Explaining Unemployment in the Caribbean Again

Roland Craigwell
Professor of Economics
University of the West Indies
Cave Hill Campus, BARBADOS
&
Research Associate
Research and Economic Analysis Department
Central Bank of Barbados, BARBADOS

Allan Wright
Senior Economist
Research and Economic Analysis Department
Central Bank of Barbados, BARBADOS

Abstract

This paper attempts to determine the main factors that influence the high and persistent unemployment rates in three Caribbean countries – Barbados, Jamaica and Trinidad and Tobago - using quarterly data covering the post 2000 period. Unlike previous work, it shows by applying dynamic ordinary least squares that the unemployment phenomenon can be explained by the growth and volatility of local income as well as income of these countries leading trading partners. Several conditional variance models are also utilised to examine persistence volatility in the unemployment rates and the speed of recovery to long run equilibrium after a shock.

Keywords: Unemployment; dynamic OLS

JEL No: J64; C22; C23

1. Introduction

Since the 1970s unemployment, especially among the youth, has increased gradually and remained at high levels in the majority of countries in the English-speaking Caribbean. Current figures of 20 percent and above are not uncommon (see Ball and Hofstetter, 2009; Archibald, Lewis-Bynoe and Moore, 2011; Craigwell, Mathouraparsad and Maurin, 2011). This phenomenon of high and persistent unemployment can have severe economic, social and political consequences associated with social instability, poverty, crime, etc. In addition, the issue of high and persistent unemployment has become even more important as people choose less to accept it, as they are more informed about the financial results related to the wealth created by firms, the distribution of income and economic growth (Borda, Craigwell, Gbaguidi and Maurin, 2012). It is therefore easy to understand the renewed interest in the problem of growing unemployment.

This paper tests the hypothesis that the natural or long-run unemployment rate in select Caribbean countries – Barbados, Trinidad and Tobago and Jamaica - can be mostly explained by the growth and volatility of local income and income of these countries leading trading partners. It builds on previous research in three aspects. One it considers the impact of income volatility. Two, it uses a different methodology, that is, it applies the dynamic ordinary least squares (DOLS) procedure in the time series and panel frameworks to examine the determinants of the long run unemployment rate as well as employs several conditional variance models to explain persistence volatility in the unemployment rates and the speed of recovery to long run equilibrium after a shock. Finally, it utilizes quarterly data and focuses on the post 2000 period; almost all other studies used annual data covering a longer span starting from around the 1970s.

2. Review of the Empirical Literature Post 2000

There have been several commentaries and descriptions of the unemployment phenomenon in the Caribbean region (see McIntyre, 1975; Harewood, 1978; Farrell, 1980; Downes and Henry, 1994). However, because of the lack of labour market information, econometric analyses of the determinants of unemployment in the region have been minimal. Craigwell and Warner (2000) review this sparse empirical literature before 2000 and found that researchers concentrated on the more developed countries of the Caribbean – Barbados, Jamaica and Trinidad and Tobago - probably due to the availability of the data. They further concluded that output changes is a key explanatory variable, and to a lesser extent, lagged unemployment with the impact of wages and prices somewhat mixed.

This section provides an update to Craigwell and Warner (2000) using a similar tabular review system (see the Appendix). The post 2000 survey on unemployment empirics saw a drive to extend the studies to the less developed countries of the Caribbean and to explore other possible determinants of unemployment. It started with Downes, Mamingi and Antoine (2004) who found that the effect of selected labour regulations, namely the minimum wage, the contributions to the National Insurance Scheme and severance payments, had little statistical significance in Barbados, Jamaica and Trinidad and Tobago. A lack of output growth was again identified as the critical regressor creating unemployment in the Caribbean.

The next paper on unemployment in the Caribbean region, done by Ball and Hofstetter (2009), used a combination of data from 19 Latin American and Caribbean countries. They concluded that rural population had a robust negative statistical association in predicting the long run unemployment rate while per capita growth, though important, was not as influential as previously thought. Archibald, Lewis-Bynoe and Moore (2011), examining the issue of demand driven shocks on Caribbean labour markets, found by applying an unbalanced panel model of the more developed and less developed countries in the region that shocks to the global economy can have large effects on unemployment. The final piece of work undertaken on unemployment in the Caribbean applied nonlinear models to confirm the hysteresis hypothesis that there is a kind of memory of events leading to the immutability of unemployment even in the presence of changing circumstances in the labour market (see Craigwell, Mathouraparsad and Maurin, 2011).

3. The Empirical Model, Econometric Method and Data

3.1. The Empirical Model

Most of the empirical studies on unemployment in developing countries like those in the Caribbean, have focused on the impact of the size of the rural population, educational attainment of the population aged 25 and over and wage levels within particular sectors of the economy (Michaelowa, 2000). However, recent research have shown that cyclical factors have a greater effect in predicting the natural rate of unemployment than these variables (Archibald, Lewis-Bynoe and Moore, 2011; Heckman and Pages, 2004). In addition, the lingering recession has had the most detrimental influence on rising unemployment and underemployment within the Caribbean (Archibald, Lewis-Bynoe and Moore, 2011; Heckman and Pages, 2004).

