pagan-test for heteroscedasticity does

not reject the assumption that they are homoscedastic. The residuals also show no significant autocorrelation (compare Figure 9 in Appendix 1), which is confirmed by a Breusch-Godfrey-test. A Shapiro-Wilk-Test is employed to test if the residuals are normally distributed. For the data on female students modelled by this ARIMA model, the p-value of the Shapiro-Wilk-Test is 0.2, meaning the assumption that the data is normally distributed is not rejected. Their distribution can also be visually confirmed by a Q-Q Plot (Appendix 1, Figure 10). All p-values of the statistical tests are collected in Table 1.

An ETS model decomposes data into a trend, a seasonal cycle, and a remainder. The data on students is yearly and contains no seasonality. An ETS (A, A, N) model, a model with additive trend and error components, is fitted on the data and tested as alternative against the ARIMA (1,1,0) model to evaluate which of the models gives the better forecast. The ETS model is subjected to the same testing as the ARIMA model, confirming that the conditions of a zero average mean, homoscedasticity, no significant autocorrelation, and a normal distribution also hold for its residuals. Its residuals are plotted in Figure 11 and 12 of Appendix 1.

For the analysis of the number of male students, the same procedure is repeated. For this data, the algorithm fits the following ARIMA (0,1,1) model with drift:

$$(4) \qquad \qquad \Delta y_t = 0.068 0.5042\varepsilon_{t-1} + \varepsilon_t$$

The chosen ETS model for the same data is an ETS (M, A, N) model, whose error term is multiplicative and whose trend is additive. Like the two models before, both the ARIMA and the ETS model for the data on male students are shown through statistical testing to have residuals with a mean not significantly different from zero, homoscedasticity, no significant serial correlation, and an approximately normal distribution. Plots of the residuals that allow to assess their distribution are found in the Appendix in Figure 13 and Figure 14 for the ARIMA (0, 1, 1) model and in Figure 15 and Figure 16 for the ETS (M, A, N) model.

	Female Students		Male Students	
	ARIMA	ETS	ARIMA	ETS
One-sample t-test	0.448	0.6954	0.9888	0.3486
Breusch-Pagan-test	0.9623474	0.6124276	0.9978268	0.9996943
Breusch-Godfrey-test	0.1963	0.8083	0.7665	0.867
Shapiro-Wilk test	0.2	0.2882	0.4506	0.6753

In Table 1, the p-values of the hypothesis tests that were conducted are collected for the two models that were applied to the data of each gender. The first test is a simple t-test for one sample, confirming that the mean of the residuals for all fits is not significantly different from zero. (If this was not the case, the mean of the models would have to be adjusted upward or downward).

The Breusch-Pagan-test tests for heteroskedasticity and reveals there is no significant heteroskedasticity in any of the models. This is important for both the subsequent test and the forecast itself. The subsequent test, the Breusch-Godfrey-test for serial correlation, is not heteroskedasticity-robust, so it would be required to adjust it correctly if it was applied to heteroskedastic data, as outlined by Wooldridge (Wooldridge, 2013, p. 422). Furthermore, if the data was heteroskedastic, bootstrapping would be used to calculate the confidence interval of the forecast.

The Breusch-Godfrey-test for serial correlation is used to ensure that there is no significant autocorrelation left in the residuals. With this, it is shown that the data does not contain significant autocorrelation up to order 10.

The last test of the table is a Shapiro-Wilk normality test. If its p-value is insignificant, then the test confirms the residuals are approximately normally distributed. This is the case in all models analysed here.

In the next step, the accuracy of the models is evaluated. They are trained on the larger part of the dataset and, using the most recent values as test data, it is

evaluated how accurately the models predict them. There is a great number of measures available to measure the deviation of the model mean prediction from the real values of the test data, including the mean error, the mean absolute error, the mean percentage error, and others. This thesis uses the mean absolute error, the mean absolute percentage error and the root mean squared error (Hyndman & Athanasopoulos, 2021, 5.8).

	Female Students		Male Students	
	ARIMA	ETS	ARIMA	ETS
Mean absolute error	0.07884306	0.2201424	0.1547319	0.398878
Root mean squared error	0.08497016	0.2520238	0.1698329	0.4413121
Mean absolute percentage error	0.7882975	2.195532	1.681.524	4.333.175
Winkler Score	0.4174636	0.5233662	0.5848026	0.9300072
CRPS	0.0537746	0.1232525	0.09472764	0.2448936

Table 1: Measures of forecast accuracy for male and female Qatari student number forecasts using ARIMA and ETS models

As can be seen in Table 2, all three types of errors are smaller for the ARIMA than the ETS models, implying the ARIMA models have a higher predictive power for the time series of both male and female students, since the values they predict are closer to the test data.

A second useful measure of the forecast quality of a model includes the prediction interval. Forecasts are nearly always associated with some uncertainty, and so the prediction intervals, which give the probability with which a value will be within a certain range, are often as important as the point forecast itself.

Two measures, the Winkler score, and the continuous ranked probability score (CRPS), have been used to compare the quality of the prediction intervals of the models. The Winkler score gives, for a specific interval, the smallest value to a model that contains most observations in the shortest range (Hyndman & Athanasopoulos, 2021, 5.9). The prediction interval of 80% was used for all models to calculate this score. The second measure used, the CRPS, is a generalization of an absolute error as used by point forecasts, and allows the comparison of probabilistic forecasts

(Gneiting & Katzfuss, 2014, p. 134). The results align with the previous findings and again show that ARIMA models have a higher predictive power for the Qatari Student data of both genders than the ETS models.

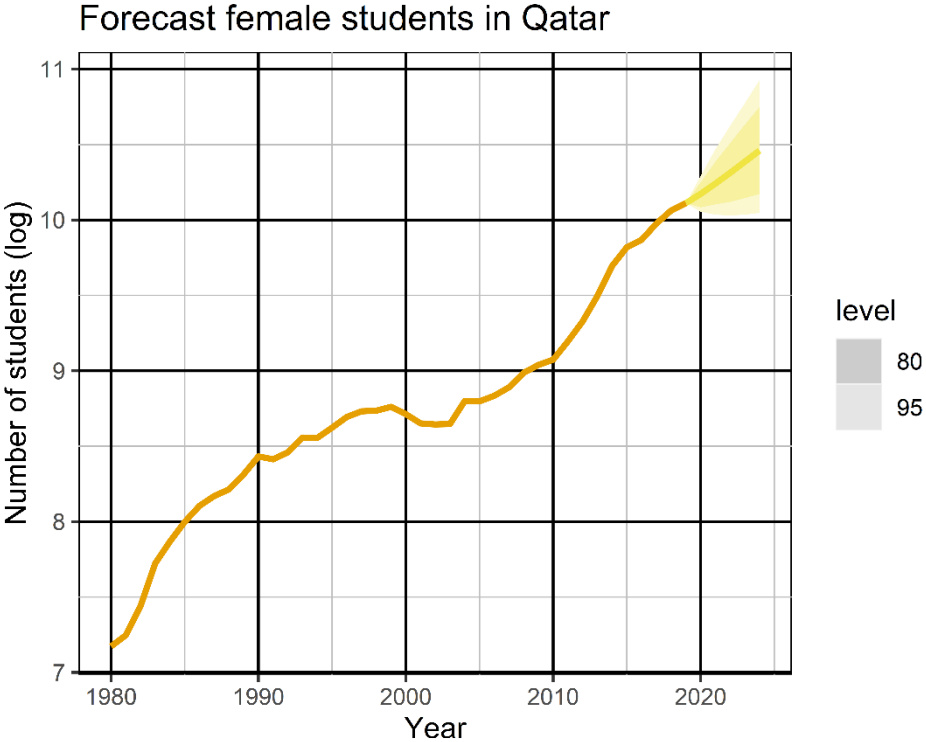Therefore, in the last step, forecasts based on the ARIMA models are obtained.

Figure 2: Forecast of the log number of female students in Qatar, using an ARIMA model

Since the natural logarithm of the number of students is used, the forecast in figure 2 is not as easily interpreted as the absolute number of students depicted previously in figure 1. However, it can be seen that the number of female students is predicted to continue its increase within the 80%-prediction interval, so Qatar likely faces a further growth of the group of highly educated young women.
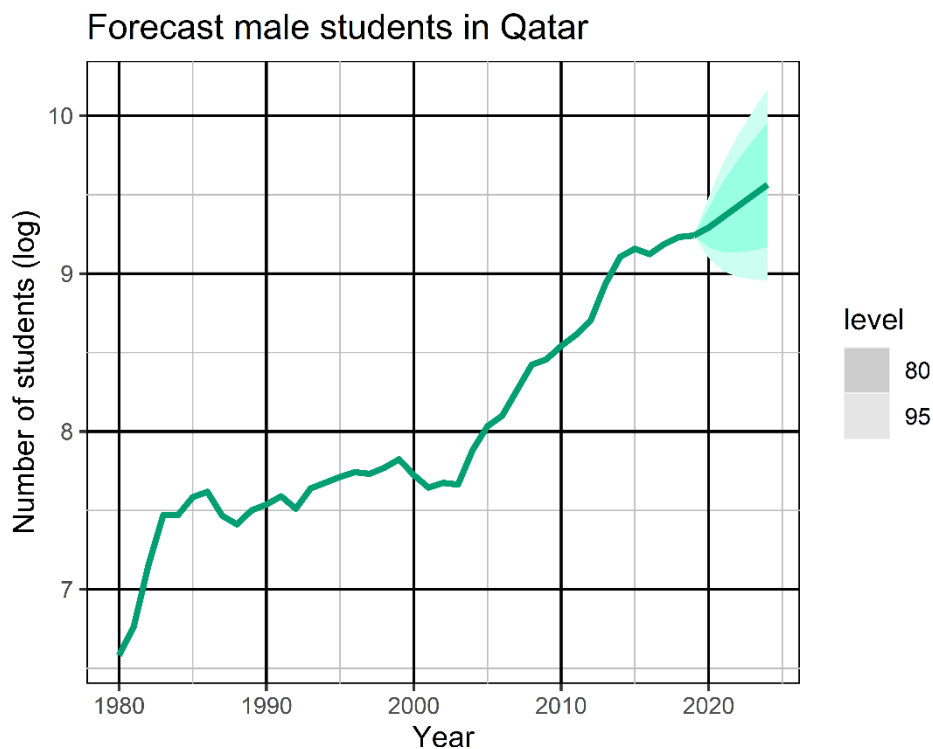
Figure 3: Forecast of the log number of male students in Qatar, using an ARIMA model

The number of male students is also predicted to grow, but the increase is slightly less certain with the lower end of the 80%-prediction interval containing the possibility of stagnation. It is more likely an increase will occur among the male students, too, but even if numbers develop according to the high end of the interval, the catching-up-effect is very unlikely to be strong enough to close the gap between male and female students within the five years predicted in this analysis.

The data is only covering the time up to and including 2019, so it does not account for possible effects of the Covid-19 pandemic. However, data on the students of the year 2019/2020 suggests a continuation of the patterns from the previous years, with the number of students of both genders rising, but the increase still being faster for female students, implying the pandemic did not create large distortionary effects for this cohort (Planning and Statistics Authority, 2020, p. 25).

Although the attempts to increase the participation of people in the Qatari higher education system have led to a noticeable increase in the number of students since 2005, this effect appears to be both stronger and more stable in the female population. As will be discussed further in the next section, the vast majority among graduates in Qatar are consequently women. A lack of female participation in the

labour market could therefore easily lead to a shortage of highly qualified employees, which would make Qatar dependent on highly educated foreign workers or signify that the economy is not very knowledge based.

4.1.2. Graduates in the public university system by nationality and subject of study

A second issue often addressed is the question if the fields the students graduate in are also those which are in demand at the local labour markets. Frequently, people suspected that people in gulf states would not choose the degrees they obtain based on employer's demand, which would lead to a mismatch at the labour market (Berrebi et al., 2009, pp. 429–430). However, recent data on the university degrees obtained in public institutions in Qatar shows a more nuanced picture (Planning and Statistics Authority, 2019, pp. 27–28).
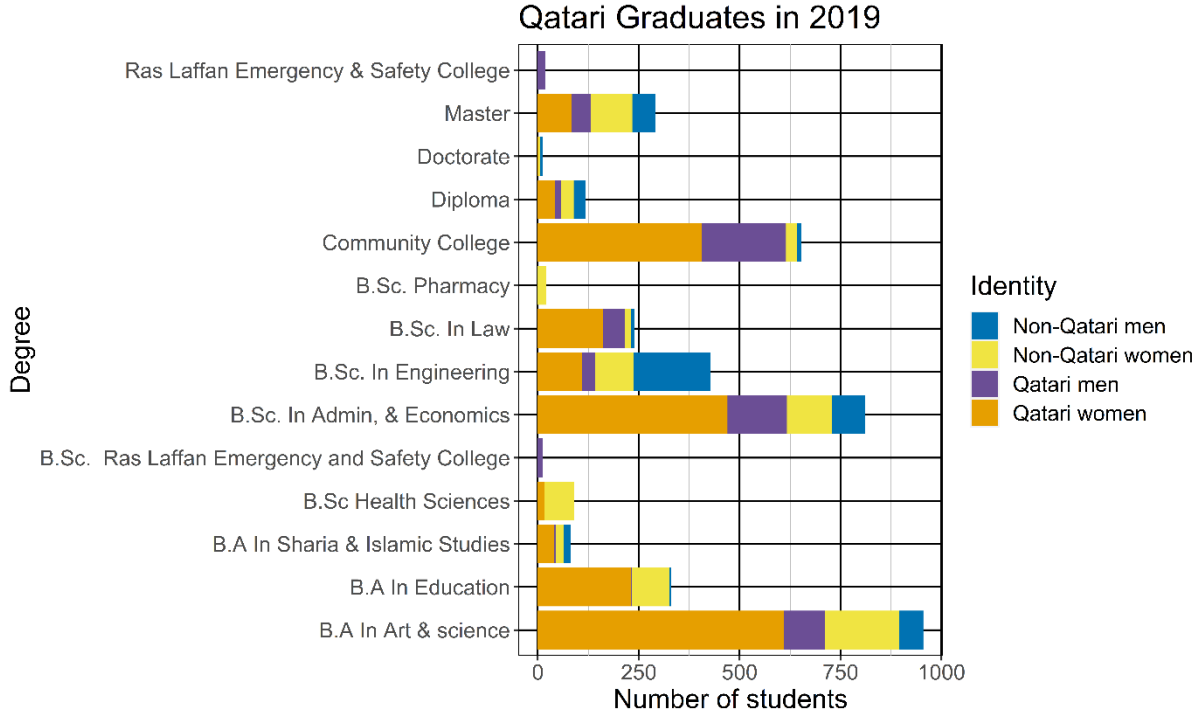

Figure 4: Graduates from Qatari public universities in 2019, by Nationality, Gender, and Degree

As Figure 4 shows, the public higher education system in Qatar offers a wide range of degrees, of which Art & Science, Admin. & Economics and Engineering are the fields with the most graduates who obtain a bachelor's degree. The bachelor's degree is the most common degree, but different types are available. A certain number of people received diplomas, which are specialized degrees in Education, and many people among the Qatari nationals also graduated from community

colleges, which offer pre-university diplomas and are rarely attended by non-Qatari nationals.

