Working Paper

Okun's Law – Evidence from Jamaica

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The study examines the appropriateness of Okun's Law for the Jamaican economy, which posits an inverse relationship between the unemployment rate and GDP growth. Using the difference, output gap and auto-regressive distributive lags (ARDL) specifications, the study finds, at the aggregate level, a statistically significant relation between the unemployment rate and the output gap. Moreover, there exists consistent evidence in line with the theory for some industries. In particular, regardless of the output gap methodology chosen, significant relationships between real industry GDP and the unemployment rate in for Community, Social & Personal Service Activities, Real Estate, Renting & Business Activities, Wholesale & Retail Trade and Manufacturing were found in the short run. Of note, the relationship between real output growth and the unemployment rate in Finance & Insurance Services industry was statistically significant but was contrary to Okun's proposition. Intuitively, the industry unemployment rate increases as GDP increases though output maybe influenced by factors other than employment. The results conclude like other studies that there are limits to the usefulness of the information proved by Okun's Law at the aggregate level and point to its utility in the short rather than long run for Jamaica.

Keywords: ARDL bound test, Economic growth, Unemployment.

JEL Classification: E24, F41, C32, J21, J64

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Introduction

The mainstay of policymakers is to create an enabling environment which facilitate macroeconomic stability and economic growth. To this end, the ultimate result of monetary and fiscal policy is to positively impact the real economy while limiting undesirable consequences of inflation, inequality and environmental degradation, amongst others. Further, it is hoped that the increase in economic activity will be associated with expansions in both real output growth as well as employment, that is, eliminating the incidence of high level of unemployment during a period of positive output growth or jobless growth. Intuitively, this speaks to the extent to which growth in output is accompanied by a reduction in the unemployment rate, the so-called Okun's Law. The rule of thumb under this law relates changes in unemployment rate to changes in output growth. Some authors posit Okun's law in reality is a statistical relationship rather than a structural feature of the economy which is subject to revisions as an economy evolves over time (Baily & Okun, 1965). Indeed the stability and usefulness of Okun's hypothesis has been disputed (Knotek & Edward , 2007). Further, it is expected that output is not only determined by employment but also other factors. The improvement in output is also determined by, amongst other things, labour force participation, hours worked per employee, output per hour worked and capacity utilization (Baily & Okun, 1965). Motivated by the prospect of gaining further insight into the patterns and evolution of the goods and labour market, this paper investigates whether the correlation between unemployment and output fluctuations exist by evaluating the appropriateness of Okun's Law to Jamaica. Using the difference, output gap and autoregressive distributive lags (ARDL) methodologies, empirical explorations are done to determine the efficacy of the unemployment –growth relationship at the aggregate and the industry levels. The study finds that there is statistically significant relationship at the aggregate level conditional on the methodology chosen as well as evidence in line with the theory at the industry-level. In particular, significant relationships between real GDP unemployment for Community, Social & Personal Service Activities, Real Estate, Renting & Business Activities, Wholesale & Retail Trade and Manufacturing. Of note, the relationship between real GDP growth and the unemployment rate in Finance & Insurance Services industry was statistically significant but was the contrary of Okun's proposition.

The rest of the paper is organized as follows: section two sets out the methodology, section three analyses the data, section four presents the results and section five concludes with some policy recommendations.

2.0 Methodology

Similar to the approach of (Sekhposyan & Owyang, 2012), this study will assess the short-run relationship between economic growth and unemployment in Jamaica by employing three benchmark versions of Okun's Law. The first two specifications, the difference and gap models, are similar to the original models proposed by Okun in his seminal paper. In addition, we will estimate a third model, the dynamic model, which represents a contemporary modification of Okun's difference model allowing for current and past output to impact the level of unemployment rate. All models will be estimated using Ordinary Least Squares (OLS).

2.1. The Difference Model

The difference version of Okun's law relates contemporaneous changes in the unemployment rate to contemporaneous changes in economic growth such that:

$$\Delta u_t = \alpha^d + \beta^d \Delta y_t + e_t^d \quad , \quad (1)$$

where u_t refers to the unemployment rate, y_t represents the natural log of real GDP and the superscript *d* highlights that the respective coefficients refer to the difference model. For this model formulation it is important to note that the negative ratio of the constant and slope coefficients, $-\alpha^d / \beta^d$, reflects the rate of economic growth that must prevail such that the unemployment rate remains stable.

2.2. The Gap Model

On the other hand, the gap specification of Okun's law requires the estimation of a model relating the unemployment rate to the contemporaneous output gap such that:

$$u_t = \alpha^g + \beta^g (y_t - y_t^n) + e_t^g$$

$$= \alpha^g + \beta^g y_t^g + e_t^g \quad , \quad (2)$$

where the term y_t^n corresponds to potential output and $y_t^g = y_t - y_t^n$ refers to the output gap – the difference between actual and potential GDP. For this specification, the constant term, α^g, denotes the unemployment rate for which the output gap is zero. Theoretically, Okun's Law in this context posits that the high rate of unemployment is associated with idle resources when actual rate of output is below its

potential. Conversely, as actual output increases above potential the rate of unemployment should decline.

It is important to note that Okun (1965) used a potential output which expanded at a constant rate of 3.5 per cent for the US while more recent studies such as (Sekhposyan & Owyang, 2012) and (Ball, Leigh, & Loungani, 2013) have allowed the path of potential output to vary across time. This study will adopt the latter method in allowing for a time-varying path in potential output. To this end, potential output, though not directly observable, is derived using a time trend, HP filter and the production function (Brown, 2016). Further, the paper investigates the extent to which the output gap- unemployment rate relationship depends on the method of calculation of the potential output gap. Additionally, the unemployment rate and GDP growth at the industry level is also examined so as to glean the extent to which industry growth is associated with reduction in their respective unemployment rate. The industry analysis is estimated by the three specifications but only uses the time trend and the Hodrick-Prescott (HP) filter specifications of the output gaps.

