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Variance Analysis of GDP for GCC Countries

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GDP (Gross domestic product) and per capita GDP data of six GCC (Gulf Cooperation Council) countries were collected and analysed by randomized complete bock design and pair-wise multiple comparison. It is observed that GDP of Saudi Arabia is significantly higher than that of all other GCC countries. The GDP of Bahrain, Qatar, Oman and Kuwait are similar. The GDP of UAE is significantly higher than Bahrain, Qatar and Oman but significantly lower than Saudi Arabia. There are no significant differences between the per capita GDP of Oman and Saudi Arabia, between Bahrain and Kuwait, and between Qatar and UAE. In terms of per capita GDP, on an average UAE is slightly better than Qatar but both UAE and Qatar are significantly higher than that of all other four GCC countries.

Field of Research: Applied Economics

1. Introduction

The gross domestic product (GDP) is a basic measure of the economic performance of a country and is the total market value of all final goods and services produced in a country in a given year. Per capita GDP is the GDP divided by the population as of 1st July of the same year. GDP or per capita GDP varies from country to country and over time. Kingdom of Bahrain (Bahrain), State of Kuwait (Kuwait), Sultanate of Oman (Oman), State of Qatar (Qatar), Kingdom of Saudi Arabia (KSA), and United Arab Emirates (UAE) are the members of Gulf Cooperation Council (GCC). This paper analyse the GDP and per capita GDP data of six GCC countries to test whether the variations of GDP or per capita GDP among GCC countries are statistically significant.

2. Literature Review

GDP can be defined in three ways, all of which are conceptually identical. First, it is equal to the total expenditures for all final goods and services produced within the country in a stipulated period of time (usually a 365-day year). Second, it is equal to the sum of the value added at every stage of production (the intermediate stages) by all the industries within a country, plus taxes less subsidies on products, in the period. Third, it is equal to the sum of the income generated by production in the country in the period—that is, compensation of employees, taxes on production and imports less subsidies, and gross operating surplus (or profits). The most common approach to measuring and quantifying GDP is the expenditure method (Wonnacott and Wonnacott, 1979).

GDP = private consumption + gross investment + government spending + (exports-imports)

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GDP is widely used by economists to measure the health of an economy, as its variations are relatively quickly identified (Samuelson and Nordhaus, 1989). However, its value as an indicator for the standard of living is considered to be limited.

The economies of GCC countries have been dominated by the oil and gas sector, and although the relative contributions of the GCC countries' various economic sectors to GDP have shifted noticeably over the years, the oil and gas sector has consistently represented the largest share in these nations' GDPs (Shediac et al., 2008). The registered growth in non-oil sectors, such as manufacturing and hospitality, generally has reflected not organic growth in those industries but, rather, spillover effects from increased oil receipts and subsequent record-high inflows of capital. This types of growth cannot be considered inherently sustainable, because they depend heavily on the dominant sector's fortunes in the marketplace—a paradigm that most nations would want to avoid. In another work (Al-Yousif, 1997) two models are used to study the relationship between exports and economic growth in each of four GCC countries: Kuwait, Oman, KSA, and UAE. Later on the long and short-run relationship between oil exports revenues (OER), non oil GDP (NGDP), and investment in five countries of the GCC: Kuwait, Qatar, KSA, and UAE are investigated (Harb, 2008). They exclude Bahrain from their studies because it is not a significant oil exporter. They claim OER generated huge flows of foreign exchange and allowed the local economies to finance the imports of consumption and capital goods to build a modern infrastructure and to recruit massive foreign labour force. They used variance analysis to estimate short-run dynamics and shows that the effect of oil exports on those variables depends on local policies.

The objective of this study is to find whether the variations of GDP and per capita GDP among all six GCC countries are statistically significant. If it is found significant then identify the country which performs significantly better than other GCC countries.

3. Methodology

Past fifteen years (from 1994 to 2008) GDP and per capita GDP data for GCC countries are obtained from internet and presented in a two-way table. As GDP varies from country to country and over time, we consider randomized complete bock design for the analysis of variance to test whether there are significant variations among the GCC countries. The following null and alternative hypotheses are considered.

