On the Quality of Higher Education in Jordan: Empirical Evidence from Princess Sumaya University for Technology

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Abstract

This paper investigates the main indicators of scores of K-12 leavers who were admitted at Princess Sumaya University for Technology, PSUT, in Jordan and their graduation scores. It uses time series data covering the period 1993-2012, including all 3,229 Bachelor graduates in all specialisations. The paper applies several statistical techniques to describe and test the relationships among educational variables. After that, the paper specifies an Auto Regressive Distributed Lag (ARDL) model that determines the relationship between K-12 leavers' grade-point average (GPA) and Bachelor graduates' GPA. It uses Granger causality to test the existence of causality. We also test score differences for gender, specialisation and time variations. Empirical results of these tests provide strong evidence that secondary GPA has no significant effect on graduation GPA. Moreover, the two GPAs had very small correlations and secondary GPA does not cause university GPA. The implication being that variations in university GPA are not caused by variations in secondary GPA. Therefore, admission policy, which is based on secondary GPA, should include other factors of admission criteria.

Keywords: quality of higher education, empirical models, GPA, Jordan

1. Introduction

For many years, job growth in Jordan is not consistent with the increase in the number of university graduates, and the chronic unemployment problem is a major obstacle to economic growth. Employers insist that their demand for graduates is not being met by educational output. Moreover, many policy makers, in education field, are increasingly calling for improvements in pre-university education system while others are blaming the higher education system for failing to provide K-12 leavers with the right specialisations that can match higher education sector outputs to labour market demand. Indeed, current rates of unemployment among Bachelor graduates in Jordan, shown in Table 1, are self-explanatory. It is unfortunate that policy makers in higher education do not fully recognize the importance of human capital in economic development.

Current debates in higher education hinge on analysis of students' academic achievements in terms of scores. Therefore, the relationship between secondary GPA and graduation GPA has significant policy implications for designing and implementing education policies at both secondary and university levels. This situation calls for a critical analysis for the quality of education including analyzing scores of students. In developed countries, agendas are driven by sophisticated analyses of data in the areas that affect student performance. It is true that for some jobs, GPAs and test scores are worthless criteria for hiring. While specialized skill sets are required for many jobs, there are some hiring attributes, such as high GPAs, which make prospective employees more desirable to employers all over the world. The first step is to utilize qualitative techniques to create measures that may be useful for both educators and researchers wishing to improve education and increase degree attainment. Although many quantitative assessments remain fragmented, education systems increasingly rely on data to determine next steps in terms of policy.

This paper follows the developments of the main indicators of students' achievements, expressed in terms of their GPAs, to contribute in the evaluation of education quality. It considers PSUT as an example of other universities in Jordan. PSUT is a Jordanian private non-for-profit university, founded in 1991, in accordance with the Ministry of Higher Education laws. The university is a private university owned by a non-for-profit organisation, the Royal Scientific Society, and together they are part of El Hassan Science City located in Amman. PSUT aims to be the hub of technology and innovation in the region, a research platform for Jordanian

industry, and strives to create a culture of entrepreneurship among students. PSUT is not only known for its high ranking in information and business technology in Jordan but also at the Arab World level. Selecting PSUT as an example implies that other universities are likely to face the same or even more problems related to students' achievements. Given these problems, there is a considerable pressure on higher education institutions for a substantial improvement in their performance.

It should be emphasised that it is not the aim of this paper to measure the quality of higher education in Jordan, which is a complicated and ambiguous issue in the academic literature, nor it aims at identifying the precise factors that affect quality of higher education. However, the objective of this paper is to contribute in solving this issue by trying to answer the following questions.

1) Do universities provide the required quality of education to secondary graduates?
2) Which specialisations helped in rising the scores of students more than others?
3) Are there significant differences between the mean of secondary GPA and the mean of university GPA at gender, specialisation and year of graduation?
4) Are there significant differences between the variance of secondary GPA and the variance of university GPA at gender, specialisation and year of graduation?
5) What are the sources of variance of secondary GPA and university GPA at gender, specialisation and year of graduation?
6) Is there a strong effect of secondary GPA on university GPA?
7) What are the policy implications for answers of the above questions?

These are all critical questions, and the answers that come from the academic literature certainly does not provide all of the answers, especially for the first and last questions. Another objective of this paper is to examine the role of secondary GPA on university GPA at PSUT using time series data from 1993-2012. Considering the effect of scores on aggregate education performance using econometric models provides guidelines for educational policies. Analysing the relationship between scores and quality of education depend on factors that are beyond the scope of this paper. However, the growing consensus in the academic literature is challenging and persuasive.

2. Review of Literature

In recent years, there has been a renewed interest in economic models that describe the factors affecting academic achievement of university students including students' achievement, entitlement, emotional intolerance, and frustration. Most research utilizes quantitative methods to analyse the processes through which students academic achievement can be increased. However, only few conceptual models for guiding analyses of students academic achievement have been constructed including validating academic experiences as key predictors of scores (Nora, Barlow, & Crisp, 2005). In a study that covered a random sample of 271 undergraduate students at Zaytoonah University in Jordan, Al-Alak (2006), used a linear structural relationship model to identify structural characteristics of relationship management between the university employees and students. The empirical results of this study were fourfold. First, greater employees' relational and student orientation resulted in higher relationship quality. Second, better education providers' attributes resulted in higher relationship quality. Third, higher relationship quality resulted in better relationship continuity. Fourth, committed student relationships resulted in student satisfaction, loyalty, positive word of mouth, and promotion. Al-Alak's study was based on opinions of students, which are usually subject to several statistical errors. Bader (2014) investigated the economic determinants of the demand for higher education at public universities in Jordan during the period 1990-2010. He applied a co-integration analysis with four explanatory variables. Dynamic relationships among the variables are explained through presenting the variance decomposition of the dependent variables. The empirical results of the study show that real disposable income and real government support affect positively the demand for higher education in public universities, whereas the effect of the consumer price index and unemployment rate is found to be negative.