The number of people obtaining a master's degree or even a doctorate is small, and although Qatari institutions offer a wide range of topics for graduate students, only one master's degree, Engineering Management, was obtained by 20 graduates in 2019, the numbers for all other master's degrees being lower (Planning and Statistics Authority, 2019, pp. 27–28). Furthermore, it is worth noticing that the vast majority of degrees were obtained by Qatari citizens, but specific subjects such as the Bachelor of Health Science as well as master's degrees have a higher percentage of non-nationals among their graduates. Few Qatari people choose to attend university after finishing a bachelor's degree. In the Qatari public education system, several thousand students graduate each year, obtaining community college or bachelor's degrees, but only around 300 obtain a master's degree. Only eleven doctorates were awarded in 2019, all in STEM fields. While master's programs also are attended by a large female majority, the gender ratio among people obtaining a doctorate is more even. However, Qatari nationals rarely obtain a doctorate: In 2019, five of the doctorates were obtained by non-Qatari men, five by non-Qatari women, a single one by a Qatari woman and none by a Qatari man (Planning and Statistics Authority, 2019, pp. 27–28).

As women are the majority of people who obtain academic degrees, especially among the Qatari citizens, they are also the largest group in most degree programs. Engineering is the only subject in which both genders were graduating in nearly even numbers in 2019, and this primarily because it is the subject most frequently chosen by non-Qatari men. The gender differences among the non-Qatari graduates are not as pronounced as among the Qatari citizens, but overall, women are also the majority among the non-Qatari graduates in total as well as in most subjects, with engineering being the only exception. Health Sciences and Pharmacy, Education and the subjects of the Faculty of Art and Science are much more frequently chosen by non-Qatari women than non-Qatari men, and they are also more likely to graduate in a master's programme than men.

Among the STEM programmes taught in public institutions in Qatar, Engineering therefore appears to have a very specific role. It is the only program with more male than female graduates and additionally, it is by far the most common STEM subject

and the only one to have its own faculty, with the natural sciences and other subjects being included in the Faculty of Science and Art. More precise information on the specialization of graduates at the Faculty of Science & Art is not available by gender. However, it is available by year. The most frequent subject chosen at this faculty by graduates in 2018/2019 was Information, in which 154 people graduated (Planning and Statistics Authority, 2019, p. 30), suggesting that while engineering remains an important subject, other STEM fields are also attracting a significant number of students.

In 2019, the public education system of Qatar saw 3980 graduates in total. They were obtaining degrees in a wide variety of fields, including hundreds of nationals who graduated in STEM fields. However, it may be problematic that many students only obtain pre-university diplomas from community colleges or bachelor's degrees. Relatively few continue their studies afterwards, especially among Qatari nationals. A possible explanation for this may be found considering the fees of Qatar University. Tuition fees are generally high at this institution, but obtaining an undergraduate degree is tuition-free for Qatari nationals (Qatar University, 2022). The small number of people obtaining higher degrees might become an issue if the labour market has a high demand for employees with master's degrees or doctorates.

For the private education system, comparable data on the types of degrees is not available. Such institutions, which are often branches from foreign universities, have a higher participation rate of non-Qatari students. Furthermore, it is worth noticing that the gender disparity among the graduates of these universities is far lower. Of the 1826 people who graduated at these universities in 2019, Qataris make up around 47%. Women are 56% of the foreign graduates and 53% of the nationals, showing these universities have a much more even gender ratio than in the public system (Planning and Statistics Authority, 2019, p. 36).

An aspect that has rarely been addressed in previous papers on the relationship between the Qatari labour market and the university system is the high number of women, who dominate, except for Engineering and the small programs at the Ras Laffan Emergency & Safety College, every field at Qatari public tertiary education. Many discussions focused only on the number of Graduates and did not consider aspects like possible labour market discrimination against women, although they might, as outlined by (Angel-Urdinola, 2008, p. 9) play important roles, even more so

in a labour market where the vast majority of university graduates are female and, according to the neoclassic theory of education as an investment, discrimination would also greatly impact the decision to attend university in the first place.

Additionally, it is difficult to assess if there is a skills mismatch by considering only the number of potential employees educated in universities. First, not all of them might enter the labour market. Second, depending on the specific structures of the local economy, the types of skills that will be required will also vary. Additional information is therefore needed to learn more about the possibility that a skills mismatch may be a problem. The second part of this analysis presents data on the labour market and unemployment, while the third one analysis some basic aspects of the Qatari economy. This should allow to gain some insight into the demand and supply on the Qatari labour market.

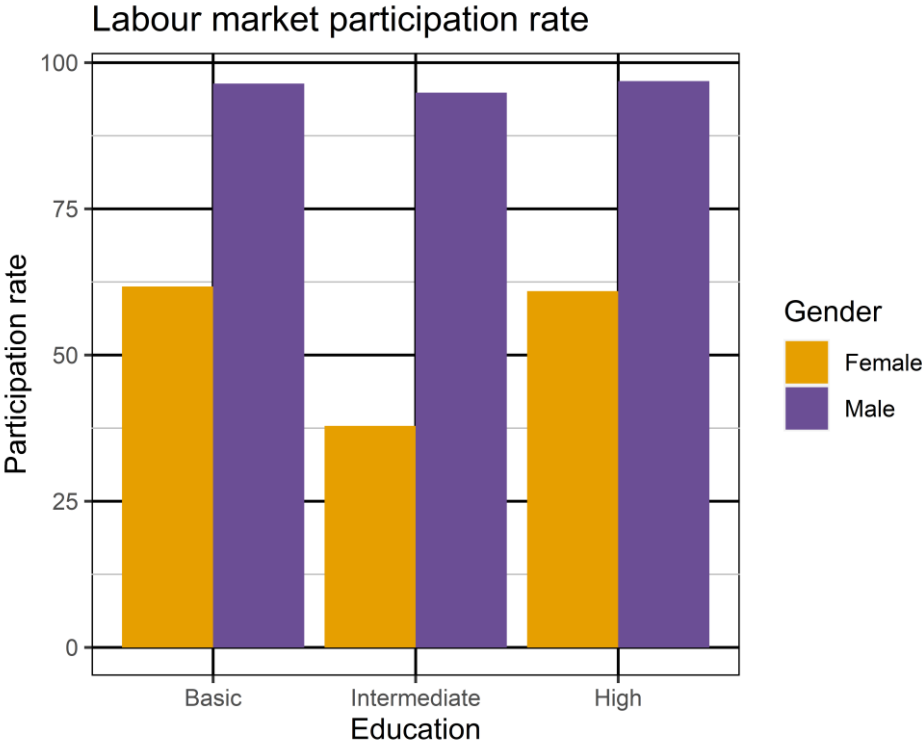## 4.2. Labour market participation

Figure 5: The Qatari labour market participation rate in 2013 by Gender and Education

Data on the Qatari labour market participation by education is only available for 2013 in the dataset. Figure 4 shows that the working-age men in Qatar have a very high participation rate, above 90% for all levels of education (World Bank, UNESCO Institute for Statistics, 2020b). The participation rate of women is generally much

lower, and especially women with an intermediate education level stay out of the labour market often, with less than 40% of the women in this group being in formal employment or job-seeking. While more than half of the working-age women with basic or higher education participate in the labour market, higher education does not increase the likelihood for a woman to participate in the labour market compared to women who only have a basic education (World Bank, UNESCO Institute for Statistics, 2020b). Labour market participation generally appears to depend much more on gender than on education.

However, as the logistic regression conducted reveals, obtaining an academic degree has a significant effect on women's labour market participation probability. The results are depicted in Table 3: There is a strong positive coefficient linking the ownership of an academic degree to the probability of participation in the labour market. The relationship is highly significant at a level of 0.1%.

Term	Estimate	Std. Error	t-Statistic	P.value
(Intercept)	-0.4938184	0.0067040	-73.66011	0***
Degree	0.9411378	0.0084597	111.24998	0***

Table 2: Result of a linear regression of owning an academic degree on the labour market participation rate of Qatari women

A likelihood ratio test confirms the model which includes degree ownership as an explanatory variable has a higher explanatory power than a baseline model with only an intercept. This finding is also significant at a 0.1%-level.

Official unemployment in Qatar is very low, and while it was markedly higher for women than for men, it stayed below 3% since the data was first available in 1991, and has fallen from 2011 to 2019 for both genders, though the ILO estimated an increase for 2020, possibly caused by the Covid-19 pandemic (World Bank, UNESCO Institute for Statistics, 2020b). Youth unemployment for women was higher, but subject to the same falling trend during the 2010's (World Bank, UNESCO Institute for Statistics, 2020b).
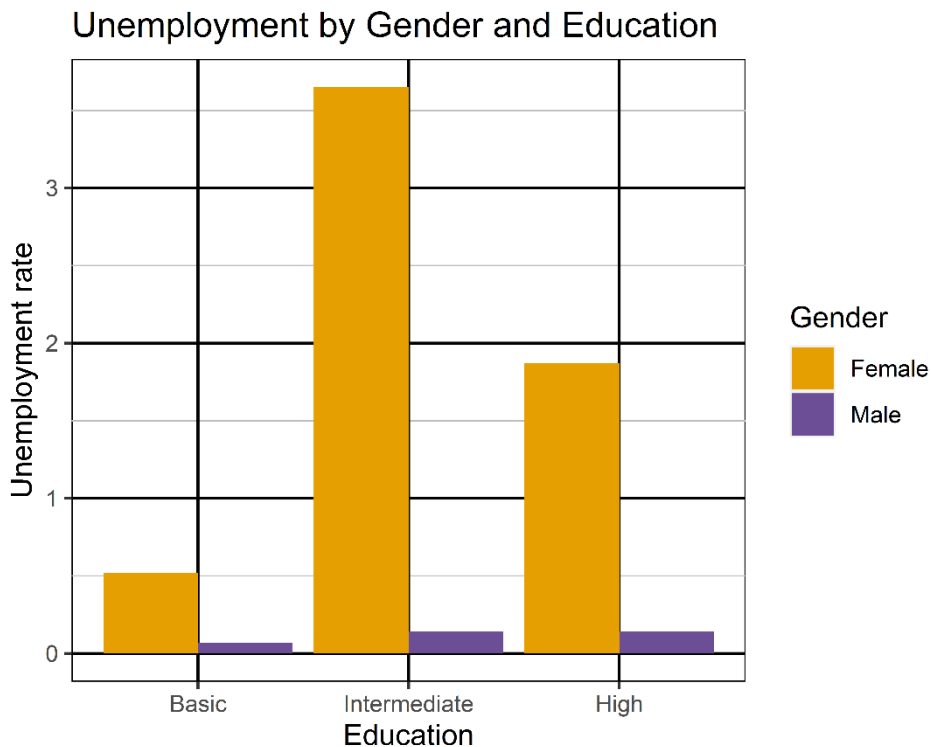
Figure 6: The Qatari Unemployment rate in 2013 by Gender and Education

Data disaggregated by education level is only available for 2013, and reflects patterns seen in the analysis of the labour market participation rate. As shown in figure 5, the unemployment rate in this year was not generally decreasing with higher education. The male unemployment rate was far below 1%, and barely changing with the education level. Simultaneously, there was a very high male labour market participation across all education levels. Female unemployment was higher for highly educated women than for those who only had a basic education and the unemployment rate was highest among women of intermediary education (World Bank, UNESCO Institute for Statistics, 2020b), mirroring the patterns observed for the female labour force participation rate.

This may be partly resulting from a composite effect: As it is likely that low-skilled foreign workers, if they lose employment, are forced to leave the country since they do not receive the same unemployment benefits as citizens and are unlikely to have large savings, the unemployment rate among low-skilled employees in Qatar may tell little about the actual labour market demand for this type of labour by the firms. However, for Qatari women of intermediate education, attaining a higher education level can reduce their unemployment risk, albeit not to the low level faced by men. Additionally, for men, the relationship between higher education and the

unemployment risk is much weaker than for women. This aspect may answer the central question why Qatari women are much more likely to pursue higher education than their male counterparts. It might be because unlike the men, they use education as a tool to increase their chance of finding employment.

Term	Estimate	Std. Error	t-Statistic	P.Value
(Intercept)	3.2791746	0.0893420	36.703622	0***
Degree	0.6813473	0.0924572	7.369326	0***

Table 3: Result of a linear regression of owning an academic degree on the employment probability of Qatari women

As the results of the logistic regression depicted in Table 4 show, obtaining an academic degree has a highly significant positive effect on the probability a Qatari woman in 2013 was employed, compared to women with intermediate education. The result is significant at the 0.1% level. A likelihood ratio test confirms the model of employment has a higher explanatory power when it includes degree ownership as an explanatory variable, compared to a baseline model with only an intercept, at a 0.1%-level of significance.

