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Modeling Sectoral Employment in Saudi Arabia

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Key Points

Saudi Arabia is undergoing broad economic reforms under Saudi Vision 2030, the government's masterplan for national development. The program, which includes over 300 specific goals and about 80 large projects slated for implementation by the year 2030, will reshape the structures and proportions of major sectors across the economy. To better understand the potential impacts of these changes on the Kingdom's labor market, we assess the historical determinants of employment in 10 sectors for both long-run and short-run timeframes. Our key findings are summarized below.

The long-run positive impact of the value-added on employment differs across sectors. Keeping other factors unchanged, a 1% increase in value-added has the smallest effect on employment in the non-oil mining sector, where it rises 0.23%, and the largest impact in government services, where it gains 1.28%. Agriculture, construction, and other services sectors each exhibit increases of about 1%.

Similarly, the long-run impact of wages is largest (in absolute value) for non-oil mining (-1.61) and smallest for the government services (-0.26).

In the long run, of the 10 sectors, non-oil manufacturing and non-oil mining display the lowest sensitivity to value-added and the highest to wages.

The short run positive effects of changes in value-added on employment growth are statistically significant in agriculture, distribution, government services, other services and utilities.

Wage growth has significant contemporaneous negative impact on employment growth in all sectors other than government services.

In the short run the agricultural sector shows the most sensitivity to changes in value-added and wages.

The magnitudes of the impacts of wages and value-added on employment differ across sectors. Therefore, policies should be designed and implemented at the sectoral level rather than as a 'one size fits all' national approach.

Employment can be increased in the examined sectors mainly by improving value-added and wages.

- Greater demand for domestically produced goods and services can be stimulated, and 'buy local' import substitution can be promoted. This would raise sectoral output levels and thus employment.
- Working-age citizens can be incentivized to participate in the labor force, and public authorities have already outlined some relevant measures in Nitaqat policy to support Saudi employment. Additionally, setting minimum wage levels for all workers, Saudis and non-Saudis alike, is recommended by the International Labor Organization and supported by previous empirical studies.

Key Points

- Increasing the minimum wage level of Saudi employees through an ‘expat levy’ would also raise the labor force participation of Saudi nationals.
- Although the underlying market-based determinants of wages, such as prices and productivity, can be impacted to increase employment, such indirect channels are rather limited.

Summary

Achieving the desired level of employment is central to macroeconomic policy. Regulators should have a better understanding of employment dynamics in order to design appropriate policies and test their impact. Healthy employment levels not only benefit household income and the production factor of firms, but also help maintain sustainable economic growth and reduce poverty. Employment is a central element in the concept of inclusive growth (UN 2006; Bhalla 2007). Therefore, the dynamics of employment determinants have been the subject of considerable research to date.

As Saudi Arabia proceeds with historic reforms, the question of what drives employment is crucial for the country's policymakers. Saudi Vision 2030 (SV2030), the government's strategic roadmap for the Kingdom's future development, and related initiatives, such as the National Transformation Program, establish numerous employment-related schemes and set targets for employment levels. Between 2016 and 2030, SV2030 aims to reduce unemployment from 11.6% to 7%; expand women's participation in the workforce from 22% to 30%; increase the employment rate of Saudi nationals in the oil and gas sectors from 40% to 75%; raise the private sector's contribution to GDP from 40% to 65%; and grow the share of non-oil exports in non-oil GDP from 16% to 50% (SV 2030; NTP 2019. To achieve these and other targets, the authorities should conduct a comprehensive examination of employment in the country; this in turn necessitates an assessment of the relationships between employment and its main determinants.

Like other emerging economies, Saudi Arabia faces constant structural change and large, persistent differences between sectors in productivity and earnings. In the context of the Kingdom, microeconomic dynamics, government support programs for certain economic activities, sectoral growth patterns, and capital-enhancing technological progress can have widely varying impacts on employment across sectors. From a policy perspective, sector-level growth and employment trends have important implications for future development strategies. Therefore, the objective of this research is to investigate the impacts of the primary determinants of employment — namely, GDP and wages — in different sectors of the Saudi Arabian economy.

We consider 10 economic sectors: agriculture and forestry; construction; distribution and retail, wholesale, hotels and catering; finance, insurance and business services; government services; non-oil manufacturing; non-oil mining; other services (including community, social and personal services); transport, storage and communication; and utilities (electricity, gas and water).

Our analysis addresses two primary research questions:

For each sector, what are the impacts of real wages and output on employment in the long and short run?

For each sector, how quickly does employment return to its long-run equilibrium path after deviating in the short run?

We apply cointegration and equilibrium correction methods to time series data for the above 10 sectors in Saudi Arabia for 1995 through 2016. Demand-side modeling of employment provides a theoretical foundation for this research.

We find that there is a long-run relationship between employment and its determinants in all 10 sectors. In other words, employment is positively affected by the value added while the impact of the wage is negative across the sectors in the long run. It is also found that growth rates of the values added

and wage have statistically significant positive and negative impacts, respectively, on employment growth across the sectors in the short run. Finally, we find that the short-run dynamics in employment converges to the long-run relationship in all the sectors since the sectoral speed of adjustment (SoA) coefficients are statistically significant and negative, indicating that the short-run dynamics converge with the long-run relationships in all sectors. However, the magnitudes of the effects vary across the sectors due to their idiosyncratic features.

The results of this study offer policymakers quantitative insight into how the key determinants of employment, such as income and wages, can affect sector-level employment in Saudi Arabia, in both the long and short run. The findings can also guide authorities seeking to balance employment across sectors. Furthermore, our observation that the impacts of output and wages vary across the 10 sectors highlights the importance of designing and implementing economic policies at the sectoral level and the shortcomings of a 'one size fits all' approach, which would fail to consider the distinct characteristics of each sector.

Employment can be increased in the sectors mainly by impacting their value-added generation and wage levels. First, policymakers can stimulate greater demand for domestically produced goods and services and promote 'buy local' import substitution of foreign goods and services. For all 10 sectors, these measures would raise long-run demand, thereby fueling greater sectoral income and, in turn, employment. However, in the short run, the potential for impact varies by sector. Agriculture and other services appear to be the most promising for the government to target, followed by government services and utilities. The distribution and retail sector exhibits less promise. The other sectors (construction; finance, insurance and business services; non-oil manufacturing; non-oil mining; and transport, storage and communication) do not exhibit potential for favorable impact in the short run. However, over the long run all the mentioned unfavorable sectors also become favorable.