An important development in recent analysis of quality of education is the use of models for quality in education. Much of the impetus for this development stems from a large number of studies showing that analysing key educational variables can enhance the search for solving some educational problems and hence increase the quality of education. For example, Al-Alak (2006), Kahn and Nauta (2001), Elias and MacDonald (2007), Eppler and Harju (1997), Gaston-Gayles (2004), Harrington (2005), Jamelske (2009), Johnson et al. (2010), Marx, Huffmon, and Doyle (2008), Poole et al. (2012), Sobol (1984), Srikanthan and Dalrymple (2002), Wilde (2012), and Wong and Cmor (2011). Another type studies applied economic and statistical models to explain the behaviour of university students related to their scores, Bisping, Patron, and Roskelley (2008), McCabe, Feghali,

and Abdallah (2008), Teixeira and Rocha (2010). These studies applied regression analysis to measure and explain the relationships among different educational variables. All supported the use of various forms of models. However, the effectiveness of these models in addressing the quality of higher education is dependent on the level of integration among all variables related to organizational culture, drawing a quality strategy, quantitative analysis of scores, and managerial factors. It can be argued that drawing a quality strategy depending on quantitative analysis of educational factors and modelling can enhance quality.

Measuring students' academic achievement, through their GPAs, only represent part of the solution to academic problems. The literature consistently indicates the importance of faculty in the academic success of students. Indeed, the analysis of faculty and facilities is extremely important especially for students whose engagement primarily occurs within the classroom (Pascarella & Terenzini, 2005). Betts and Morell (1999) analyzed the GPA of more than 5,000 undergraduates at the University of California, San Diego. Personal background strongly affects GPA. Graduates of different high schools obtain significantly different GPAs, even after controlling for personal background. These school effects in part reflect the incidence of poverty and the level of education among adults in the school neighborhood. Teachers' experience in the student's high school bears a positive and significant link to the student's university GPA, but the effect is small. No such positive link with GPA emerged for the teacher-pupil ratio or teachers' level of education. In a paper involving 105 undergraduate students, Wilde, 2012 indicated that the frustration discomfort scale was statistically significant and accounted for 23% of the variance when predicting overall college GPA. High school grades and standardized test scores account for approximately 25% of the difference between predicted and actual GPA. Kahn and Nauta (2001) examined the academic self-efficacy model for first-year college persistence using hierarchical logistic regression analyses to examine high school and first-semester college performance predictors. They found that first-semester GPA significantly predicted persistence to second year of college. The social learning constructs (self-efficacy beliefs, outcome expectations, or performance goals) did not play a significant role in college persistence during the first semester of their first year. Gore (2006) found that the timing of the assessment of academic self-efficacy to be a crucial factor. Scores from the College Self-Efficacy Inventory (CSEI) given at the beginning of their college career did not account for variance in students' GPA. However, CSEI scores from the end of first semester were a significant predictor of GPA, which is similar to the findings from Kahn and Nauta (2001).

Robbins et al. (2004) conducted a study using meta-analysis of 109 studies (including more than 9,000 subjects) examining the relationship between multiple psychological and paper skill factors and college persistence. Results suggest that academic self-efficacy may account for up to 14% of the variance in college students' GPA. There was also a significant correlation between academic self-efficacy and college persistence. The study concluded that academic self-efficacy accounted for variance in both college persistence and GPA beyond that accounted for by measures such as standardized test scores and high school GPA. Elias and MacDonald (2007) also found that self-efficacy beliefs accounted for a significant amount of variance in college GPA. Hierarchical regression analysis indicated that academic self-efficacy beliefs accounted for a significant amount of unique variance beyond past performance in predicting college GPA. Carini et al. (2006) reported that several measures of student engagement were positively correlated with such desirable learning outcomes as critical thinking and grades, although most of the relationships were weak. The results suggest that the lowest-ability students benefit more from engagement than classmates do. Laird, Chen, and Kuh (2008) were interested in rates of persistence of first year students. Of the hundreds of colleges and universities examined, 570 were doing as expected and 174 institutions doing better than expected. Kuh et al. (2008) found those students' demographic characteristics, pre-college experiences, and prior academic achievement as predictors of GPA. Together, they account for 29% of the variance in first-year grades. Taken together, measures of prior academic achievement had the strongest influence on first-year GPA. Similar studies analysed GPA for school students and undergraduates in an attempt to solve students' competences and measure the association between students' GPA and library workshop attendance, including Eppler and Harju (1997), Jamelske (2009), Johnson et al. (2010), Poole et al. (2012), Sobol (1984), Wong and Cmor (2011), and Wong and Webb (2011).

3. Methodology and Data

3.1 Methodology

This paper applies quantitative statistical analysis investigating the main measures of academic achievement for K-12 leavers and university graduates with Bachelor degree. We tested for the normality of variables using D'Agostino-Pearson test. After that, we performed a t-test, which is suitable for nominal variables that are normally distributed, for testing differences between means of grades. In order to explore the association between secondary GPA and university GPA, this paper employs an Auto Regressive Distributed Lag (ARDL) model, or bounds testing approach, proposed by Pesaran et al. (2001). We conduct a unit root test using two

methods: Augmented Dicky-Fuller and Phillips-Perron. Finally, we applied Granger's causality to test the causal relationship between university and secondary scores. To avoid the possibility of loss in the power of the model associated with the danger of omitted variable bias that could result from the use of bivariate analysis, this paper considers the main indicators of 3,229 Bachelor students who graduated from all specialisations.