2.3 The Dynamic Model

The dynamic specification represents an extension of the difference and output gap models in that it is an autoregressive distributed lag (ARDL) specification of these models. In this regard, the dynamic model relates the changes in the unemployment rate to past changes in unemployment as well as current and past changes in output/output gap. In addition to allowing for short run dynamics, this specification importantly facilitates the correction of serial correlation that is often present in the original difference and gap models. Additionally, the ARDL methodology aims to capture the potential long run and short run relationship between output growth and unemployment rate. The ARDL approach was utilized as it yields consistent estimates of the long-run coefficients that are asymptotically normal irrespective of whether the underlying repressors are stationary or non-stationary. Furthermore, the estimation of cointegrating relationships using the ARDL representation does not require symmetry of lag lengths, thereby allowing each variable to have a different number of lag terms (Pesaran, Shin, & Smith, 2001). Algebraically, the ARDL is denoted by the following:

$$\Delta u_t = \alpha^l + \sum_{i=1}^{p} \theta_1^l u_{t-i} + \sum_{i=0}^{p} \beta^l \Delta y_{t-i} + e_t^l \quad , \quad (3).$$

3.0 Data & Discussion of the Results

The paper utilizes quarterly data for the sample period 1996 Q1 to 2015 Q4 at the aggregate level and for selected industries, where available. The sample period for the remaining industries was 2008 Q1 to 2015 Q4. Data for the unemployment rate and real gross domestic product (GDP) were garnered from the Statistical Institute of Jamaica. All data used in the empirical investigation were logged and seasonally adjusted.

3.1 Structure the Data

From a cursory examination of the data it is clear throughout the sample structure of employment and output in Jamaica has not changed significantly (See Figure 1 and 2). The top five industries of employment in descending order are Community, Social & Personal Services, Wholesale & Retail Trade, Agriculture, Forestry & Fishing, Hotels & Restaurant and Construction. The five largest industry value added are Wholesale & Retail Trade, Producers of Government Services (corresponds with activities associated with Community, Person & Social Services), Real Estate, Renting & Business Services, Finance & Insurance Services and Transport, Storage & Communication (see Figure 1). It is therefore reasonable to assume that the coefficients of the regressions are relatively stable over the sample. Therefore, it was not considered critical to test whether the coefficient would be time varying.

Figure 1. Share of Output

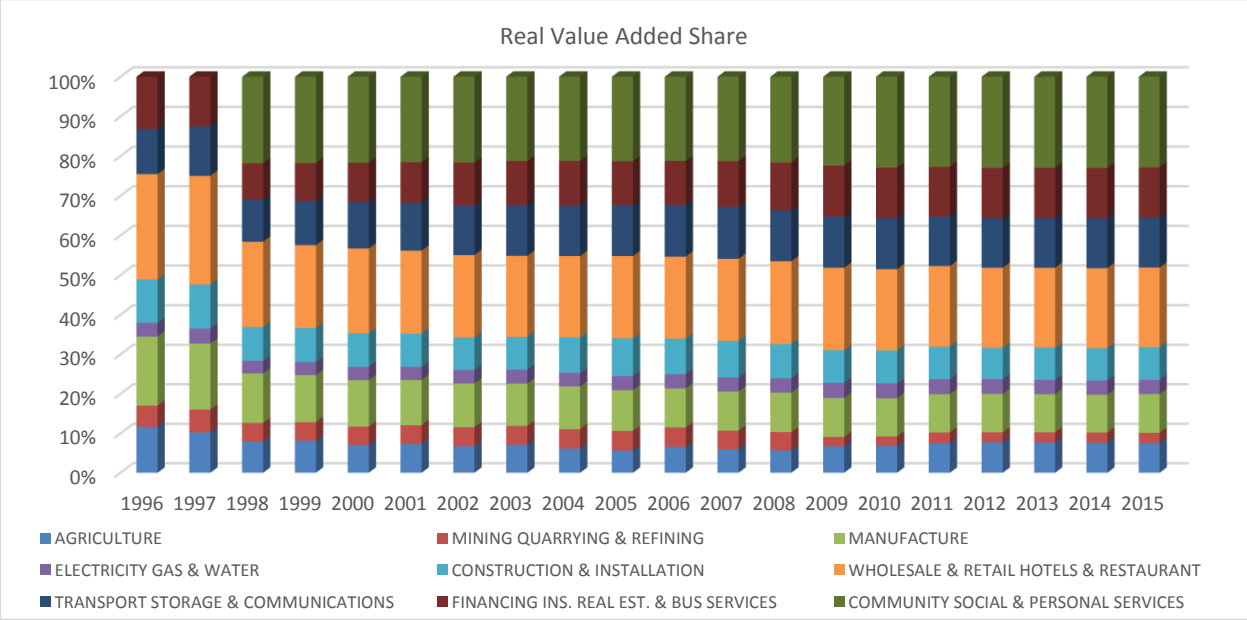
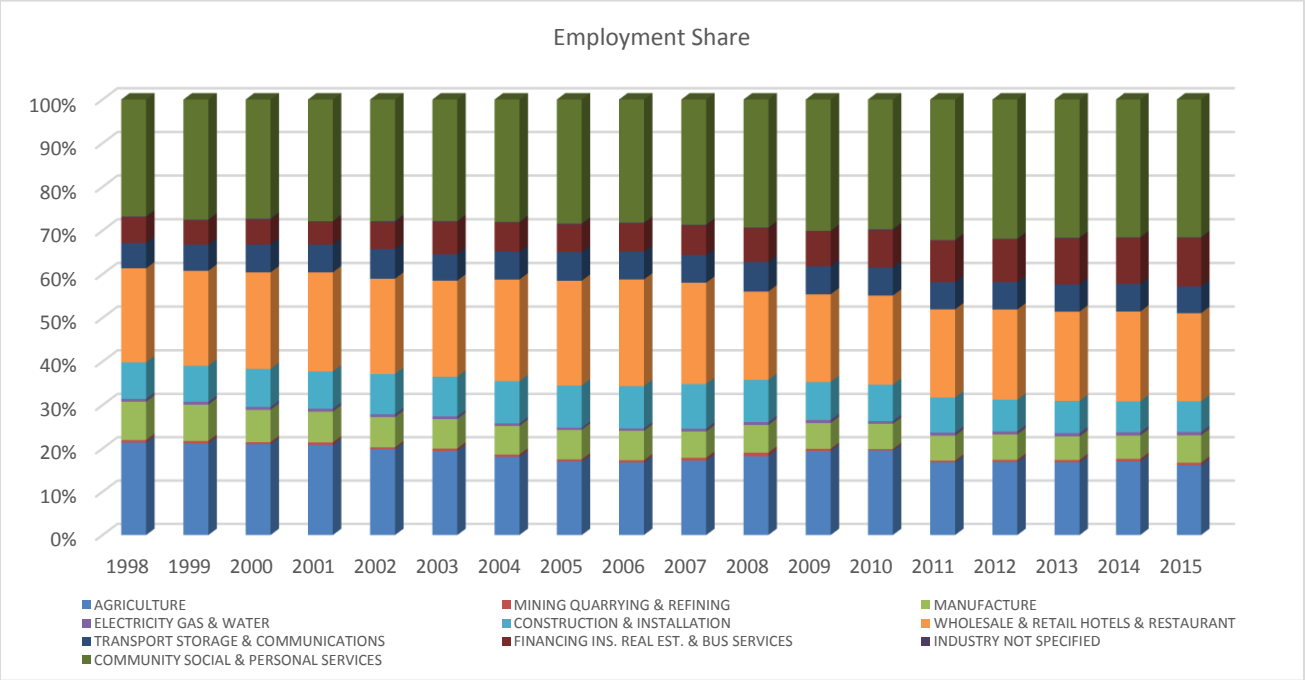