Second, employment can be increased by inducing working-age people currently outside the labor force to join it, especially through wage-related policies. The Nitaqat ('Saudization') policy to support employment of Saudi nationals outlines some relevant regulations. Setting a minimum wage level for all workers (both Saudis and foreigners) is supported by the International Labor Organization (ILO) and previous empirical research (ILO 2018; Hertog 2018). Additionally, the labor force participation rate of Saudi nationals could be improved with minimum wages and/or an employment subsidy specifically for Saudis, which can be funded through an 'expat levy.' Moreover, the determinants of wages, such as prices and productivity, can be impacted to boost salaries and thereby lift employment in targeted sectors, although these indirect channels are rather limited.

This research contributes to the existing literature on employment in Saudi Arabia in the following ways. First, this research relies on the theoretical foundation and investigates employment effects of both output and wages, whereas earlier studies considered only the former. Second, we evaluate the relationships between employment and these two drivers at the sector level for 10 primary sectors of the Kingdom's economy. Third, we use up-to-date econometric techniques and tools including Autometrics, which provides parsimonious and theoretically interpretable specification and accounts for any policy and/or regime changes and the stability of the estimated coefficients.

Literature Review

In this section, we review relevant literature on the determinants of employment, especially economic output and wages, in Saudi Arabia. To the best of our knowledge, only five such studies exist for the Kingdom. We review these below, as well as research that examines other economies.

According to the existing literature, the most common factors of employment are labor costs (i.e., wages) and economic output/activity (e.g., Nickell 1984; Peterson 1988; Pesaran, Pierse, and Kumar 1989). Other explanatory variables can also be included in employment analysis, such as exchange rates (Bruno, Falzoni, and Helg 2004), inflation (e.g., Loboguerrero and Panizza 2003; Skare and Caorale 2014), trade (e.g., Freeman 2004; Bruno, Falzoni, and Helg 2004), oil prices (Papapetrou 2001; Uri 1996; Davis and Haltiwanger 2001), and taxation (e.g., Nickell 2003; Bassanini and Duval 2006).

Khodeir and Al Nuwaiser (2016) investigate the determinants of industrial employment in Saudi Arabia. They model industrial employment as a function of foreign direct investment (FDI), inflation (measured by consumer price index), and exports as a percentage of gross domestic product (GDP). The authors utilize annual time series data spanning from 1990 to 2014 and employ the autoregressive distributed lag (ARDL) bounds testing method developed by Pesaran, Shin and Smith (2001). Their long-run estimates reveal a negative relationship between FDI and employment. On the other hand, the study concludes that higher exports and inflation have statistically significant positive impact on employment. In the short run, all variables have negative but statistically insignificant impacts on employment. The study does not consider the main theoretically predicted determinants of employment, namely output and wages.

Alkhateeb et al. (2017a) assess the role of financial market development in job creation in Saudi Arabia by examining annual time series data for 1980 to 2015. The authors model employment as a function of total credit to GDP, remittances outflows, human capital index and investment. The authors also consider Saudization by measuring it with a dummy variable, which takes unity after the implementation of the policy in 1985 and zero prior to 1985. The results of their ARDL bounds testing indicate that in Saudi Arabia, financial market development, Saudization, and investment tend to promote employment, whereas outflow remittance and human capital index erode it (though the latter was found statistically insignificant). As with the above study by Khodeir and Al Nuwaiser (2016), this research does not consider either output or wages.

Another paper by Alkhateeb et al. (2017b) investigates the role of oil price fluctuations and economic growth in employment in Saudi Arabia, again examining annual data from 1980 to 2015. The authors measure the symmetric and asymmetric impacts of oil prices on employment using linear and non-linear ARDL models. The parameter estimates show that oil prices and economic growth each have significant positive effects on generating more jobs within the economy. In the long run, with each 1% increase in these variables, employment rises by 0.19% and 0.005%, respectively. In the short run, economic growth with two lags has positive and statistically significant impact on employment. From the asymmetric ARDL model with oil price increases and decreases, a 1% increase in economic growth raised employment by 0.002%. In the short run, a 1% increase in economic growth increases employment by 0.0027%.

A third study by the same authors examines the impacts of oil revenue, government expenditures, and economic growth on employment in Saudi Arabia from 1991 to 2016 (Alkhateeb et al. 2017c). Based on the results of a Johansen cointegration test, they conclude long-run relationships between employment and considered explanatory variables. In addition, the authors find Granger causality running from oil revenue, public spending, and economic growth to employment over the long run whereas in the short run, only oil revenues and public spending cause employment. Unfortunately, the study does not report any long- or short-run coefficients/elasticities for the considered explanatory variables, including economic growth.

Alkhateeb, Sultan and Mahmood (2017) also examine whether trade openness, government spending on education, and economic growth influence employment in Saudi Arabia, once more examining annual time series data covering 1980-2015. The results obtained from ARDL estimations reveal that all these variables have positive long-run impacts on employment, which rises by 0.005% for each 1% increase in economic growth.

None of the four studies above discuss why wages, one of the theoretically articulated determinants of employment, have not been considered. The authors also do not explain why GDP growth, rather than GDP level, is considered in the analysis.

Additional research analyzes the link between economic growth and unemployment in Saudi Arabia based on Okun's law (e.g., Al-Habees and Abu Rumman 2012; Khrais and Al-Wadi 2016; Abou Hamia 2016). A few other studies (e.g., Alotaibi 2017) describe employment in the Kingdom but do not apply any statistical and/or econometric tools to estimate the relationships in the labor market.

Due to the lack of empirical research that models employment in Saudi Arabia by considering its theoretically articulated determinants, we extend this review to studies of other economies that explore the relationships between employment and its drivers.

Chletsos and Kollias (1997) investigate the relationships of employment to real wages and the output of various sectors (secondary, agricultural and non-agricultural) in Greece using annual data from 1960 to 1992. They report evidence supporting the presence of long-run relationships between employment and these variables. Their analysis also confirms causal relationships of employment with secondary sector and non-agricultural output.

Aydiner-Avsar and Onaran (2010) identify real wages and real output as the primary drivers of employment for Turkey's manufacturing sector and also measure the impact of other factors on employment, including trade. They examine annual data from 1973 to 2001 to analyze employment dynamics using panel data econometric techniques. Their estimated model reveals that output and real wages are key determinants of employment in the manufacturing industry sector though the role of output is higher than real wages.

Mourre (2006) investigates the behavior of employment in the euro area using quarterly data from 1970 to 2002. To model employment, the author utilizes a constant returns to scale production function with output, labor costs, and labor intensity as the main determinants, and includes a time trend as an additional variable to capture technological progress. The results, based on an error correction model, indicate that higher employment dynamics during the 1970s and earlier 1990s can be attributed to lagged growth of output and wages and the time

trend. Nonetheless, using data from 1997 to 2001, the model estimates that the identified determinants partially explain employment. In other words, the author finds that alternative factors, namely shifts in the sectoral composition of employment, labor tax, and changes in labor laws, also contribute to employment dynamics.

