Do interest rate and inflation affect unemployment? evidence from Australia

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Abstract

This paper explores the Granger-causal relationship between monetary policy, represented by interest rate and inflation rate, and the unemployment rate in Australia using the standard time series techniques. The analysis uses quarterly data covering a ten-year period. Interest rates used here is the long term interest rate, inflation rate is represented by the CPI excluding food and energy, and unemployment rates is measured in percentage-form for Australia. The findings evidence a positive long term (theoretical) relationship between interest rate and unemployment, and a negative long term relationship between inflation and unemployment. It also suggests that interest rate is the strongest exogenous variable, followed by the inflation rate, in determining unemployment. As such, it is recommended for the policy makers of small open economies such as, Australia to control the exogenous variables in order to achieve a certain desired target of unemployment rate. Or, should these two relatively exogenous variables be to some extent "uncontrollable" due to factors such as, crisis and calamity, their movements could be reliable indicators for the governments to embark on contingency plans to minimize the impact of unemployment.

Key Words: Interest rate, inflation, unemployment, monetary policy Granger-causality, Australia

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1. Introduction

In recent years, the connection between monetary policy and unemployment has been a central focus of many researchers. It seems that knowing the determinants of unemployment, especially from the monetary policy perspective, is desirable, thus provide solutions to the unemployment phenomena at the status quo (Sachsida et al, 2011; Gali, 2010; Altavilla and Ciccarelli, 2010; Boianovsky and Presley, 2009; Blanchard and Gali, 2008). Although the primary objective of monetary policy is to maintain price stability in a country (Mishkin, 2010), there is ongoing political interest to shift the main objective to creating "full employment". Despite there is a different opinion regarding the main objective of monetary policy, it is preference of the researcher that under the regime of economy contractions like today, the prime objective of monetarist shall be to minimize the impact of crisis towards the real sector, particularly to unemployment problem, through controlling money supply. In another words, society through its political parties has now been more attentive on the impact of monetary policies to microeconomic variables, such as unemployment, given the assumption that the monetary authority of a country is irresistible to political pressures (Baccaro and Rei, 2005).

It is a fact that (involuntary) unemployment rate has been escalating over the years all over the world as an impact of world's economic recession. Although the impact's pace differs amongst countries, only a few countries could avoid this. ILO (2012) has reported that there is 200 million unemployment at the present, among which 27 million are resulted since the crisis begun. It signifies 600 million of new jobs must be created over the next 10 years in order to achieve a sustainable global growth. Simply stated, it is a tough task to be cleared.

Australia is one amongst few countries which is less affected by recent financial crisis. According to World Economic Outlook of the IMF 2012, Australia is one amongst the strongest economic fundamentals. It implies that the country has similarities in term solid economic growth as well as low (or expected) unemployment rate. Australia is also expected to grow by 3.5 per cent in 2012, followed by 4.1. per cent in 2013, plus with a constant 5.2 per cent unemployment rate to retain in both years, is affirmed outperformed others developed countries (SMH, 2012). Australia also shows its stability as it maintains the credit rating at "AAA" whilst other advanced countries such as the U.S. and some countries in the E.U. are downgraded. Due to the fact that Australia is small open country, as well as it is less affected by the crisis whilst

experiencing a stable growth, it is deemed that Australia is the most suitable country for our study.

1.1. Problem Statements

The world has yet to finish its poverty, famine, war, energy crisis, and global warming problems, human had added unemployment problems. The mounting numbers of jobless people due to subprime mortgage and sovereign debt crises that hit two "gigantic" regions, namely the U.S. and E.U., seems to be the result of a mistake in monetary policy making. Therefore, this study states several problems:

1. Do interest rate, inflation, and unemployment have a (theoretical) long-run relationship?
2. Should they have long-run relationships, can interest and inflation rate be used to explain the changes in unemployment?

1.2. Research Objective and Motivation

Unemployment has been studied exhaustively by many researchers for various reasons. One of the reasons may be that many researchers are curious in understanding this phenomenon. Since theory and techniques are developing, throughout the years, there is also an urgency to understand the phenomenon; as such valid suggestions could be proposed to the policy makers. This is also the motivation for the researcher to study this subject. Moreover, it is the objective of the study to analyze the dynamic relationships between unemployment and monetary policy through:

1. analyzing the cointegration amongst the variables,
2. analyzing the causality relationships amongst the variables.

