Sources of Macroeconomic Fluctuations in Malaysia: An Empirical Test of the Keynesian Model*

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Identifying the sources of macroeconomic fluctuations is critical to formulating macroeconomic policies. This paper investigates the sources of macroeconomic fluctuations in Malaysia based on the traditional Keynesian framework, using both the standard VAR and structural VAR methods. The joint behaviour of the key macroeconomic variables in Malaysia is shown to be consistent with the dynamic transmission of demand and supply shocks through the mechanisms described in the Keynesian model. Positive supply shocks increase output while negative supply shocks contract output and increase price level. Money supply shocks stimulate output and increase the price level. These results are further supported by a variance decomposition analysis.

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INTRODUCTION

Identification of the causes of macroeconomic fluctuations is a critical issue that deserves serious attention in designing effective macro policies to maintain economic stability. As a result, the relationship between short-run macroeconomic fluctuations and long-run economic growth has taken centre-stage discussion among economists and policy-makers alike. Most economists agree that the economic cyclical fluctuation is the result of variations to the equilibrium of aggregate supply and aggregate demand. The widespread view has focused on the assertion that economies are perturbed by various random disturbances that lead to short-run variations in economic activity. The hypothesis, however, regarding the dominant source of these shocks and its propagation mechanisms remains a subject of debate among competing macroeconomic schools

of thought such as the Keynesian, Monetarist, New Classical, New Keynesian and Real Business Cycle (RBC) (Romer 2001).

Knowing which shocks generate the business cycles is fundamental for macroeconomic policy-making. A mis-identification of the sources of shocks can result in serious policy-induced economic fluctuations, which might also harm social welfare. For example, if fluctuations are due to domestic demand shocks, resorting to fiscal and monetary policies can be appropriate to 'fine-tune' the economy. On the other hand, if fluctuations are from the supply side, such as technological change, labour supply shocks or structural reform, policies should focus on reducing economic uncertainty rather than reducing fluctuations *per se*; for example, by having a sound and stable institutional framework.

With the advancements in computing and econometric techniques and data collection processes, especially since the introduction of the Vector Autoregression (VAR) technique proposed by Sims (1980), numerous studies have been conducted to investigate the behaviour of macroeconomic variables in the short run with the objective of assessing the key theoretical propositions of the competing economic theories. Most of the studies, however, have focused primarily on industrialized countries, with less attention being given to developing countries.[1] Despite the fact that the developing countries might experience larger and more volatile macroeconomic fluctuations than their developed counterparts, comprehensive studies on the business cycles of these developing economies have been very limited. Several pioneering studies which attempted to explain the sources and dynamics of macroeconomic fluctuations in the developing countries started to appear only after the second half of the 1990s. Among the notable studies are Kose and Riezman (1998), Yamagata (1998), Agénor, McDermott and Prasad (2000), Kim, Kose and Plummer (2000),[2] Hoffmaister and Roldós (2001) and Ahmed (2003). Notwithstanding these developments, empirical research on macroeconomic fluctuations in the Malaysian economy is relatively scarce. Therefore, this study investigates the sources of short-run macroeconomic fluctuations in the Malaysian economy. In particular, it examines if the traditional Keynesian model provides a relevant framework for analysing the business cycle fluctuations in the country.

The rest of this paper is structured as follows. An outline of the major competing macroeconomic models on business cycles is given in the following section, highlighting selected empirical studies. Then there is a description of the empirical methodology and model specification, after which the empirical findings are reported and discussed. Finally, the paper ends with a concluding section.

THEORETICAL FRAMEWORK AND LITERATURE REVIEW

The traditional Keynesian interpretation of macroeconomic business fluctuations relies on the theoretical framework of the relationship between aggregate demand and aggregate supply. The aggregate demand describes the relationship between the quantity demanded of all goods and services and the aggregate price level, *ceteris paribus*. It captures the behaviour of the aggregate demand for goods and services, given the price level. Meanwhile, the aggregate supply characterises the relationship between the quantity supplied of all goods and services and the aggregate price level, *ceteris paribus*. It captures the behaviour of prices, given the output, and includes a relationship between unemployment and output.