Tadjoeddin and Chowdhury (2012) estimate employment behavior in Indonesia with lagged employment, output, and real wages as key variables. They examine aggregate employment data, divided into eight sectors, from 1993 to 2006. Their study applies the generalized method of moments estimation technique to assess the contributions of the identified determinants to sectoral employment before and after the Asian financial crisis, which began in mid-1997. Their empirical results suggest that sectoral output is the key determinant of employment in all sectors. Lagged employment plays a significant role in four sectors, while real wages are only important in agriculture and services. During the post-crisis period, sectoral output remains the main driver of employment in all sectors while the other variables are also influential in most sectors.

Sahin, Tansel and Berument (2013) analyze the association between output and employment in Turkey using quarterly data from 1988 to 2008 at the aggregate country level and for nine sectors. Their empirical results show the absence of a long-run relationship between economic output and employment. However, their long-run analysis indicates relationships between aggregate output and non-agricultural employment, and between sector-level employment and economic output for seven of the nine sectors. For the short run, their results suggest the lack of significant relationships between sector-level employment in most sectors, including non-agricultural employment, and economic output.

Islam and Nazara (2000) estimate employment elasticity in Indonesia by modeling employment as functions of GDP and output for five sectors (agriculture, industry, trade, services, and other). They employ the ordinary least squares estimation method using annual data from 1977 to 1996. Their findings indicate that employment is determined by aggregate as well as sectoral output.

In concluding the literature review we offer three remarks. First, to the best of our knowledge, few studies exist that investigate employment in Saudi Arabia. Second, they do not analyze wages and consider output growth instead of output level for their long-run analysis. Third, the studies of other economies reviewed above confirm that economic output and wages are viewed as the main determinants of employment in prevailing empirical analysis.

Therefore, this research contributes to the existing literature by modeling the long-run and short-run impacts of economic output and wages on employment for 10 sectors in Saudi Arabia. The results of our empirical analysis can help inform policymakers regarding the extent to which economic output and wages impact employment in the long and short run.

Sectoral Employment Structure in Saudi Arabia

Sector-level employment dynamics offer insight into overall labor market development in Saudi Arabia. Table 1a shows the shares of employment for 10 major sectors of the Kingdom's economy from 1995 to 2017. Overall, the distribution of employment varied little during this timeframe. The three largest sectors — distribution, government and others — account for the majority of total employment, but their collective share declined from 58% in 1995 to 52% in 2017.

The construction sector dropped from 16% of employment in 2016 to 11% in 2017. The share of finance, insurance and business services (FIBU) increased from 4% in 1995 to 5.8% in 2017. As the proportion of expatriates in Saudi Arabia's labor force is more than 50%, foreign labor may be one reason for the stagnant labor share in various sectors in the last 20 years.

Table 1a. Sectoral employment shares, 1995-2017 (%).

	1995	2000	2005	2010	2015	2016	2017
AGR	6.75	6.12	4.16	4.30	5.76	4.52	5.92
CON	11.52	9.03	11.39	11.65	13.01	16.26	10.83
DIS	18.65	18.66	19.65	21.00	12.54	14.39	16.18
FIBU	3.99	3.19	4.51	4.77	3.77	3.64	5.82
GOV	19.62	19.54	19.65	17.74	17.70	17.77	18.43
MANNO	0.44	0.50	0.55	0.39	0.63	0.58	0.58
MINOTH	1.50	1.59	1.56	1.18	1.23	1.15	1.19
OTHS	19.75	18.62	19.14	16.69	19.66	16.76	17.01
TRACOM	4.26	4.24	4.05	4.70	4.61	4.61	4.65
U	1.52	1.33	1.09	1.12	1.22	1.06	1.08

Note: AGR=agriculture and forestry; CON=construction; DIS=distribution-retail, wholesale, hotels and catering; FIBU=finance, insurance and business services; GOV=government service; MANNO=non-oil manufacturing; MINOTH=non-oil mining; OTHS=other services (community, social and personal services); TRACOM=transport, storage and communication; U=utilities-electricity, gas and water; ET=total employment.

Table 1b summarizes the growth rates of employment in the 10 sectors. The rightmost column shows that over the entire period of 1995 to 2017, employment grew fastest in FIBU (11.26% per annum) followed by non-oil manufacturing (9.88%). We also note declines in employment during certain periods for agriculture (between 1995 and 2005) and distribution (between 2010 and 2015). Overall, table 1b indicates that for most of the sectors, employment increased faster from 2010 to 2017 than during earlier time periods.

Table 1b. Growth rates per annum.

	1995-2000	2000-2005	2005-2010	2010-2015	2010-2017	1995-2017
ET	1.92	4.93	4.82	5.42	8.15	6.30
AGR	-0.15	-3.03	5.61	14.05	18.81	4.97
CON	-2.82	11.44	5.38	8.40	6.17	5.65
DIS	1.94	6.25	6.52	-4.82	1.68	4.86
FIBU	-2.50	15.26	6.26	0.11	14.34	11.26
GOV	1.83	5.07	2.40	5.36	9.25	5.64
MANNO	5.20	7.62	-2.59	20.85	21.92	9.88
MINOTH	3.28	4.46	-1.23	6.45	8.23	4.02
OTHS	0.66	5.63	1.64	9.95	8.68	4.79
TRACOM	1.80	3.78	8.85	4.92	7.82	7.27
U	-0.81	0.45	5.38	7.77	7.30	3.18

Table 2. Saudi versus non-Saudi private sector employment growth rates and distribution.

Sectors		Employment growth rates per annum (%)				Share of total employment (%)			
		2005-2010	2010-2015	2010-2017	2005-2017	2005	2010	2015	2017
AGR	SA	1.50	20.53	15.10	10.09	2.17	1.80	2.72	3.18
	NSA	6.01	6.61	2.16	4.14	97.83	98.20	97.28	96.82
MINOTH	SA	-3.78	16.8	12.5	4.32	67.14	59.99	76.14	80.01
	NSA	2.1	-2.71	-4.25	-1.87	32.86	40.01	23.86	19.99
MANNO	SA	4.91	25.25	16.06	13.72	11.90	12.10	21.79	23.16
	NSA	4.42	1.87	-0.42	1.55	88.10	87.90	78.21	76.84
U	SA	-5.2	69.64	47.17	18.2	45.51	37.50	80.05	81.21
	NSA	0.6	-6.59	-8.05	-3.2	54.49	62.50	19.95	18.79
CON	SA	3.76	38.64	29.54	22.03	8.77	6.71	11.26	12.75
	NSA	11.74	13.11	7.28	11.64	91.23	93.29	88.7	87.25
DIS	SA	3.89	23.53	21.99	16.95	11.21	12.59	20.18	22.94
	NSA	0.93	4.8	3.27	2.38	88.79	87.41	79.82	77.06
FIBU	SA	-7.66	91.92	75.75	24.09	30.29	9.55	43.81	49.53
	NSA	30.8	-4.85	-4.59	6.03	69.71	90.45	56.19	50.47
TRACOM	SA	95.56	-6.71	-6.63	27.59	15.63	15.3	21	24.29
	NSA	98.5	-10.96	-8.28	12.41	84.37	84.7	79	75.71
OTHS	SA	6.85	16.89	17.69	15.91	14.67	31.61	21.71	23.94
	NSA	3.28	5.61	4.56	4.91	85.33	68.39	78.28	76.06
Total labor force	SA	3.24	28	23.15	17.05	11.63	10.37	16.38	18.6
	NSA	6.45	8.33	4.66	6.28	88.37	89.63	83.62	81.4

Note: SA=Saudi employment, NSA=non-Saudi employment

Source: Saudi Monetary Agency Annual Statistics (2018).