H_0: There are no significant differences between GDP (or per capita GDP) for GCC countries.

H_a: There are significant differences between GDP (or per capita GDP) for GCC countries.

The test statistic to test the above hypotheses is F = $\frac{MSS(Country)}{MSS(Error)}$ which follows Snedecor's F-distribution with 5 and error degrees of freedom. The test suggests that GDP as well as per capita GDP varies significantly among the GCC countries. Then we apply pair-wise comparison. In a randomized complete block design, the standard error of the difference between any pair of means is $\sqrt{\frac{2s^2}{r}}$; hence the observed difference between any pair of treatments divided by $\sqrt{\frac{2s^2}{r}}$ is distributed as Student's t-distribution with residual degrees of freedom (See Clarke and Kempson, 1997). It follows that any pair that differ by $t_{\alpha/2}\sqrt{\frac{2s^2}{r}}$ or more are significantly different, where $t_{\alpha/2}$ stands for the two-tailed critical value of t at significance level α with the residual degrees of freedom.

3. Results and Discussion

The past fifteen years (from 1994 to 2008) GDP data (in billion US $) of six GCC countries obtained from internet are presented in Table 4.1.

Table 4.1: GDP of six GCC countries at different years

Year	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
1994	4.86	24.80	12.92	7.37	120.17	37.12
1995	5.85	26.56	13.80	8.14	127.81	42.74
1996	6.10	31.07	15.28	9.06	141.32	47.88
1997	6.35	30.03	15.84	11.30	146.49	50.25
1998	6.18	25.33	14.09	10.26	128.34	47.17
1999	6.62	29.66	15.61	12.20	139.38	51.86
2000	8.60	44.80	19.60	12.30	191.00	41.50
2001	10.10	29.30	19.60	15.10	232.00	54.00
2002	8.40	30.90	21.50	16.30	241.00	51.00
2003	9.80	34.20	22.40	17.20	242.00	53.00
2004	11.29	41.46	36.70	17.54	287.80	57.70
2005	13.01	48.00	38.09	19.49	310.20	63.67
2006	15.90	47.36	40.39	24.46	346.30	115.80
2007	18.02	55.91	44.53	26.37	366.20	129.50
2008	24.61	138.60	61.21	57.69	572.20	145.80

Figure 4.1 is the graphical presentation of the data in Table 4.1. From the graph it is evident that there are variations of GDP among GCC countries. In order to test whether these variations are statistically significant, we conduct two-way analysis of variance test. The test results are given in Table 4.2.