Combined with the data on the labour market participation choice, this indicates obtaining an academic degree is a sensible choice for a Qatari woman of intermediate education who wishes to enter the labour market and find employment. The same is not true for men, whose unemployment rate is equally low at 0.14% for those who have intermediate education and those who completed a degree of the tertiary education system.

Being able to obtain a job is an important target for most people, and despite the rentier characteristics, Qatar does not appear to be an outlier in this respect, as the high labour market participation rate for men suggests. People in the gulf states clearly see working as the norm (Diwan et al., 2018, p. 31; Hvidt, 2015, p. 37), and while the employment they often obtain serves a rent-sharing purpose (Hertog, 2020, p. 4), it is worth noticing that rentier economies could alternatively simply hand out every citizen a part of the obtained rent, but almost always prefer to let their citizens work for them.

Furthermore, the data implies that private Qatari firms appear to place little value on education. The decrease in unemployment risk with higher education that is observed

in many countries (Becker, 1994, pp. 229–230) only holds for a very specific subgroup in Qatar, for women who are at an intermediate education level compared to those who are at a high education level. Neither men nor women reduce their unemployment risk by reaching an intermediate education level compared to a basic level, and higher education also appears to have no effect for the men.

Additionally, the gender differences in unemployment are large, especially considering the aspect that many women do not participate in the formal labour market, and it is possible some of them preferred to leave the market entirely instead of being registered as unemployed, as observed in other MENA states (Assaad et al., 2020, p. 843). Firms in the Qatari labour market clearly show a high preference to hire men, even though the education level and the unemployment rate of women are higher.

While much attention has been given to the state and employee practices in the Qatari economy, less attempts have been made to discuss the preferences of private firms in the labour market of the gulf states. To gain some insight into possible causes of the observations above, the next part evaluates some data on the composition of the Qatari economy.

4.3. GDP composition

Qatar is commonly considered to be a rentier state economy, where natural resources are an important part of the economy. But the government started diversification efforts and as Figure 7 shows, these were at least partly successful. Although the total natural resources rent remains large in its absolute value, its importance for the Qatari GDP is decreasing. While it still accounted for over 40% of the Qatari GDP in 2005, this value fell to around 20% until 2019 (World Bank, UNESCO Institute for Statistics, 2020b). The primary cause of this decrease was the significant growth of the Qatari economy, especially from 2005 to 2011, as can be seen in the graph. Even though the absolute value of the natural rents were larger in 2019 than in 2005, they accounted for much less of the GDP. It is also visible that rent is a part of the economy which is subject to large changes in its yearly value. The value of the total natural resources rent grew to more than 200 billion in 2011 but fell to 100 billion in 2016. Such patterns are probably reflecting the high susceptibility of the sector to price changes on the world market and possibly other influences like

political decisions to extract more or less of the resources during a given year. Value changes in all other sectors are more gradual.
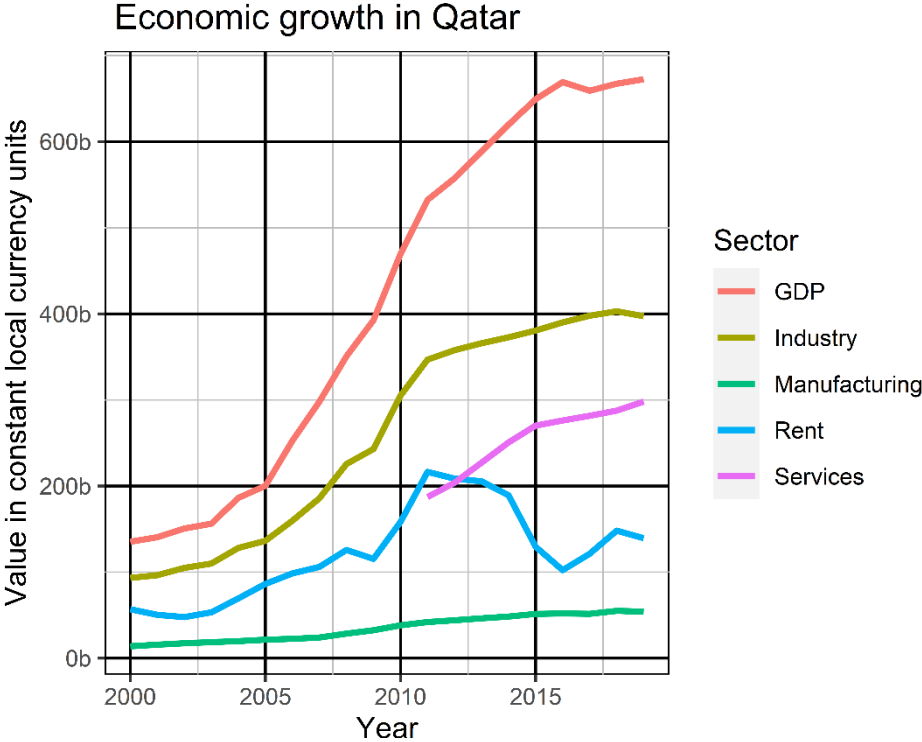

Figure 7: Economic growth of the Qatari GDP and sectors of the Qatari economy. The Qatari industry includes a noticeably large non-manufacturing part of the industrial sector, and this part also expanded much faster than manufacturing especially from 2005 to 2011. It should be noticed that besides rent, the construction sector appears to have been a major driving force behind the large growth from 2005 to 2011. Industry as defined in the data which is used here is including construction, manufacturing, and a few smaller sectors such as water and waste management. The gap between the manufacturing and the industrial sector in the graph therefore shows a part of value generation that can be attributed not exclusively, but partly to construction. The importance of the construction sector was reflected by findings of Diop et al., who surveyed a sample of blue-collar workers in Qatar in which construction workers and construction supervisors were among the most frequent professions, accounting combined for slightly more than a quarter of all workers in the survey (Diop et al., 2020, p. 143). The rapid growth of this part of the economy coincides with the high GDP growth rates Qatar saw in these years.

Manufacturing grew as well, but at a much slower pace. Data for the Service Sector is only available starting at 2011, but since then, the importance of services in the

country increased. However, economic growth has stagnated in recent years, probably reflecting the continuing importance of the non-manufacturing industrial sector, whose growth slowed, and the rent, which decreased during this period. Growth in the Manufacturing and Services Sector slowed too and could not compensate for the decreased growth in other sectors.
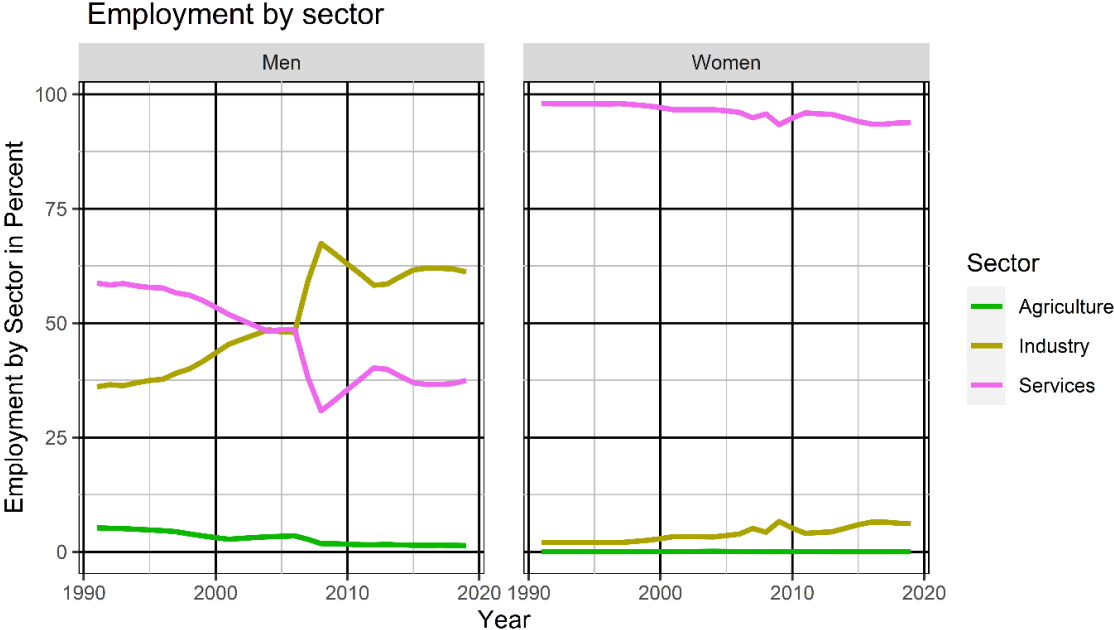

Figure 8: Employment in the Agricultural, Industrial and Service Sector in percent of the employed of the respective gender

Strong gender differences persist in employment by sector. Like many nations, Qatar saw a decreasing importance of Agriculture for men, as can be seen in Figure 8, while the number of women formally employed there has been very low since at least 1990. The graph also shows that women are nearly exclusively employed in the Service Sector, which accounts for more than 90% of the female employees, a number which did only decrease slowly during the last three decades and is still very high. Likewise, the importance of the industrial sector grew for female employment but is still below 10%. The situation of men is more mixed, but the Service Sector has been also declining in importance for employment of men, and industry grew in importance. However, while these changes were large, they were also not happening continuously with an especially sudden shift towards employment in the industry in the late 2000's, probably reflecting the quick growth of the industrial sector of the Qatari economy at that time. Afterwards, the importance of the industry for employment declined again slightly, and entered a phase of stagnation in the late 2010's.

The near-absence of women in the industrial sector despite the low number of highly educated men in Qatar further confirms that there is not much knowledge-based activity in this sector or, if it is, few Qataris educated at national universities are employed in it. The situation may be different in the Services Sector, which might contain very knowledge-intensive work as well as more routine-based tasks and which employs workers that are more mixed in terms of gender. However, while it cannot be said certainly to which extent it relies on highly educated people, the importance of this sector has been declining for male employment, suggesting that if knowledge activity is taking part in this sector, an increasing number of men living in Qatar might not take part in it.

5. Interpretation

5.1. Development of the higher education system

Considering the development of the absolute number of students, Qatar's initiatives to encourage higher education are a success. The number of students attending universities in Qatar has been growing in recent decades, and it has risen especially fast in the decade from 2010 to 2020, an increase which will most likely continue in the future if there are no large structural changes. However, the gender gap caused by a relatively low number of men attending tertiary education compared to women has also been widening, and if current trends continue, it will widen further in the next years. The causes for the gender gap have been rarely researched despite the generally large interest in the reforms of gulf state education systems.

Various aspects of the education sector may give hints at to which extent a rentier mentality is prevalent and if so, who exactly exhibits it and which consequences follow from it: If the public university education was underfinanced by the state, for example, in countries with such a large amount of wealth like Saudi Arabia and Qatar, then this might imply the state neglects the crucial investment that is education, maybe in favour of funding the military to an overly large degree or other not economically rational projects as Beblawi and Luciani already warned it might happen in such states (Beblawi & Luciani, 1987, p. 84). But this does not appear to be the case in Qatar. If, on the other hand, the universities are well-funded, but many people hold no degrees, then this may hint at a rentier mentality among young adults. As Qatar has much more female students, this implies that more men are not ready

to put much effort into their education, and rentier mentality might indeed be less prevalent among women.

The low propensity of men to obtain university degrees is in line with the rentier state theory. The neoclassical theory as formulated by Becker argues that education, especially tertiary education constitutes an investment which students undertake to gain advantages like higher wages and better job security (Becker, 1994, p. 17). Following on from this consideration, the rentier state theory problematizes structures in which people receive large gains without having worked or taken risks for it (Beblawi & Luciani, 1987, pp. 50–52). In such cases where work and reward are disconnected, it is assumed that people develop little motivation to conduct efforts. This is given as a possible reason why the gulf states lack behind comparably rich nations in educational achievements (Hvidt, 2015, pp. 30–31). Unlike the people in many other states (Becker, 1994, pp. 29–30), Qatari people do not gain a higher employment chance if they receive a university degree.

Evidence for the existence of a rentier state mentality has been collected from the World Value survey (Hertog, 2020, pp. 1–3). But to the best of the author's knowledge, no attempts have yet been made to analyse Qatari student data with respect to this framework. The analysis conducted shows that while Qatar's efforts to reform its education sector were indeed accompanied by an increase in the number of students and this number is likely to rise, the increase is much stronger for women, who already constituted a majority of the students in the state for decades. The gender education gap can therefore be assumed to widen further in the future unless measures are taken to close it. A possible cause of this increase is that the rentier mentality, through the channels through which the state distributes rent, might affect men stronger than women. As Hertog and Hvidt pointed out, a key function of rent distribution is state employment (Hertog, 2020, p. 4; Hvidt, 2015, p. 38), and the lack of effort orientation they attributed to the public sector suggests other characteristics may have an even higher impact on work opportunities than in other countries. However, they did not address directly if this might imply that certain groups are more affected by effects of the rentier system than others. Puranen and Widenfalk mentioned closeness to the ruling elite instead of achievement to be a determining factor of wages (Puranen & Widenfalk, 2007, p. 131). But there has been, to the best of my knowledge, no empirical investigation yet on the possible impact of gender

discrimination in a rentier-based system, where it may be amplified and become cause of specific patterns.

The data discussed in this analysis shows that this might be the case in Qatar. The unemployment rate for men in this country is very low regardless of the education level, giving them a possible reason not to put effort into obtaining a degree. The situation of women is different: While unemployment among women is not very high, it is higher than among the men and unlike the unemployment risk for men, the unemployment risk for women who have secondary education can be decreased by obtaining an academic degree, suggesting achievement has a higher influence on their working opportunities than of those of the men. A similar pattern is observed among the labour market participation rate which changes little among men, but is low for women of intermediate education and, while still much lower than for men, relatively higher among highly educated women. Depending on the extent to which women leave the labour market because they believe they will not be able to find a suitable job, the effect may be stronger than suggested by the unemployment rate alone. It has been observed in several Middle Eastern and North African states that unemployment and leaving the labour force are at least partial substitutes (Assaad et al., 2020, p. 817) and the impact of degree ownership on labour market participation observed in the analysis suggests a relation where women actively decide to enter the labour market or not based on how they view their employment chances may be prevalent in Qatar as well.