2. Literatures Review

2.1. Monetary Policy and Unemployment

There are vast researches on the relationship between monetary policy and unemployment. It was Keynes in 1936 who marked the relationship between monetary policy (or economic policy in general) and unemployment through a book entitled "The General Theory of Employment, Interest and Money" in which he rejected the view of neoclassical economics by arguing that level of employment is determined by the spending of money and not through price of labor (or wage). Boianovsky and Presley (2009) also mentioned that it

was D.H. Robertson who explored the connection between the natural rates of unemployment and monetary policy and its instrument in the 1930s. Robertson was the expert who brought up this issue for the first time, particularly the connection between the twin notions of a natural rate of interest and a natural (or normal) rate of unemployment which equilibrate the market for goods and the market for labor, respectively. Robertson in 1930s defined the "normal" rate of unemployment in the long period as the rate consistent with the long run expected real wages and profits when the economy is in monetary equilibrium at the natural rate of interest. In simple wordings, Robertson was a "pragmatic" because he believes that any form of full employment equilibrium was unattainable and indeed undesirable because it might be on the expense of economic progress whereas Keynes was an "optimist" because he believes that economic policy could be justified in attempting to create full employment (Presley, 1986). Due the criticism of Keynesian economics, New-Keynesian economics is born. Hence, along this paper, New-Keynesian economics is employed as the frame of discussion[1].

Blanchard (2003) contributed his thought on the relationship between monetary policy and the real interest rate and hence unemployment. He argued that would the fact that monetary policy affects the real interest rate for long term period be accepted by most economists, they must also accept that interest rate can indeed affect output or unemployment for equal period. His rationale is this. The real interest rates affect the cost of capital; as such it affects capital accumulation. The later affects the demand for labor, and demand for labor affects unemployment. Since monetary policy must be able to affect real interest rates for a long period of time, it justifies that interest rate affects unemployment for at least equal period of time.

Monetary policy is often assumed to have less direct impact to the real sector of the economy. However, Taylor (2008) proved that it is not. He explained that it was loose-fitting monetary policy which triggered the house boom as well as the house bust, which ultimately resulted in financial bust in the United States. Federal Reserves (henceforth, The Fed) at that

[1] New Keynesian economists are born due to the criticism on Keynesian economics. The heart of Keynesian economics is preserved, that economic policy is utilized to reach a less than full employment. However, two main assumptions in the New Keynesian are that market is (1) all households and firms have rational expectations, and (2) competition is imperfect, as such price is sticky. Furthermore, New Keynesian economists agree that money supply is neutral in the long run, whereas in the short run it does increase (decrease) output. Thus, it encourages monetary authorities for stabilization instead of fluctuation.

time (from 2004 – 2007) set the interest rate way to low (i.e. 1 per cent) in comparison what it should be according to the Taylor Rule. It is mentioned by Mishkin (2010) that the U.S. monetary policy is "just-do-it" approach due to the fact that the Fed does not follow any of monetary targeting or inflation targeting strategies. As the result, the economy was *illusionary* growing and the unemployment rate was having its low in the year 2006 before touching down its bottom in 2007 and the hurt was worsen a year later. Due to the fact that monetary policy indeed influences the output, Taylor (2008) urged to monetary authorities to keep policy interest rates on track in this globalized economy.

Furthermore, there are numbers of researches have extended the thoughts into contemporary thoughts. Levin and Williams (2003) has accounted for the model uncertainty with a Bayesian model averaging approach. According to them, given considerable uncertainty regarding the true structure of the economy, policy makers aim to minimize a weighted sum of the unconditional variances of the inflation rate, the output gap, as well as the changes in the short-term nominal interest rate as the monetary policy instrument. Altavilla and Ciccarelli (2010) investigated that inflation forecasting models lead to different estimated effects of monetary policy on unemployment. As such, they recommended to policy makers that having a combined inflation forecasts from many models would yield more accurate forecasts and thus is appropriate for a benchmark rather than judgmental policy maker's forecast. Moreover, Andersson et al (2006) broadened the concept of monetary policy actions to include unexpected signals from speeches, inflation reports and minutes from monetary policy meetings which they called central bank communication.

2.2. Inflation and Unemployment: Phillips Curve

It was Milton Friedman and Edmund Phelps in the 1970s who critically challenged the theoretical underpinning of Phillips curve. Friedman challenged A.W.Phillips theoretical view that there is a stable negative relation between unemployment and wages that is high level of unemployment will entail falling wages, and vice versa. Furthermore, he observed that there is strong relationship between inflation rate and level of unemployment, in which he called this as "the phenomenon". This phenomenon shows that high inflation rate is likely to cause high unemployment rate. As such, changes in wages do not necessary entail in increasing or decreasing unemployment rate because wages only constitute a small portion of

production costs. Furthermore, during his Nobel lecture, Friedman mentioned that what matter most for employment theory are not the nominal wages in monetary term, but real wages, i.e. the inflation-adjusted purchasing power of money wages (Friedman, 1976).