Table 2 shows that private sector employment (i.e., the sectors identified above, excluding government) remains dominated by expatriates, with the exception of three sectors (non-oil mining, utilities and FIBU). However, from 2005 to 2017, dependency on foreign labor declined in all 10 sectors, albeit at a slow rate, as the overall proportion of Saudi labor rose from 11.6% to 18.6%. These trends are the result of ongoing labor market reforms. As of 2017, agriculture, manufacturing, construction, and community services are still dominated by foreign workers, contributing to higher unemployment among the expanding Saudi labor force. By contrast, the non-oil mining and utility sectors have shifted most toward the employment of Saudi nationals.

Foreign workers comprise over 80% of the private sector workforce primarily because they earn lower wages, at comparable levels of education, than their Saudi counterparts. Easy access to low-wage foreign workers has meant that sectors such as wholesale and retail trade, personal services, transport and construction have been the main drivers of private sector growth (IMF 2013).

Increasing trend of proportion of Saudi labor share and drastically increasing growth rates of Saudi labor forces in all sectors is the result of labor market reforms in Saudi Arabia.

Recently, Saudi Arabia has launched several initiatives to increase the employment of Saudi nationals in the private sector. These include reforming education and training systems, better targeting of wage subsidies, increasing labor fees on foreign workers, and refining the employment quotas system to require all employees in certain sectors to be Saudi nationals (IMF 2017).

Theoretical Framework

Our sectoral employment model follows studies such as those by Nickell (1984), Peterson (1988) and Pesaran, Pierse, and Kumar (1989). We take a demand-side theoretical approach, in which employment (ET) is a function mainly of economic output (GDP) and real wage (W):

$$ET = f(GDP, W) \quad (1)$$

For empirical analysis purposes, this can be written as:

$$et = \alpha_0 + \alpha_1 gdp + \alpha_2 w + \mu \quad (2)$$

Where α_0, α_1 and α_2 are the coefficients to be estimated econometrically and μ is the error term. Small letters show the variables are in the natural logarithmic form.

We see a rise (decline) in demand for labor when economic output is booming (contracting) and thus $\alpha_1 > 0$. Conversely, we find a negative relationship between demand for labor and its cost (wages) hence $\alpha_2 < 0$.

In this study, we model employment for a given sector i (ET_{ti}) as a function of economic output/ value-added (GVA_i) and real wages (W_i) in that sector using time series data. Therefore (2) can be re-expressed as:

$$et_{ti} = \alpha_{0_i} + \alpha_{1_i} gva_{ti} + \alpha_{2_i} w_{ti} + \mu_{ti} \quad (3)$$

Where i takes values from 1 to 10 to represent the 10 sectors of AGR, CON, DIS, FIBU, GOV, MANNO, MINOTH, OTHS, TRACOM, and U as defined in the notes accompanying Table 1a, above.

Econometric Methodology

Since we use time series data in our estimations, the stationarity features of the variables first need to be tested. We employ mainly the Augmented Dickey-Fuller (ADF) unit-root test (Dickey and Fuller 1981). In some instances we also use the Elliott-Rothenberg-Stock Dicky-Fuller generalized least squares (DF-GLS) (Elliott, Rothenberg, and Stock 1996) and Kwiatkowski et al. (1992) tests to clarify the case.

As a second step, the series should be tested for a common long-run movement. For this purpose, we use the residual based test (Engle-Granger 1987), trace and maximum eigenvalue tests (Johansen 1988; Johansen and Juselius 1990), Variable Addition Test (VAT) (Park 1990) and autoregressive distributed lags bounds testing approach to cointegration (Pesaran and Shin 1999; Pesaran, Shin, and Smith 2001).

After finding the cointegration among the variables, the numerical values of the long-run relationships can be estimated. For this, we employ the vector error correction model (VECM) (Johansen 1988; Johansen and Juselius 1990), fully modified ordinary least squares (FMOLS) (Phillips and Hansen 1990), dynamic ordinary least squares (DOLS, Saikkonen 1992; Stock and Watson 1993), and autoregressive distributed lagged models (ARDLBT, Pesaran and Shin 1999; Pesaran, Shin, and Smith 2001).

Next, the equilibrium correction term (ECT) can be constructed as follows:

$$ECT_{ti} = et_{ti} - (\hat{\alpha}_{0i} + \hat{\alpha}_{1i} gva_{ti} + \hat{\alpha}_{2i} w_{ti}) \quad (4)$$

Where $\hat{\alpha_{0i}}$, $\hat{\alpha_{1i}}$ and $\hat{\alpha_{2i}}$ represent the estimated values of α_{0i}, α_{1i}, α_{2i}. Where $\hat{\alpha_{0i}}$, $\hat{\alpha_{1i}}$ and $\hat{\alpha_{2i}}$ are the estimated values of α_{0i}, α_{1i} and α_{2i}, respectively.

Next the equilibrium correction model (ECM), which incorporates the long-run relationship ECT into the short-run dynamics expressed in changes of the independent and dependent variables, can be written as:

$$d(et_{ti}) = \gamma_i ECT_{i,t-1} + \beta_{0i} + \sum_{j=1}^{p} \beta_{1ij} d(et_{it-j}) +$$

$$\sum_{j=0}^{p} \beta_{2ij} d(gva_{it-j}) + \sum_{j=0}^{p} \beta_{3ij} d(w_{it-j}) + \varepsilon_{ti} \quad (5)$$

We denote the difference operator as d for consistency throughout the paper. γ_i is the speed of adjustment (SoA) coefficient, which indicates how much time is needed for the employment in sector i to adjust from short-run disequilibrium to long-run equilibrium in one period, that is year. Deterministic regressors such as time trend and dummy variables can be included in both the long-run (3) and short-run (5) equations to capture technological changes, structural developments, shocks, and other unusual factors believed to be relevant (see Juselius 2006; Hendry and Juselius 2000; Pesaran, Shin, and Smith 2001, inter alia).