The data does not allow to assess if a similar phenomenon exists for the wages, but it was observed by Hertog that women show a higher preference for government positions than men (Hertog, 2020, p. 7) so additionally, they might be inclined to engage in higher effort in order to obtain a specific job position. Qatari women, despite being less frequently in employment, invest more on average than their male counterparts, which is contrary to the neoclassical theory of education. It states that women usually spend less time in the workforce and therefore have less incentive to invest in their education (Becker, 1994, p. 88). That this does not hold in Qatar may be explained by their low reservation wages: Their willingness to take on non-public sector jobs is low, and their employment chances are comparatively small, because the state prioritizes male employment. It is therefore likely an effect of the distributional mechanism of the Qatari rentier state.

This consideration that the way in which rent is distributed may affect men and women differently and selectively cause men to invest less in education is supported by observations from the UAE and Qatar: Hvidt noticed findings from the UAE imply that men often drop out from school because they can find well-paid work early (Hvidt, 2015, pp. 36–37) and it is possible a similar phenomenon affects labour market choices in Qatar. The labour market participation rate of men is very high in Qatar, and by national estimate, it was around 79% for men between 15 and 24 in 2020, the highest in the world (World Bank, UNESCO Institute for Statistics, 2020b), suggesting that many men who could potentially study or still go to school might have entered the labour market at a very young age. This may be a major issue since although distribution may be a major function of their positions, these men do not technically earn money for doing nothing. They get paid for working, implying people who obtain such full-time positions are not expected to attend university and giving them an additional motive to leave the educational system early, which likely contributes further to the gender imbalances both among students as well as in the workforce. This motive would not be present if, for example, the natural resources rent was distributed unconditionally and equally among all citizens. Such a method is employed by the Alaska Permanent Fund and it has been shown to introduce no significant effect on the employment rate (Jones & Marinescu, 2022, 337-228), suggesting its consequences are less distortive than the results from the current mechanism applied in Qatar.

Another aspect was addressed by Lee, who argued the education system offered essentially two tracks, an internationalized, private, English-speaking one and a national, public track where Arabic is the primary language (Lee, 2021, p. 125). He pointed out that despite the rentier nature of the state, education achievements matter and for several reasons, people who attended international universities have advantages on the labour market: They speak better English, which is a necessity as the economy, with its large dependence on expatriates, is dominated by English as primary business language, and they also are more likely to have acquired prior experience of international environments (Lee, 2021, p. 126). If people acquire such traits may highly depend on their cultural and ideological background (Lee, 2021, p. 127). Unfortunately, the lack of data on private graduates does not allow to gain insight into aspects like their preferred fields of studies or employment chances compared to public sector graduates. What is known about the private education

system is in line with the possibility that rentier characteristics in this system are weaker than in the public sector. The gender ratio at English-language private universities is much more even than on public institutions, implying Qatari men who attended English schools are more willing to invest into private university education, which is in line with Lee's argument that Qataris with degrees from these private institutions are much more likely to find attractive positions in the private sector (Lee, 2021, p. 126). However, this only affects a minority as most Qataris, if they study, attend the public education system (Lee, 2021, p. 117).

The theory that Qatari women are much more likely to attend public university because unlike men, they have strong incentives to do so to increase their employment chances is very well in line with the presented data and the analytic results. However, other explanations for the high propensity of women to obtain academic degrees cannot be excluded by this thesis. It is possible Qatari women are more likely to study towards a degree than men because they receive larger advantages in status or higher psychic or social benefits or they may value such advantages more (Pseiridis et al., 2018, p. 268). This might also tie into the situation of Qatari women who are not in the labour market: If they have intermediate education and are pessimistic about their chance to find a job they would accept, they might prefer studying as compared to staying out of the labour market or unemployed.

Furthermore, it is valid to assume that while it is not developed in response to the private labour market and therefore unlikely to be tailored specifically to the needs of local firms, the education level of Qataris and especially Qatari women in the public sector is higher than what would be expected based on the current private sector demand alone. It might also likely be higher than what would be expected if people only engaged in education to the extent to which this is rewarded by local companies, considering the low current propensity of the private sector to invest in education. For Qatar's development towards a knowledge economy, this is an important advantage. But it also highlights the importance of addressing shortcomings in female labour market participation, low private investment in knowledge, low-quality jobs and the related short-term employee-firm relationships and other underdevelopments of the private sector. Many firms are used to hiring workers through short-term contracts (Diop et al., 2020, p. 141), few offer tenure (Berrebi et al., 2009, p. 438; Hvidt, 2015, p. 39). This causes issues for, for example, Qataris who wish to take on a mortgage

payment and require proof of steady income for this (Berrebi et al., 2009, p. 437). Additionally, entrepreneurs, especially female ones, may face barriers because of the risk involved in entrepreneurship as opposed to secure employment (Langworthy & Warnecke, 2021, pp. 326–327).

5.2. Development of the private economy

Many authors identified it as a challenge to the economy or proof of a rentier state mentality that few Qataris work in the private sector and concluded them to be undereducated (Gonzalez et al., 2008, pp. 29–30; Hertog, 2020, pp. 4–6). However, the data revised here suggests more complex dynamics. First, while relatively few of the male Qataris obtain a tertiary education degree and the number of people who obtain a master's degree is generally very small, there is little evidence that the current labour market has a large demand for highly educated graduates, making it a questionable assumption that the term of undereducation, education below the level demanded on the labour market, can be used to accurately describe the occurring phenomena. The male unemployment rate does generally not decrease with higher education. Women, who are educated better than men, face higher unemployment rates, and while they can lower their unemployment risk by obtaining an academic degree, they also have a higher preference to work for the state, even compared to the generally strong preference for state employment among men, suggesting firms put little effort into attracting highly qualified female employees. Additionally, the comparatively low number of highly educated migrants in Qatar also suggests they only see limited career opportunities, as does the low university attendance rate of foreigners in the public education system Qatar, where they are very rare in most fields except engineering and a few social professions like health. These factors imply many firms primarily hire large numbers of migrants with low education, suggesting that firm's demand for and willingness to pay better educated workers are limited.

Therefore, it is questionable to which extent Qatari's preference for state employment reflects a rentier mentality and to which extent it is caused by shortcomings in the private sector. It cannot be excluded that firms exhibit a rentier mentality, too, and may be more used to simply being able to hire foreigners with often low education for little pay and not put much effort into hiring higher educated people at better conditions or investing in the education of their employees. The private sector is also not as likely to create jobs with tenure (Hvidt, 2015, p. 39). Furthermore, the lack of a

Professional Development Track, the lack of the opportunity to gain a higher position within a certain field as an expert who gained in-depth-knowledge is likely another obstacle, as even if someone obtained more expertise, it would neither give them a better position, nor would the company make use of it. Hvidt highlights this issue for the public sector and considers it a possible reason why so many gulf professionals enter management (Hvidt, 2015, p. 42), but it might possibly be an issue for private firms as well.

In research on the rentier state economy, few attempts have been made to investigate developments of the demand side of the labour market, rendering uncertainty about the level and form of education required by the national economy a major issue. People in Qatar graduate in a large number of fields, but it remains unclear which subjects are preferred on the labour market. Suggested fields in the literature included English, engineering, finance and accounting, marketing and public relations, computer skills (Berrebi et al., 2009, p. 429), information and communication technology skills (Gonzalez et al., 2008, p. 49) and natural and technical sciences (Hvidt, 2015, p. 34), the importance of soft skills for employment was also highlighted (Gonzalez et al., 2008, p. 49). But as discussed above, there is little empirical evidence people from any of these fields would be hired at competitive wages in large numbers.

Likewise, it is uncertain if the low number of people achieving master's degrees may be problematic. If Qatar was indeed developing to become a knowledge economy, as the government aims to encourage, the relative shortage of people with master's degrees and doctorates might become an issue. But as discussed above, there are signs Qatar might have few firms who prefer hiring highly educated workers. This is an important indicator that the current private sector in the state is not very knowledge based.

Willingness to invest into education of the workforce and incentives to care for working conditions are low, with the Qatari system often tying visa to employment at specific firms (Berrebi et al., 2009, p. 439), which explains why, despite low unemployment rates, companies are not used to having to compete for workers. Additionally, firms strongly tend to hire low-educated workers, a preference so developed that despite the tendency of Qatari men not to obtain academic degrees, the educational status of Qataris in the 2004 census was higher than the educational

status of non-Qatari migrants in the country (Berrebi et al., 2009, p. 435), suggesting further that the lack of incentive to obtain higher education caused by rentier characteristics is not the main challenge for the country's attempts to become a knowledge economy, and that the low firm willingness to pay well-educated workers is a considerable issue.

Legal insecurities (Langworthy & Warnecke, 2021, pp. 327–328) and the demands they often face to conduct domestic work (Langworthy & Warnecke, 2021, p. 330) cause further obstacles for women who wish to become employees or employers in the private sector. Additionally, entrepreneurs, especially female ones, may face cultural barriers because of the risk involved in entrepreneurship as opposed to secure employment (Langworthy & Warnecke, 2021, pp. 326–327). Although it are especially women who often found enterprises in the services sector, which contributes increasingly to employment, they rarely take on business loans (Langworthy & Warnecke, 2021, p. 327). Women are still facing considerable legal constraints in Qatar when it comes to equality in payment, starting a business, managing assets or getting a pension as well as in aspects of everyday life (Langworthy & Warnecke, 2021, pp. 327–328), which gives them additional motives to prefer state employment over the uncertainty of private employment. These aspects remains problematic although early-stage entrepreneurial activity in Qatar is as frequent among women as it is among men (Langworthy & Warnecke, 2021, p. 328). Care responsibilities are often not compatible with formal labour, for entrepreneurs as well as female workers, with short maternity leave times being common (Langworthy & Warnecke, 2021, p. 328) and women spending nearly four times as many hours on care work as men in Qatar (Langworthy & Warnecke, 2021, p. 330). These findings are supporting Hertog's suspicion that their high preference for jobs with low working hours in the formal labour market are more related to informal obligations (Hertog, 2020, p. 7) and not to a rentier mentality.

However, by lowering aggregate demand, the precarious work conditions of people, which likely significantly contribute to the tendency of women not to participate in the labour market, also harm the overall economy. Therefore, from an economic perspective, even in non-rentier states, it may be optimal especially for women to show such a strong preference for state employment as long as the costs from discrimination in the private sector are very high, and this may also be the best option for the economy as a whole (Seguino & Braunstein, 2019, p. 1002). Since this work

in the public sector, offering better conditions to women, both gives them incentives to participate in higher education and increases domestic demand, it might mitigate the negative effects of discrimination in the private sector on the labour share of income and, consequently, economic growth to a certain extent. However, this is only possible as long as the state is able afford it. Even then, it would be unlikely to compensate entirely for the problems caused by a lack of high-quality jobs in the private sector, since the absence of such jobs is most likely related to additional issues like monopsonist structures in the labour market like visas being tied to employment in specific firms (Berrebi et al., 2009, p. 439), which have been shown to harm employment prospections, especially concerning job quality (Angel-Urdinola, 2008, p. 2). Qatar can afford to fund public sector employment, giving Qatari women an incentive to obtain a higher education, but as Hvidt noticed, the low rate of people educated in the public education system which later work in the private sector also implies that the economy gains relatively little from it (Hvidt, 2015, p. 34).

As Seguino and Braunstein pointed out, norms that consider women responsible for caring labour and see their income as of secondary importance compared to men tend to lead to hiring practices where men are preferred for positions with training on the job, tenure and better payment, while women are pressured into positions with low pay and high turnover (Seguino & Braunstein, 2019, p. 979). Such norms exist in most countries to a certain degree (Seguino & Braunstein, 2019, p. 978), and to the extent to which they persist in Qatar, they may create major distortions on the labour market, even more than in other countries, because women are more willing to undergo additional training than men, but also value job security more. This may be leading to a possible situation where an increasing number of local female university graduates will not fill the positions open in the labour market because firms exhibit such a high preference towards hiring men. The comparatively high female unemployment rate despite the relatively high average educational attainment of women is one of several factors that suggest this may be an issue, as is the uneven gender ratio in the state and especially the migrant population.

These issues occur on top of the already low willingness of firms to invest in their employee's education, based on the perception of a high turnover rate and their tendency to hire based on short-term contracts, even though, as Diop et al. pointed out, it is not necessarily the case that workers only remain temporarily in the country (Diop et al., 2020, p. 149). This may be the most important obstacle to attempts to

turn Qatar into a knowledge society: Since knowledge-based economic activities require continuous investment in the skills of employees, it is highly doubtful if such private investment will take place at a significant level as long as short-term contracts instead of tenure are the norm in the private economy. So far, it does not appear to happen to a significant extent. While the state and specifically the female citizens are ready to invest much into education with the government aiming to create a knowledge economy with well-paid tenure jobs for highly educated citizens, many firms continue to rely on a high quantity of low-skilled, primarily male workers employed in series of short-term contracts.

It should be noticed that this is in line with the assumption firms may have adopted a rentier mentality. The concept is often applied to employees, but the labour market patterns in Qatar suggest similar issues may shape the behaviour of private employers there: Firms are used to being able to hire new workers at will, despite their obvious lack of confidence in their ability to keep or attract workers (Diop et al., 2020, pp. 146–147), giving them an incentive to invest very little into their employees. The issue with this behaviour is not the hiring of migrants as such, which is done in many countries. What is problematic about the situation in Qatar specifically is the tendency to neglect employer-employee relationships based on the unjustified assumptions that they will be generally short-term, falsely believing firm behaviour would not be as important in the long run and that investment would not need to be undertaken. Firms neither prefer to hire better educated employees, nor do they appear to invest significantly in training on the job. Consequently, large parts of the Qatari private economy still are limited to sectors which are not necessarily knowledge-intensive, like construction. Engineering is the only subject in which male migrants in the public education system graduate in large numbers compared to Qatari women, which is additionally hinting at a lack of diversification among the few knowledge-intensive jobs available, but even there, few people continue after having obtained a bachelor's degree.