Friedman (1976) also mentioned what is so called the natural rate of unemployment (*un*). *Un* is the unemployment rate such that the actual price level is equal to the expected price level and the actual inflation rate is equal to the expected inflation rate $\left(\pi_t = \pi_t^e\right)$. In another words, the *un* is the rate of unemployment required to keep the inflation rate constant, or also known as non accelerating inflation rate of unemployment (henceforth, NAIRU). As such, the new Phillips equation will be as follows:

$$\pi_t - \pi_{t-1} = -\alpha\left(u_t - u_n\right) \quad \text{.....} \quad (1)$$

Where:

$\pi_t - \pi_{t-1}$: The change in inflation rate

α : The strength of the effect of unemployment on the wage

u_t : The actual unemployment rate

u_n : The natural unemployment rate

It can be inferred in the equation that the change in inflation rate depends on the difference between the actual unemployment (*ut*) and the natural rate of unemployment (*un*). It implies that while the *ut* is higher than *un* the inflation rate decreases, and while the *ut* is lower than *un* the inflation increases.

Many studies have been dedicated to empirically proof this theory. Amongst them, the contemporary study is carried by Palley (2012) who examines the theory of the Phillips curve focusing on the distinction between "formation" of inflation expectations and "incorporation" of inflation expectations. Palley (2012) has proven through his conceptual study that higher inflation is the cost for reducing unemployment. Likewise, Blanchard and Gali (2008) study the fluctuation of the unemployment-inflation trade-off, but under different settings. An important finding from their research is that the optimal policy (i.e. a balance between unemployment stabilization and strict inflation targeting strategies) is proposed in order to achieve a substantial reduction in unemployment volatility at relatively small costs in terms of inflation volatility. Furthermore, Russell (2011) also confirmed that Friedman-Phelps insight is approximately true using 50 years of United States inflation data.

3. Research Methodology

3.1. Research Methods

This study employed a standard time series techniques, in particular cointegration, error correction modeling and variance decomposition, in order to find empirical evidence of the nature of relations amongst inflation, interest rate, and unemployment, as is elucidated in previous sections. This method is likened because the starting point is to exploit the information that one can get from a variable that is available through the variable itself (Asteriou and Hall, 2007). Unlike its predecessor -linear regression, the strength of time series techniques are as follows: (1) these techniques allow the researcher to test long-run theoretical relationships amongst the variables (i.e. cointegration), and (2) these techniques also allow the researcher to test the causality relationship (via Granger-causality test) amongst the variable. Overall, time series analysis allows the researcher to capture and examine the dynamics of the data.

Before testing the cointegration, unit-root test is conducted in the first step. According to Brooks (2008), formal tests for identifying non-stationarity are needed because of several reasons; (1) the stationarity or non-stationarity of a series can strongly influence its behavior and properties, (2) the use of non-stationarity data can lead to spurious regressions, and lastly (3) non-stationary variables will result in invalid assumptions for asymptotic analysis, i.e. "t-ratios" will not follow a t-distribution, and F-statistic will not follow an F-distribution. It is known that a variable is said to be integrated of order d, I(d), if it requires differencing d times to achieve stationarity. Our main focus is to have I(1), that is the variables are stationary in the first-differenced form. As such, the researcher exercised ADF (Augmented Dickey-Fuller) unit root test, before succeeding to lags determination in the step 2.

After determining the order of lags, Johansen approach is employed in the cointegration test (step 3). Johansen approach is used instead of Engel-Granger approach because it allows the researcher having more than one cointegrating vector in a multivariate variables model. Henceforth, long run structural modeling (LRSM) is exercised to estimate theoretically meaningful long-run (cointegrating) relations by normalizing the variable of interest as well as tests the underlying economic theory. At this stage, the researcher knows that the variables are cointegrated in the long run.

Next steps are aimed to have deeper understanding on the role of the variables whether they are explanatory or dependent variables. Error Correction Model (ECM) test, Variance Decompositions (VDCs) test are taken in order to understand which are leading and which are following. Nonetheless, the order of the leader are given in the VDCs. Furthermore, graphical visualization of the relationship is shown in Impulse Response Functions (IRFs) graphs. And it is concluded with Persistence Profiles (PP) graphs which along with IRFs graphs visualize the dynamic response path of the long-run relation. The distinguish line between the two is that PP trace out the effects of a system-wide shock. In other words, would external shock affect the model, how long the variables need to return back to their equilibrium.