Given this background and the discussion in the preceding section, the econometric model used here for unemployment (UR_t) in the Caribbean relies on a maximization approach that attempts to determine the impact of local and international income growth. It utilizes three leading variables, namely, per capita gross domestic product ($PGDP_t$) of the local economies, GDP growth rates of the leading trading partners (GR_t) and the consumer price index (CPI_t) (Archibald, Lewis-Bynoe and Moore, 2011; Ball and Hofstetter, 2009). It is assumed that the first two set of regressors ($PGDP_t$, GR_t) will positively impact the unemployment rate within the markets of Barbados, Trinidad and Tobago and Jamaica. For the CPI_t, it is hypothesized that unemployment will decrease as prices rise. This can be rationalized through the new Keynesian Phillip's curve theory where an upward movement in prices should expand expected output and demand and reduce the level of unemployment at least in the short run (Blanchard and Gali, 2007).

Formally, the model for the study is specified as:

$$\Delta(\phi) = \prod \phi_{t-1} + \sum_{i=1}^{k-1} \alpha \Delta \phi_{t-1} + \delta \gamma_t + e_t \qquad (1)$$

where Δ is the first difference operator, (ϕ) is a data vector explaining the real relationship which includes the dependent variable, that is, the unemployment rate (UR) and the independent variables of per capita GDP of the local economies, GDP growth rates (GR) of the main source markets (Europe, USA and Canada), and the relative consumer price index (CPI), $\prod$ is the coefficients of the natural rate of unemployment with respect to per capita GDP, GDP growth rates of the primary trading partners and prices as stated by Ball and Hofstetter (2009), γ_t is a vector of deterministic variables, and e_t is the random term expected to be white noise.

Since this model assumes a critical role for income growth on unemployment in the Caribbean, it is expected that volatility in the growth rates will adversely affect the unemployment rates. As such volatility models will also be investigated to decide the speed and persistence of an adverse shock. To tackle these issues autoregressive conditional heteroskedastic (ARCH) and generalized autoregressive conditional heteroskedastic (GARCH) processes are frequently used (Hamilton, 1988, 1989; Hoti et al., 2005). This paper will consider these and other conditional variance models (listed below in Section 3.3) to examine what determines and explains persistence volatility in Caribbean unemployment rates and the speed of recovery to long run equilibrium after a shock.

3.2   The Econometric Method: Panel Dynamic Ordinary Least Squares

The panel dynamic ordinary least squares (PDOLS) model partially developed by Kao and Chiang (2000) and Mark and Sul (2003) is applied to determine the long and short run properties of the determinants of unemployment in the three Caribbean markets of Barbados, Trinidad and Tobago and Jamaica. This procedure is based on the time series version (DOLS) propounded by Saikkonnen (1991) and Stock and Watson (1993) and therefore provides efficient estimates, is useful to estimate variables that are stationary and non-stationary and behaves well in small samples as well as avoids endogeneity issues.

PDOLS estimation involves three steps. First, the stochastic nature of the variables are checked using the panel unit root procedures of Levin, Lin and Chu (LLC) (2002), and Breitung (2002) [which have a common unit root process as their null hypothesis], Im, Pesaran and Shin (IPS) (2002), and the Augmented Dickey Fuller - Fisher Chi-square (ADF) [which have individual unit root processes] and the Hadri z-statistic which has a null hypothesis of no unit root.   Second, if the variables are non-stationary co-integration is examined utilising the residual based panel and group statistics tests of Pedroni (1999).   Finally, the short and long run factors impacting the unemployment rate (UR) is determined starting with general specifications that are reduced to parsimonious models with the retention of statistically significant variables.

The estimation of the long –run relationship for Equation (1) is based on the following regression:

$$UR_t = \alpha_0 + \beta X_t + \sum_{i=-k}^{k} \phi \Delta X_{t-1}^1 + e_t \qquad (2)$$

where X is a vector of all explanatory variables, X^1 is a subset of I(1) variables of X, β is a vector of long – run coefficients and e is a well behaved error term. The leads and lags of the first differenced I (1) regressors are included to deal with the problems of endogeneity and autocorrelation. This paper sets k at 5 since quarterly data is applied.

To investigate the short run dynamics, the estimates from Equation (2) are used to derive a general error correcting model of the form:

$$\Delta UR_t = \beta_o + \sum_{1=1}^{m} \beta_{1_t} \Delta UR_{t-1} + \sum_{1=0}^{m} \beta_2 \Delta X_{t-1}^1 + \sum_{1=0}^{m} \beta_3 Z_{t-1} + \sum_{i=1}^{m} \varphi(UR_{t-1} - \beta X_{t-1}) + \mu_t \quad (3)$$

Changes in the unemployment rate are a function of its past, lagged first difference non-stationary variables (X^1), lagged stationary variables (Z) and the lagged error correction term. The short run effects are captured by $\beta_1, \beta_2 and \beta_3$ while the rate at which the unemployment rate (natural rate of unemployment) readjusts to steady state after disequilibrium have occurred is given by φ.