Figure 2. Structure of Employment



The interrogation of the data proceeds further with a look at the output gaps. The alternate measures of the output gap utilized are compared in Figure 3. From the graphical depiction we note that there are fairly significant deviations between the time trend and the HP filter measures across several different time periods. Also noteworthy is that the estimates of the potential output generated by the HP filter and the production function are very similar. Of particular interest also is the divergence of the HP filter and the time trend measures in the post-2002 segment of the sample. Against this background, it is expected that there may be sensitivity to the measure of output gap used.

Figure 4 summarizes the relationship between the unemployment rate and economic growth/output gap using scatterplots. The plots provide preliminary evidence of the negative relationship between the unemployment rate and output gap variables at the aggregate level. However, it is interesting to note that the overall correlations are relatively low between the changes in the unemployment rate and output growth (-0.01) and only moderate for correlations between the unemployment rate and measures of

output gaps used (see Figure 5). At the aggregate level, the overall correlation between the unemployment rate, time trend, HP filter and the production versions of the output gap for the full sample are -0.53, -0.17 and -0.37, respectively. For most industries, the correlation between output gaps and the unemployment rate have a negative relationship, the strongest of which is between GDP and the output gap specification, in particular the time trend output gap.

Figure 3. Output Gaps

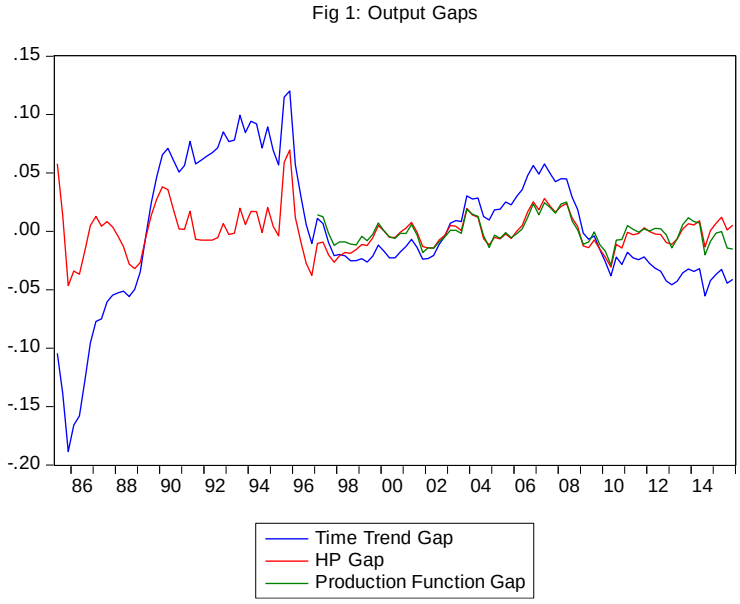


Figure 4. Scatterplots

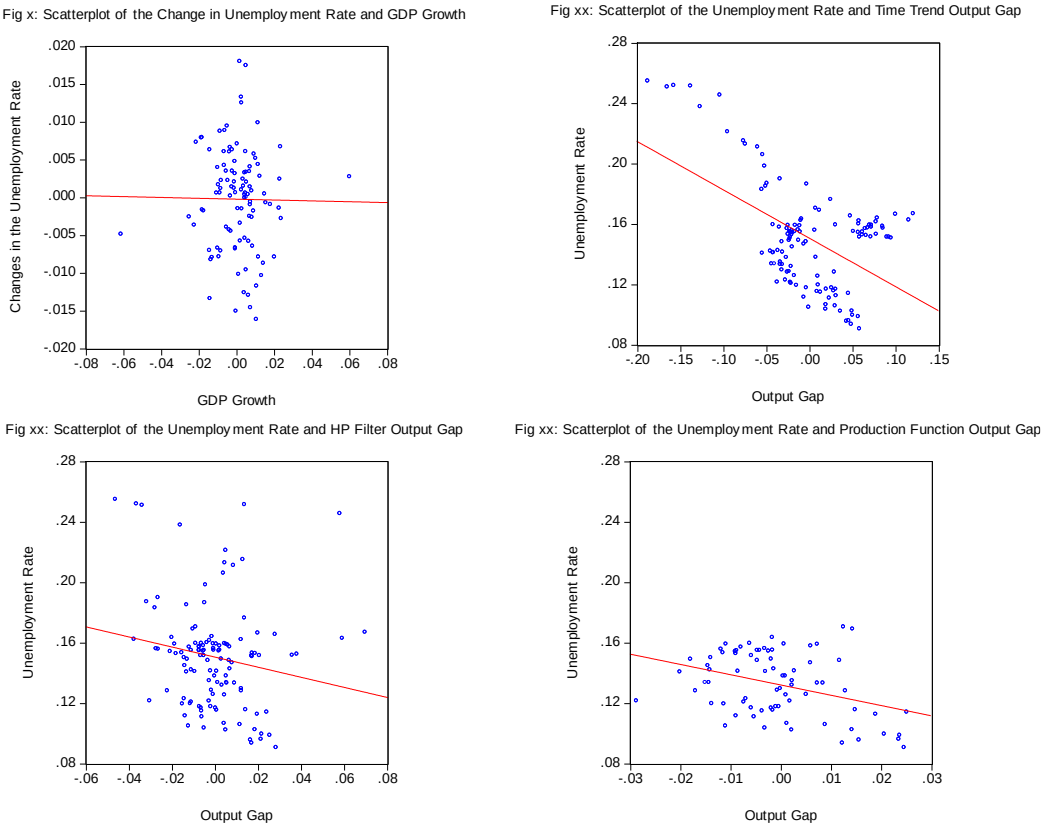
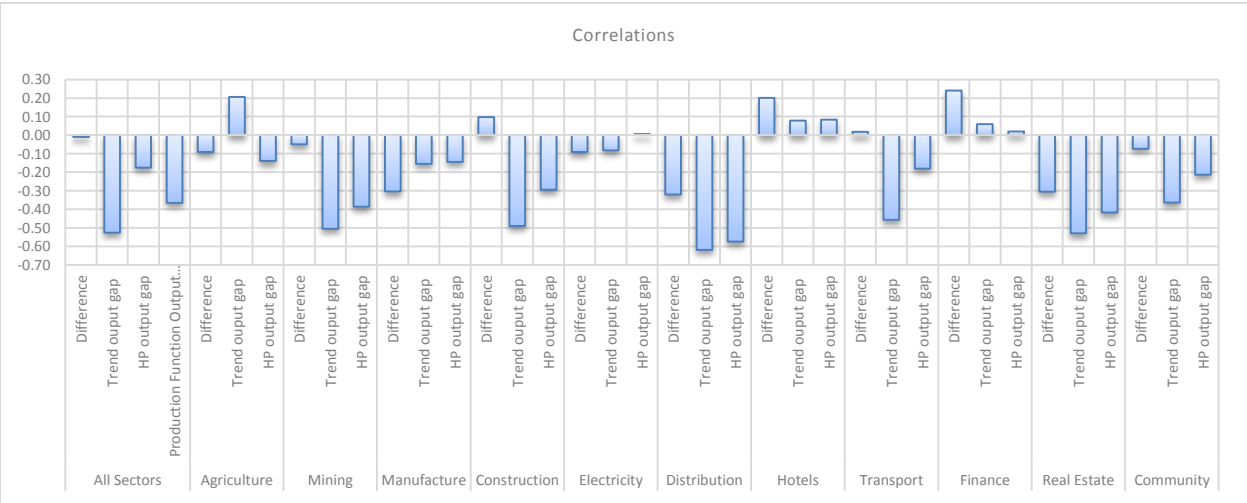