3.2. Data

The data used in this study are quarterly data of Australian long-term interest rate (INT), Australian CPI (Consumer Price Index) excluding Food and Energy (CPINFNE), and lastly Australian rate of unemployment (UNEMP) covering a ten-year period. Thus, a total of 38 observations were obtained. These data are obtained from OECD stat which includes data and metadata for OECD member countries and selected non-member countries. It is downloadable at http://stats.oecd.org/.

4. Result

4.1. Testing The Non-Stationarity of Each Variable

As mentioned previously, ADF unit root test is employed to determine non-stationarity or stationarity of each variable. We are interested to have I(1), meaning that the first-differenced form of the variable is stationary, whereas the level form is non-stationary. The first difference-form for each variable is created by taking the difference of their log forms. It is calculated as follows:

$$DUNEMP = LUNEMP - LUNEMP_{t-1}$$

$$DCPINFNE = LCPINFNE - LCPINFNE_{t-1}$$

$$DINT = LINT - LINT_{t-1}$$

Table 1 summarizes the result, whereas Table 2 shows the implications from the result. Worth to note that in order to select which test-statistic to compare with ADF statistic, it is determined based on the highest value of AIC and SBC. The result shows that all AIC

and SBC values are consistent, i.e. they give the same order. From the result, it can be concluded that all variables are I(1) variables.

Table 1. ADF Unit Root Test Results

		Test-Statistic	AIC	SBC	ADF
Levels form					
Intercept and trend	UNEMP	-2.0278	53.7027	50.7712	-3.5562*
	CPINFNE	-2.5929	22.8155	19.8840	-3.5562*
	INT	-2.9753	39.8211	36.8896	-3.5562*
First-differences					
Intercept but not a trend	UNEMP	-2.9780	50.0592	47.9082	-2.9591*
	CPINFNE	-4.3923	20.8047	17.2198	-2.9591*
	INT	-4.5950	36.9203	34.7693	-2.9591*

* indicates significance at 5%.

Table 2. Implication for Unit Root Test

	Variables	Implication
Levels form		
Intercept and Trend	UNEMP	Non-stationary
	CPINFNE	Non-stationary
	INTE	Non-stationary
First-differences		
Intercept but not a trend	UNEMP	Stationary
	CPINFNE	Stationary
	INTE	Stationary

4.2. Determination of Order of the VAR Model

Here, the order of lag for the VAR model is determined. The order of lag is determined by selecting the highest value of AIC and SBC. Table 3 shows the result.

Table 3. Determination of Lags

Order	AIC	SBC
6	**131.0349**	90.1662
2	113.6661	**98.6092**

Therefore, as it can be inferred from Table 3, there is indeed conflicting result between AIC value and SBC Value. AIC (Akike-Information Criterion) mainly focus on the best order of lags. As such AIC tends to overlook the over-parameterization problem, and it is predicted that AIC usually select higher order of lags than the SBC. On the other hand, SBC considers over-parameterization problem, thus it tends to be “conservative” by choosing smaller order of lags. Considering over-parameterization problem and also the

number of observation that is not large, the researcher decided that the study shall continue with order of lag is 2.

4.3. Cointegration Test

Cointegration implies that the relationship among the variables is not spurious. It implies that there is theoretical relationship among the variables, namely unemployment, interest rate, and inflation rate, and they are equilibrium in the long run. There are two well-known cointegration tests that can be employed here, namely Engle-Granger (henceforth, EG) approach and Johansen approach. However, since the EG approach has various shortcomings, Johansen approached is employed. Table 4 depicts the result based on Maximal Eigenvalue and also Trace of the Stochastic Matrix.

Table 4. Cointegration Test Result

	Null	Alternative	Statistic	95% Critical Value	90% Critical Value
Maximal Eigenvalue	r = 0	r = 1	30.1806	25.4200	23.1000
	r ≤ 1	r = 2	**15.8434**	19.2200	17.1800
Trace	r = 0	r = 1	52.7111	42.3400	39.3400
	r ≤ 1	r = 2	**22.5305**	25.7700	23.0800

It can be inferred from result depicted in Table 4, that there is consistency between maximal eigenvalue and trace result at "r" equals to one (1). Therefore, it is concluded that there is only one cointegrating vectors in the model.