3.3 The Conditional Variance Models

The conditional variance models employed are as follows:

(i) $\quad \sigma_t^2 = \omega + \alpha \varepsilon_{t-i}^2$ - ARCH (Engle, 1982)

(ii) $\quad \sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \beta \sigma_{t-1}^2$ - GARCH (1,1) (Bollerslev and Taylor, 1986)

The short run persistence (α) is shown through the ARCH process while the GARCH specification with a value of $(\alpha + \beta)$ close to 1 indicates that volatility shocks are quite persistent. To determine if positive and negative cyclical shocks have a differential impact on the natural rate of unemployment or long run unemployment (UR), the asymmetric processes of threshold GARCH (TGARCH) and exponential GARCH (EGARCH) are employed. Both processes are outline below:

(iii) $\sigma_t^2 = \omega + \alpha \varepsilon_{t-i}^2 + \beta \sigma_{t-i}^2 + \gamma \varepsilon_{t-i}^2 \tau_{t-i}$ - TGARCH (Glosten et al, 1993)

In this model, positive and negative shocks have differential effects on the conditional variance: negative shocks increase volatility if $\gamma > 0$, and $\gamma < 0$ implies positive shocks which expand volatility; while shocks are symmetric if $\gamma = 0$.

(iv) $\sigma_t^2 = \omega + \beta \sigma_{t-i}^2 + \alpha \left| \dfrac{\varepsilon_{t-i}}{\sigma_{t-i}} \right| + \gamma \dfrac{\varepsilon_{t-i}}{\sigma_{t-i}}$ - EGARCH (Nelson, 1990)

The model is asymmetric as long as $\alpha \neq 0$. When $\gamma < 0$, then positive shocks generate less volatility than negative shocks.

Determining the speed of recovery to long run equilibrium after a shock, the component GARCH (CGARCH) process is utilized. It is expressed as:

(v) $m_t = \omega + \rho(m_{t-i} - \omega) + \phi(\varepsilon_{t-i}^2 - \sigma_{t-i}^2)$ CGARCH (Ding et al, 1993)

The speed of mean reversion to equilibrium is ρ and a value close to 1 indicates a rapid speed of adjustment after a shock and m$_t$ is the time varying long run volatility.

3.4 Data

Quarterly data is utilized in this paper covering the period 2000Q1 to 2011Q4 for three Caribbean markets and were taken from the websites of the various central banks of these countries, as well as from the International Monetary Fund's International Financial Statistics and the World Bank's Statistics Database. The dependent variable is the unemployment rate (UR) and the independent variables are as follows: per capita GDP of the local economies, GDP growth rates (GR) of the main source markets (Europe, USA and Canada) and relative consumer price index (CPI). Table 1 reports the descriptive statistics.

Table 1: Descriptive Statistics

	GDPUS	GDPCAN	GDPEUR	CPIS_CPID	PGDP	UR
Mean	10284.6	1018.4	601.572	1.01	231.9	9.7
Median	10164.5	926.04	619.3	1	231.8	9.5
Maximum	13484.9	1389.8	729.9	1.9	433.6	17.9
Minimum	9248.6	728.9	452.3	0.6	230	3.9
Std. Dev	1731.1	306.4	182.4	0.3	10	3.5
Skewness	0.02	0.3	0.2	1.1	-0.04	0.2
Kurtosis	1.51	1.5	1.5	2.8	1.8	1.6
Jarque-Bera	1032.2	10201.3	483.9	43347.8	712.8	3.7
Probability	0	0	0	0	0	0
Sum	1.65E+07	12421327	5893684	12312.1	381372.6	308.1
Sum Sq.Dev	3.47E+10	1.15E+09	1.63E+08	1192.6	12975.8	236.2

4. Estimation Results

4.1 Panel and Individual Country

The results of the panel unit root tests mentioned above revealed that all the variables are integrated of order 1 [I(1)], that is, they need to be differenced once to become stationary (see Table 2). Checking for co-integrating vectors among the variables using the residual based tests of Pedroni (1999) is next, with the results showing that the null hypothesis cannot be accepted (see Table 3), therefore the variables form a unique co-integrated set.

The long run determinants of the PDOLS model are presented in Table 4. The function appears to be well specified and no non- normal results are present. The variables - per capita GDP (PGDP), growth rates of the USA, Europe and Canada (GR$_{USA}$, GR$_{EUR}$, GR$_{CAN}$) - are shown to significantly influence the natural rate of unemployment and have the a priori signs. The findings show that cyclical changes in income have a critical impact on the unemployment levels within the Caribbean markets that are highly dependent on the source markets for trade and foreign exchange earnings. Not impacting the long run unemployment rate is the consumer price index, which is a result in line with previous conclusions made by Blanchard and Gali (2007).

Table 2: Unit Roots Tests

	LLC	Breitung	IPS	ADF	PP	Hadri
Variable						
UR	-23.87***	-10.612***	-21.76***	186.16***	210.812***	-0.56*
PGDP	-35.87***	-14.813**	-12.97***	187.82***	218.39***	-1.01*
GR$_{EUR}$	-34.81***	-12.671***	-21.45***	199.54***	182.12***	-0.871*
GR$_{USA}$	-26.90***	-23.76***	-18.33***	165.231***	215.71***	-0.812*
GR$_{CAN}$	-18.82***	-9.761***	-17.27***	127.43***	156.90**	-1.12*
CPI	-9.671***	-8.1892***	-16.281**	187.81***	187.99***	0.91*

Note: ***, ** and * indicate significance at the 1, 5 and 10% level of testing, respectively.