3.2 Data

This paper uses data covering the period of PSUT establishment, 1991, until end of first semester of 2012. The source of data is the official internal files at the Admission and Registration Department. Unlike several studies, the data in this paper is free from any measurement problems such as estimation of original data or missing data or approximation or those problems faced in opinion polls. It should be noted that the early birds of four graduates that took place in 1993 were transferred to PSUT from other universities. Their inclusion in the analysis, which was mainly to avoid any loss of information, will not alter the results if they are excluded.

4. Statistical Analysis

4.1 Higher Education and Unemployment

The higher education is one of the most important factors related to human resources in Jordan. The Jordanian government has paid a special attention to higher education in order to have it at the top of national priorities, (Jordan, 2014). The expansion of higher education institutions and the number of students enrolled in higher education is unprecedented: from three universities in 1985 to 27 in 2013 and from 25,000 students in 1985 to nearly 236,000 students, (Jordan, 2014). This is expected to continue in the near future and will have great implications for the labour market in Jordan. University graduates are expected to pose a serious pressure on the labour market when the domestic demand is not expected to absorb this supply of labour. University graduates will aggravate the unemployment problem if certain measures are not taken beforehand. Their voice is heard more than the voiceless poor with simple or no education, not only because of their number but also of their social and political connections.

Resolving the unemployment problem is one of the main goals of the government economic issues. However, despite the implementation of several economic and social programs, unemployment is still in double digits. While labour market problems affect all young people, some groups are affected more than others. As can be seen in Table 1, the percentage of unemployed with post-secondary level, which includes Bachelor graduates, is relatively high among the labour force with secondary or less than secondary education. One can notice that this percentage was increasing all the time during 2008-2012. These figures lead to one conclusion: no foreseeable decrease in the percentage of unemployed with post-secondary level of education regardless of unemployment rate. These figures point to a clear need to couple labour market demand more tightly with education.

Table 1. Percentage distribution of Jordanian unemployed persons age 15+ years by educational level

Level of education	Year				
	2008	2009	2010	2011	2012
Primary	47.3	46.1	45.4	45.3	44.6
Secondary	22.2	21.8	19.8	19.9	17.9
Tertiary	30.3	30.7	34.3	34.4	37.0

Source: World Bank Site. Available at: http://www.indexmundi.com/facts/topics/labour-and-social-protection

4.2 Main Characteristics of Scores

With regard to students' academic status, presented in Table 2, it can be seen that both GPA variables are normally distributed, according to D'Agostino-Pearson test for normal distribution. Establishing the normality of scores allow us to perform several statistical tests, as in the following sections. Moreover, the coefficients of skewness, for both secondary GPA and university GPA, do reject the property of skewness at less than 0.01significance level, and the coefficients of kurtosis are very small.

Table 2. Main characteristics of scores and normality test

Variable: Secondary GPA	
Sample size	3,299
Lowest value	59.0000
Highest value	99.8000
Arithmetic mean	79.8780
Median	80.2000
Standard deviation	8.6010
Coefficient of Skewness	-0.1172 (P=0.0061)
Coefficient of Kurtosis	-0.5285 (P<0.0001)
D'Agostino-Pearson test for Normal distribution	reject Normality (P<0.0001)
Variable: University GPA	
Sample size	3,299
Lowest value	60.0000
Highest value	95.2000
Arithmetic mean	70.6783
Median	69.6000
Standard deviation	7.0826
Coefficient of Skewness	0.6944 (P<0.0001)
Coefficient of Kurtosis	-0.02976 (P=0.7541)
D'Agostino-Pearson test for Normal distribution	reject Normality (P<0.0001)

With regard to students' academic status, presented in Table 3, the vast majority of the students 38.4% reported an overall college GPA of "satisfactory". Only a small percentage of students (5.8%) graduated with "excellent" level. In addition, there is a clear gender difference regarding GPA level, as females have done better than males. The percentage of females who graduated with "very good" and "excellent" level was 20.4 and 7.3 in comparison to male students, 15.3 and 5.2, respectively. There is no doubt that females GPAs are higher than those of males.

The reason for that might be that females are expecting fierce male competition in job hunting after graduation along with the growing conscious about the importance of education for females. Looking at specialisations, we can see that only 3.2% and 7.4% of students who studied computer science and computer graphics & animation graduated with "excellent" grade, while relatively higher percentages are for computer engineering and communication engineering, 12.8 and 10.4, respectively. The worst times for the level of graduation GPA were those during 1997-2002 and 2005-2006, as the percentage of graduates with "satisfactory" level reached unprecedented values, ranging from nearly 42 to 50, while the percentage of graduates with "excellent" level went down during these two periods to range between 1.5-3.8 and 4.5-6.6, respectively.