The most likely explanation is that currently, the Qatari economy generally offers very little incentive for men to obtain a degree, for citizens and migrants alike. Besides the natural resources rent (whose sector generates considerable revenue, but little employment) one of the most crucial sectors of the Qatari economy is construction. As long as this sector appears to rely on a large number of cheap workers and labour fluctuation is as high as it is and other sectors remain comparatively small, there is

little reason to expect this dynamic to change. In several aspects, the Qatari labour market is inefficient. The Qatari economy underwent profound changes in the recent two decades, with the GDP more than tripling in size and the relative proportion of the rent in the economy decreasing. However, the economic growth especially in the high growth phase from 2005 to 2011 appears to have been primarily driven by the construction industry while growth of the manufacturing sector is slow compared to overall growth rates. This large reliance on construction could be problematic in several aspects: The construction industry is highly reliant on foreign workers who, as Diop et al. showed, often receive low wages and often live in collective accommodations (Diop et al., 2020, pp. 143–144). The sector appears to be unable to create better living conditions and therefore remains vulnerable to losing its workers and to not being able to hire new ones, neither domestic nor on the international labour market.

One reason for this may be caused by the structure of the construction sector: A construction firm which participates in large projects like the building of structures for the World Cup in Qatar but might also have to bridge gaps of time with few commissions between such projects does not have the continuous labour demands found in most other sectors. Since it is very susceptible to fluctuations in the number of workers it requires, it has a high incentive to hire workers only temporarily. This strongly reduces the incentive of both the firm and the worker to invest in a higher long-term efficiency of the work by, for example, better accommodations and training.

Finally, there is the possibility that the people who are in charge of the employment process themselves undervalue long-term effects, both possible gains from higher education and losses from gaining a bad reputation. This would, again, be more in line with what the rentier state theory proposes. The recent growth of the service sector may create more employment possibilities for the highly educated people who will enter the labour market in the next years, but currently, Qatar is still relying highly on natural resources rent and construction sectors where it is doubtful if they are able to create a large number of high-paid professional knowledge jobs like the states aims for to its plans.

Although the scope of the analysis conducted here is limited, it shows some successes as well as areas where further work will be required in Qatar's policy efforts to become a knowledge economy. Qatar successfully expanded its tertiary

education sector, a system in which an increasing number of students in a diverse set of fields are currently learning. However, this also implies that the economy needs to adapt to integrate a large number of graduates in order to avoid overeducation and unemployment. Additionally, many people are discouraged from continuing studying after they finished a bachelor's degree, possibly because they do not consider obtaining a master's degree a significant advantage on the labour market while tuition fees are high and effects of higher education on employment chances appear to be weak or absent for men, while labour market participation is still low for women. The low unemployment rate among less educated people and the strong reliance of the Qatari economy on natural resources and construction may highlight instead that there are generally relatively few employment opportunities for highly educated people.

The preference of work over university attendance which is shown by many young Qatari men poses another obstacle on the path to become a knowledge economy. This is an issue rarely previously addressed. Although a rentier mentality may be present, as the high male employment rate shows, Qatari society holds work in the labour market in high esteem, which can be problematic if it leads to a neglect of the importance of other forms of work like work in the household or the efforts of obtaining academic degrees. Therefore, the Qatari state should suspend its practice to employ young men who did not obtain a degree yet. Instead, the state may offer more stipends or expand similar programs like they already exist for the bachelor to the master. Proponents of the rentier state theory started early to voice justified concerns that states who obtain a large amount of rent incomes may engage in problematic spending such as high expenditures for non-productive uses (Beblawi & Luciani, 1987, p. 84). While this is a possibility, one should not overlook that the considerable amount of wealth also allows states like Qatar to fund important sectors like infrastructure and the educational system very generously (Hvidt, 2015, p. 31).

At the same time, it should not be underestimated that rentier structures may shape firm systems as well. Currently, Qatari firms appear to have little preference for employing highly educated workers and a high tendency to create only short-term employment. Therefore, not only do state policies need to be shaped in a way that encourages men to participate in higher education, but also, the corresponding high-quality jobs need to be created in the private sector. It is imperative that working conditions are adapted to encourage more women to participate in the labour market

since they are highly educated but appear to be often held back by aspects like domestic work, discrimination, and legal insecurity. If Qatar does not increase its efforts to integrate them into the local economy, it wastes much potential.

6. Conclusion

In recent years, Qatar has put much effort into the reform of its university education and succeeded in building a tertiary education system that continues to attract an increasing number of people pursuing higher education. This thesis showed that an ARIMA model is suited well to create a prognosis for the logarithm of the number of students for both genders, and the most likely scenario for the future development is a continuing increase for both numbers. However, large gender differences persist in tertiary education and are likely to widen further. Women are already a large majority among the student population, especially among the Qatari citizens who attend university. But while the number of female students will continue to rise almost certainly, the possibility of stagnation is within the 80% confidence interval of the prognosis for the number of male students. Their number is likely to continue increasing as well, but it is unlikely to accelerate its growth to the extent where the gender gap in academic education could shrink or even remain constant, so the gap is likely to widen further. There are various aspects which may account for these dynamics.

To explain imbalances in the labour market of gulf states like Qatar, the rentier state theory is still the dominant framework. Many findings, especially concerning male participation in the labour market and their low willingness to attend tertiary education, are in line with the rentier state theory. However, considering the fact that Qatar has an extreme gender imbalance when it comes to higher education, with women strongly overrepresented among the country's students, it is clear that some of the rentier state dynamics do not appear to hold for the women of the country. While men profit from the rentier incomes more directly, often being employed by the state despite low educational attainment, Qatari women are more indirectly affected. The education system gives them the opportunity to receive academic degrees at a comparably low cost, but this is only partly by a lack of tuition fees and partly by the aspect that Qatari women, unlike men, have relatively few foregone earnings since their labour market perspectives especially without a tertiary degree are more difficult. This appears to hold less for the minority of people who underwent private

education and are better equipped for private sector employment for a number of reasons, (Lee, 2021, p. 126), but it strongly affects the majority of Qataris who attend the public education system.

This thesis found and discussed patterns of the Qatari tertiary education sector and the labour market that are in line with rentier state characteristics and the possibility that the labour market in Qatar may suffer from several distortions that are typical for labour markets with a lack of knowledge orientation and little long-term orientation in employer-employee relationships and which have a particularly negative effect on the labour market participation of women. An often-neglected aspect is that such rentier characteristics not only shape the labour market supply, but also influence the demand side: Many Qatari firms have developed strategies which are primarily based on employing a large number of low-educated workers through a system which is not competitive. This is giving them little incentive to invest in their workers and causes a major problem for Qatar's aim to develop into a knowledge economy. It also causes educated people, especially women, who face other forms of discrimination like higher legal insecurity, to prefer public sector employment.

The logistic regression conducted showed that for women of intermediate education, obtaining a tertiary degree increased the labour market participation rate as well as the employment probability, but the main driver of this is the public sector. While Qatari women therefore have, on average, an increasingly good educational level, the rentier system continues to give little incentive to men to complete degrees, most highly educated Qataris seek employment in the public sector and the generation of high-quality knowledge-based jobs in the private sector is still very low. To change this will be an important challenge for the state to ensure that its well-educated people can find suitable employment into the private economy. The causes and effects of different forms of rent distributions on aspects of society such as gender, labour, and education as well as Qatar's attempted transformation into a knowledge economy remain a fruitful field for further research.

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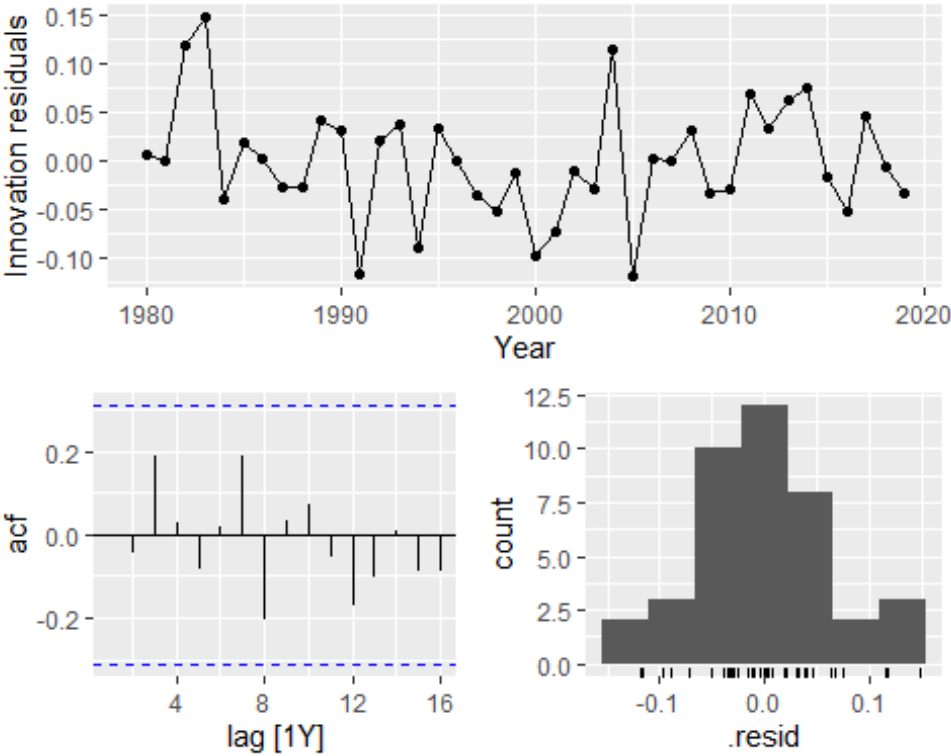## Appendix 1: Plots of residual diagnostics

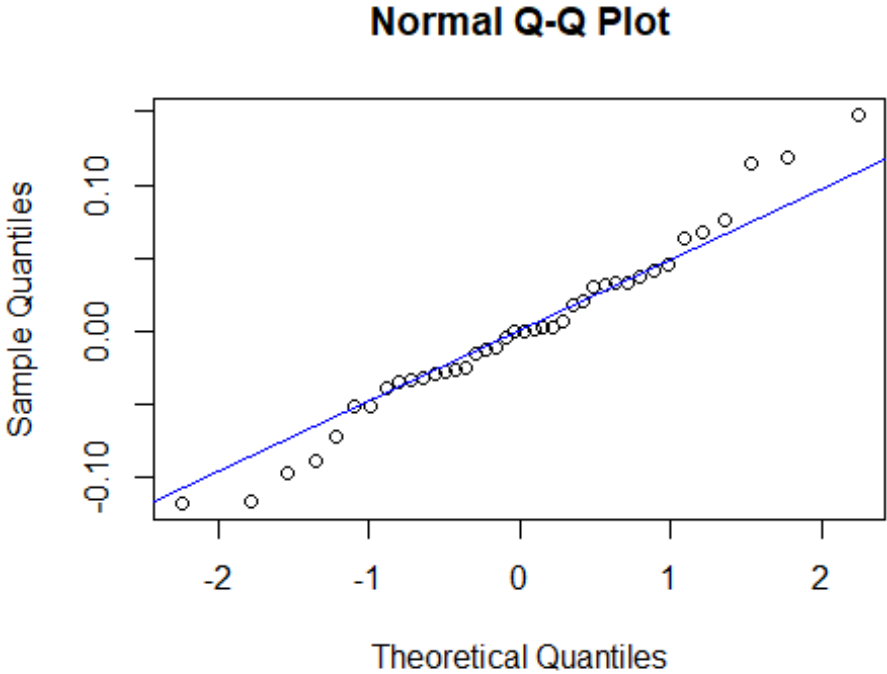*Figure 9: Residual diagnostics for the ARIMA model of female students*

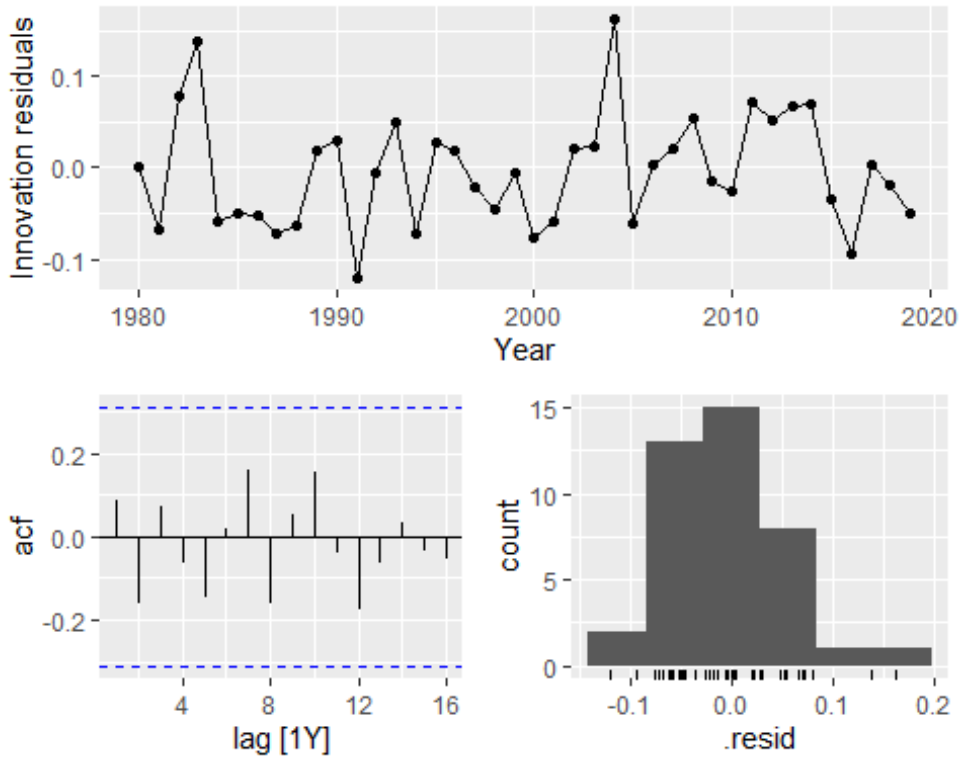*Figure 10: Normal Q-Q Plot for the ARIMA model of female students*