To estimate ECM, we follow the general to specific modeling (Gets) approach and use automatic model selection (AMS) (Hendry, Johansen, and Santos 2008; Doornik and Hendry 2009; Doornik 2009; Doornik and Hendry 2018). AMS combines Gets, impulse indicator saturation (IIS) and step indicator saturation (SIS), making it more powerful than conventional modeling devices. IIS and SSI automatically capture all breaks in the time path of the modeled variable (whether one-time, temporary or permanent), alleviating the need for a modeler to know how many breaks occurred or when. This approach first includes all the relevant variables (including their lags and leads) based on the related theoretical framework; the result is referred to as a general unrestricted model. Then a specific model, the final ECM, is selected by excluding statistically insignificant variables, comparing the

standard errors of the regressions and performing the required battery of tests: autocorrelation, serial correlation, normality, heteroscedasticity, misspecification, and encompassing, as well as IIS and SIS, if needed.

We perform AMS using the computer program PcGive (Doornik and Hendry 2001a,b; Hendry and Doornik 2001; Hendry and Krolzig 2001, inter alia), which was developed in OxMetrics econometric software. For modeling short-run relationships, we also use OxMetrics 8.0 and PcGive 15.0 (Doornik and Hendry 2018) alongside EViews 10. An advantage of PcGive is that it allows a modeler to choose which diagnostic tests to run and to set the level of significance for testing. Detailed discussion/description of Gets with AMS can be found in works by Krolzig and Hendry (2001), Campos, Ericsson, and Hendry (2005), Davidson et al. (1987), Hendry, Pagan, and Sargan (1984), Ericsson, Campos, and Tran (1990), de Brouwer and Ericsson (1995), and Hendry and Doornik (1994).

Data in Brief

We use annual time series data from 1995 to 2016 for the following variables.

- ET_i is thousands of employed people in a given sector.
- GVA_i is gross value-added (GVA) in a given sector, measured in millions of Saudi Arabian Riyal (SAR) at constant 2010 prices.
- W_i is real wages in a given sector, measured in millions of SAR at constant 2010 prices. To obtain the real values, a sector's nominal wage values were divided by its GVA deflator.

Sectoral employment data are taken from Saudi Arabia General Authority for Statistics (GaStat 2018), with the exception of government sector employment data, which come from Saudi Monetary Authority (SAMA 2018). The sectoral GVA and nominal wage data are also provided by GaStat (2018). In some cases, to match the 1995-2016 timeframe, the values of earlier years for the variables are interpolated using backcasting techniques. The sectoral GVA deflators are calculated using the relevant nominal and real values, again from GaStat (2018).

We study 10 sectors, which are AGR, CON, DIS, FIBU, GOV, MANNO, MINOTH, OTHS, TRACOM and U, as defined above.

Empirical Estimation Results

Unit root tests results

Following the methodology laid out in the Econometric Methodology section, we first test the unit root properties of the variables. Table 2 summarizes the results: all variables are non-stationary at log levels while their growth rates are stationary. For *d(gva)*, the ADF test does not reject the null hypothesis of unit root in the first difference of gva in three sectors, DIS, MINOTH and TRACOM. However, the DF-GLS test (Elliott, Rothenberg, and Stock 1996) concludes stationarity at 5% significance level for DIS and TRACOM, while the KPSS test indicates the stationarity for *d(gva)* in MINOTH. We note that as Juselius (2006) discusses, stationarity at second differenced form does not seem reasonable when the sample size is smaller than 30 observations.

Table 2. Unit root test results.

Variable		AGR	CON	DIS	FIBU	GOV	MANNO	MINOTH	OTHS	TRACOM	U
et	C	0.56	0.76	-0.96	-0.75	0.50	-2.26	-1.31	0.90	0.95	-0.82
	C&T	-1.00	-2.02	-3.16	-2.14	-2.05	-2.70	-2.24	-1.84	-2.28	-2.12
gva	C	0.21	0.13	-0.71	-0.27	-0.26	-0.58	-1.24	2.02	0.01	-0.70
	C&T	-1.70	-1.49	-2.04	-2.62	-1.90	-2.22	-2.88	-3.13	-2.86	-2.51
w	C	-4.23	-1.63	-1.30	-1.85	-1.58	-2.00	-1.58	-2.89 c	-2.42	-1.67
	C&T	-2.18	-2.59	-2.66	-1.97	-3.47 c	-2.24	-1.52	-3.51 c	-2.61	-1.76
d(et)	C										
		-6.83 [a]	-3.62 [b]	-3.62 [b]	-4.68 [a]	-3.22 [b]	-4.04 [a]	-5.60 [a]	-3.85 [a]	-4.32 [a]	-4.48 [a]
d(gva)	C										
		-3.62 [b]	-2.94 [b]	-2.38 [*]	-3.17 [b]	-2.64 [c]	-3.25 [b]	-1.54 [**]	-3.22 [b]	-2.57 [*]	-3.99 [a]
d(w)	C										
		-5.54 [a]	-4.25 [a]	-3.81 [a]	-4.72 [a]	-4.29 [a]	-5.62 [a]	-4.60 [a]	-4.93 [a]	-4.84 [a]	-3.59 [b]

Notes: C and T denote intercept and linear time trend, respectively; significance levels: a = 1%, b = 5%, and c = 10%; *Elliott-Rothenberg-Stock DF-GLS test concludes stationarity at 5% significance level; **Kwiatkowski-Phillips-Schmidt-Shin test concludes stationarity at any significance level; d=difference operator.

Hence, we can proceed to testing the cointegration relationships between the variables.

Cointegration test results

Table 3 displays the cointegration test results.

Table 3. Cointegration test results.

Test type	AGR	CON	DIS	FIBU	GOV	MANNO	MINOTH	OTHS	TRACOM	U
EG	C [b]		C [c]		C [a]		C [a]	C [a]		
BT				C [a]						C [a]
Johansen		C [b]							C [b]	
VAT						C [a]				

Notes: EG=Engle-Granger cointegration test; Johansen=Johansen cointegration test; BT=Pesaran Bounds Test for cointegration; VAT=variable addition test for cointegration; C means the test rejects the null of no cointegration (for the VAT test only, the null is cointegration); significance levels: a = 1%, b = 5%, and c = 10%.

The table shows that in all cases, the tests conclude long-run co-movement among the variables.

Long-run estimation results

Table 4 shows the long-run estimation results of employment by sector.

The signs of the estimated coefficients are positive for value-added and negative for wages, in line with the theoretical expectations discussed in Section 3. The results show that value-added and wages have statistically significant long-run impacts on employment in all sectors. The impact of value-added ranges from 0.23 for non-oil mining to 1.28 for government services. For wages, results likewise vary across sectors and are lowest (in absolute value) for government services (-0.26) and highest (in absolute value) for the non-oil mining sector.