Figure 5. Correlations



With the exception of the production function derived output gap, granger causality test also corroborate that changes in output and/or the output gap determine the overall unemployment rate (See Appendix). At the industry level, the results indicate that the changes in output granger caused the unemployment rate for Agriculture, Forestry & Fishing, Mining & Quarrying and Transport, Storage & Communication. However, the results were mixed and dependent on the measure of output gap used.

4.1 Difference Specification

Before estimating the models, stationarity tests for all series were done using the Augmented Dickey Fuller (ADF) Test. The results of the ADF tests which suggests that all variables are without a unit root and are therefore stationary (See Appendix). Further, we test the existence of structural breaks for each specification in order to identify and understand potential shifts. The Quant-Andrews unknown breakpoint test for the difference and gap models was employed and breakpoints were tested separately for the mean coefficients. Regarding the dynamic model, breakpoints were tested for the constant and included where necessary (see Appendix) .

Table 1 shows the results for the modified OKun's Law regression with appropriate dummy variables. The results for the benchmark specification indicates that there exists no statistically significant relationship between the changes in the unemployment rate and economic growth at the aggregate level. However, with the exception of Finance & Insurance Services, similar regressions with Manufacturing, Wholesale & Retail Trade, Real Estate, Renting & Business Activity were found to be statistically significant and in line with *a priori* expectations. More specifically, a 1 per cent increase in output growth reduces the unemployment rate in Manufacturing, Wholesale & Retail Trade and Real Estate, Renting & Business Activity by 0.29 percentage points, 0.58 percentage points and 1.6 percentage points, respectively. The results for Finance & Insurance Services were also significant and indicated that a one percentage point increase in output growth would increase its unemployment rate by 0.75 percentage points (See Table 1). The results confirm that intra industry dynamics unveil evidence of Okun's law concealed at the aggregate level. This estimated sensitivity of the unemployment rate compares to the findings of (Baily & Okun, 1965)and (Nugent & Schmid, 2013) of 0.3 and 0.35, respectively, for the United States and Jamaica. The difference in magnitude found in this paper relative to Okun's findings may highlight cross-country differences between the US and Jamaica based on variations in the structure of the respective labour markets. The sensitivity of the unemployment rate in Jamaica relative to that for the US may partly reflect a greater skills mismatch or labour market inefficiency in some industries than others. Further, the findings for the Finance & Insurance Services could possibly be evidence of, amongst other things, other

determinants of output. Additionally, the result could be illustrative of increased automation within the industry over the sample period as the model of banking and financial services has change to a less labour intensive outlay.

Table 1. Difference Specification

Dependent Variable: ΔUR		C	ΔLGDPSA	DUMMY1
All Sectors	Benchmark with break	0.00	0.00	0.00
	p-value	*0.53*	*0.93*	*0.52*
Agriculture, Forestry & Fishing	Benchmark with break	0.00	-0.01	0
	p-value	*0.49*	*0.65*	*0.79*
Mining & Quarrying	Benchmark with break	0	-0.15	0
	p-value	*0.76*	*0.12*	*0.87*
Manufacture	Benchmark with break	0	-0.29**	0
	p-value	*0.92*	*0.00*	*0.96*
Construction	Benchmark with break	0.01	0.38	-0.01
	p-value	*0.38*	*0.44*	*0.37*
Electricity	Benchmark with break	0	0.44	0
	p-value	*0.89***	*0.15*	*0.9***
Wholesale & Retail Trade	Benchmark with break	0	-0.59	0
	p-value	*0.71*	*0.11*	*0.96*
Hotels	Benchmark with break	0	0.18	0
	p-value	*0.9*	*0.33*	*0.74*
Transport, Storage & Communication	Benchmark with break	0	-0.03	-0.01
	p-value	*0.51*	*0.9*	*0.32*
Finance & Insurance	Benchmark with break	0	0.76	0
	p-value	*0.75*	*0.07*	*0.89*
Real Estate, Renting & Business Activity	Benchmark with break	0	-1.95**	0
	p-value	*0.47*	*0.05*	*0.48*
Community, Social & Personal Services	Benchmark with break	0	-0.19	0
	p-value	*0.76*	*0.52*	*0.9*

4.2 Gap Specification

Time Trend

This section highlights the results for the evaluation of the Okun's law using the output gap analysis. The paper explores the hypothesis that the unemployment rate is related to the difference between actual GDP and potential GDP. As mentioned before, in this study the potential GDP is measured by three methods, namely, a time trend, HP filter and from the estimation of the production function. Using the simple time trend, evidence is found at the industry level but not that the aggregate level. In particular, results complicit with Okun's law outlined that a 1 per cent increase in the output gap results in a reduction in the unemployment rate of Mining & Quarrying, Construction, Electricity, Wholesale & Retail Trade, Real Estate, Renting & Business Activity and Community, Social & Personal Service Activities by 0.1 percentage points, 0.23 percentage points, 0.25 percentage points, 0.43 percentage points, 0.08 percentage points, 0.85 percentage points and 0.33 percentage points, respectively (see Table 2). As demonstrated in Table 5 the results for the regression including the structural break dummies.