Figure 11: Residual diagnostics for the ETS model of female students
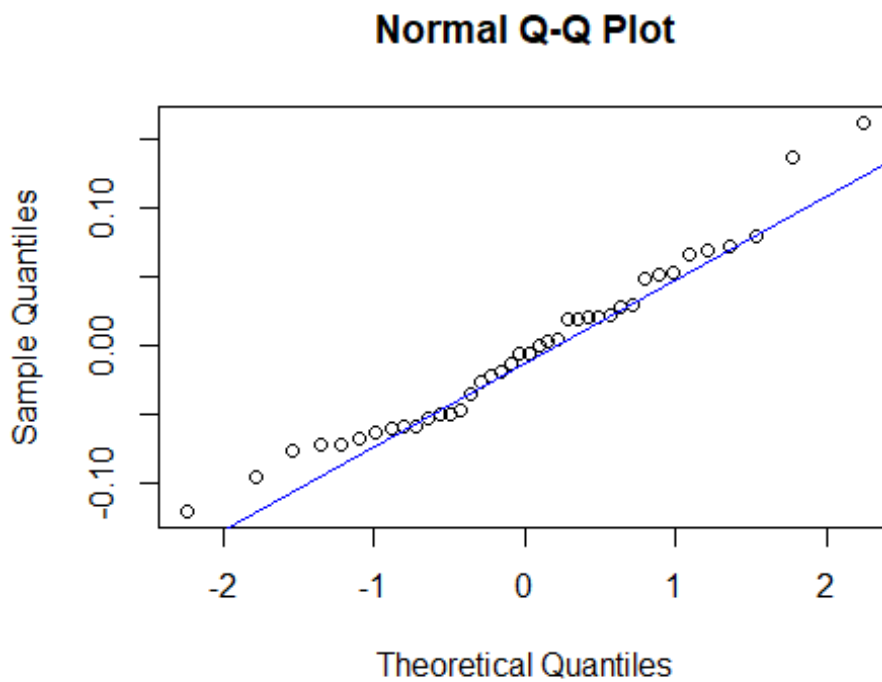
Normal Q-Q Plot

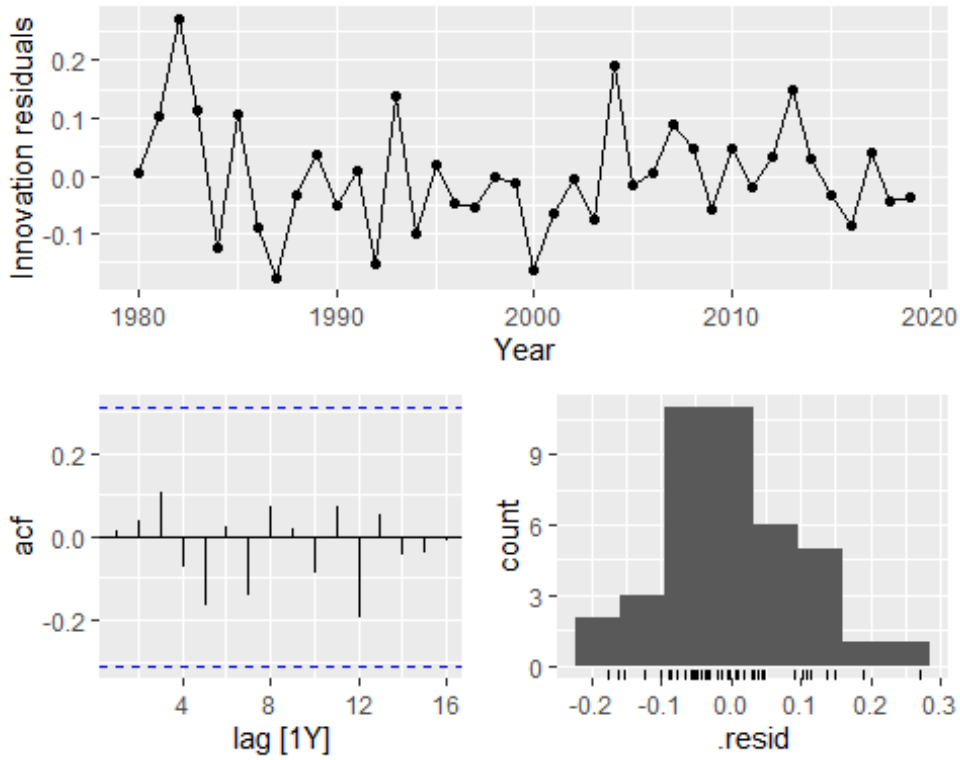*Figure 12: Normal Q-Q Plot for the ETS model of female students*

Figure 13: Residual diagnostics for the ARIMA model of male students
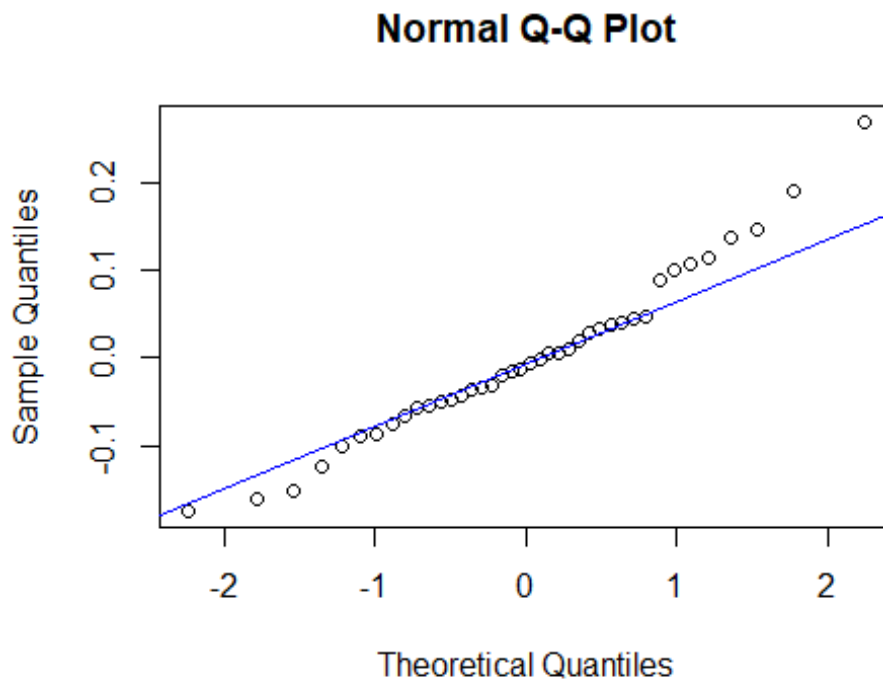

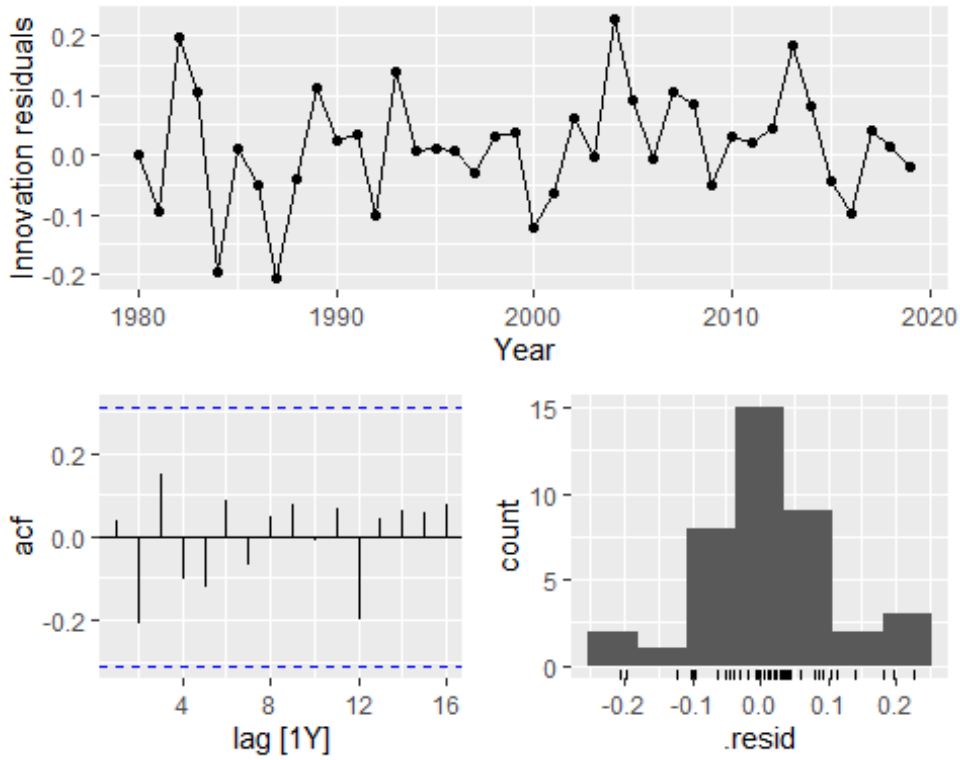*Figure 14: Normal Q-Q Plot for the ARIMA model of male students*

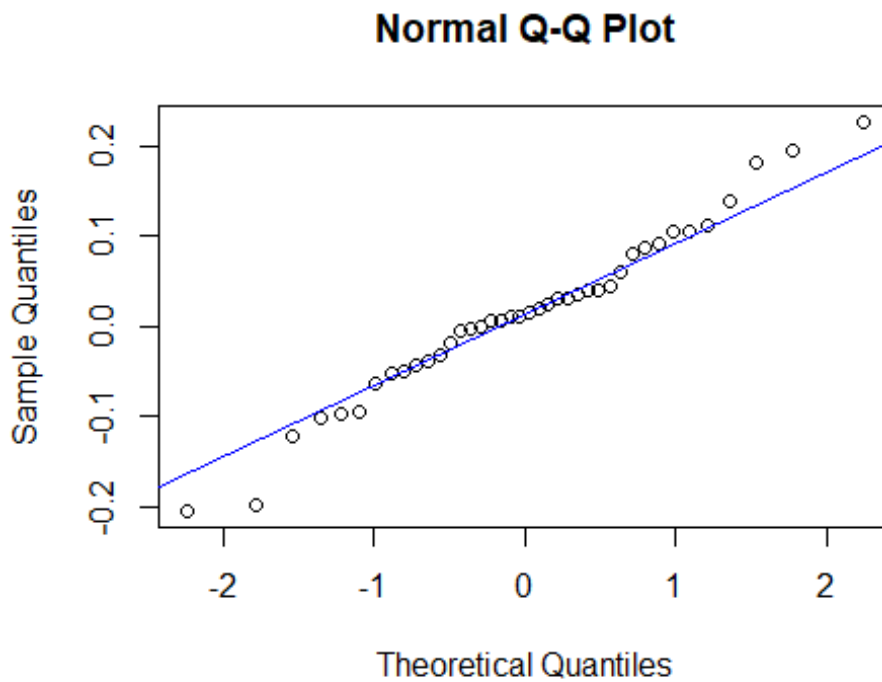*Figure 15: Residual diagnostics for the ETS model of male students*

Figure 16: Normal Q-Q Plot for the ETS model of male students

Appendix 2: Commented R-Code

Load packages:

```
library(fpp3)
```

```
library(tidyverse)

library(fable)
library(tsibble)

library(lmtest)

library(readxl)

library(scales)
cbPalette <- c( "#E69F00", "#6B4E95", "#000000", "#F0E442",
"#0072B2", "#D55E00", "#CC79A7")
```

1. Tsibble objects: First, we need the data: Qatter contains data for total, male, and female.

```
Qatter <- read.csv2("Enrolment in tertiary Qatar.csv") #Load data

Qatter1 <- Qatter[1,5:54] #Pick Members of both sexes in tertiary
education, absolute number
Qatter2 <- Qatter[2,5:54]  #Females
Qatter3 <- Qatter[3,5:54] #Males

#Note: Qatter and Qatter1 are in wide format. We need long format
for R!

Qattertotal <-as.data.frame(t(Qatter1))
Qatterfemale <-as.data.frame(t(Qatter2))
Qattermale <- as.data.frame(t(Qatter3))
```

To account for missing values:

This data is incomplete. Cut at 1980.

```
Year <- as.data.frame(1980:2019)

Qattertotal <- Qattertotal[11:50,]
Qattertotal <-as.data.frame(cbind(Qattertotal, Year))

Qatterfemale <- Qatterfemale[11:50,]
Qatterfemale <-as.data.frame(cbind(Qatterfemale, Year))


Qattermale <- Qattermale[11:50,]
Qattermale <-as.data.frame(cbind(Qattermale, Year))

colnames(Qattermale) <- c("number", "year")

colnames(Qatterfemale) <- c("number", "year")

colnames(Qattertotal) <- c("number", "year")
```

Replace missing values:

For Qatari males, the value of 2006 is missing. This is simply the number of total minus female students.

```r
Qattermale[27,1] <- (10161-6866)
```

To convert these into tsibbles:

```r
Ttsibble <- tsibble(
  Year = Qattertotal$year,
  Observation = Qattertotal$number,
  index = Year
)

Ftsibble <- tsibble(
  Year = Qatterfemale$year,
  Observation = Qatterfemale$number,
  index = Year
)

Mtsibble <- tsibble(
  Year = Qattermale$year,
  Observation = Qattermale$number,
  index = Year
)
```