Table 3: Pedroni Residual Co-integration Tests

Common AR Coefficients within dimension			Individual AR Coefficients between dimension		
	Statistic	P Value		Statistic	P Value
Panel v	2.726***	0.0000	Group rho	-9.674***	0.0000
Panel rho	-12.76***	0.0000	Group PP	-14.689***	0.0000
Panel PP	-9.172***	0.0000	Group ADF	-10.271***	0.0000
Panel ADF	-10.279***	0.0000			

Note: ***, ** and * indicate significance at the 1, 5 and 10% level of testing, respectively

Table 4: Long Run Coefficients of the Natural Rate of Unemployment (UR)

$$UR_t = 9.87 - 0.87\,PGDP - 1.17\,GR_{USA} - 0.68\,GR_{EUR} - 0.41\,GR_{CAN}$$
$$\qquad (10.53^{***}) \qquad (-3.95^{***}) \qquad (-5.28^{***}) \qquad (-8.61^{***}) \qquad (-5.85^{***})$$

Diagnostic Tests

$R^2 = 0.6168$ $\overline{R}^2 = 0.5921$ F = 94.17   DW = 1.92   NORM = 5.327

AR = 0.3261   ARCH = 0.289   HET = 0.651   RESET = 1.32

Note: t- statistics of regressors are shown in parentheses.. ***, ** and * indicates significance at the 1, 5 and 10% level of testing, respectively. However, all diagnostics tests are performed at the 5% level of testing. R^2 is the coefficient of determination, $\overline{R}^2$ is the coefficient of determination adjusted for degrees of freedom, F is the F-Statistic for the joint significance of the explanatory variables. DW is the Durbin Watson statistic and the NORM is the test for normality of the residuals based on the Jarque- Bera test statistics. AR is the Lagrange multiplier test for residual autocorrelation and ARCH is the autoregressive conditional heteroscedasticity.

HET is the unconditional heteroscedasticity test based on the regression of squared residuals. Finally, RESET is the Ramsey test for functional form misspecification.

It is useful at this juncture to look at the individual country long run results. This involves employing the DOLS procedure in the time series context, the steps of which are very similar to the PDOLS methodology, that is, test for unit roots and then for co-integration. The results of the popular Augmented Dickey-Fuller, Phillips-Perron and Kwiatkowski-Phillips-Schmidt-Shin unit root statistics (available on request) reveal that all the variables are I(1). The findings from the long-run functions (Tables 5 to 7) indicate that the three models are well specified with the correct a prior signs. For Barbados, the long run natural rate of unemployment is significantly influenced by the GDP growth changes in Europe and the USA, the two being it leading trading partners of domestic exports and private equity investment in tourism and the construction industries. Trinidad and Tobago which is a more resource materials (petroleum) based economy than Barbados, is less affected by growth rate changes in the USA, Europe and Canada, than the existing wealth income within the local economy as measured by the per capita GDP level. The unemployment rate for Jamaica is significantly impacted by the business cycle in the North American markets and existing levels of income within the local economy.

Table 5: Barbados Long Run Coefficients of the Natural Rate of Unemployment

$UR_t = 13.71 - 0.57\,PGDP - 0.86\,GR_{USA} - 1.38\,GR_{EUR} - 0.53\,GR_{CAN}$

$\qquad\qquad (8.51^{***}) \qquad (-10.86^{***}) \qquad (-3.15^{***}) \qquad (-4.98^{***}) \qquad (-4.89^{***})$

Diagnostic Tests

$R^2 = 0.4910$ $\overline{R^2} = 0.4676$ F = 71.11 DW = 1.82 NORM = 3.129
AR = 0.1920 ARCH = 0.152 HET = 0.91 RESET = 0.94

Note: t- statistics of regressors are shown in parentheses.. ***, ** and * indicates significance at the 1, 5 and 10% level of testing, respectively. However, all diagnostics tests are performed at the 5% level of testing. Δ is the first difference operator. R^2 is the coefficient of determination, $\overline{R^2}$ is the coefficient of determination adjusted for degrees of freedom, F is the F- Statistic for the joint significance of the explanatory variables. DW is the Durbin Watson statistic and the NORM is the test for normality of the residuals based on the Jarque- Bera test statistics. AR is the Lagrange multiplier test for residual autocorrelation and ARCH is the autoregressive conditional heteroscedasticity. HET is the unconditional heteroscedasticity test based on the regression of squared residuals. Finally, RESET is the Ramsey test for functional form misspecification.