Table 3. Students' academic achievements *(percentages)*

		Graduation GPA level			
	N	Satisfactory	Good	Very good	Excellent
Gender					
Male	2,352	*42.7*	*36.9*	*15.3*	*5.2*
Female	947	*27.9*	*44.5*	*20.4*	*7.3*
Specialisation					
Computer sciences	1,760	*42.4*	*39.9*	*14.5*	*3.2*
Electronic engineering	670	*36.6*	*38.1*	*17.8*	*7.6*
Computer engineering	156	*30.8*	*39.1*	*17.3*	*12.8*
Communication engineering	279	*30.5*	*35.5*	*23.7*	*10.4*
Computer graphics & animation	162	*35.2*	*36.4*	*21.0*	*7.4*
Management information systems	265	*32.1*	*40.8*	*19.2*	*7.9*
Business administration	7	*28.6*	*57.1*	*0.0*	*14.3*
Year of graduation					
1993	4	*0.0*	*25.0*	*25.0*	*50.0*
1994	78	*21.8*	*47.4*	*20.5*	*10.3*
1995	91	*33.0*	*45.1*	*19.8*	*2.2*
1996	87	*32.2*	*43.7*	*20.7*	*3.4*
1997	133	*44.4*	*34.6*	*18.0*	*3.0*
1998	160	*45.6*	*38.8*	*13.8*	*1.9*
1999	199	*48.7*	*36.2*	*13.6*	*1.5*
2000	247	*41.7*	*40.5*	*15.8*	*2.0*
2001	211	*46.9*	*35.5*	*13.7*	*3.8*
2002	212	*41.5*	*41.0*	*14.6*	*2.8*
2003	192	*39.1*	*43.8*	*13.5*	*3.6*
2004	193	*31.1*	*45.6*	*17.6*	*5.7*
2005	156	*42.3*	*41.0*	*12.2*	*4.5*
2006	167	*50.3*	*31.7*	*11.4*	*6.6*
2007	103	*35.9*	*40.9*	*12.6*	*10.7*
2008	143	*39.2*	*34.3*	*16.8*	*9.8*
2009	226	*31.0*	*34.5*	*20.4*	*14.2*
2010	289	*27.3*	*43.9*	*19.7*	*9.0*
2011	315	*34.6*	*34.6*	*23.2*	*7.6*
2012(end of 1st semester)	93	*40.9*	*37.6*	*17.2*	*4.3*
Average (1993-2012)	3,299	*38.4*	*39.0*	*16.7*	*5.8*

Note: Graduation GPA is between 60 and 100. "Excellent" level is for scores ≥84, "very good" is 76-83.9, "good" is 68.0-75.9, and "satisfactory" is 60.0-67.9. The normality assumption of secondary GPA and university GPA is tested and accepted as shown in Table 2.

As Figure 1 shows, female students' grades were very much better than their corresponding grades for males. It can be concluded that grades of female students are higher than those for females.
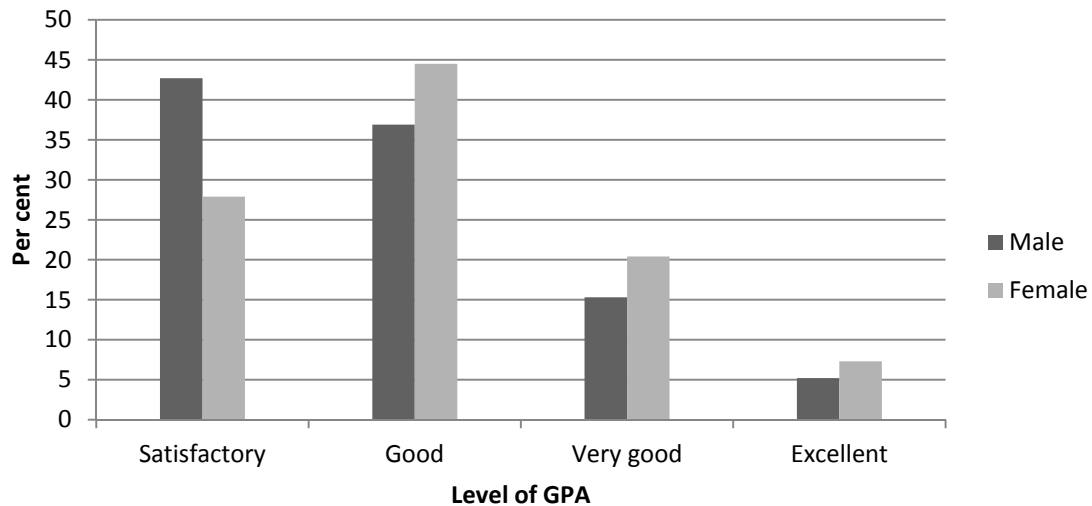
Figure 1. Comparison of university GPA's by gender and level

4.3 Measuring Correlations

The aim of applying linear correlation is to detect relationships between secondary and university GPAs for three factors: gender, specialisation, and time. As can be seen, from Table 4, all bivariate correlation coefficients are low and significant only at the 0.01 level or less, except for 1993 which is attributed to small sample size. However, the results are much the same when the 1993 data are excluded. The correlation coefficient between secondary GPA and university GPA for male students reached only 33.9% were it reached 44.2% for female students indicating that there was a less decrease in university GPA, relative to secondary GPA, for female students in comparison to male students. Relatively high correlation values, by specialisation, are those for computer graphics & animation followed by business administration indicating that students at those two specialisations have, relatively maintained the strength between their secondary GPA and Bachelor GPA. The lowest two correlations were for computer engineering, 33.4%, and communication engineering, 33.8%.