This result is indeed in line with the underlying economic theory and also previous studies. Monetary policy, which is represented by inflation and interest rate, and unemployment are cointegrated, which means that there are theoretical relationship behinds the cointegration amongst them. In addition to that, these variables are proven to contain information for the prediction of other variables. Given the proof that inflation, interest rate, and unemployment are moving together in the long run, it brings signals on

the effectiveness of the monetary policy established by The Reserve Bank of Australia before targeting their inflation rate. Coupled with well-understanding on the trade-off between inflation and unemployment, Australian government (and monetary authority) can take proper and effective policy to affect the endogenous variable which is investigated in the next steps.

4.4. Long Run Structural Modeling (LRSM)

In this step, the objective is to estimate theoretically meaningful long-run relationship through identification and over-identification based on expected theoretical value and information that is available in the underlying theory.

Table 5. LRSM Exact Identification result

Level-form	Vector 1	Standard Error
UNEMP	1.0000	*NONE*
INT	2.2367	.52241
CPINFNE	-.51230	.16247
Trend	.0052053	.0020213

In this endeavor, the researcher normalized the variable of interest, which is unemployment. Hence, unemployment is put to be equal to one (1). Table 5 shows the result of exact identification. By a glance view, it seems that all variables are significant. This "significant and insignificant" implication can be determined through a division between coefficients of variables and standard errors of variables, as such t-ration could be derived. A variable is called to be significance if its t-ratio is more than 2 (t-ratio > 2) and it is insignificant when it is otherwise. Table 6 depicts the implication of LRSM exact identification result.

Table 6. Implication of LRSM result

Level-form	T-Ratio	Implication (significant/insignificant)

UNEMP	-	-
INT	4.281503	Significant
CPINFNE	-3.1532	Significant
Trend	2.575224	Significant

Overlooking the minus sign, it is concluded that all variables are significant. As such, the researcher proceeded to the next steps using this model[2]. Thus it is concluded that interest rate, CPI excluding food and energy (and also trend) are all significant and shall be preserved in the next steps. Following is the cointegrating equation (standard errors are in parentheses):

$$\text{UNEMP} + 2.2367\text{INT} - 0.5123\text{CPINFNE} \rightarrow I(0)$$
$$(.52241) \qquad (.16247)$$

4.5. Vector Error Correction Model (VECM)

It is concluded that so far, all three variables are cointegrated to a significant degree in our model. It implies that these three variables are indeed move together in the long-run hence understanding the causal relationship amongst the three would be very beneficial for theory development as well as an informative input for policy makers. As such, VECM endeavors to shows not only that the variables are moving together theoretically, but also informs which explanatory variables (i.e. exogenous variables) are and which is endogenous variables. In addition to that VECM also checks the assumptions as it is in regression analysis.

The VECM results are indeed very useful for decision making and establishment of a policy. In this particular case, it is very important to know which variables are explanatory, that is influencing other variables, and which is (are) dependent variable(s). The scenario in VECM test is that the three variables are put to be dependent variable, hence are examined through its probability value (p-value). Probability value, in this particular scenario, shows how significant the variable is being explained by the variable itself, i.e. the higher the p-value implies that the higher the variable is being explained by

[2] The researcher has attempted several times to exercise over-identification with various possibilities of restrictions, but Microfit always rejects the over-identification function by stating: "Error while processing the restriction(s)! Please correct using the editor."

itself. On the other hand, the lower the p-value implies that the variable is not being explained by itself, thus it is dependent to other variables which can explain (influence) their movement. Table 7 depicts the VECM results and Table 8 shows the implication of the result.

Table 7. VECM results

	Coefficient	Standard Error	T-Ratio [p-value]
dLUNEMP	.24263	.051828	4.6815[.000]*
dLCPINFNE	.37285	.18326	2.0345[.051]
dLINT	-.12768	.12160	-1.0500[.302]

* indicates significance at 1%

Table 8. Implication of The Result

	Implication
UNEMP	Endogenous
CPINFNE	Exogenous
INT	Exogenous

As it can be seen in Table 8 that unemployment is the dependent variable, whereas the other two, namely CPI excl. food and energy and interest rate, are the explanatory variables. It is interesting to observe, since it affirms the theory underlying in this research and also reconfirms findings from previous studies. Baccaro and Rei (2005), for instance, found the same causal relationships amongst interest rate, inflation, and unemployment, although they also added more variables in their model and using different techniques in their analysis. Furthermore, Dogrul and Soytas (2010) also found that interest rate is exogenous to unemployment using similar techniques.