Next, let's plot them. For this, we need the observations to be numeric.

```r
is.numeric(Ttsibble$Observation)

Ttsibble$Observation <- as.numeric(Ttsibble$Observation)

is.numeric(Ttsibble$Observation)

is.numeric(Ftsibble$Observation)

Ftsibble$Observation <- as.numeric(Ftsibble$Observation)

is.numeric(Ttsibble$Observation)

is.numeric(Mtsibble$Observation)

Mtsibble$Observation <- as.numeric(Mtsibble$Observation)

is.numeric(Mtsibble$Observation)

#Some easier to read column names:
colnames(Ftsibble) <- c("Year", "Students")
colnames(Ttsibble) <- c("Year", "Students")
colnames(Mtsibble) <- c("Year", "Students")
```

There are various ways to deal with missing values. One way is to model them using an ARIMA model:

```r
Mtsibblefill <- Mtsibble %>%
  # Fit ARIMA model to the data containing missing values
```

```r
  model(ARIMA(Students)) %>%
  # Estimate the number of students for all periods
  interpolate(Mtsibble)

Ftsibblefill <- Ftsibble %>%
  # Fit ARIMA model to the data containing missing values
  model(ARIMA(Students)) %>%
  # Estimate the number of students for all periods
  interpolate(Ftsibble)


Ttsibblefill <- Ttsibble %>%
  # Fit ARIMA model to the data containing missing values
  model(ARIMA(Students)) %>%
  # Estimate the number of students for all periods
  interpolate(Ttsibble)

Mtsibblefill$Students <-  round(Mtsibblefill$Students, digits = 0)

Ttsibblefill$Students <- round(Ttsibblefill$Students, digits = 0)

Ftsibblefill$Students <- round(Ftsibblefill$Students, digits = 0)
```

Next, depict the data:

```r
Ftsibble1= bind_cols(Ftsibblefill, rep(as.factor("Female"),
times=40))

Mtsibble1= bind_cols(Mtsibblefill, rep(as.factor("Male"), times=40))

Ttsibble1= bind_cols(Ttsibblefill, rep(as.factor("All"), times=40))

colnames(Ftsibble1) <- c("Year", "Students", "Gender")
colnames(Ttsibble1) <- c("Year", "Students", "Gender")
colnames(Mtsibble1) <- c("Year", "Students", "Gender")
AllTsibble <-rbind.data.frame(Ttsibble1, Ftsibble1, Mtsibble1)
is_tsibble(AllTsibble)

cbPalette <- c("#009E73", "#E69F00", "#6B4E95", "#000000",
"#F0E442", "#0072B2", "#D55E00", "#CC79A7")
# To use for fills, add
# scale_fill_manual(values=cbPalette)
# To use for line and point colors, add
ggplot(AllTsibble, aes(Year, Students, group = Gender, col-
our=Gender)) +
geom_line(size=1.2)+scale_colour_manual(values=cbPalette)
```

 Change the style of this plot and export:

```r
graph_Qatari_Students <-  ggplot(AllTsibble, aes(Year, Students,
group = Gender, colour=Gender)) +
geom_line(size=1.2)+scale_colour_manual(values=cbPalette)+
   labs(title="Students in Qatar by Gender", y="Number of students"
```

```
) +
   theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
         plot.background = element_rect(fill="white", col-
our="white"),
   panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
   panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))


png(filename="Students in Qatar by gender.png",
    type="cairo",
    units="in",
    width=5,
    height=4,
    pointsize=12,
    res=1080)
graph_Qatari_Students
dev.off()
```

Transform the data, take the logarithm:

```
Mtsibblefill$Students <- log(Mtsibblefill$Students)
Ftsibblefill$Students <- log(Ftsibblefill$Students)
```

Do some statistical tests: First, separate forecast and fit:

```
fit1 <- Ftsibblefill %>%
  model(ARIMA(Students, greedy=FALSE, approximation = FALSE))
fc1 <- fit1 %>% forecast(h = 5, bootstrap = TRUE)
autoplot(fc1, Ftsibblefill) +
   labs(title="Forecast Qatari Female students", y="Number of stu-
dents" )
```

Augment data, report:

```
aug1_log <- Ftsibblefill %>%
  model(ARIMA(Students)) %>%
  augment()

report(fit1)
```

Next, test for heteroskecasticity:

```
#Breusch-Pagan-test:
Diff_Ftsibblefill <- diff(Ftsibblefill$Students, lag=1, diff=1)

fitaux <- lm((diff(aug1_log$.resid))^2 ~-1+
as.matrix(Diff_Ftsibblefill))
df <- ncol(Ftsibblefill) - 1
bp.statistic <- (length(aug1_log$.resid)-1) * sum-
mary(fitaux)$r.squared
```

```
#Calculate p-value by comparing bp.statistic to the chi-squared dis-
tribution
bp.pvalue <- pchisq(bp.statistic, df)
bp.pvalue
```

There is no significant heteroskedasticity. A normal bg-test can therefore be used. Boot-strapping is not necessary if the residuals are also normally distributed.

Next, test for serial correlation:

```
Diff_Ftsibblefill <- diff(Ftsibblefill$Students, lag=1, diff=1)

bgtest(Diff_Ftsibblefill~diff(lag(aug1_log$.fitted)), order=10)
```

There is no significant serial correlation under the condition of heteroskedasticity.

Next, test for the residual mean being zero: Zero-mean t-test:

```
t.test(aug1_log$.resid)
```

Therefore, the residual mean is no significantly different from zero.

Finally, test for normal distribution of residuals:

```
shapiro.test(aug1_log$.innov)
```

The test is not significant. As normal distribution is the null hypothesis, it can be assumed that the residuals are normally distributed.

Plots of residual diagnostics:

```
Ftsibblefill %>%
  model(ARIMA(Students)) %>%
  gg_tsresiduals()

#A way to see if the residuals are normally distributed
qqnorm(aug1_log$.innov)
qqline(aug1_log$.innov, col = "blue")
```

Continue with ETS: Fit data, augment, report fit.

```
fit1e <- Ftsibblefill %>%
  model(ETS(Students))

aug1e <- Ftsibblefill %>%
  model(ETS(Students)) %>%
  augment()
report(fit1e)
```

Next, test for heteroskecasticity:

```
#Correct version, Breusch-Pagan-test:
e <- aug1e$.resid
fitaux <- lm(e^2 ~ as.matrix(Ftsibblefill))
df <- ncol(Ftsibblefill) - 1
bp.statistic <- (length(e)) * summary(fitaux)$r.squared
```

```
#Calculate p-value by comparing bp.statistic to the chi-squared dis-
tribution
bp.pvaluee <- pchisq(bp.statistic, df)
bp.pvaluee
```

No heteroskedasticity in the time series.

Test for serial correlation:

```
library(lmtest)

bgtest(Ftsibblefill$Students~-1+aug1e$.fitted, order=10)

#This is the data, regressed on the model's fitted values.
```

No serial correlation. Next, test for the residual mean being zero: Zero-mean t-test:

```
t.test(aug1e$.resid)
```

Therefore, the residual mean is no significantly different from zero.

Finally, test for normal distribution of residuals: A way to see if the residuals are normally distributed:

```
shapiro.test(aug1e$.innov)
```

The test is not significant. As normal distribution is the null hypothesis, it can be assumed that the residuals are normally distributed.

Plot residuals:

```
Ftsibblefill %>%
  model(ETS(Students)) %>%
  gg_tsresiduals()

qqnorm(aug1e$.innov)
qqline(aug1e$.innov, col = "blue")
```

Accuracy of forecasts can only be used if training and test datasets are used.

```
Ftest <- Ftsibblefill[36:40,]
Ftrain <- Ftsibblefill[1:35,]
```

Create test forecasts:

```
fit1test <- Ftrain%>%
  model(ARIMA(Students, greedy = FALSE, approximation = FALSE))
fc1test <- fit1test %>% forecast(h = 5)

fit1etest <- Ftrain %>%
  model(ETS(Students~error("A") + trend("A") + season("N")) ) #Adapt
model type to ETS model determined by fit
fc1etest <- fit1etest %>% forecast(h = 5)
```

Absolute errors:

```
accuracy(fc1test, Ftest)

accuracy(fc1etest, Ftest)
```

Winkler and CRPS values:

```
fc1test %>%
  accuracy(Ftsibblefill,
    list(winkler = winkler_score), level = 80)

fc1etest %>%
  accuracy(Ftsibblefill,
    list(winkler = winkler_score), level = 80)

fc1test %>%
  accuracy(Ftsibblefill,
    list(crps= CRPS), level = 80)

fc1etest %>%
  accuracy(Ftsibblefill,
    list(crps = CRPS), level = 80)
```

Do some statistical tests: First, separate forecast and fit:

```
Mit1 <- Mtsibblefill %>%
  model(ARIMA(Students, greedy=FALSE, approximation = FALSE))
Mc1 <- Mit1 %>% forecast(h = 5, bootstrap = TRUE)
autoplot(Mc1, Mtsibblefill) +
    labs(title="Forecast Qatari Male students", y="Number of stu-
dents" )

aug2 <- augment(Mit1)
```

Next, test for heteroskecasticity:

```
#Breusch-Pagan-test:

e <-diff( aug2$.resid)
fitaux <- lm(e^2 ~-1+ diff(Mtsibblefill$Students))
df <- ncol(Mtsibblefill) - 1
bp.statistic <- (length(e)-1) * summary(fitaux)$r.squared
#Calculate p-value by comparing bp.statistic to the chi-squared dis-
tribution
bp.pvaluem <- pchisq(bp.statistic, df)
bp.pvaluem
```

There is no significant heteroskedasticity. A normal bg-test can therefore be used.

Next, test for serial correlation:

```
library(lmtest)

bgtest(diff(Mtsibblefill$Students)~diff(lag(aug2$.resid)), order=10)
```

There is no significant serial correlation.

Next, test for the residual mean being zero: Zero-mean t-test:

```
t.test(aug2$.resid)
```

Therefore, the residual mean is no significantly different from zero.

Finally, test for normal distribution of residuals:

```
shapiro.test(aug2$.innov)
```

The test is not significant. As normal distribution is the null hypothesis, it can be assumed that the residuals are normally distributed. Since the data is also homoscedastic, bootstrapping is not necessary.

Plots of residual diagnostics:

```
Mtsibblefill %>%
  model(ARIMA(Students)) %>%
  gg_tsresiduals()

#A way to see if the residuals are normally distributed:
qqnorm(aug2$.innov)
qqline(aug2$.innov, col = "blue")
```

Next, repeat for ETS:

```
Mit2 <- Mtsibblefill %>%
  model(ETS(Students))
Mc2 <- Mit2 %>% forecast(h = 5, bootstrap = TRUE)
autoplot(Mc2, Mtsibblefill) +
    labs(title="Forecast Qatari Male students", y="Number of students" )

aug2e <- augment(Mit2)
```

Next, test for heteroskecasticity:

```
#Breusch-Pagan-test:
e <- aug2e$.resid
fitaux <- lm(e^2 ~ -1+as.matrix(Mtsibblefill))
df <- ncol(Mtsibblefill) - 1
bp.statistic <- (length(e)) * summary(fitaux)$r.squared
#Calculate p-value by comparing bp.statistic to the chi-squared distribution
bp.pvalueme <- pchisq(bp.statistic, df)
bp.pvalueme
```

No heteroskedasticity. Test for serial correlation.

```
library(lmtest)

bgtest(Mtsibblefill$Students~-1+aug2e$.fitted, order=10)

#This is the data, regressed on the model's fitted values.
```

No serial correlation. Next, test for the residual mean being zero: Zero-mean t-test:

```
t.test(aug2e$.resid)
```

Therefore, the residual mean is no significantly different from zero.

Finally, test for normal distribution of residuals: A way to see if the residuals are normally distributed:

```
shapiro.test(aug2e$.innov)
```

The test is not significant. As normal distribution is the null hypothesis, it can be assumed that the residuals are normally distributed.

Plots of residual diagnostics:

```
Mtsibblefill %>%
  model(ETS(Students)) %>%
  gg_tsresiduals()

#A way to see if the residuals are normally distributed

qqnorm(aug2e$.innov)
qqline(aug2e$.innov, col = "blue")
```

Accuracy of forecasts can be estimated by using training and test datasets.Split up the data:

```
Mtest <- Mtsibblefill[36:40,]
Mtrain <- Mtsibblefill[1:35,]
```

Create test forecasts:

```
Mit1test <- Mtrain%>%
  model(ARIMA(Students, greedy = FALSE, approximation = FALSE))
Mc1test <- Mit1test %>% forecast(h = 5)

Mit1etest <- Mtrain %>%
  model(ETS(Students~error("M") + trend("A") + season("N")) )
Mc1etest <- Mit1etest %>% forecast(h = 5)
```

Look at their errors: Absolute errors:

```
accuracy(Mc1test, Mtest)
```

```
accuracy(Mc1etest, Mtest)
```

Winkler and CRPS scores:

```
Mc1test %>%
  accuracy(Mtsibblefill,
    list(winkler = winkler_score), level = 80)

Mc1etest %>%
  accuracy(Mtsibblefill,
    list(winkler = winkler_score), level = 80)
```

```
Mc1test %>%
  accuracy(Mtsibblefill,
    list(crps= CRPS), level = 80)

Mc1etest %>%
  accuracy(Mtsibblefill,
    list(crps = CRPS), level=80)
```

Create Forecasts:

```
Mit <- Mtsibblefill %>%
  model(ARIMA(Students))
Mc <- Mit %>% forecast(h = 5)
autoplot(Mc, Mtsibblefill) +
    labs(title="Forecast Qatari Male students", y="Number of stu-
dents" )
```

Save forecasts:

```
graph_forecast_Qatari_male_Students <-  autoplot(Mc, Mtsibblefill,
show_gap = FALSE, size=1.1, colour="#009E73") +geom_line(aes
(x=Year, y= Students), size=1.1, colour="#009E73")+
    labs(title="Forecast male students in Qatar", y="Number of stu-
dents" ) +
    theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
        plot.background = element_rect(fill="white", col-
our="white"),
  panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
  panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))


png(filename="Forecast male students in Qatar.png",
    type="cairo",
    units="in",
    width=5,
    height=4,
    pointsize=12,
    res=1080)
graph_forecast_Qatari_male_Students
dev.off()
```