In sum, the overall correlation coefficient between secondary GPA and university GPA is very weak, 37.3%. In other words, no strong link emerged from the students' secondary GPA to the student's university GPA. This is another evidence that, after four or five years of teaching new entrances, PSUT did not maintain the high entrance grades but lowered them by about 9.2 points, as depicted in Table 4. Whether this evidence is a good or bad sign for the quality of higher education remains ambiguous question. The highest differences between secondary GPA and university GPA were these associated with the three engineering specialisations. For communication engineering, the difference reached almost 16 points, which is the highest in all specialisations, followed by computer engineering, 14.9 points, then electronic engineering, 14.8 points. Students of management information systems, computer sciences and computer graphics & animation got smaller decreases in secondary GPA, 5.99, 6.01, and 7.85 points, respectively, as shown in Figure 2. It can also be seen that the difference between secondary GPA and university GPA has grown over the period 1993-2012, although there were some low differences during 2005-2008. In sum, there was an obvious upward trend in the difference between secondary and university GPAs, as depicted in Figure 3.

Table 4. Averages of GPAs and correlation coefficients

Sex	Secondary GPA	University GPA	Difference	Correlation coefficient
Male	79.43	70.05	9.38	0.339[***]
Female	80.98	72.24	8.74	0.442[***]
Specialisation				
Computer sciences	75.83	69.73	6.10	0.377[***]
Electronic engineering	86.08	71.27	14.81	0.338[***]
Computer engineering	87.45	72.58	14.87	0.334[***]
Communication engineering	88.43	72.53	15.90	0.409[***]
Computer graphics & animation	79.43	71.58	7.85	0.502[***]
Management information systems	77.82	71.83	5.99	0.429[***]
Business administration	83.23	71.29	11.94	0.498[***]
Year of graduation				
1993	78.98	81.75	-2.77	0.727
1994	73.06	73.32	-0.26	0.484[***]
1995	71.76	70.75	1.01	0.490[***]
1996	71.33	71.05	0.28	0.397[***]
1997	73.83	70.05	3.78	0.383[***]
1998	77.74	69.47	8.27	0.414[***]
1999	78.55	69.05	9.50	0.357[***]
2000	78.89	69.76	9.13	0.317[***]
2001	79.79	69.29	10.50	0.354[***]
2002	81.03	69.71	11.32	0.364[***]
2003	80.59	70.10	10.49	0.328[***]
2004	81.53	71.50	10.03	0.479[***]
2005	81.37	69.44	11.93	0.203[***]
2006	80.08	69.51	10.57	0.358[***]
2007	81.17	70.99	10.18	0.449[***]
2008	78.34	71.10	7.24	0.442[***]
2009	81.19	72.81	8.38	0.505[***]
2010	82.71	72.15	10.56	0.397[***]
2011	84.16	71.96	12.20	0.402[***]
2012	83.60	70.35	13.25	0.365[***]
Average	79.88	70.68	9.20	0.373[***]

Note: Arithmetic means are approximated to the nearest two decimal points. *** Correlation is significant at the 0.01 level (2-tailed).
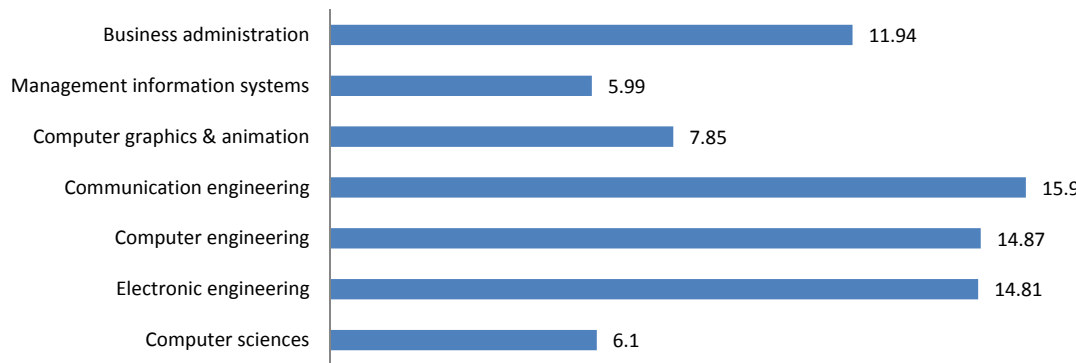
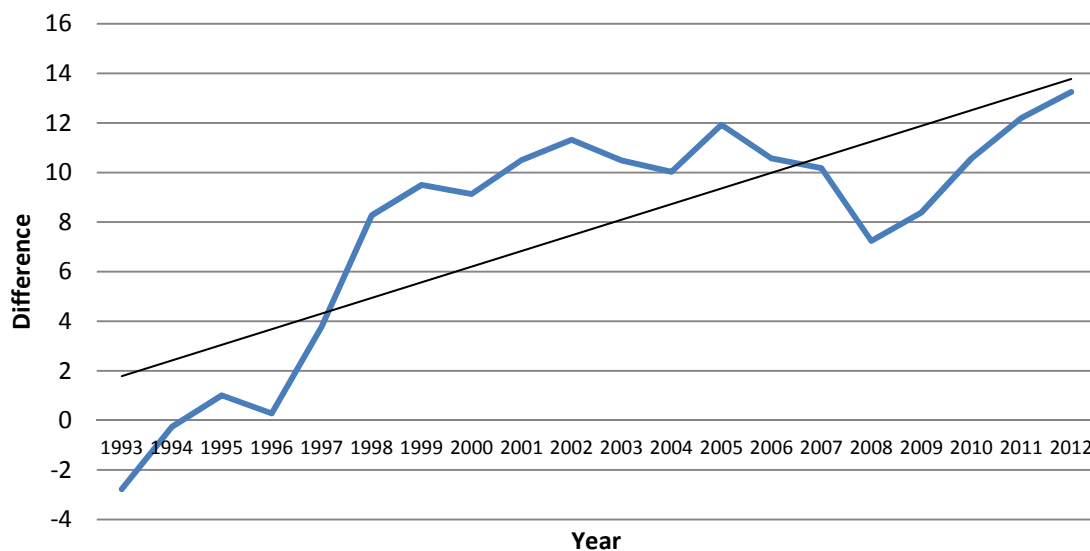Figure 2. Difference between secondary GPA and university GPA by specialisation