Therefore, the implications of this result would be the concern of The Reserve Bank of Australia. It is such because monetary authority has pertinent role in stabilizing prices as well as preserving the growth and health of an economy via its monetary policy. Interest rate, as the instrument for monetary policy, is found to have a direct and positive influence to unemployment as the endogenous variable. Therefore, a careful process in determining short term, as well as long term, interest rate should be conducted before arriving to the number. A lesson from the Fed during the era of Alan Greenspan needs to be learnt here, that is judgmental decision making in determining interest rate would

create a short term economy growth, yet illusionary because the effect afterwards are rapid increase of unemployment rate. In addition to this, inflation is seen to also influence the unemployment rate, in negatively manner. This result confirms the underlying theory, i.e. Phillips curve, and also in line with previous studies such as Leu and Sheen (2011), Karanassou and Sala (2010), Altavilla and Cicarelli (2010), Gali (2010), Blanchard and Gali (2008), Blanchard (2003), and many others. Hence, rising prices is not always bad to an economy as it boosts incentive for producers to produce more goods which ultimately increases employment rate. This also implies that wages –as the price of labor- only constitutes a small portion in the total costs of production of producers in the long run. Therefore, it suggests strict inflation targeting might be less favorable strategy for The Reserve Bank of Australia in order to achieve healthy and growing economy.

Moreover, VECM also gives an indication of the speed of short term adjustment to bring about long term equilibrium. Simply stating, ECM coefficient indicates how long it will take to get back to long term equilibrium if the variable is shocked. As such, it can be inferred from the result that when there is a shock applied to the variable, interest rate would take the shortest period on average, that is 1.3 quarters, meanwhile unemployment will take 2.4 quarters to come back to its equilibrium, and inflation will take 3.7 quarters to come back to equilibrium. Therefore, it shows that VECM allows us to distinguish between the "short-term" and "long-term" Granger-causality.

In addition to that, VECM also tests the assumptions of the regression analysis in the model. In Table 9, it shows that all variable are free from problems, except for unemployment variable which is seemingly to have functional form misspecification and heteroscedasticity problems. The failure of the functional form and heteroscedasticity tests suggests that there may be important non-linearities in the relationship. However, the researcher has attempted to improve the result by creating the inverse of the unemployment rate. The remedy has successfully removed the problems, however it evokes autocorrelation problem. Up to this point, based on discretionary of the researcher, the original result is preserved.

Table 9. Diagnostic Results of The Regression Analysis

	Serial	Functional	Normality	Hetero-

	Correlation		Form				scedasticity	
	LM Test	F-Test	LM Test	F-Test	LM Test	F-Test	LM Test	F-Test
UNEMP	.030518 [.861]*	.025453 [.874]*	10.2580 [.001]	11.9548 [.002]	5.4758 [.065]*	n.a.	7.7722 [.005]	9.3616 [.004]
CPINFNE	2.2272 [.136]*	1.9784 [.170]*	1.9735 [.160]*	1.7400 [.197]*	1.5116 [.470]*	n.a.	.39334 [.531]*	.37559 [.544]*
INT	.0019763 [.965]*	.001647 [.968]*	.46847 [.494]*	.39554 [.534]*	2.6951 [.260]*	n.a.	.019560 [.889]*	.018484 [.893]*

* indicates significance at 5%

4.6. Variance Decompositions (VDCs)

Despite the fact that VECM has enabled the researcher to know which exogenous variables are, the strongest exogenous variable remains silent. Understanding the strongest exogenous variable is important for policy makers as such to enhance the effectiveness of the policy. Since VECM is unable to inform the strongest explanatory variable, VDC is taken as an affirmative step whilst sharpens the policy implication. Through decomposing (or partitioning) the variance of the forecast error of the particular variable into proportions attributable to shocks in each variable in the system –including its own, VDC allows us to examine relative exogeneity of the variable explained by its own past shocks.

There are two approach for generating VDCs values. First approach is called orthogonalized VDCs, and the second is generalized VDCs. Orthogonalized VDCs informs the researcher which is most exogenous variable based on particular ordering of the variable, hence it is bias. Moreover, when one-specific variable is shocked, all other variables are switched-off, as such it is less realistic in nature. On the contrary, generalized VDCs generate the values in more realistic nature, since: (1) it does not follow the particular-ordering of the variables, and (2) when a variable is shocked, all other variables may change as the reaction of the shock. As such, the changes of other variables are interpreted as *mainly* occurred due to the shock of that particular variable. Table 10 shows the generalized result.