Forecast for female students:

```
Ftsibblefill %>%
  model(ARIMA(Students)) %>%
  forecast(h = 5) %>%
  autoplot(Ftsibblefill) +
  labs(title="Forecast Qatari Female students", y="Number of stu-
dents" )
```

Save forecast for female students:

```
graph_forecast_Qatari_female_Students <-  autoplot(fc1, Ftsibble-
fill, show_gap = FALSE, size=1.1, colour="#F0E442") +geom_line(aes
(x=Year, y= Students), size=1.1, colour="#E69F00")+
   labs(title="Forecast female students in Qatar", y="Number of stu-
dents" ) +
   theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
        plot.background = element_rect(fill="white", col-
our="white"),
  panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
  panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))


png(filename="Forecast female students in Qatar.png",
    type="cairo",
    units="in",
    width=5,
    height=4,
    pointsize=12,
    res=1080)
graph_forecast_Qatari_female_Students
dev.off()
```

Create tibble: Save the Education levels as ordinal values so ggplot keeps the order of varia-
bles when plotting.

```
data <- data.frame(Unemployment = c( 0.52, 3.65, 1.87,0.07, 0.14,
0.14), Gender = c( "Female", "Female", "Female","Male", "Male",
"Male"),Education= factor(c("Basic","Intermediate",  "High",
"Basic","Intermediate",  "High"), ordered = TRUE) )

Education <- data$Education

Education <- factor(Education, order=TRUE, levels = c("Basic", "In-
termediate", "High") )

data$Education <- Education
data <- as_tibble(data)
is_tibble(data)
```

Note: 1 = Basic education, 2 = Intermediate Education, 3= Higher Education. Plot this:

```
ggplot(data=data, mapping = aes(x=Education,
y=Unemployment))+geom_line(aes(group = Gender, color=Gender))
```

Save plot:

```
graph_Qatar_Unemployment <-  ggplot(data=data, mapping =
aes(x=Education, y=Unemployment))+geom_col(aes(group = Gender,
```

```r
fill=Gender),size=1.1, colour="#E69F00") +
   labs(title="Unemployment by Gender and Education",
y="Unemployment rate" ) +
   theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
        plot.background = element_rect(fill="white", col-
our="white"),
  panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
  panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))


   graph_Qatar_Unemployment <-  ggplot(data=data, mapping =
aes(x=Education, y=Unemployment))+geom_col(aes(group = Gender,
fill=Gender)
  , position="dodge")+scale_fill_manual(values=cbPalette)+
     labs(title="Unemployment by Gender and Education",
y="Unemployment rate" ) +
   theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
        plot.background = element_rect(fill="white", col-
our="white"),
  panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
  panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))

png(filename="Unemployment by Gender and Education.png",
    type="cairo",
    units="in",
    width=5,
    height=4,
    pointsize=12,
    res=1080)
graph_Qatar_Unemployment
dev.off()
```

Next, do the same for the labour market participation rate:

```r
data2 <- data.frame(Part = c( 61.73, 37.9, 60.94 ,96.42, 94.87,
96.84), Gender = c( "Female", "Female", "Female","Male", "Male",
"Male"),Education= factor(c("Basic","Intermediate",  "High",
"Basic","Intermediate",  "High"), ordered = TRUE) )

Education <- data2$Education

Education <- factor(Education, order=TRUE, levels = c("Basic", "In-
termediate", "High") )

data2$Education <- Education
```

```r
data2 <- as_tibble(data2)
is_tibble(data2)

graph_Qatar_Labour_market <-  ggplot(data=data2, mapping =
aes(x=Education, y=Part))+geom_col(aes(group = Gender, fill=Gender),
position="dodge")
cbPalette <- c( "#E69F00", "#6B4E95", "#000000", "#F0E442",
"#0072B2", "#D55E00", "#CC79A7")
```

Save graph:

```r
graph_Qatar_Labour_market <-  ggplot(data=data2, mapping =
aes(x=Education, y=Part))+geom_col(aes(group = Gender, fill=Gender),
position="dodge")+scale_fill_manual(values=cbPalette)+
   labs(title="Labour market participation rate", y="Participation
rate" ) +
   theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
         plot.background = element_rect(fill="white", col-
our="white"),
   panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
   panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))

png(filename="Labour participation rate by Gender and Educa-
tion.png",
    type="cairo",
    units="in",
    width=5,
    height=4,
    pointsize=12,
    res=1080)
graph_Qatar_Labour_market
dev.off()
```

Load data on Qatari Graduates:

```r
Qatar_Graduates_2020 <- read_excel("Qatar_Graduates_2020.xlsx")

colnames(Qatar_Graduates_2020) <- c("Qatari men", "Qatari women",
"Non-Qatari men", "Non-Qatari women")
Graduates <- pivot_longer(Qatar_Graduates_2020, c("Qatari men", "Qa-
tari women", "Non-Qatari men", "Non-Qatari women"), names_to =
"Identity", values_to = "Degree", names_repair = "unique")

colnames(Graduates) <- c("Degree", "Identity", "Graduates")
```

Next, prepare to plot this, summarize Master, Doctorates, Diploma:

```r
Graduates[is.na(Graduates)] <- 0

Doctorate <- Graduates[165:192,]
```

```
Master <- Graduates[57:164,]
Diploma <- Graduates[45:56,]

Graduates_summary_1 <- Graduates[1:44,]
Diploma_summary <-  Diploma %>%  group_by(Identity) %>% summarise(
Sum = sum(Graduates))

Master_summary <-  Master %>%  group_by(Identity) %>% summarise( Sum
= sum(Graduates))

Doctorate_summary <-  Doctorate %>%  group_by(Identity) %>% summa-
rise( Sum = sum(Graduates))

Doctorate_summary <- cbind( rep("Doctorate",
times=length(Doctorate_summary$Identity)),Doctorate_summary)

Diploma_summary <- cbind( rep("Diploma",
times=length(Diploma_summary$Identity)),Diploma_summary)

Master_summary <- cbind( rep("Master",
times=length(Master_summary$Identity)),Master_summary)

colnames(Master_summary) <- c("Degree", "Identity", "Graduates")
colnames(Diploma_summary) <- c("Degree", "Identity", "Graduates")
colnames(Doctorate_summary) <- c("Degree", "Identity", "Graduates")


Graduates_summary <- bind_rows(Graduates_summary_1, Diploma_summary,
Master_summary, Doctorate_summary)
```

Depict them:

```
cbbPalette <- c(     "#0072B2","#F0E442",
"#6B4E95","#E69F00","#D55E00",  "#CC79A7","#000000")

ggplot(Graduates_summary)+geom_col(aes(x=Degree, y=Graduates,
fill=Identity))+coord_flip()+scale_fill_manual(values=cbbPalette)

graph_Qatari_Graduates <-
ggplot(Graduates_summary)+geom_col(aes(x=Degree, y=Graduates,
fill=Identity))+coord_flip() +
  labs(title="Qatari Graduates in 2019", y="Number of students" ) +
  theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
        plot.background = element_rect(fill="white", col-
our="white"),
  panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
  panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))+scale_fill_manual(values=cbbPalette)+theme(text =
element_text(size = 16))
```

```
png(filename="Qatari Graduates.png",
    type="cairo",
    units="in",
    width=10,
    height=6,
    pointsize=12,
    res=1080)
graph_Qatari_Graduates
dev.off()
```

Calculate:

```
Calculation <- read_excel("Calculation.xlsx")
```

```
View(Calculation)
Calculation <- as_tibble(t(Calculation))

#Percentage of working age women:

Matrix <- matrix(c(1,    1    ,1,
0.6094, 0.379,  0.6173,
0.0187*0.6094,0.0365*0.379,0.0052*0.6173
), nrow=3, byrow=TRUE)

 Matrix_b<-matrix(c(401618,224143,3586))

solve(Matrix, Matrix_b)
```

In the matrix, the first row gives the number of women with a certain educational status above 15. The second gives the number of these women the labour force. The third gives the number of these women unemployed.

Now, we can construct a "full" dataset:

```
data_high_participation <- data_frame(
  Degree1 = c(rep(1, 157893)),
  Degree = c(rep(1, 157893)),
  Participation = c(rep(0, 157894*0.39), rep(1, 157894*0.61 ))
)

data_intermediate_participation <- data_frame(
  Degree1 = c(rep(1, 94537)),
  Degree = c(rep(0, 94537)),
  Participation = c(rep(0, 94538*0.621), rep(1, 94538*0.379
 ))
)
data_test <- rbind(data_high_participation, da-
ta_intermediate_participation)


data_intermediate_participation <- data_frame(
  Degree1 = c(rep(1, 94537)),
```

```
  Degree = c(rep(0, 94537)),
  Participation = c(rep(0, 94538*0.621), rep(1, 94538*0.379
))
)
```

Logistic regression of data on participation:

```
summary(glm(data_test$Participation ~data_test$Degree, fami-
ly="binomial"))
```

```
require(broom) # for tidy()
```

```
require(knitr) # for kable()
```

```
model <- glm(data=data_test, Participation ~ Degree, fami-
ly="binomial")
out <- tidy(model)
out
```

```
kable(out)
```

Likelihood ratio test:

```
require(lmtest)
```

```
lrtest(model)
```

Construct a full dataset for unemployment:

```
data_high_employment <- data_frame(
  Degree1 = c(rep(1,  157893*0.6094)),
  Degree = c(rep(1, 157893*0.6094)),
  Employment = c(rep(0, 96220*0.0187), rep(1, 96220*0.9813 ))
)

data_intermediate_employment <- data_frame(
  Degree1 = c(rep(1, 94537*0.0379)),
  Degree = c(rep(0, 94537*0.0379)),
  Employment = c(rep(0,94537*0.0379*0.0365), rep(1, 94537*0.0379*(1-
0.0365)
))
)
data_test_2 <- rbind(data_high_employment, da-
ta_intermediate_employment)
model_Employment <- glm(data=data_test_2, Employment ~ Degree, fami-
ly="binomial")
summary(model_Employment)
```

Likelihood ratio test:

```
lrtest(model_Employment)
```

Export summaries:

```
require(broom) # for tidy()
require(knitr) # for kable()


model <- glm(data=data_test_2, Employment ~ Degree, fami-
ly="binomial")
out <- tidy(model)
out

kable(out)


Qatardata <- read_excel("Qatardata.xlsx")
View(Qatardata)
```

Calculate absolute value of Rent:

```
Qatardata1 <- mutate(Qatardata, Rent= (Qatardata$`Total natural re-
sources rents (% of GDP)`/100)*Qatardata$GDP)
Qatardata1$Year <- seq(2000,2019)
Qatardata1$`Total natural resources rents (% of GDP)`=NULL

Qatardata3 <- Qatardata1 %>% pivot_longer(c(GDP, Industry, Rent,
Manufacturing,Services), names_to = "Sector", values_to = "Number")

Qatardata3$Economy <- as.factor(Qatardata3$Sector)

ggplot(data=Qatardata3, aes(x=Year, y=Number,
col=Sector))+geom_line(aes(group=Sector))
```

Scale plot:

```
Industry_plot <- ggplot(data=Qatardata3, aes(x=Year, y=Number,
col=Sector))+geom_line(aes(group=Sector), size=1.1)+
   labs(title=" Economic growth in Qatar", y="Value in constant lo-
cal currency units" ) +
   theme(panel.background = element_rect(fill = "#FFFFFF", colour =
"black"),
        plot.background = element_rect(fill="white", col-
our="white"),
  panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),
  panel.grid.minor = element_line(size = 0.25, linetype = 'solid',
colour = "grey"))+scale_y_continuous(labels=
  label_number(scale=1e-9, suffix="b", accuracy=1))

png(filename="Value added by sector.png",
    type="cairo",
    units="in",
    width=5,
    height=4,
    pointsize=12,
```

```
    res=1080)
Industry_plot

dev.off()
```

#Plot of employment by sector:

```
Jobs_by_sector <- read_excel("~/R/Master Thesis/Master thesis Qatari
economy/Jobs by sector.xlsx")
View(Jobs_by_sector)
#Jobs_by_sector <- Jobs_by_sector%>%filter(contains('male'))

Employment <- Jobs_by_sector %>% pivot_longer(-c('Country Name',
'Series Name'), names_to = "Year", values_to = "Employment rate")


Year <- rep(1991:2019,6)
Employment$Year <- Year
Employment$`Employment rate` <- round(Employment$`Employment rate`,
2)

Employment <-Employment %>% separate( 'Series Name',
c('Gender','in', 'Sector'))
Employment <-Employment %>% select(!contains(c('in', 'country')))

Employment$Gender <- as.factor(Employment$Gender)
Employment$Sector <- as.factor(Employment$Sector)
```

Paint graph:

```
Colorpalette <- c("#0CB702","#ABA300", "#ED68ED")

Linechart <-  ggplot(data=Employment, aes(x=Year, y=`Employment
rate`, color=Sector))+geom_line(aes(group=Sector),
size=1.1)+facet_grid(~Gender)+ labs(title=" Employment by sector",
y="Employment by Sector in Percent" ) +    theme(panel.background =
element_rect(fill = "#FFFFFF", colour = "black"), plot.background =
element_rect(fill="white", colour="white"),
  panel.grid.major = element_line(size = 0.5, linetype = 'solid',
colour = "black"),  panel.grid.minor = element_line(size = 0.25,
linetype = 'solid', colour =
"grey"))+scale_color_manual(values=Colorpalette)+theme(panel.spacing
= unit(0.6, "cm", data = NULL))

png(filename="Employment by sector.png",
    type="cairo",
    units="in",
    width=7,
    height=4,
    pointsize=12,
    res=1080)
```

```
Linechart
dev.off()
```