Table 6: Trinidad and Tobago Long Run Coefficients of the Natural Rate of Unemployment

$UR_t = 5.59 - 1.43\,PGDP - 0.92\,GR_{USA} - 0.44\,GR_{EUR} - 0.1032\,GR_{CAN}$

$\qquad\qquad (7.11^{***}) \qquad (-3.10^{***}) \qquad (-5.14^{***}) \qquad (-9.01^{***}) \qquad (-3.79^{***})$

Diagnostic Tests

$R^2 = 0.5755$ $\overline{R^2} = 0.5316$ F = 56.6 DW = 1.93 NORM = 4.881
AR = 0.271 ARCH = 0.321 HET = 1.34 RESET = 0.79

Note: t- statistics of regressors are shown in parentheses.. ***, ** and * indicates significance at the 1, 5 and 10% level of testing, respectively. However, all diagnostics tests are performed at the 5% level of testing. Δ is the first difference operator. R^2 is the coefficient of determination, $\overline{R^2}$ is the coefficient of determination adjusted for degrees of freedom, F is the F- Statistic for the joint significance of the explanatory variables. DW is the Durbin Watson statistic and the NORM is the test for normality of the residuals based on the Jarque- Bera test statistics. AR is the Lagrange multiplier test for residual autocorrelation and ARCH is the autoregressive conditional heteroscedasticity. HET is the unconditional heteroscedasticity test based on the regression of squared residuals. Finally, RESET is the Ramsey test for functional form misspecification.

Table 7: Jamaica Long Run Coefficients of the Natural Rate of Unemployment

UR_t = 16.92 $-$ 0.47PGDP $-$ 1.63 GR$_{USA}$ - 0.32GR$_{EUR}$ $-$ 0.69GR$_{CAN}$
(6.00***)   (- 2.87***)   (-3.76***)   (-6.77***)   (-5.32***)
Diagnostic Tests
R^2 = 0.4416 $\overline{R}^2$ = 0.4295 F = 125 DW = 1.98 NORM = 3.721
AR = 0.110   ARCH = 0.411   HET = 1.29   RESET = 0.83

Note: t- statistics of regressors are shown in parentheses.. ***, ** and * indicates significance at the 1, 5 and 10% level of testing, respectively. However, all diagnostics tests are performed at the 5% level of testing. Δ is the first difference operator. R^2 is the coefficient of determination, $\overline{R}^2$ is the coefficient of determination adjusted for degrees of freedom, F is the F- Statistic for the joint significance of the explanatory variables. DW is the Durbin Watson statistic and the NORM is the test for normality of the residuals based on the Jarque- Bera test statistics. AR is the Lagrange multiplier test for residual autocorrelation and ARCH is the autoregressive conditional heteroscedasticity. HET is the unconditional heteroscedasticity test based on the regression of squared residuals. Finally, RESET is the Ramsey test for functional form misspecification.

Now return to the error correcting model for the panel data. These results are outlined in Table 8. The model is well specified and is an adequate representation of the data generation process. The magnitude of the coefficient on the error correcting term (-0.2319) reveals that it will take approximately five periods for the natural rate of unemployment to adjust to its long run equilibrium after a shock.

The variables (per capita GDP, growth rates of GDP from the leading industrial nations and the consumer price index) are all significant with the correct signs in the short run. The results show that cyclical and price changes have an important impact on the natural rate of unemployment in these three Caribbean islands.

Table 8: Error Correcting Model of the Natural Rate of Unemployment (UR)

$\Delta UR_{t=}$ 10.61 - 0.194ΔPGDP$_{t-1}$ - 0.518Δ GR$_{USAt-2}$ - 0.41Δ GR$_{EURt-1}$
(2.18**)   (-4.62***)   (-3.51***)   (-8.24***)
- 0.276Δ GR$_{CANt-1}$ - 0.205Δ CPI - 0.2319 ECT$_{t-1}$
(-9.35***)   (-5.61***)   (-12.86***)
Diagnostic Tests
R^2 = 0.4791 $\overline{R}^2$ = 0.4490 F = 176 DW = 1.81 NORM = 6.5192
AR = 0.46   ARCH = 0.29   HET = 0.1720   RESET = 1.65

Note: t- statistics of regressors are shown in parentheses.. ***, ** and * indicates significance at the 1, 5 and 10% level of testing, respectively. However, all diagnostics tests are performed at the 5% level of testing. Δ is the first difference operator. R^2 is the coefficient of determination, $\overline{R}^2$ is the coefficient of determination adjusted for degrees of freedom, F is the F- Statistic for the joint significance of the explanatory variables. DW is the Durbin Watson statistic and the NORM is the test for normality of the residuals based on the Jarque- Bera test statistics. AR is the Lagrange multiplier test for residual autocorrelation and ARCH is the autoregressive conditional heteroscedasticity. HET is the unconditional heteroscedasticity test based on the regression of squared residuals. Finally, RESET is the Ramsey test for functional form misspecification.

4.2 Volatility Models

To begin estimating the conditional variance models the panel unit root tests discussed above are applied to the deseasonalized series to check their stochastic properties. The autoregressive properties of the variables are then determine utilizing the correlogram. After this, the maximum likelihood estimation method is used to explore the effects of economic shocks and volatility on the mean unemployment equation as well as to check the presence of persistence in the variances. One aspect that must be determined before is the nature of the conditional distribution.