Figure 3. Growth of difference between secondary GPA and university GPA, 1993-2012

4.4 Test of Means

Having established that the data follow a normal distribution, Table 2, and the samples are of equal size, we first perform a test for equal means for secondary and university GPAs. After that we compare several means using the analysis of variance (ANOVA). The idea behind ANOVA is that any differences among mean scores should be reflected in the variances among the samples: gender, specialisation, and time.

4.4.1 Test of Two Means

This test divides our population into two groups: male and female students. We test the hypothesis that the mean of GPAs for male students is equal to the mean of GPAs of female students. That is H_0: μ_{Male} - $\mu_{Female} = 0$ against H_1: μ_{Male} - $\mu_{Female} \neq 0$, assuming 2-tailed 0.05significance level. As shown in Table 5, the significant values corresponding to *t*-values, indicating a significant difference between the means at the 0.05 level. If we consider specialisations, it can be concluded that, for university GPA, there are significant differences between male and female scores except for computer engineering and communication engineering (at 0.1 significance level).

Table 5. Test for equality of GPA means by gender

Type of education	Relation between variances	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
All students						
Secondary	Equal variances assumed	-4.684	3297	.000	-1.546	.330
	Equal variances not assumed	-4.811	1851.564	.000	-1.546	.321
University	Equal variances assumed	-8.142	3297	.000	-2.198	.270
	Equal variances not assumed	-8.219	1783.021	.000	-2.198	.267
Computer sciences						
Secondary	Equal variances assumed	-8.765	1758	.000	-3.440	.392
	Equal variances not assumed	-8.559	880.631	.000	-3.440	.402
University	Equal variances assumed	-5.381	1758	.000	-1.837	.341
	Equal variances not assumed	-5.488	964.870	.000	-1.837	.335
Electronic engineering						
Secondary	Equal variances assumed	.877	668	.381	.472	.538
	Equal variances not assumed	.891	107.568	.375	.472	.530
University	Equal variances assumed	-2.075	668	.038	-1.780	.858
	Equal variances not assumed	-2.070	106.362	.041	-1.780	.860
Computer engineering						
Secondary	Equal variances assumed	-.720	154	.473	-.686	.952
	Equal variances not assumed	-.729	96.207	.468	-.686	.940
University	Equal variances assumed	-.393	154	.695	-.535	1.360
	Equal variances not assumed	-.396	94.618	.693	-.535	1.351
Communication engineering						
Secondary	Equal variances assumed	-.507	277	.612	-.342	.674
	Equal variances not assumed	-.550	199.105	.583	-.342	.622
University	Equal variances assumed	-1.864	277	.063	-1.946	1.044
	Equal variances not assumed	-1.903	171.752	.059	-1.946	1.023
Computer graphics & animation						
Secondary	Equal variances assumed	-3.775	160	.000	-5.086	1.347
	Equal variances not assumed	-3.770	158.113	.000	-5.086	1.349
University	Equal variances assumed	-4.381	160	.000	-4.815	1.099
	Equal variances not assumed	-4.391	159.983	.000	-4.815	1.096
Management information systems						
Secondary	Equal variances assumed	-4.885	263	.000	-4.735	.969
	Equal variances not assumed	-4.912	262.948	.000	-4.735	.964
University	Equal variances assumed	-5.172	263	.000	-4.410	.853
	Equal variances not assumed	-5.175	261.048	.000	-4.410	.852

Notes: *Statistics for business administration are not presented due to small sample size (n=7) and hence degrees of freedom (df.=5). **We used a general approach of the t-distribution for testing since the t-distribution approaches the normal distribution for large samples. However, using Z-table where Z=1.645 leads to the same conclusion of rejecting H_0.

4.4.2 Analysis of Variance

This paper applies the ANOVA technique to determine the source of variations in GPAs due to variances in gender, specialisation, and time. More precisely, we applied ANOVA as a tool to find those factors in econometric model, presented in Section 6, which influence the model most. As Table 6 shows, there is a clear empirical evidence that the non-existing of variation hypothesis for each of the three sources (gender, specialisation, and time) is rejected at 0.01 significance level. This implies that there are significant variations in the scores of male and female students, there are significant variations in scores among different specialisations, and there are significant variations in scores due to time trend. This is true for both secondary and university GPAs. These three findings are in line with the previous ones related to differences between secondary and university GPAs.

Table 6. Analysis of variance in GPAs by gender, specialisation and year of graduation

Type of education	Source of variation	Sum of Squares	df	Mean Square	F	Sig.
Secondary	Between Sexes	1613.015	1	1613.015	21.943	.000
	Within Sexes	242362.561	3297	73.510		
	Total	243975.576	3298			
University	Between Sexes	3260.443	1	3260.443	66.284	.000
	Within Sexes	162175.968	3297	49.189		
	Total	165436.412	3298			
Secondary	Between Specialisations	85268.717	6	14211.453	294.783	.000
	Within Specialisations	158706.859	3292	48.210		
	Total	243975.576	3298			
University	Between Specialisations	3805.233	6	634.205	12.917	.000
	Within Specialisations	161631.179	3292	49.098		
	Total	165436.412	3298			
Secondary	Between Years	33700.879	19	1773.730	27.659	.000
	Within Years	210274.697	3279	64.128		
	Total	243975.576	3298			
University	Between Years	5536.177	19	291.378	5.975	.000
	Within Years	159900.234	3279	48.765		
	Total	165436.412	3298			

Note: The goal of ANOVA is to compare means not variances.