Table 2. Time Trend Output Gap

Dependent Variable: UR	**C**	**Output GAP (Time trend)**	**DUMMY1**	**DUMMY2**
All Sectors	Benchmark with break	0.15	-0.01	-0.040902
	p-value	*0*	*0.79*	*0*
Agriculture, Forestry & Fishing	Benchmark with break	0.03	0	0.01
	p-value	*0*	*0.74*	*0*
Mining & Quarrying	Benchmark with break	0.1	-0.1	0.08
	p-value	*0*	*0.01*	*0*
Manufacture	Benchmark with break	0.14**	-0.06	-0.05
	p-value	*0*	*0.64*	*0.01*
Construction	Benchmark with break	0.16**	-0.23	0.08
	p-value	*0*	*0*	*0*
Electricity	Benchmark with break	0.08**	-0.25	-0.06
	p-value	*0*	*0*	*0*
Wholesale & Retail Trade	Benchmark with break	0.1**	-0.43	0.01
	p-value	*0*	*0*	*0*
Hotels	Benchmark with break	0.2**	0.15	0
	p-value	*0*	*0.66*	*0.93*

Dependent Variable: UR	C	Output GAP (Time trend)	DUMMY1	DUMMY2
Transport, Storage & Communication	Benchmark with break	0.07**	-0.08	0
	p-value	*0*	*0*	*0.07*
Finance & Insurance Services	Benchmark with break	0.03**	0.07	0.02
	p-value	*0*	*0.75*	*0*
Real Estate, Renting & Business Activity	Benchmark with break	0.08**	-0.85	0.01
	p-value	*0*	*0*	*0.02*
Community, Social & Personal Service Activities	Benchmark with break	0.1**	-0.33	0.02
	p-value	*0*	*0.05*	*0*

HP Filter

Examining the output gap generated by using the potential GDP estimated by an HP filter showed that there is evidence to suggest that an increasing output gap reduce the overall unemployment rate. More specifically, a 1 per cent increase in the output gap would result in a 0.16 percentage points decline in the unemployment rate (See Table 3). Similar statistically significant relationships are found between the output gap of industries and their unemployment rate. In particular, the unemployment rate for Agriculture, Forestry & Fishing, Mining & Quarrying, Construction, Wholesale & Retail Trade, Real Estate, Renting & Business Activity and Community, Social & Personal Service Activities would decline by 0.1 percentage points, 0.15 percentage points, 0.48 percentage points, 0.74 percentage points, 1.41 percentage points and 0.66 percentage points, respectively, for a 1 per cent increase in the output gap (see Table 3).

Table 3. HP filter Output Gap

Dependent Variable: UR		C	Output Gap (HP Filter)	DUMMY1	DUMMY2
All Sectors	Benchmark with break	0.15	-0.16**	-0.040578	0.029105
	p-value	*0*	*0.03*	*0*	*0*
Agriculture, Forestry & Fishing	Benchmark with break	0.03	-0.01	0.01	
	p-value	*0*	*0.07*	*0*	
Mining & Quarrying	Benchmark with break	0.09	-0.15**	0.1	
	p-value	*0*	*0.01*	*0*	
Manufacture	Benchmark with break	0.14	-0.25	-0.05	

Dependent Variable: UR		C	Output Gap (HP Filter)	DUMMY1	DUMMY2
	p-value	*0*	*0.22*	*0*	
Construction	Benchmark with break	0.16	-0.48**	0.09	
	p-value	*0*	*0*	*0*	
Electricity	Benchmark with break	0.07	-0.07	-0.04	
	p-value	*0*	*0.73*	*0*	
Wholesale & Retail Trade	Benchmark with break	0.1	-0.74**	0.01	
	p-value	*0*	*0*	*0*	
Hotels	Benchmark with break	0.2	0.16	0	
	p-value	*0*	*0.64*	*0.92*	
Transport, Storage & Communication	Benchmark with break	0.07	-0.13	0	
	p-value	*0*	*0.11*	*0.86*	
Finance & Insurance Services	Benchmark with break	0.03	0.05	0.02	
	p-value	*0*	*0.84*	*0*	
Real Estate, Renting & Business Activity	Benchmark with break	0.08	-1.41**	0.01	
	p-value	*0*	*0.01*	*0.03*	
Community, Social & Personal Service Activities	Benchmark with break	0.1	-0.66	0.03	
	p-value	*0*	*0.04*	*0*	

Production Function Output Gap

The output gap obtained by deriving the potential GDP from the production function (i. e. using labour, capital and total factor productivity) was used to evaluate Okun's hypothesis. While this methodology was only done at the aggregate level, the results validate *a priori* expectations and finds that a 1 per cent increase in the output gap would decrease the unemployment rate by 0.39 percentage points (See table 4). From the table below we see that though the relationship between unemployment rate and output growth is statistically significant the Durbin-Watson statistic indicates the presence of autocorrelation and validates the use of lags of the dependent variable.

Table 4. *Production Function Output Gap*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.145892	0.002242	65.05845	0.0000
Output Gap (Production Function)3	-0.394251	0.131857	-2.989978	0.0038
DUMMY1	-0.033832	0.003344	-10.11588	0.0000
DUMMY2	0.027297	0.003943	6.922592	0.0000

R-squared	0.653818	Mean dependent var	0.132689
Adjusted R-squared	0.639394	S.D. dependent var	0.020908
S.E. of regression	0.012555	Akaike info criterion	-5.866187
Sum squared resid	0.011349	Schwarz criterion	-5.743517
Log likelihood	226.9151	Hannan-Quinn criter.	-5.817162
F-statistic	45.32769	Durbin-Watson stat	0.514034
Prob(F-statistic)	0.000000		

4.3 Dynamic Specification

The ARDL methodology was used to investigate the dynamic relationship between the unemployment rate and GDP growth. At the aggregate level, there exists no statistically significant evidence of long-run nor short run relationship to support Okun's hypothesis using the difference specification. Using the gap specification revealed a statistically significant negative relationship between the output gap measures and the unemployment rate for Wholesale & Retail Trade and Community, Personal & Social Services (See Table 5). However, there exist no evidence of a long run relationship given that the F-statistic lies between the critical bounds.