Short-run estimation results

The short-run estimation results (i.e., the final ECM specifications) are reported in Table 5. The estimated elasticities are all statistically significant. Additionally, all the post-estimation tests results are in favor of the validity of the selected final ECM specifications. Moreover, the estimated parameters, including SoA coefficients, have the expected signs.

Table 4. Long-run estimation results.

Regressor	AGR[D]	CON[V]	DIS[D]	FIBU[V]	GOV[D]	MANNO[F]	MINOTH[D]	OTHS[F]	TRACOM[V]	U[A]
gva	0.93 [a]	1.06 [a]	0.27 [a]	0.65 [a]	1.28 [a]	0.27 [C]	0.23 [a]	1.11 [a]	0.65 [a]	0.42 [a]
w	-0.78 [a]	-0.56 [a]	-0.38 [a]	-0.52 [a]	-0.26 [a]	-1.53 [a]	-1.61 [a]	-0.60 [a]	-0.85 [a]	-0.49 [a]
Deterministic regressor										
C	0.92	0.60	7.87 [a]	3.51 [a]	-6.09 [a]	16.97 [b]	21.92 [a]	1.47	-7.54	5.68 [a]
T	0.03 [a]									
DP2007									0.11 [a]	
DP2008		-0.16 [b]								
DP2009								-0.10 [b]		
DP2012									-0.16 [a]	-0.28 [a]
DP2013									-0.12 [a]	
DP2014								0.10 [b]		0.24 [a]
DP2015		0.001								
Regression statistics										
R^2	0.997	0.20	0.97	0.99	0.998	0.46	0.89	0.99	0.74	0.99
Adj. R^2	0.99	0.12	0.96	0.98	0.997	0.43	0.79	0.99	0.67	0.98
SER	0.02	0.11	0.05	0.05	0.01	0.43	0.07	0.03	0.02	0.04

Notes: [D] DOLS is used; [F] FMOLS is used; [V] VECM is used; [A] ARDL is used; significance levels: a = 1%, b = 5%, and c = 10%; C and T denote intercept and linear time trend, respectively; DP[year is a pulse dummy taking 1 for a given year and 0 otherwise; R^2 and Adj. R^2 are the coefficients of determination and adjusted determination; SER is standard error of regression.

Discussion of Findings

It is important to compare our empirical results with those of previous research. However, we could not find any existing analysis of sectoral employment for Saudi Arabia vis-à-vis value-added and wages, prohibiting any direct comparison. Nonetheless, the stochastic (integration and cointegration) properties of employment and its determinants can be compared across studies despite differences in focus.

The unit root tests find that sectoral employment, value-added and wages are non-stationary at the log level but stationary when their growth rates are considered. In other words, their order of integration is one (i.e., I[1]), which is the expected result for many economic variables. This means that the levels of both employment and the identified determinants of GDP and wages evolve stochastically over time, with changing mean, variance and covariance, implying that any shock can create a permanent change and hence should not be used in forecasting. However, the growth rates of these variables are stationary and therefore can be utilized. Alkhateeb et al. (2017b, 2017c) and Alkhateeb, Sultan and Mahmood (2017) also find that aggregate employment and GDP are I(1) variables in Saudi Arabia. Similarly, Khodeir and Al Nuwaiser (2016) find that industrial employment follows I(1) process.

Having non-stationarity at the level also implies that the variables may share a common stochastic trend in their evolvement. The cointegration results documented in Table 3 confirm long-run relationships among employment, value-added and wages for each of the 10 sectors considered. This finding aligns with conclusions of previous studies, such as those by Chletsos and Kollias (1997) for Greece, Aydiner-Avsar and Onaran (2010) and Sahin, Tansel, and Berument (2013) for Turkey, and Skare and Caporale (2014) for 119 economies, which also concluded cointegration relationships among employment, output and wages (with other explanatory variables in some cases). Although we found no study investigating both determinants (GDP and wages) of employment for Saudi Arabia, Alkhateeb et al. (2017b,c) and Alkhateeb, Sultan, and Mahmood (2017) find long-run relationships between aggregate employment and GDP at the country level. Additionally, Khodeir and Al Nuwaiser (2016) find long-run relationships between industrial employment and other macroeconomic indicators (foreign direct investment, exports and consumer price index) although they do not consider industrial value-added and/or wages.

Our results indicate that value-added and wages have statistically significant impacts on employment for all 10 sectors in the long-run. As Table 4 presents, we found elastic and inelastic long-run elasticities for employment with respect to both value-added and wages across the sectors, while all the short-run elasticities are inelastic (with one exception of value-added for agriculture), as shown in Table 5. This corroborates the economic theory that impacts are usually higher in the long-run than the short-run. We also note that employment responds differently across sectors, primarily due to two factors: the idiosyncrasies of a given sector and its stylized features in the Saudi economy.

Four sectors — agriculture, construction, government services and other services — exhibit a nearly one-to-one relationship between employment and value-added in the long run, as indicated by estimated elasticities around unity. Thus for these sectors, a 1% increase in value-added will result in an equivalent rise in employment.

Government services and non-oil mining exhibit the highest and the lowest value-added elasticities, respectively, findings we view as reasonable for

Saudi Arabia. We offer three explanations for the former. First, the government sector is heavily labor intensive. Hasanov et al. (2019) estimated that the labor and capital elasticities of value-added are 0.48 and 0.21, respectively, in the production function of the government service sector in Saudi Arabia for the period 1996 to 2016. Second, as in other developing economies, the government service sector exhibits significant room for efficiency improvement in Saudi Arabia. Empirical studies, such as those by Al-Faris (2002), Joharji and Starr (2010), Alshahrani and Alsadiq (2014), and Eid and Awad (2017), highlight the inefficiency of various government services. Saudi Vision 2030 (SV2030), the government's development masterplan, particularly the Fiscal Balance Program, includes numerous initiatives to increase government efficiency (FBP 2017). Additionally, the SV2030 Human Capital Program identifies increasing government efficiency and providing world-class government services as its key priorities. Regarding the high estimated elasticity of employment for government services, such inefficiency means that additional activity requires more than the optimal number of government employees. Third, Saudi nationals prefer to work in government institutions rather than in private entities. Official statistics show that rather on average, Saudis comprised only 13.2% of private sector employment from 2005 to 2016 (SAMA 2019). Additionally, an official labor survey conducted in 2016 shows that the public sector accounted for 67% of total employment of Saudi Nationals (SLMR 2016).