4.5 Test of Variances

This paper applies Levene's test to provide empirical evidence regarding the equality of the variances of GPAs. The results of Levene's test of equality of variances do not reject the equality assumption for variances, indicating no statistically significant differences in the variability in GPAs. As presented in Table 7, the level of significance is higher that 5% for each specialisation. The only exception is for secondary GPA for students who were admitted at communication engineering. The test of variances is meant to provide evidence of equality of variances to meet the assumptions of model construction of normal variables under study.

Table 7. Results of Levene's test for equality of variances

Type of education	Specialisation	F	Sig.
	Computer sciences		
Secondary		1.107	.293
University		2.171	.141
	Electronic engineering		
Secondary		.686	.408
University		.268	.605
	Computer engineering		
Secondary		.187	.666
University		.858	.356
	Communication engineering		
Secondary		7.544	.006[***]
University		.428	.513
	Computer graphics & animation		
Secondary		.084	.773
University		2.184	.141

Management information systems		
Secondary	3.488	.063
University	.011	.915
Business administration		
Secondary	.896	.387
University	3.142	.136

Note: *** = significant at .01 level.

5. The Model

Following Pesaran et al. (2001) and many others, we apply the following Auto Regressive Distributed Lag (ARDL) model using a constant without time trend:

$$UGPA_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} UGPA_{t-i} + \sum_{i=0}^{m} \alpha_{2i} SGPA_{t-i} + \varepsilon \tag{1}$$

$$\Delta UGPA_t = \beta_0 + \sum_{i=1}^{n} \beta_{1i} \Delta UGPA_{t-i} + \sum_{i=0}^{m} \beta_{2i} \Delta SGPA_{t-i} + \varepsilon \tag{2}$$

We also apply the following ARDL model using a constant and time trend:

$$UGPA_t = \gamma_0 + \sum_{i=1}^{n} \gamma_{1i} UGPA_{t-i} + \sum_{i=0}^{m} \gamma_{2i} SGPA_{t-i} + \gamma_3 t + \varepsilon \tag{3}$$

$$\Delta UGPA_t = \delta_0 + \sum_{i=1}^{n} \delta_{1i} \Delta UGPA_{t-i} + \sum_{i=0}^{m} \delta_{2i} \Delta SGPA_{t-i} + \delta_3 t + \varepsilon \tag{4}$$

For simplicity, *n* and *m* represent the maximum number of lags, which is determined by the estimation method. α, β, γ and δ are coefficients to be estimated and ε is assumed white noise. The application of ARDL model is based on three validations. First, ARDL model suggests that after specification of the order of the ARDL, one can estimate the level and first difference relationship between variables using ordinary least squares method. Second, the order of integration of appropriate variables may not necessarily be the same. Therefore, the ARDL technique has the advantage of not requiring a specific identification of the order of the underlying data. Third, this technique is suitable for small sample size (Pesaran *et al*., 2001). The above model uses a time series of the averages of both secondary GPA (*SGPA*) and university GPA (*UGPA*) during the period 1993-2012.

6. Empirical Results

Before applying regression analysis, we test for the existence of unit root for the two main variables under study: secondary GPA and university GPA. After that, we apply Granger's causality test to examine the causal relationship between university and secondary scores. Finally, we estimate the equations of the ARDL model under several assumptions.

6.1 Unit Root Test

The unit root tests on the secondary GPA and university GPA are performed including only a constant then including a constant and a linear trend. A unit root test for the first difference should be performed only if the variables in level have a unit root, which is the case for *SGPA* variable. The null hypothesis for a unit root for *UGPA* is rejected for large negative values, in Table 8, at 0.01 significance level while it was necessary to test for first differences in SGPA (*ΔSGPA*) as test values were not significant. The results of the first differenced variables show that the ADF test statistics for all the variables are higher than the critical values at 1% and 5% levels except for *SGPA* whose test statistic is less than the critical value at 1% level. However, the PP test statistics for all the variables are less than the critical values at 1% level except for *SGPA* whose test statistic is significant at 5% level. The unit root tests confirmed the stationarity hypothesis for *UGPA* at level and for *SGPA* at first difference.

Table 8. Empirical results of unit root test

Variables	Augmented Dickey-Fuller test		Phillips-Perron test	
	Constant	Constant & Trend	Constant	Constant & Trend
SGPA	-0.919	-3.224	-1.069	-3.325[*]
ΔSGPA	-4.836[***]	-4.415[**]	-5.023[***]	-4.721[***]
UGPA	-8.860[***]	-9.017[***]	-7.411[***]	-9.057[***]
ΔUGPA	-6.747[***]	-5.642[***]	-7.907[***]	-6.456[***]

Notes: *=significant at .1 level; **=significant at .05 level; ***=significant at .01 level.

The maximum number of lags is set to 4 but the actual length is automatically selected based on SIC.

6.2 Causality Test

The empirical results for causality test fully support a unilateral hypothesis that secondary GPA does not cause university GPA, even when the number of lags reaches 3. As shown in Table 9, all probability values are higher than 5%, which leads to the conclusion that the null hypothesis of no causality cannot be rejected. It is worth noting that since secondary GPA (*SGPA*) is stationary at level, we do not need to test for the first difference (*ΔSGPA*). Furthermore, it is illogical to assume that university GPA causes secondary GPA and hence a test of causality in this direction is meaningless.