Table 5. ARDL		Long Run Coefficients						Critical Value Bounds		
Dependent Variable: UR		DLGDPSA	DUMMY1	DUMMY2	C	@TREND	F-statistic		**I0 Bound**	**I1 Bound**
All Sectors	Benchmark	-0.44	-0.01	0.04	0.18	0.00	3.70	**10%**	**5.59**	**6.26**
	p-value	*0.11*	*0.62*	*0.00*	*0.00*	*0.01*		**5%**	**6.56**	**7.3**
Agriculture, Forestry & Fishing	Benchmark	-0.03	0.01		0.01	0.00	8.30	**10%**	5.59	6.26
	p-value	*0.32*	*0.15*		*0.29*	0.11		**5%**	6.56	7.3
Mining & Quarrying	Benchmark	-0.21	0.09		0.09	0.00	13.00	**10%**	5.59	6.26
	p-value	*0.15*	*0.06*		*0.19*	*0.99*		**5%**	6.56	7.3
Manufacture	Benchmark	-0.98	0.02		0.28	0.00	5.30	**10%**	5.59	6.26
	p-value	*0.07*	*0.58*		*0.00*	*0.00*		**5%**	6.56	7.3
Construction	Benchmark	-0.42	0.04		0.08	0.00	5.90	**10%**	5.59	6.26
	p-value	*0.19*	*0.08*		*0.02*	*0.01*		**5%**	6.56	7.3
Electricity	Benchmark	0.05	0.02		0.17	0.00	35.70	**10%**	5.59	6.26
	p-value	*0.76*	*0.21*		*0.00*	*0.00*		**5%**	6.56	7.3
Wholesale & Retail Trade	Benchmark	-1.73	0.95		1.04	-1.22	3.70	**10%**	5.59	6.26
	p-value	*0.01*	*0.00*		*0.00*	*0.00*		**5%**	6.56	7.3
Hotels	Benchmark	0.36	-0.13		0.00	0.00	17.10	**10%**	5.59	6.26
	p-value	*0.22*	*0.00*		*0.96*	*0.00*		**5%**	6.56	7.3
Transport, Storage & Communication	Benchmark	-0.28	-0.01		0.06	0.00	6.70	**10%**	5.59	6.26
	p-value	*0.31*	*0.41*		*0.00*	*0.43*		**5%**	6.56	7.3
Finance & Insurance Services	Benchmark	-0.20	-0.02		0.00	-0.11	23.40	**10%**	5.59	6.26
	p-value	*0.34*	*0.05*		*0.93*	*0.00*		**5%**	6.56	7.3
Real Estate, Renting & Business Activity	Benchmark	1.01	-3.52		0.02	0.18	9.30	**10%**	5.59	6.26
	p-value	*0.55*	*0.00*		*0.77*	*0.00*		**5%**	6.56	7.3
Community, Social & Personal Service Activities	Benchmark	-1.32	0.01		0.07	0.00	4.20	**10%**	5.59	6.26
	p-value	*0.08*	*0.48*		*0.01*	*0.27*		**5%**	6.56	7.3

Using the difference specification, the results indicate evidence to support a negative relationship between GDP growth and unemployment in Wholesale & Retail Trade and Community, Social & Personal Service Activities in the short run (see table 5). However, the long run equations were not statistically significant as the F-statistics were below the critical value bounds and hence the null hypothesis of no long relationship could not be rejected.

Using the time trend output gap, the results show that a one percent increase in output gap reduces unemployment rate by 0.44 percentage point. However, the results also indicate a failure to reject the null hypothesis of no long run relationship at the aggregate level. At the industry level however, the results substantiate a negative and statistical significant long run relationship between the output and unemployment rate for Agriculture, Forestry & Fishing, Mining & Quarrying, Wholesale & Retail Trade and Real Estate, Renting & Business Activity. More specifically, a one percentage point increase in the output gap would lead to a decline in unemployment rate of 0.02 percentage points, 0.21 percentage points, 0.98 percentage points, 2.51 percentage points in Agriculture, Forestry & Fishing, Mining & Quarrying, Wholesale & Retail Trade and Real Estate, Renting & Business Activity, respectively. However, a positive and significant long run relationship was found for Construction and Transport, Storage & Communication of 0.37 and 0.47 (see Table 6). Of note, the long run relationship could only be statistically validated for Mining, Construction, Wholesale & Retail Trade, Transport & Communication and Real Estate, Renting & Business Services.

The analysis using the ARDL and the HP filter output gaps showed that on an aggregate level the long run relationship could not be statistically validated as the F-statistic is less than the critical bounds. However, the results indicate that above trend growth of one percent reduces the industry unemployment rate by 0.21, 0.33 and 2.51 percentage points, for Mining & Quarrying, Transport, Storage & Communication and Real Estate, Renting & Business Activity, respectively.

Similar to the result from the time trend output gap, the HP filter output gap also indicated a 0.44 percentage point reduction in the overall unemployment rate in response to a one per cent increase in overall output gap with the absence of empirical results to substantiate of a long run relationship. However, a long run relationship in line with Okun's law was only validated for Mining & Quarrying, Construction and Real, Estate, Renting & Business Activity.

