

## Question 1

A popular theory in Macroeconomics is the twin deficit hypothesis. The twin deficit hypothesis is based on the Mundell-Fleming model and supposes that fiscal deficits lead to external current account deficits. However, some economists opine that the observed link between fiscal and current account deficits could be due to causality running from the current account deficit to the fiscal deficit. This reverse causation is sometimes referred to as “current account targeting”. There could also be bi-directional causality from the two deficits to each other, a possibility built upon the simultaneous existence of the factors that support mutual causation.

Ariel Mermaid is interested in determining the nature of the relationship between the fiscal and the current account in the Kingdom of Atlantica. She decides to conduct Granger-Causality tests. She collects quarterly data on the fiscal deficit (FD) and current account deficit (CA) over the period 1965Q1 to 2019Q4. As a preliminary step to the empirical analysis, Ariel conducted unit root tests to determine the order of integration of the variables. Her results indicated that both variables were I(1).

Ariel used the SIC and AIC to select the number of lags required to conduct the Granger Causality Test. Both criteria suggest a lag length of two. Ariel estimated the following model:

$$CA_t = \alpha_0 + \alpha_1 CA_{t-1} + \alpha_2 CA_{t-2} + \alpha_3 CA_{t-3} + \beta_1 FD_{t-1} + \beta_2 FD_{t-2} + \beta_3 FD_{t-3} + u_t$$

$$FD_t = \gamma_0 + \gamma_1 CA_{t-1} + \gamma_2 CA_{t-2} + \gamma_3 CA_{t-3} + \delta_1 FD_{t-1} + \delta_2 FD_{t-2} + \delta_3 FD_{t-3} + \epsilon_t$$

The results are given below:

Null Hypothesis	$\chi^2$ test statistic	$\chi^2$ critical value (5%)
$\beta_1 = \beta_2 = 0$	0.097	5.991
$\gamma_1 = \gamma_2 = 0$	6.281	5.991

- a) Assuming that Ariel’s model is correct, what do Ariel’s results imply about the relationship between the fiscal and current accounts?

[8 marks]

- b) Ariel’s boss, Sir Triton, reviewed Ariel’s results and made the following comments:

This approach is flawed. First, both variables are I(1). You should thus test for cointegration. If there is cointegration among the variables, then Granger-Causality should be conducted within a VECM. If the variables are not cointegrated, you should conduct the tests with the variables in first differences. Second, if both the AIC and SIC recommended using two lags, why would you estimate the model with three? This makes no sense. Finally, you did not test whether the disturbances were white noise. How could you not?

Do you agree with the Sir Triton’s comments? Explain.

[12 marks]

**PLEASE TURN OVER**

## Question 2

The classical views on wage determination are rooted in human capital theory. Casually speaking, human capital refers to the stock of knowledge or characteristics embodied in a worker that contributes to his/her productivity. Since worker productivity is intimately associated with wages (at least according to conventional economic wisdom), individuals with greater human capital should (in theory) receive higher wages. One key way in which human capital can be accumulated is through schooling.

While the positive correlation between schooling, productivity and wages has generally been accepted, human capital theory does have its critics. The concept of “screening” has been introduced as an alternative to human capital theory. Screening theories suggest that education is more of a ‘signal’ of greater productivity and abilities, and this is often rewarded with higher wages. Generally, it is very difficult and expensive to discern an individual’s productive capability at the time of hiring. The firm therefore has to use the observable characteristics – such as education.

It should be noted that both the screening and human capital theories propose a positive relationship between educational attainment and income. Mahalia is interested in estimating the relationship between wages and education using panel data. Her database consists of 2,203 young women over the period 1980-1987. Mahalia estimated a Mincer-type wage equation. Specifically, she estimated a woman’s log real wage as a function of her:

- *Education*, which captures the number of years of schooling
- *Experience*, which is measured in years
- *Experience*<sup>2</sup>, which is the square of the experience variable

As a starting point, Mahalia estimated the wage equation using pooled OLS, fixed effects and random effects estimators respectively. The results are given in the table below:

	Pooled OLS		Fixed Effects		Random effects	
	Coefficient	p-value	Coefficient	p-value	Coefficient	p-value
Education	0.127	0.000	0.149	0.000	0.135	0.000
Experience	0.087	0.000	0.123	0.001	0.117	0.000
Experience <sup>2</sup>	-0.003	0.000	-0.004	0.021	-0.005	0.000

- a) Compare the impact of education on wages in each model. What conclusion do you draw from this comparison?
- [8 marks]**
- b) An important step in estimating panel regressions is choosing between the pooled OLS, fixed effects and random effects estimators. The results of the Breusch-Pagan Lagrange Multiplier (LM) test, the F-test for fixed effects and the Hausman test is given below:

	p-value
Breusch-Pagan LM test	0.023
F-test for fixed effects	0.042
Hausman test	0.562

Interpret the results of each test and determine which model is most appropriate for modelling the data.

**[12 marks]**

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### Question 3

Consider the following bi-variate reduced form VAR:

$$\begin{aligned} A_t &= 0.8A_{t-1} + 0.2B_{t-1} + e_{1t} \\ B_t &= 0.2A_{t-1} + 0.8B_{t-1} + e_{2t} \end{aligned}$$

- a) Suppose  $e_{1t} = u_{At} + 0.5u_{Bt}$  and  $e_{2t} = u_{Bt}$ . Calculate the contemporaneous and one period ahead impulse response of  $A_t$  to a one-unit shock to  $u_{At}$ . Repeat for a one-unit shock to  $u_{Bt}$ . (Be sure to show your working).

[10 marks]

- b) Suppose instead  $e_{1t} = u_{At}$  and that  $e_{2t} = 0.5u_{At} + u_{Bt}$ . Calculate the contemporaneous and one period ahead impulse response of  $A_t$  to a one-unit shock to  $u_{At}$ . Repeat for a one-unit shock to  $u_{Bt}$ . (Be sure to show your working).

[10 marks]

- c) Use your answers in (a) and (b) above to explain why the ordering in Choleski decompositions is imperative.

[5 marks]

- d) Variance decomposition was employed to further uncover the interrelationship between variables  $A$  and  $B$ . The table below shows the variance decomposition results obtained with the Choleski ordering:  $A_t, B_t$ . Interpret these results.

Variance Decomposition of:	Period	A	B
A	1	100.00	0.00
	2	98.78	1.22
	3	98.78	1.22
	4	98.78	1.22
	5	98.78	1.23
B	1	17.98	82.02
	2	17.65	82.35
	3	18.90	81.10
	4	18.93	81.07
	5	19.94	81.06

[5 marks]

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#### Question 4

Recently, there has been renewed focus on forging greater links within the Caribbean. The main regional grouping is the Caribbean Community and Common Market (CARICOM), which embraces 15 Caribbean countries. One of the essential elements of furthering the goal of regional integration is policy convergence, which occurs when macroeconomic policies pursued by countries move toward being identical. Convergence in macroeconomic policies should lead to greater economic integration, as it should increase intra-regional trade in goods, services and investment, as economic agents in two or more countries will receive the same treatment from governments.

The literature has been relatively silent on policy convergence in CARICOM. Empirical work to date suggests that there could be some degree of policy convergence in the region. For instance, Giudici and Mollick (2007) found evidence of conditional convergence of growth rates in the Eastern Caribbean. If per capita output growth in the region is converging, there is a possibility that policy convergence is driving the process. Meanwhile, Jackman and Moore (2008) investigated economic policy co-movement in Latin America and the Caribbean using realized correlation ratios. These authors found evidence of policy co-movement in monetary policies in CARICOM, but found weak evidence of co-movement in CARICOM's fiscal and trade policies. The realized correlation ratios used in the work of Jackman and Moore (2008) informed on the degree of similarity in policies, but ignores the dynamic properties of the variables under consideration. As such, they cannot speak to convergence, that is, the extent to which policies move towards being identical. To address this short coming in the literature, Jackman (2020) decided to test policy convergence in CARICOM using panel unit root tests.