Table 10. Result of Generalized VDCs

Horizon:		Percentage of Forecast Variance Explained by Innovations in:		
Quarters		dUNEMP	dINT	dCPINFNE

4	Relative Variance in dUNEMP	33.36%	64.48%	2.16%
12		33.84%	64.28%	1.88%
20		33.87%	64.30%	1.83%
4	Relative Variance in dINT	25.07%	73.46%	1.47%
12		26.53%	70.10%	3.36%
20		27.07%	69.06%	3.87%
4	Relative Variance in dCPINFNE	13.77%	46.26%	39.96%
12		15.65%	50.38%	33.97%
20		16.03%	51.30%	32.67%

Table 11. The Rank of Exogeneity

	Horizon = 4			Horizon = 12			Horizon = 20		
	dUNEMP	dINT	dCPINFNE	dUNEMP	dINT	dCPINFNE	dUNEMP	dINT	dCPINFNE
dUNEMP	33.36%	64.48%	2.16%	33.84%	64.28%	1.88%	33.87%	64.30%	1.83%
dINT	25.07%	73.46%	1.47%	26.53%	70.10%	3.36%	27.07%	69.06%	3.87%
dCPINFNE	13.77%	46.26%	39.96%	15.65%	50.38%	33.97%	16.03%	51.30%	32.67%

It can be inferred from Table 11 that at horizon 4 and 12, Interest rate is the most exogenous variable followed by CPINFNE, and the weakest (i.e. the endogenous variable) is unemployment rate. However at horizon equals to 20 quarters, although it is a thin difference among the two, the rank between unemployment and CPINFNE swap whilst the strongest exogenous variable is still held by interest rate. However, the first two forecasts (at 4 and 12 quarters) are more in line with VECM results. As such, the result tends to incline with the first two forecasts.

In this stage, the policy implication that a policy maker could draw is that in order to achieve to a certain desirable rate of unemployment (i.e. controlling unemployment rate), The Reserve Bank of Australia could determine the most exogenous variable, i.e. interest rate, using various available approach, such as Taylor rule. Through a control in the interest rate, and also the inflation, The Reserve Bank of Australia is expected to arrive at its natural rate of unemployment.

4.7. Impulse Response Functions (IRFs)

The information contained in the VDCs *can be equally* represented by IRFs. As such, one can conclude that IRFs are essentially graphical visualization of the VDCs as such they

map out the dynamic response path of a variable owing to a one-period standard deviation shock to another variable. In other words, in IRFs, shocks are made to a specific particular variables and the graphs will show the impact of the shock to other variables (in the case of generalized). Following is Figure 1, Figure 2, and Figure 3 of generalized IRF for each of variables.