We also applied three options concerning the lag length in pairwise Granger causality test to provide more empirical evidence of the causal relationship between secondary and graduation GPA's, as the number of observations allows us to do so.

Table 9. Results for Granger's causality test

Pairwise Granger Causality Tests				
Sample: 1993-2012				
Null Hypothesis:	Lags	Observations	F-Statistic	Probability
SGAP does not Granger Cause *UGAP*	1	19	0.42271	0.5248
SGAP does not Granger Cause *UGAP*	2	18	2.29001	0.1406
SGAP does not Granger Cause *UGAP*	3	17	1.90068	0.1935

Note: SGPA is secondary GPA and UGPA is university GPA.

6.3 Estimation results

Table 10 shows the results of the ARDL estimation of five suggested forms of the model. As can be seen, all estimation results are statistically not acceptable. Estimated coefficients of the variables are not significant, the coefficients of determination (R^2) and their corresponding adjusted values are extremely small, and F-statistics are not significant. All these results indicate the weak power of secondary GPA in explaining the variations in university GPA. The results of other models including higher lags and first differences, not presented here, gave estimation results that lead to similar conclusions. It should be noted that the results of non-significant variables are intentionally presented here to provide an empirical evidence of the weak effect of *SGPA* on *UGPA*, under several assumptions that are driven from the above ARDL model equations (1) and (3).

Furthermore, we are not interested in modelling secondary GPA since it is illogical to assume that university GPA affects secondary GPA.

Table 10. Results of *UGPA* equations

Variable	Model 1 t-Statistic (Probability)	Model 2 t-Statistic (Probability)	Model 3 t-Statistic (Probability)	Model 4 t-Statistic (Probability)	Model 5 t-Statistic (Probability)
Constant	5.271579 (0.0001)	10.50926 (0.0000)	10.56054 (0.0000)	2.076318 (0.0533)	-0.247121 (0.8080)
Trend (t)				-1.858532 (0.0805)	0.652080 (0.5236)
$SGPA_t$	-0.086053 (0.9324)		-1.107570 (0.2844)	1.439028 (0.1683)	
$SGPA_{t-1}$		0.500818 (0.6229)	1.201928 (0.2469)		-2.04822 (0.8403)
SE	2.837682	1.273220	1.264814	2.662006	1.295306
R^2	0.000411	0.014540	0.084714	0.169215	0.040051
Adj. R^2	-0.055121	-0.043429	-0.029697	0.071476	-0.079943
F-statistic	0.007405	0.250819	0.740437	1.731288	0.333774

Note: The results of non-significant variables are intentionally presented here to provide an empirical evidence of the weak effect of *SGPA* on *UGPA*, under several assumptions that are driven from the above ARDL model equations (1) and (3).

7. Conclusions and Policy Implications

Exploring the association between secondary and university GPAs for Bachelor graduate students at Princess Sumaya University for Technology, in Jordan, during 1993-2012 has enabled us to reach some conclusions regarding the quality of education.

First, the unprecedented expansion of higher education institutions providing some unneeded specialisations have posed a serious pressure on the labour market since the domestic demand is not expected to absorb this army of unemployed graduates. The continuing high unemployment rates among university graduates is a sign of the failure of higher education system to couple its output of graduates with the needs of the labour market. The negative consequences on the economy do not need more emphases if certain measures are not taken soon. Second, the vast majority of the students at PSUT reported an overall graduation GPA of "satisfactory" or "good" (77.4%) while only a small percentage of students (5.8%) graduated with "excellent" level. Third, the findings of this study suggest that secondary GPAs have very little impact on overall student success as measured by graduation GPA, as the overall correlation between secondary and university GPAs is very small (37.3%) indicating a "very weak" association. Considering other factors, such as faculty, facilities, personal characteristics and economic status, are more likely to result in a stronger association with graduation GPA. There is also strong evidence that, after four or five years of teaching new entrances, PSUT did not maintain the high entrance grades but lowered them by about 9.2 points, although this varies among specialisations. Fourth, there are significant variations in the scores of male and female students, with clear evidence that females have done better than males. These variations exist among different specialisations and are persistent over time. Fifth, causality test fully supports a unilateral hypothesis that secondary GPA does not cause university GPA, under several assumptions of the model. Finally, empirical results of the ARDL model indicate the weak power of secondary GPA in explaining the variations in university GPA.

The above conclusions have several implications. First, there is a need to carry out extensive research to analyse the factors that would enhance the quality of higher education in Jordan. In this context, Jordanian universities are advised to establish a new institution to train scientists who can become experts in analyzing education data for solutions that will ultimately advance student success. The new institution could carry out several studies and offer workshops in new techniques designed to get at modelling educational processes including assessing the impact of admission policies on educational attainment and the needs of the labour market. Advanced and more sophisticated techniques require a team of specialised scientists who can use data to represent educational processes and outcomes on a large scale and question traditional admission rules and practices to shape the

higher education policy and offer new solutions. Second, it is recommended that new designs to answer the question of whether particular interventions make a difference for Bachelor students should be introduced to educational system in Jordan. Third, scholars and business managers, meeting regularly at national conferences to advance new applications in industry and provide more employment jobs, should be involved in social network analysis. Finally, we recommend the replication of this study on other universities to gain more evidence on the quality of higher education in Jordan and include more factors that would enhance students educational attainment with special emphasis on the demand for labour by specialisation.

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