Table 6 ARDL Time Trend		Long Run Coefficients							Critical Value Bounds		
Dependent Variable: UR		GDP_GAP1 (Time trend)	DUMMY1	DUMMY2	C	@TREND		F-statistic		**I0 Bound**	**I1 Bound**
All Sectors	Benchmark	-0.44	-0.01	0.04	0.18	0.00		5.2	10%	5.59	6.26
	p-value	*0.00*	*0.64*	*0.00*	*0.00*	*0.04*			5%	6.56	7.3
Agriculture, Forestry & Fishing	Benchmark	-0.02	0.01		0.02	0.00		**17.5**	10%	5.59	6.26
	p-value	*0.04*	*0.02*		*0.00*	*0.15*			5%	6.56	7.3
Mining & Quarrying	Benchmark	-0.21	0.09		0.09	0.00		**14.9**	10%	5.59	6.26
	p-value	*0.04*	*0.23*		0.32	*0.99*			5%	6.56	7.3
Manufacture	Benchmark	-0.98	0.02		0.28	0.00		3.2	10%	5.59	6.26
	p-value	*0.02*	*0.60*		*0.00*	*0.00*			5%	6.56	7.3
Construction	Benchmark	0.37	-0.26		0.03	0.05		38.4	10%	5.59	6.26
	p-value	*0.00*	*0.00*		*0.16*	*0.00*			5%	6.56	7.3
Electricity	Benchmark	0.05	0.02		0.17	0.00		37.4	10%	5.59	6.26
	p-value	*0.56*	*0.41*		*0.00*	*0.00*			5%	6.56	7.3
Wholesale & Retail Trade	Benchmark	-0.95	0.01		0.01	0.01		10.4	10%	5.59	6.26
	p-value	*0.00*	*0.09*		0.82	*0.00*			5%	6.56	7.3
Hotels	Benchmark	0.41	-0.05		-0.13	0.00		11.6	10%	5.59	6.26
	p-value	*0.08*	*0.00*		0.03	*0.00*			5%	6.56	7.3
Transport, Storage & Communication	Benchmark	0.47	-0.34		-0.01	0.04		31.3	10%	5.59	6.26
	p-value	*0.00*	*0.00*		0.69	*0.00*			5%	6.56	7.3
Finance & Insurance Services	Benchmark	-0.09	0.00		0.00	0.00		15.2	10%	5.59	6.26
	p-value	*0.74*	*0.84*		0.99	*0.00*			5%	6.56	7.3
Real Estate, Renting & Business Activity	Benchmark	-2.51	0.02		0.18	0.00		10.5	10%	5.59	6.26
	p-value	*0.00*	*0.04*		0.00	*0.08*			5%	6.56	7.3
Community, Social & Personal Service Activities	Benchmark	0.42	-0.77		0.01	0.04		10.9	10%	5.59	6.26
	p-value	*0.19*	*0.00*		*0.71*	*0.00*			5%	6.56	7.3

Table 7. ARDL HP Filter		**Long Run Coefficients**								**Critical Value Bounds**	
Dependent Variable: UR		GDP_GAP2 HP Filter	DUMMY1	DUMMY2	C	@TREND		F-statistic		**I0 Bound**	**I1 Bound**
All Sectors	Benchmark	-0.44	-0.01	0.04	0.18	0.00		5.06	10%	5.59	6.26
	p-value	*0.04*	*0.62*	*0.00*	*0.00*	*0.01*			5%	6.56	7.3
Agriculture, Forestry & Fishing	Benchmark	-0.02	0.01	0.02		0.00		**21.97**	10%	5.59	6.26
	p-value	*0.06*	*0.01*	*0.00*		*0.12*			5%	6.56	7.3
Mining & Quarrying	Benchmark	-0.21	0.09	0.09		0.00		**15.69**	10%	5.59	6.26
	p-value	*0.04*	*0.06*	*0.18*		*0.99*			5%	6.56	7.3
Manufacture	Benchmark	-0.98	0.02	0.28		0.00		3.28	10%	5.59	6.26
	p-value	*0.07*	*0.56*	*0.00*		*0.00*			5%	6.56	7.3
Construction	Benchmark	-0.42	0.04	0.08		0.00		6.58	10%	5.59	6.26
	p-value	*0.05*	*0.07*	*0.01*		*0.01*			5%	6.56	7.3
Electricity	Benchmark	0.05	0.02	0.17		0.00		37.35	10%	5.59	6.26
	p-value	*0.78*	*0.21*	*0.00*		*0.00*			5%	6.56	7.3
Wholesale & Retail Trade	Benchmark	-0.95	0.01	0.01		0.01		6.14	10%	5.59	6.26
	p-value	*0.00*	*0.11*	*0.82*		*0.00*			5%	6.56	7.3
Hotels	Benchmark	0.41	-0.05	-0.13		0.00		11.68	10%	5.59	6.26
	p-value	*0.09*	*0.00*	*0.03*		*0.00*			5%	6.56	7.3
Transport, Storage & Communication	Benchmark	-0.33	-0.01	0.06		0.00		7.69	10%	5.59	6.26
	p-value	*0.10*	*0.39*	*0.00*		*0.33*			5%	6.56	7.3
Finance & Insurance Services	Benchmark	-0.01	0.00	-0.09		0.00		17.35	10%	5.59	6.26
	p-value	*0.92*	*0.60*	*0.01*		*0.00*			5%	6.56	7.3
Real Estate, Renting & Business Activity	Benchmark	-2.51	0.02	0.18		0.00		8.8	10%	5.59	6.26
	p-value	*0.01*	*0.05*	*0.00*		*0.07*			5%	6.56	7.3
Community, Social & Personal Service Activities	Benchmark	-1.32	0.01	0.07		0.00		4.38	10%	5.59	6.26
	p-value	*0.13*	*0.48*	*0.01*		*0.26*			5%	6.56	7.3

Conclusion

The study examines the efficacy of Okun's Law and investigates the proposition that changes in output or movement in the output gap is associated with the changes unemployment rate. Further, it probed into the existence of evidence to support the hypothesis at the aggregate level as well as the industry level aiming to detail the industries less likely to demonstrate jobless growth. While conceding that unemployment rate – GDP/ output gap nexus may be influenced by factors other than employment such as labour force participation, hours worked per employee, output per hour worked and capacity utilization, the paper finds that there is limited empirical support for the relation between unemployment rate and output at the aggregate level. In particular, the HP filter gap and production function gap specification supports Okun's rule of thumb. More specifically, the HP filter specification shows that the unemployment rate will decline by 0.16 percentage points and 0.36 percentage points in response to a one percent increase in HP filter gap and production function gap, respectively. At the industry level, only Real Estate, Renting & Business Activities illustrated statistically significant short run relationship across all specifications with the unemployment rate falling by between 0.85 percentage points to 2.51 percentage points due to an increase in output/output gap. The long run relationship for this industry was strongest when the gap models are employed. Other industries which displayed statistical significance through the output gap specifications were Wholesale & Retail Trade and Community, Social and Personal Activities, the two largest employers of labour.

The dynamics outlined are informative in the policy sphere as Jamaica underwent structural changes to the economy under the International Monetary Funds Extended Fund Facility and will undergo further changes under the new proposed IMF Stand-by Agreement. In particular, notwithstanding greater macroeconomic stability, economic growth has lagged. Additionally, though optimism from consumers and business remain high and employment grows marginally, the unemployment rate remains elevated and the skill level of the labour force is low. It can be gleaned that, though the economy is changing, the economy in current state would have to grow significantly to make a substantial dent to the unemployment rate. The results support a focus on increasing the value added of and expanding the activities within services industries, namely, Real Estate, Renting & Business activities to effectively reduce the overall unemployment rate. With respect to Community, Social & Personal activities, the top industry of employment, with the impending expansion of the public sector transformation, which ultimately lead to a reduction in the size of the government, challenges policymakers to place greater effort towards

retraining and re-integrating the current and future workforce to minimize the potential fall out to the overall unemployment rate.