To ascertain this, the unconditional distributions are compared to used distributions such as the normal and t, employing quantile plots. The nature of the conditional distribution is then found after testing the distribution residuals against the normal, t and generalized error distribution.

The findings from the various univariate models indicate mostly that the ARCH (1) and the GARCH (1, 1) processes with residuals following a normal distribution are appropriate. The covariance stationarity restriction was upheld and the Q- statistics show no significant evidence of serial correlation. The ARCH models and its variants for the three Caribbean markets include a volatility component in the mean equation as unemployment displayed changes to unexpected shocks. The own spillover volatility (ARCH) coefficients are highest for Jamaica (0.73), followed by Barbados (0.58) and Trinidad and Tobago (0.36). The long run persistence parameter estimates from the GARCH process were of more concern for Jamaica (0.89), than Barbados (0.70) and Trinidad and Tobago (0.48) as that market showed a bigger effect after a cyclical shock. With significant coefficients of 0.49 (Jamaica), 0.28(Barbados) and 0.51(Trinidad and Tobago) the EGARCH and TGARCH models reveal that negative shocks increase volatility in all three markets. Using the CGARCH framework, Trinidad and Tobago displayed the fastest mean reversion after a shock followed by Barbados and then Jamaica.

The above findings suggest that Trinidad and Tobago, unlike Jamaica and Barbados, is less impacted by cyclical changes as reflected by lower long run persistence and a faster mean reversion after a shock. This conclusion is in keeping with the previous work of Archbald, Lewis-Bynoe and Moore (2011) which reveals that tourist dependent economies are generally more severely affected by cyclical changes in the North Atlantic Markets than economies which have a stronger non- traded sector or are resource (minerals) rich. The adverse effects of cyclical changes are likely also to be felt more by vulnerable groups within the society (such as the elderly, young and females).

Conclusion

The paper shows with the aid of the panel dynamic ordinary least squares (PDOLS) methodology that the income levels of three select Caribbean countries, namely Barbados, Jamaica and Trinidad and Tobago, along with the growth rate of their leading source markets have a statistical significant impact on determining the long run or natural rate of unemployment. In the short run along with these variables consumer prices also affect the unemployment rate.

The above results are different from most studies conducted within the Caribbean, which usually attempt to determine the natural rate of unemployment by considering the level of secondary school enrollment as a proxy for education, as well as the share of the rural population, wages and per capita GDP, using single equation econometric models. This previous research failed to recognize that income growth of the leading economies of the North Atlantic rim, who are usually the major trading partners of goods and services from the Caribbean, is significant in explaining the long run or natural rate of unemployment in these markets, a result that is not dissimilar to the findings of Archibald *et al* (2011).

The paper also uses conditional variance models to provide evidence on how long the Caribbean markets will take to return to an equilibrium point after a cyclical shock. Given the relatively lower long run persistence and the faster mean reversion, the article reveals that Trinidad and Tobago, a resource (minerals) rich island is less impacted by cyclical changes than the tourist dependent economies of Jamaica and Barbados who are generally more severely affected by cyclical changes in the North Atlantic markets.

References

Archibald, X., Lewis-Bynoe, D and W. Moore (2011), Caribbean Labour Markets and the "Great Recession", mimeo, Caribbean Development Bank.
Ball, L. and M. Hofstetter (2009), Unemployment in Latin America and the Caribbean, mimeo, John Hopkins University.
Bollerslev, T. (1986), "Generalised Autoregressive Conditional Heteroskedasticity." *Journal of Econometrics* 31: 307-327.
Blanchard, O. and J. Gali (2007), A New Keynesian Model with Unemployment, Kiel Working Papers 1335, Kiel Institute for the World Economy.
Borda, P., Craigwell, R., Gbaguidi, D. and A. Maurin (2012), Growth and Unemployment in the Caribbean: An Empirical Analysis of Okun Law Using Markov Switching Models, mimeo, in process.

Breitung, J. (2002), "Non-Parametric Tests for Unit Roots and Co-integration." *Journal of Econometrics* 108: 343-363.

Craigwell, R., Mathouraparsad, S. and A. Maurin, (2011), "Unemployment Hysteresis in the English-Speaking Caribbean: Evidence from Non-Linear Models," *International Research Journal of Finance and Economics,* Issue 78, pp. 137-57.

Craigwell, R. and A. Warner (2000), "Unemployment in Barbados: 1980-1996", in A. Maurin and P. Watson (Eds.), *Empirical Studies in Caribbean Economy,* Technical Papers Vols. 5 and 6, Caribbean Centre for Monetary Studies, Trinidad and Tobago, pp. 43-91.

Ding, Z., Granger, C. W. J and Engle, R. F. (1993), "A Long Memory Property of Stock Market Returns and a New Model." *Journal of Empirical Finance* 1: 83-106.

Downes, A., Mamingi, N. and R. Antoine (2004), "Labour Market Regulation and Employment in the Caribbean" in J. Heckman and C. Pages (Eds.), *Law and Employment Lessons from Latin America and the Caribbean* (Chicago: University of Chicago Press), pp. 517-551.