For non-oil mining, we attribute the observed low value-added elasticity of employment with the commonly accepted fact that mining is a less labor-intensive economic output. This implies that factors other than employment, such as capital and total factor productivity, drive the development of the sector and that its expansion will be associated more with such other variables, and also that the labor absorption capacity of the sector is limited.

Regarding the long-run impact of real wages on sectoral employment, we find it interesting that sectors driven less by value-added, namely non-oil mining and non-oil manufacturing, are the most sensitive to wages (see Table 4). Precisely speaking, a 1% increase in real wages decreases employment in these two sectors by around 1.6%. We note that generally, manufacturing is labor intensive and exhibits a tight relationship between employment and value-added. However, our estimated value-added elasticity of employment of 0.27 indicates that the sector behaves differently in Saudi Arabia. This is supported by previous research: Alkhateeb et al. (2017c) argue that the Kingdom's industrial sector heavily depends on capital-intensive technology and Hasanov et al. (2019) estimate the employment elasticity of value-added for the country's non-oil manufacturing sector to be 0.23.

Among the 10 sectors, government services exhibits the least sensitivity of employment to wages, with elasticity of -0.26. This can be explained by the above-mentioned preference of Saudi nationals to work in the government, where on average 85% of employees were Saudis from 2005 to 2016 (SAMA 2019). They often prefer a public sector job, probably due to the stable job environment.

Before concluding the discussion of long-run findings, it is worthwhile to underscore that employment levels in non-oil manufacturing and non-oil mining are found be the least value-added driven and the most wage sensitive. Together with agriculture, these sectors comprise the bulk of Saudi Arabia's non-oil tradable production. Development of the non-oil tradable industries can help the Kingdom avoid the so-called 'Dutch disease' of overreliance

on a single sector and boost the SV2030 export-led growth strategy; thus these three sectors deserve more detailed research in future.

Turning to the short-run estimations reported in Table 5, we highlight the following results. First, SoA coefficients appear statistically significant and negative, as expected, for all 10 sectors. This indicates that the long-run relationships of employment to value-added and wages are stable over time and the impacts of shocks or changes to the corresponding long-run relationships are temporary and do not create permanent deviations. Additionally, the statistically significant negative SoA coefficients imply long-run causality running from value-added and wages to employment. Moreover, the SoA coefficients for all sectors, with the exception of other services, fall within the range of (0;-1). Thus for these nine sectors, employment takes more than one year to correct from short-run disequilibrium back to long-run equilibrium, while requiring less than a year in the case of other services. (For the details of correction and overcorrection processes, see Loayza and Ranciere 2005; Enders 2015, pp. 374, 377-378; Shittu, Yemitan, and Yaya 2012; Olczyk and Kordalska 2017.)

Second, wage growth has statistically significant contemporaneous negative impact on the employment growth in all the sectors, except for the government service sector. This indicates that wages play an important role in shaping employment growth outside the public sector. As for government services, we do not find any contemporaneous or lagged effects of wage growth to be statistically significant, in line with the above findings that the sector exhibits the least long-run sensitivity of employment to wages. We again believe this stems from the preference of Saudi nationals for government employment.

Third, value-added growth has statistically significant positive impact on the employment growth only in five sectors: agriculture, distribution, government services, utilities, and other services. Also, these positive effects happen contemporaneously. By combining the long-run and short-run effects of value-added on employment across the sectors, we see that the majority of these five sectors also have quite high value-added elasticity in the long-run. This implies that employment in these sectors is responsive to value-added/activities probably caused by their nature. We do not find any statistically significant positive influence of value-added growth on employment growth of the remaining five sectors.

Finally, among the 10 sectors, agriculture exhibits the most sensitivity in employment growth to value-added and wages, according to the short-run estimation results in Table 5.

Table 5. Final ECM specifications by sector.

Variable	AGR	CON	DIS	FIBU	GOV	MANNO	MINOTH	OTHS	TRACOM	U
ECT_{t-1}	-0.568[a]	-0.260[a]	-0.966[a]	-0.485[b]	-0.198[b]	-0.130[a]	-0.134[a]	-1.441[a]	-0.095[a]	-0.348[a]
C	0.035[a]	-0.016	0.033[a]	0.003	0.007	0.021	0.034[a]	0.001	0.047[a]	
Δet_{t-1}	-0.169[a]					0.109[c]				
Δet_{t-2}		-0.232[b]	0.435[a]							
Δgva	1.984[a]		0.190[c]		0.686[a]			0.759[c]		0.550[a]
Δgva_{t-2}			0.229b							
Δw	-0.785[a]	-0.699[a]	-0.534[a]	-0.393[a]		-0.208[b]	-0.189[b]	-0.456[a]	-0.087[c]	-0.190[a]
Δw_{t-1}			-0.134[a]			0.122				
D(DP2008)		-0.152[a]								
DP2003		-0.271[a]						0.073[b]		
D(DP2009)		-0.145[a]						-0.074[b]		
DP1983						-0.399[a]				
DP1984						-1.032[a]				
DP2013			-0.091[a]	-0.162[b]	0.075[a]					
DP2012									-0.139[a]	
DP2008					0.061[a]					
DP2007									0.109[a]	
DB1213										-0.211[a]
DP2009										0.144[b]
DB1011						-0.348[a]				
DB0910							-0.188[a]			
DB1415							0.172[a]			0.204[a]
DP2001						0.182[b]				
DP2002							0.122[a]			
DB1314									-0.082[a]	

Variable	AGR	CON	DIS	FIBU	GOV	MANNO	MINOTH	OTHS	TRACOM	U
R-squared	0.974	0.931	0.986	0.921	0.819	0.939	0.919	0.724	0.856	0.926
Adjusted R-squared	0.967	0.897	0.976	0.901	0.776	0.921	0.894	0.618	0.801	0.898
S.E. of regression	0.027	0.039	0.016	0.043	0.014	0.070	0.033	0.038	0.025	0.049
Serial correlation LM test	0.282 (0.759)	0.849 (0.457)	1.184 (0.350)	0.908 (0.427)	2.607 (0.107)	0.572 (0.572)	0.726 (0.501)	1.247 (0.325)	0.345 (0.716)	0.391 (0.686)
Heterosce-dasticity test	0.089 (0.985)	1.096 (0.418)	0.555 (0.778)	0.599 (0.625)	1.260 (0.324)	0.644 (0.734)	1.470 (0.254)	0.923 (0.497)	0.506 (0.767)	0.627 (0.706)
Normality test	2.907 (0.234)	0.552 (0.759)	2.864 (0.239)	0.470 (0791)	5.720 (0.057)	4.915 (0.086)	0.441 (0.802)	0.274 (0.872)	0.858 (0.651)	2.114 (0.348)
Ramsey RESET test	0.376 (0.551)	1.044 (0.329)	0.102 (0.757)	0.595 (0.454)	0.250 (0.624)	2.681 (0.114)	2.414 (0.141)	0.161 (0.695)	0.000 (0.991)	2.275 (0.157)

Notes: Serial correlation LM Test=Breusch-Godfrey serial correlation LM Test; Heteroscedasticity test=White test for Heteroscedasticity; Normality test=Jarque–Bera goodness-of-fit test; Ramsey RESET test=Ramsey's Regression Equation Specification Error Test; p-values are in parenthesis; d=difference operator.