Figure 1. Generalized IRF for Unemployment

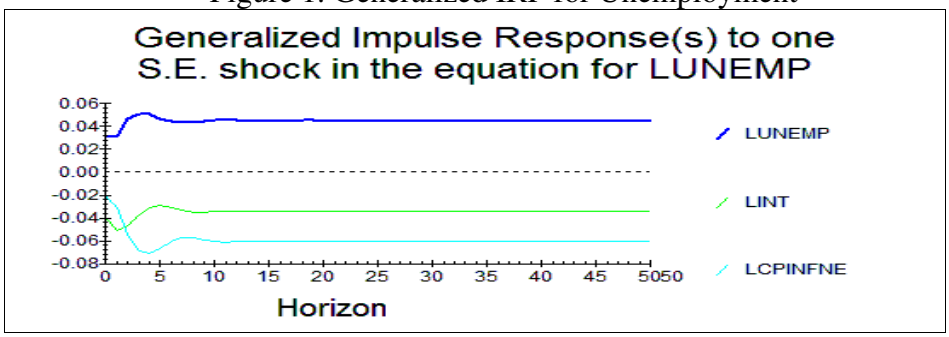


Figure 2. Generalized IRF for Interest Rate

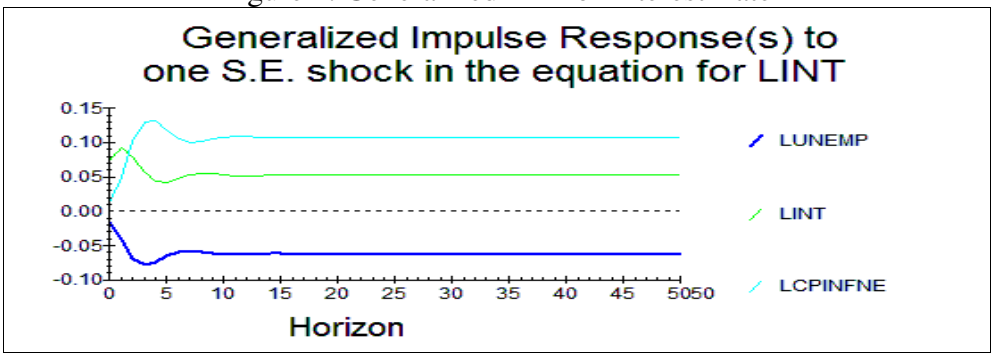
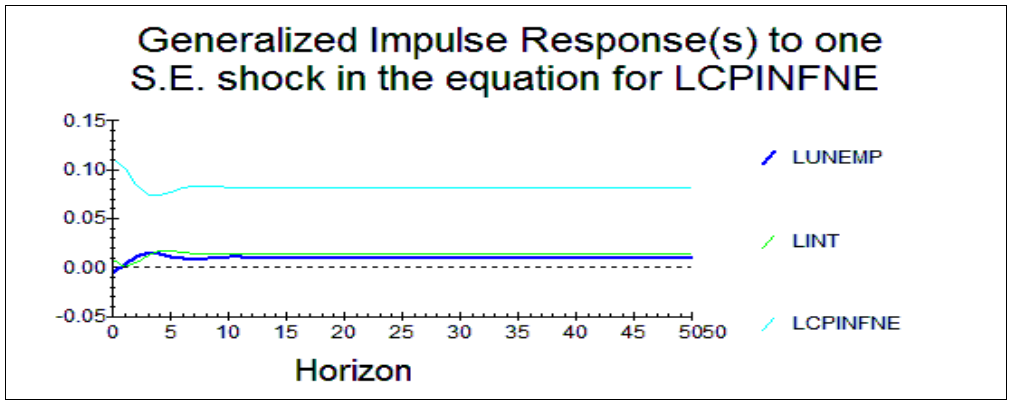


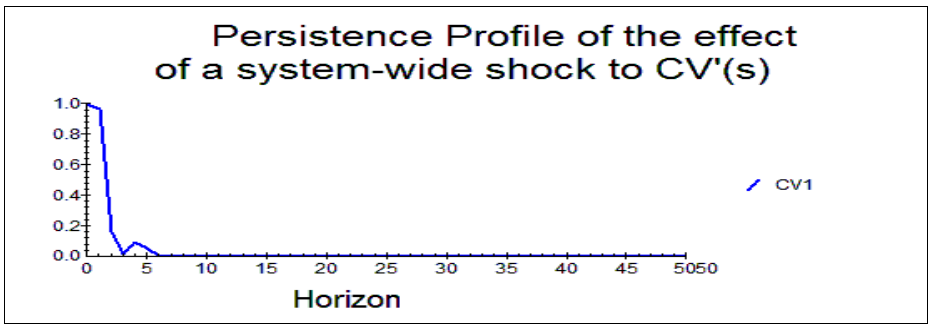
Figure 3. Generalized IRF for CPINFNE



4.8. Persistence Profile (PP)

In Persistence Profile, it maps out the dynamic response path of the long-run relations, i.e. the external shock occurred to the system, as such Figure 4 shows how long it takes of the system (i.e. the cointegrating vector –or the model) to come back to its equilibrium.

Figure 4. Persistence Profile



It can be seen in Figure 4 that it would take approximately 6 quarters for the cointegrating vectors to return to its equilibrium following a system-wide shock.

5. Conclusion

5.1. Recommendation

Here, it is evidenced that interest rate, inflation and unemployment have a (theoretical) long-run relationship. Furthermore, the result from VDCs shows that the most exogenous variable is interest rate, followed by inflation, thus the endogenous variable is unemployment rate. Therefore, recommendation to policy makers, i.e. the Reserve Bank of Australia, is suggested here that:

a. monetary policy has direct impact on unemployment,
b. it is pertinent for the respective monetary authority to establish a rigorous approach in determining the interest rate,
c. controlling interest rate and inflation will result in controlling unemployment, and
d. should the objective be to change unemployment to a lower rate; a lower interest rate should be also set along with increasing rate of inflation.

5.2. Limitations and Suggestions for Future Research

There are some limitations in this research which then posit suggestions for future research are mentioned. This study is limited to understanding the relationships of monetary policy and unemployment. However, it might be also interesting to study the relationship amongst monetary policy, fiscal policy, and unemployment. In addition to that, other factors affecting unemployment such as wages, commodity prices, and other possible variables should be added in the future research. As such it shows more comprehensive views, hence bigger contribution is attributed to the development of unemployment theory.

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