Downes, A. and R. Henry (1994), "Labor Market Issues in Caribbean Monetary Union" in T. Farrell and D.Worrell (Eds.), *Caribbean Monetary Integration* (Port of Spain, Caribbean Information Systems and Services Ltd), pp. 144-72.

Durbin, J., and Watson, G. S. (1971) "Testing For Serial Correlation in Least-Squares Regression, III." *Biometrika*, 58: 1-19.

Engle, R. F. (1982). "Autoregressive Conditional Heteroskedasticity with Estimates of the Variance of United Kingdom Inflation." *Econometrica* 50: 987-1007.

Farrell, T. (1980), "The Root of Unemployment", *Social and Economic Studies*, Vol. 29, No.4, pp.95-111.

Glosten, L.R., Jaganathan, R. and Runkle, D. (1993). "On the Relation Between the Expected Value and The Volatility of the Normal Excess Return on Stocks." *Journal of Finance 48*: 1779-1801.

Hamilton, J. (1989). "A New Approach to The Economic Analysis of Non-Stationary Time Series And Business Cycle." *Econometrica* 57, no. 2.

Hoti S, Leon, C. and McAleer, M. (2005). "International Tourism Demand and Volatility Models for the Canary Islands." Unpublished paper, school of economics and commerce, University of Western Australia.

Harewood, J. (1978), *Unemployment and Related Problems in the Caribbean*, Occasional Papers: Human Resources, No.2, ISER, Trinidad and Tobago.

Heckman, J. and C. Pagés, (2004). "Introduction to "Law and Employment: Lessons from Latin American and the Caribbean", NBER Chapters, in: Law and Employment: Lessons from Latin America and the Caribbean, pages 1-108 National Bureau of Economic Research, Inc.

Jarque, C. and Bera, A.K. (1980). "Efficient Tests for Normality, Heteroskedasticity and Serial Independence of Regression Results." *Economic Letters* 6: 253-259.

Kao, C. and M. Chiang (2000). "On The Estimation and Inference of A Co-integrated Regression in Panel Data." *Advances in Econometrics* 15: 179-222.

Levin, A., Lin, C. and J. Chu (2002). "Unit Root Tests in Panel Data: Asymptotic and Finite-Sample Properties." *Journal of Econometrics* 108 no.1: 1-24.

Lm, K., Pesaran, M. and Y. Shin (2003). "Testing for Units Roots in Heterogeneous Panels." *Journal of Econometrics* 115: 53-74.

Maddala, G. and Wu, S. (1999). "A Comparative Study of Unit Root Tests with Panel Data and A New Simple Test." *Oxford Bulletin of Economics and Statistics* 61 s1: 631-652.

Mark, N., Sul, D. (2003). "Co-integration Vector Estimation by Panel DOLS and Long-run Money Demand." *Oxford Bulletin of Economics and Statistics* 65, no.5: 655-80.

Michaelowa. K. (2004). "Aid Effectiveness Reconsidered - Panel Data Evidence for the Education Sector -,"Discussion Paper Series 26374, Hamburg Institute of International Economics.

McIntyre, A. (1975), "Reflections on the Problem of Unemployment in the Commonwealth Caribbean" in A. Singham (Ed.) *The Commonwealth Caribbean into the Seventies* (Montreal, Center for Developing Area Studies, McGill University, pp.1-15.

Nelson, D. (1990). "Conditional Heteroskedasticity in Asset Returns: A New Approach." *Econometrica* 59: 347-370.

Pedroni, P. (1999). "Critical Values for Co-Integration Tests in Heterogeneous Panels with Multiple Regressors." *Oxford Bulletin of Economics and Statistics* 61: 653-670.

Ramsey, J. B. (1969). "Tests for Specification Errors In Classical Linear Least Squares Regression Analysis." *Journal of Royal Statistical Society*, Series B 31: 350-371.

Saikkonnen, P. (1991). "Asymptotically Efficient Estimation of Co-integration Regressions." *Economic Theory* 7: 1-21.

Stock, J. H and Watson, M. W. (1993). "A Simple Estimator of Co-integrating Vectors in Higher Order Integrated Systems." *Econometrica* 61: 783 -820.