According to Jackman (2020), economic policies in CARICOM are said to be converging if the differentials in economic policies for CARICOM are stationary over the period of observation. Differentials in economic policies for CARICOM were computed as:

$$X_{it} = Y_{it} - \bar{Y}_t$$

where  $i = 1, 2, \dots, N$  denote the individual CARICOM countries,  $t = 1, 2, \dots, T$  time periods,  $Y_{it}$  represents an economic policy for a CARICOM country  $i$  at period  $t$  and  $\bar{Y}_t$  is the CARICOM-specific economic policy mean.

Jackman (2020) utilized the Im, Pesaran and Shin test and the Hadri test. The table below reports the tests for convergence in fiscal, monetary and trade policies in CARICOM. The tests were estimated with panel-specific intercepts.

Method	Monetary policies	Fiscal policies	Trade policies
	p-value	p-value	p-value
Im, Pesaran and Shin test	0.001	0.921	0.001
Hadri test	0.212	0.000	0.009

Carefully discuss the results and what they imply about policy convergence in CARICOM.

[15 marks]

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### Question 5

- a) Consider the following linear regression:

$$Y_t = X_t' \beta + e_t$$

Jim Screechy is interested in testing for ARCH effects. As such, he ran the following auxiliary regression using annual data over the period 1918 to 2017:

$$\hat{e}_t^2 = \alpha_0 + \alpha_1 \hat{e}_{t-1}^2 + \alpha_2 \hat{e}_{t-2}^2 + \alpha_3 \hat{e}_{t-3}^2 + u_t$$

The estimated results are given below:

$$\begin{aligned} \hat{e}_t^2 &= 0.321 + 0.092 \hat{e}_{t-1}^2 + 0.058 \hat{e}_{t-2}^2 + 0.021 \hat{e}_{t-3}^2 \\ R^2 &= 0.582; \bar{R}^2 = 0.513; SIC = 0.123; AIC = 0.100 \end{aligned}$$

Conduct a test to determine if there are ARCH effects. Note, at the 5% level of significance, the critical value is 7.815.

[5 marks]

- b) Lady Spice suggested that Jim estimate the following model instead

$$\begin{aligned} Y_t &= X_t' \beta + e_t \quad e_t \sim N(0, \sigma_t^2) \\ \sigma_t^2 &= \alpha_0 + \alpha_1 e_{t-1}^2 + \alpha_2 \sigma_{t-1}^2 \end{aligned}$$

- i. Suppose Jim obtained the following parameter estimates for the variance equation:

$$\hat{\alpha}_0 = 0.01; \hat{\alpha}_1 = 0.5; \hat{\alpha}_2 = 0.25$$

If Jim has data available up to and including time  $T$ , and knows that  $\sigma_T^2 = 2$ , calculate the one, two, and three-step-ahead forecasts for the conditional variance. (Be sure to show your working!)

[15 marks]

- ii. Suppose Jim had obtained the following parameter estimates instead

$$\hat{\alpha}_0 = 0.02; \hat{\alpha}_1 = 0.51; \hat{\alpha}_2 = 0.84$$

What implications would this have for the conditional forecast variance?

[5 marks]

**PLEASE TURN OVER**

c) A third researcher, Miss Darlene, suggests the following model:

$$Y_t = X_t' \beta + e_t \quad e_t \sim N(0, \sigma_t^2)$$
$$\log(\sigma_t^2) = \gamma_0 + \gamma_1 \left( \frac{e_{t-1}}{\sigma_{t-1}} \right) + \gamma_2 \left| \frac{e_{t-1}}{\sigma_{t-1}} \right| + \gamma_3 \ln(\sigma_{t-1}^2)$$

The results for the variance equation are given in the table below.

Variable	Coefficient	p-value
Constant	0.524	0.011
$(e_{t-1}/\sigma_{t-1})$	0.250	0.027
$ e_{t-1}/\sigma_{t-1} $	-0.123	0.148
$\ln(\sigma_{t-1}^2)$	0.231	0.004

Carefully discuss the implication of these results.

**[5 marks]**

**END OF QUESTION PAPER**