Figure 4.1: Graph showing GDP of six GCC countries

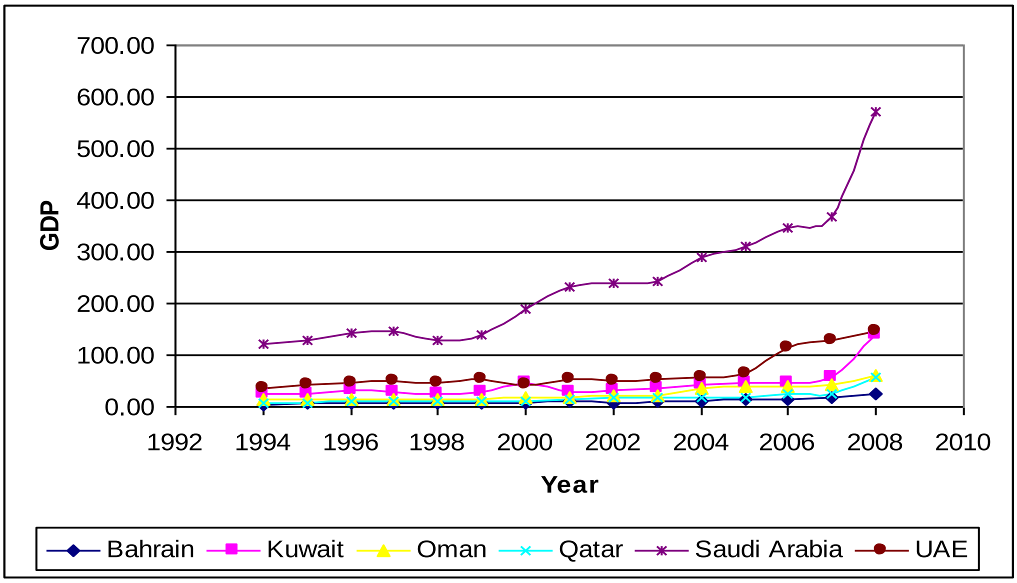

Table 4.2: Analysis of variance table for GDP of GCC countries

Source of Variation	*SS*	*df*	*MSS*	*F*	*P-value*
Year	105694.96	14	7549.640	3.698	0.00013
Countries	564947.72	5	112989.544	55.352	0.00000
Error	142890.11	70	2041.287		
Total	813532.80	89			

The p-value for testing the null hypothesis that there are no significant differences of GDP among GCC countries is approximately zero. This indicates that GDP varies significantly among GCC countries. Then for pair-wise comparison first we find the average GDP for all GCC countries and presented in Table 4.3 and then compare the differences between the GDP with the least significant difference at 5% level, $t_{0.025}\sqrt{\frac{2s^2}{r}}$ = 32.896 = LSD (say).

Table 4.3: Pair-wise differences between GDP of GCC countries

Country	Average GDP	Difference	Difference
Bahrain	10.380 = B		
Qatar	17.652 = Q	B - Q = 7.272 < LSD	K- B = 32.152 < LSD
Oman	26.103 = O	O – Q = 8.451 < LSD	U- B = 55.552 > LSD
Kuwait	42.532 = K	K – O = 16.429 < LSD	U- Q = 48.280 > LSD
UAE	65.932 = U	U – K = 23.400 < LSD	U- O = 39.829 > LSD
KSA	239.481 = S	S – U = 173.549 > LSD	

Therefore, there are no significant differences between the GDP of Bahrain, Qatar, Oman and Kuwait. The GDP of UAE is significantly higher than Bahrain, Qatar and Oman but significantly lower than Saudi Arabia. GDP of Saudi Arabia is significantly higher than that of all other GCC countries. The past fifteen years (from 1994 to

2008) per capita GDP data (in US $) of six GCC countries obtained from internet are presented in Table 4.4.

Table 4.4: Per capita GDP of six GCC countries at different years

Year	Bahrain	Kuwait	Oman	Qatar	KSA	UAE
1994	8710	13550	6302	12498	6785	16281
1995	10121	13557	6477	14796	7003	17727
1996	10187	14838	6901	16179	7505	19315
1997	10240	13592	7023	19821	7520	19149
1998	9617	11154	6159	18993	6362	16991
1999	9941	13155	6712	20673	7004	17651
2000	13700	22500	8000	17000	9000	17700
2001	15900	15000	7700	20300	10500	22800
2002	13000	15100	8200	21200	10600	21100
2003	14000	15000	8300	21500	10500	22000
2004	16900	19000	13100	21500	11800	23200
2005	19200	21300	13100	23200	12000	25200
2006	23100	20300	13500	28300	13100	45200
2007	25800	23100	14400	29800	13600	49700
2008	34700	55300	19100	75900	20700	55200