Appendix
Summary of Labour Papers

Title, Author	Purpose	Findings	Methodology, Data	Caribbean Country Specific Unemployment Results	Weaknesses
Labor Market Regulation and Employment in the Caribbean (Downes et al, 2004)	Examining the impact that labor market regulations have on employment creation in the English speaking Caribbean	Output growth is the key factor in generating employment in the region, labor market regulations had little statistical significance	Used Phillips - Loretan Nonlinear Least squares method to determine long run employment. Data covered the period 1975-2000	All markets (Barbados, Trinidad and Jamaica) show that output activity is the most significant factor impacting unemployment.	Data limitations prevented deeper analysis of cyclical trends and impact
Unemployme nt in Latin America and the Caribbean. (Ball and Hofstetter, 2009)	Examine long run unemployment in 19 Latin America and Caribbean countries, motivated by the desire to provide systematic explanation of variations across markets and informative understanding of the key determinants	Unemployment rates were explained by measures of economic development, such as income per capita and education as well as the existing percentage of the population in rural areas. The results confirmed that short run changes in unemployment influenced the natural rate (long run unemployment) conflicting with conventional macroeconomic theory. Using a measure of long run unemployment to test cross section regressions, Ball and Hofstetter uncovered that cyclical factors – per capita growth showed less significance in predicting the natural rate than previously thought (Heckman and Pages, 2004) and the only result that stands out as robust	IADB data and a data set developed by authors both used to explain differences in unemployment across countries. Two categories of variables were used to explain long run unemployment: development and labour institutional variables. Included in development are: Per capita GDP and GDP growth rate Education measure consisting of educational attainment of the total population aged 25 and over. Value added of the agricultural sector as a	Jamaica experiencing capital flight fears and a fall in exports during the period 1973-78 the unemployment rates increase up to 25%. With a return to political stability and exports recovery which produced positive growth, unemployment trended downwards to 17% during the 1984-92 periods. Trinidad and Tobago as a result of lower oil prices experienced a fall in GDP by 28% from 1982 to 1989, with unemployment rising to over 20% during this period. However this situation was reversed when macro conditions shifted; oil prices recovered and the currency was devalued.	Obtaining consistency of data measure across countries, some countries unemployment rates covered a few cities or a whole nation while others covered different groups with the definition of unemployment varying across nations. The authors failed to provide a suitable explanation of unemployment hysteresis within the Latin America and Caribbean region

		and statistically significant is that countries with a larger rural population have lower unemployment rates. Explaining this result Ball and Hofsteffer, showed that imperfect information in the labour market may make frictional unemployment worse, especially in urban areas where communities are much larger and the time to match the available jobs with people seeking work is much longer.	proportion of GDP Rural population as a % of total population Labour Institutional variables: Two alternative sources, the indexes developed by Heckman and Pages (HP) and Ball and Hofsteller. The HP indexes includes the Advance Notice, Indemnity for Dismissal, Seniority Payments and the Social Security Contribution, while the Ball and Hofsteller indexes are Rigidity of Employment , Non-Wage Costs, Firing Costs and Labor Tax		
Caribbean Labour Markets and the "Great Recession" (Archibald et al, 2011)	Provide an empirical assessment of demand driven shocks on regional labour markets	The paper using an econometric model of Caribbean labour markets, suggest that while employment in the region tends to be relatively sticky downwards, shocks to the global economy can still have large effects on employment in the region. The paper estimates that for every year the global	Using an unbalanced panel model the study presents an econometric model of the Caribbean labour market in order to investigate the long run impact of external shocks on regional employment.	Overall the employment impacts of the recession have been severe and have exacerbated already high levels of unemployment in the region. These adverse impacts have also mirrored the cross country differential impacts on output, affecting the more tourism	The focus on the employment impacts of the recession which limits the range of policy recommendations. More in-depth analysis of other differentials related to socioeconomic status or educational

| | | economy spends in recession, employment in the region falls by approximately 65k persons. These negative adverse effects on employment also tend to be quite persistent, particularly for females.

The study provides a detailed assessment of the effects of the current recession on regional labour markets. The assessment identifies the main crisis impacts as rising unemployment and underemployment, as well as threats to job security. It further indicates that the fallout has generally been severe on tourism dependent economies and has disproportionately affected vulnerable groups particularly the youth | The sample of countries employed includes Antigua and Barbuda, The Bahamas, Barbados, Belize, The Cayman Islands, Dominica, Grenada, Guyana, Jamaica, Saint Lucia, Suriname and Trinidad and Tobago for the period 1970 to 2008. | and export manufacturing dependent territories worse than the commodity exporters. Indeed, Guyana and Haiti registered negligible labour market impacts from the recession, while in Belize the initial shock to the labour market was significant, but quickly began to dissipate, and Trinidad and Tobago appears to be experiencing negative labour market impacts with a lag. Meanwhile, severe labour market dislocation has been observed in key tourism destination like the Bahamas, Barbados, Grenada, Jamaica, Saint Kitts and Nevis and Saint Lucia. | attainment would be of great interest to academics, policymakers and the public. |
|---|---|---|---|---|---|
| Unemployment Hysteresis in the English Speaking Caribbean: Evidence from Non- Linear Models (Craigwell et al, 2011) | Using nonlinear models the article provides an empirical examination of the hypothesis of hysteresis and also reviews the phenomenon of high and persistent unemployment in the economies of the Caribbean | The results confirmed the hypothesis of hysteresis with the shocks to the level of unemployment having a lasting effect in their developments. To reproduce the asymmetry and persistence characterizing unemployment data, the non-linear STAR models were more appropriate than the linear AR models. | Using nonlinear models the quarterly unemployment series post 1970 were studied for the economies of Barbados and Trinidad | For Barbados the LSTAR model which allows for asymmetric deviations of unemployment from its equilibrium level is preferred while in the case of Trinidad an ESTAR specification which reproduces a dynamic series of differential unemployment rate around a system of positive growth and a regime of negative growth is selected | Fuller comparison of the regime switching models could have been completed to better verify the dynamics of the unemployment rate and the speed at which it moves from one state to another. |