Conclusions and Policy Insights

Policymakers in any economy benefit from an advanced understanding of employment dynamics as they design economic programs and conduct relevant monitoring and evaluation. Sustainable economic growth also requires the promotion of a healthy and stable employment market. Therefore, the determinants of employment dynamics have been investigated extensively in the literature.

Saudi Arabia faces significant challenges in this area and has set ambitious targets for improvement under SV2030. These include lowering the unemployment rate from 11.6% to 7% and increasing women's participation in the workforce from 22% to 30% (Saudi Vision 2030). In order for the authorities to successfully achieve these goals and to better understand employment dynamics in general, employment should be modeled as a function of its determinants. Hence, this study investigates sectoral employment in Saudi Arabia in the long and short run utilizing cointegration and ECM modeling techniques.

Our study provides policymakers with empirical insight into how employment can be impacted via its identified determinants — economic output and wages — in different sectors of the Kingdom's economy in both the long and short run. The results can also help authorities balance employment growth across sectors. Because the magnitudes of the impacts of output and wages on employment are different in each sector, our findings highlight the value of designing and implementing employment policies at the sectoral level rather than as 'one size fits all' national policy.

The ability of the government to affect sectoral employment dynamics in the private sector may be relatively limited but it can still play a role, primarily by impacting economic output and wages. First, additional demand for domestically produced goods and services can be created, both directly and indirectly. For example, by building new schools or bridges, it increases demand directly for construction services and indirectly for the manufacturing and mining products and services used in the construction. Second, the authorities can promote substitution of imported goods and services with domestic ones.

These measures will raise demand in targeted sectors, thereby encouraging greater production and revenue; in turn, the resulting increase in economic activity in turn will boost employment.

This will lead to a virtuous cycle in which this process will continue until resources, especially labor and capital, reach full utilization. In other words, the economy will be on the vertical part of the aggregate supply curve. However, after this point any rise in demand components will tend to lead to high inflation, without further increase in labor and capital, and thus in production of goods and services.

Thus through demand creation and import substitution, domestic economic output can be enlarged and thereby increase employment. Expansion of domestic goods production and services would also help increase local content, a central element in Saudi Arabia's plans for economic diversification. Additionally, these measures would strength public-private partnerships, which are important for sustainable development. Moreover, they would create an important opportunity for different sectors of the economy to mitigate any potential harmful effect of the ongoing domestic energy price and fiscal reforms.

The above measures would improve demand in the long run for all 10 sectors we examined, thereby enhancing sector-level employment. However, in the short run, the effectiveness varies across sector.

Agriculture and other services display the highest short-run sensitivity to the stimulus, followed by government services and utilities. The distribution and retail sector exhibits less short-run promise. The other sectors indicate potential for favorable impact in the long run only. It appears intuitive that from the above-discussed measures (i.e., creating employment through income/economic activity) standpoint, agriculture and other services sectors seem to be more promising, public service and utilities sectors are seen to be promising, and the distribution sector is seen to be less promising in the short-run. While construction, FIBU, non-oil manufacturing and mining as well as transport and communication sectors do not seem favorable in the short run. However, over the long run all the mentioned unfavorable sectors also become favorable. It is quite reasonable to think that the government investment demand for goods and services produced locally can lead to the growth of the sectors in the long run, in particular through infrastructure development, efficiency and productivity increase, which all would increase employment.

Turning to the other examined determinant of employment, labor is a primary expense for the private sector and higher wages will reduce profit. Accordingly, private businesses will increase wages only if they have additional demand for production requiring additional employment. While production can theoretically be raised without greater employment, due to perfect substitution of labor with capital or total factor productivity increase, this is unlikely for Saudi Arabia. (See Hasanov (2019) for discussion of the pathways regarding usage of production factors to increase industrial production).

Employment can be further increased by inducing more of the working age population to participate in the labor force. Some relevant measures are outlined in Nitaqat policy to support employment of Saudi nationals. In addition, the establishment of a minimum wage level for all workers (i.e., Saudis and non-Saudis alike) is recommended by the ILO and supported by empirical research (ILO 2018; Hertog 2018). Note that although Saudi Arabia does not have an official minimum wage per se, Nitaqat policy recommends SAR 3,000 per month for Saudi employees. For the Gulf Cooperation Council (GCC) states, including Saudi Arabia, the ILO has proposed guidelines for minimum wages that include the needs of workers, economic impacts and outcomes, and avoiding nationality-based setup. One of the organization's key recommendations is a single minimum wage for all workers regardless of citizenship. Studies, such as by Hertog (2018), support this, arguing that a minimum wage for foreign labor would prevent employers from passing on new fees and payments to low-paid and vulnerable migrant workers. Hertog also concludes that an employment subsidy would be more effective at attracting Saudis to the labor force than an employment quota. The employment subsidy can be increased (effectively raising the minimum wage level) for Saudi employees through so-called 'expat levy' taxes on foreign workers. The experiences of Kuwait and other GCC countries can help guide successful implementation of these policies.

Lastly, we note that although the determinants of real wages, such as prices and productivity, can be impacted with the aim of increasing employment, the ability to do so is rather limited.

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Notes

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About the Project

The KAPSARC Global Energy Macroeconometric Model (KGEMM) project aims to develop a domestic policy analysis tool that captures the interactions between the Saudi and global economies. Commonly available models are typically more focused on the global economy (and the major contributors to global GDP). They typically use an oversimplified representation of major oil and gas exporting economies to capture energy flows into the global system. They fail to take into account the importance of Saudi Arabia's energy sector, or the growing importance of the domestic Saudi economy as a driver of domestic demand and, hence, available oil exports. KGEMM covers the real, monetary, fiscal, external, energy and labor sectors of the Saudi economy. It takes a demand-side view of the economy with some supply-side representations. KGEMM has been developed by KAPSARC for the following purposes:

- To provide a representation of the Saudi economy that takes into account its particular features.
- To offer KAPSARC's stakeholders a macroeconometric model with which to evaluate different policy scenarios, such as energy price reforms, fiscal policy changes and the impacts of different oil price regimes.
- To connect the Kingdom's macroeconomic-energy environment with other models of the global economy.

KGEMM has a sound theoretical foundation. Its estimations are based on cutting-edge econometric methods used in developing and enhancing the model. It is easy to customize, so that it can address future research/policy questions.

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