Figure 4.2: Graph showing per capita GDP of six GCC countries

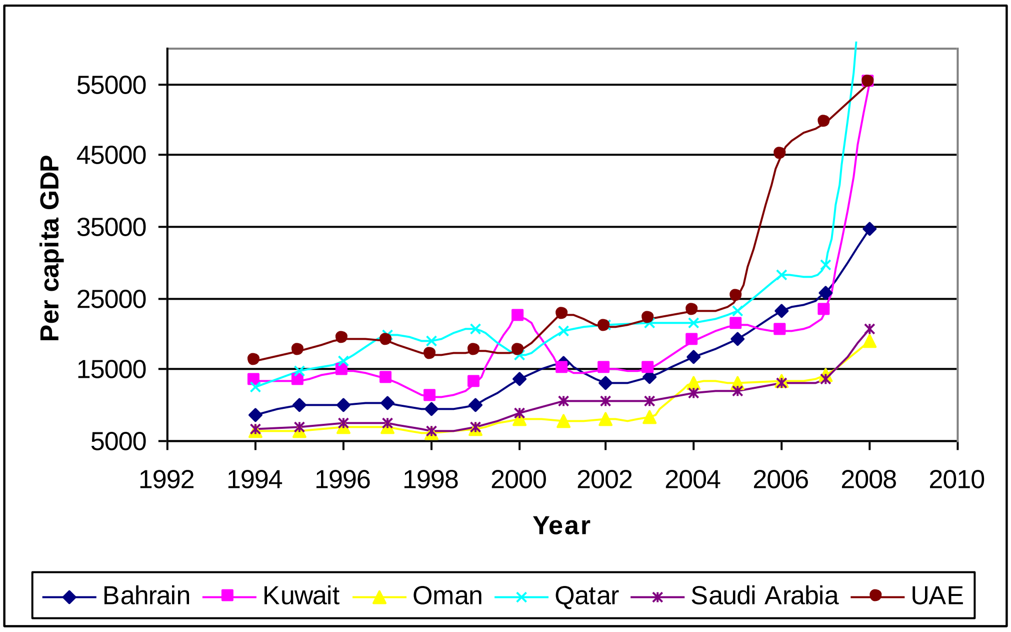

Figure 4.2 is the graphical presentation of the data in Table 4.4. From the graph it is evident that there are some variations of per capita GDP among GCC countries. In order to test whether these variations are statistically significant, we conduct two-way analysis of variance test. The test results are given in Table 4.5.

Table 4.5: Analysis of variance table for per capita GDP of GCC countries

Source of Variation	*SS*	*df*	*MSS*	*F*	*P-value*
Year	6026410611.82	14	430457900.844	13.539	0.0000
Countries	3519962177.66	5	703992435.531	22.143	0.0000
Error	2225493492.18	70	31792764.174		
Total	11771866281.66	89			

The p-value for testing the null hypothesis that there are no significant differences of per capita GDP among GCC countries is approximately zero. This indicates that per capita GDP varies significantly among GCC countries. Then for pair-wise comparison we find the average per capita GDP for all GCC countries and presented in Table 4.6 and then compare the differences between the per capita GDP with the least significant difference at 5% level, $t_{0.025}\sqrt{\frac{2s^2}{r}}$ = 4105.43 = LSD_1 (say).

Table 4.6: Pair-wise differences between per capita GDP of GCC countries

Country	Average per capita GDP	Difference
Oman	9664.93 = O	
KSA	10265.27 = S	S - O = 600.34 < LSD_1
Bahrain	15674.40 = B	B – S = 5409.13 > LSD_1
Kuwait	19096.40 = K	K – B = 3422.00 < LSD_1
Qatar	24110.67 = Q	Q – K = 5014.27 > LSD_1
UAE	25947.60 = U	U – Q = 1836.93 < LSD_1

Therefore, there are no significant differences between the per capita GDP of Oman and Saudi Arabia, that of Bahrain and Kuwait, that of Qatar and UAE. The per capita GDP of Qatar and UAE are significantly higher than that of all other four GCC countries. The per capita GDP of Bahrain and Kuwait are significantly higher than that of Oman and Saudi Arabia.

5. Conclusion

GDP of Saudi Arabia is significantly higher than that of all other GCC countries. The GDP of Bahrain, Qatar, Oman and Kuwait are similar. The GDP of UAE is significantly higher than Bahrain, Qatar and Oman but significantly lower than Saudi Arabia. There are no significant differences between the per capita GDP of Oman and Saudi Arabia, between Bahrain and Kuwait, and between Qatar and UAE. In terms of per capita GDP, on an average UAE is slightly better than Qatar but both UAE and Qatar are significantly higher than that of all other four GCC countries.

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