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Appendix

Table 1 Granger Causation

	Null Hypothesis:	Obs	F-Statistic	Prob.
All Sectors	DUR does not Granger Cause DLGDPSA	118	1.87436	0.1201
	DLGDPSA does not Granger Cause DUR		5.49048	0.0005
	UR does not Granger Cause GDP_GAP1	119	1.0355	0.3923
	GDP_GAP1 does not Granger Cause UR		4.39506	0.0025
	UR does not Granger Cause GDP_GAP2	119	0.61025	0.6561
	GDP_GAP2 does not Granger Cause UR		2.84084	0.0276
	UR does not Granger Cause GDP_GAP3	72	1.18611	0.3256
	GDP_GAP3 does not Granger Cause UR		0.9315	0.4515
Agriculture, Forestry & Fishing	DUR does not Granger Cause D(LGDP_SA)	76	1.50834	0.2097
	D(LGDP_SA) does not Granger Cause DUR		4.03799	0.0054
	UR does not Granger Cause GDP_GAP1	77	2.66352	0.0398
	GDP_GAP1 does not Granger Cause UR		3.74789	0.0082
	UR does not Granger Cause GDP_GAP2	77	0.96915	0.4302
	GDP_GAP2 does not Granger Cause UR		4.26992	0.0038
Mining & Quarrying	DUR does not Granger Cause D(LGDP_SA)	76	0.52182	0.72
	D(LGDP_SA) does not Granger Cause DUR		3.67944	0.0091
	UR does not Granger Cause GDP_GAP1	77	0.50889	0.7293
	GDP_GAP1 does not Granger Cause UR		2.04902	0.0972
	UR does not Granger Cause GDP_GAP2	77	0.71186	0.5867
	GDP_GAP2 does not Granger Cause UR		1.99515	0.1051
Manufacture	DUR does not Granger Cause D(LGDP_SA)	76	1.63975	0.1745
	D(LGDP_SA) does not Granger Cause DUR		1.68983	0.1626
	UR does not Granger Cause GDP_GAP1	77	2.38255	0.0599
	GDP_GAP1 does not Granger Cause UR		1.18314	0.3261

	Null Hypothesis:	Obs	F-Statistic	Prob.
	UR does not Granger Cause GDP_GAP2	77	1.92339	0.1165
	GDP_GAP2 does not Granger Cause UR		1.2358	0.304
Construction	DUR does not Granger Cause D(LGDP_SA)	76	2.71856	0.0368
	D(LGDP_SA) does not Granger Cause DUR		1.65591	0.1706
	UR does not Granger Cause GDP_GAP1	77	2.61337	0.0428
	GDP_GAP1 does not Granger Cause UR		1.57658	0.1905
	UR does not Granger Cause GDP_GAP2	77	2.27286	0.0703
	GDP_GAP2 does not Granger Cause UR		1.17604	0.3292
Electricity	DUR does not Granger Cause D(LGDP_SA)	76	1.11132	0.3586
	D(LGDP_SA) does not Granger Cause DUR		0.4985	0.7369
	UR does not Granger Cause GDP_GAP1	77	1.82486	0.1341
	GDP_GAP1 does not Granger Cause UR		0.48192	0.7489
	UR does not Granger Cause GDP_GAP2	77	0.77664	0.5442
	GDP_GAP2 does not Granger Cause UR		0.5823	0.6765
Wholesale & Retail Trade	DUR does not Granger Cause D(LGDP_SA)	28	0.56584	0.6904
	D(LGDP_SA) does not Granger Cause DUR		1.29154	0.3085
	UR does not Granger Cause GDP_GAP1	29	0.91705	0.4733
	GDP_GAP1 does not Granger Cause UR		1.35619	0.2843
	UR does not Granger Cause GDP_GAP2	29	0.52711	0.7171
	GDP_GAP2 does not Granger Cause UR		1.10373	0.3821
Hotels	DUR does not Granger Cause D(LGDP_SA)	28	1.49208	0.2441
	D(LGDP_SA) does not Granger Cause DUR		1.44337	0.2584
	UR does not Granger Cause GDP_GAP1	29	2.42501	0.0818
	GDP_GAP1 does not Granger Cause UR		1.8395	0.1609
	UR does not Granger Cause GDP_GAP2	29	2.29375	0.095
	GDP_GAP2 does not Granger Cause UR		1.78434	0.1716
	DUR does not Granger Cause D(LGDP_SA)	76	1.15742	0.3375

	Null Hypothesis:	Obs	F-Statistic	Prob.
Transport, Storage & Communication	D(LGDP_SA) does not Granger Cause DUR		2.84229	0.0307
	UR does not Granger Cause GDP_GAP1	77	0.81428	0.5205
	GDP_GAP1 does not Granger Cause UR		2.92173	0.0272
	UR does not Granger Cause GDP_GAP2	77	0.97941	0.4247
	GDP_GAP2 does not Granger Cause UR		3.39983	0.0135
Finance & Insurance	DUR does not Granger Cause D(LGDP_SA)	28	4.09876	0.0146
	D(LGDP_SA) does not Granger Cause DUR		2.82081	0.0542
	UR does not Granger Cause GDP_GAP1	29	4.49752	0.0094
	GDP_GAP1 does not Granger Cause UR		0.87123	0.4984
	UR does not Granger Cause GDP_GAP2	29	4.15613	0.0131
	GDP_GAP2 does not Granger Cause UR		0.9466	0.4577
Real Estate, Renting & Business Activity	DUR does not Granger Cause D(LGDP_SA)	28	1.84482	0.1619
	D(LGDP_SA) does not Granger Cause DUR		1.96998	0.1402
	UR does not Granger Cause GDP_GAP1	29	0.42635	0.7878
	GDP_GAP1 does not Granger Cause UR		3.39363	0.0284
	UR does not Granger Cause GDP_GAP2	29	0.45623	0.7668
	GDP_GAP2 does not Granger Cause UR		3.37891	0.0288
Community,Social & Personal Service Activities	DUR does not Granger Cause D(LGDP_SA)	76	0.31515	0.8669
	D(LGDP_SA) does not Granger Cause DUR		0.97451	0.4274
	UR does not Granger Cause GDP_GAP1	77	1.55068	0.1975
	GDP_GAP1 does not Granger Cause UR		1.59472	0.1857
	UR does not Granger Cause GDP_GAP2	77	0.66072	0.6214
	GDP_GAP2 does not Granger Cause UR		1.43951	0.2305