Following the aggregate demand – aggregate supply (AD–AS) framework in the short run, aggregate

demand shocks influence output and prices in the same direction, but aggregate supply shocks move them in the opposite direction. In the long run, the effects of aggregate demand shocks are reflected mostly in prices and wages, but not in output, resulting in a vertical long-run aggregate supply curve. On the other hand, aggregate supply shocks, which include shocks to productivity, are more likely to have long-run effects on output. Based on these, the movements of output in the short run are dominated by the demand shocks (temporary effects), whereas in the long run they are dominated by the supply shocks (permanent effects). Therefore, macroeconomic fluctuations in the short run can be reduced by policies that affect the demand side of the economy, underlining the role of fiscal policy in bringing an economy back to its full capacity utilisation levels. The extension to the open economy is quite straightforward, as provided by the analytical frameworks of the Mundell-Fleming or Dornbusch sticky price models.

While the standard Keynesian framework of the business cycle fluctuations dominates the discussion in the standard textbooks as well as in the macro-econometric models, it has come under heavy criticism. In particular, the new classical economists have attacked the theoretical structure of this framework as 'fundamentally flawed' (Bernanke 1986; Sims 1986). Critics of the traditional Keynesian framework emphasise that useful macroeconomic models should be based on the rational expectation concept.[3] According to the critics, since economic agents behave rationally, anticipated aggregate demand changes have no effect on output and unemployment. The so-called new classical 'policy ineffectiveness paradox' states that since output and unemployment are insensitive to aggregate demand policies in both the short and long run, systematic monetary and fiscal policy actions that change the aggregate demand will not affect output and employment even in the short run.

Empirically, there are ample studies that investigate the sources and dynamics of macroeconomic fluctuations in both the industrialised and developing countries. These studies range from the approaches used in identifying the types of shocks and their propagation process, to analyses of the duration and effects. Although, most empirical studies do not support a single theory that explains the sources of fluctuations in the economy, there is some agreement that supply shocks have permanent influence on output in the long run, whereas demand shocks and aggregate supply disturbances have significant effects on inflation in the short run. Here the study focuses on a few empirical studies that have used structural VAR in order to identify the sources of shocks causing the economic fluctuations. Bernanke (1986) investigates the role of nominal versus real shocks in the RBC setting, using both unrestricted VAR and structural VAR models. Bernanke's study finds that the real interest rate, money and monetary base exert considerable influence on real output at a twelve-quarter horizon. After the exclusion of the time trend from the model, however, the influence of money on real output evaporated. These findings led to another study, by Blanchard and Watson (1986), which identifies a structural VAR model by restricting contemporaneous correlations of a one-step-ahead forecast error. The study finds that fluctuations in the United States (US) economy since World War II are due to approximately equal proportions of fiscal, monetary, demand and supply shocks. Blanchard (1989) further extends the study by examining whether the dynamic joint behaviour of the US output, unemployment, prices, wages and nominal money, is consistent with the traditional interpretation of macroeconomic fluctuations. His study is supportive of the theory that demand shocks account for most of the short-term

output fluctuations and are associated with increases in prices and wages. Supply shocks account for the medium- and long-term impact and are associated with a decrease in prices and wages. By modelling the aggregate supply shocks as three independent shocks—labour supply, total factor productivity and oil price, Shapiro and Watson (1988) investigate the effects of aggregate supply and demand shocks on output in the US. They find that aggregate demand shocks accounted for only 25% of the variance of the unpredictable changes in output in a one-quarter horizon, leaving the remainder to be explained by aggregate supply shocks. Labour supply shocks were found to explain about 50% of the variance of real output in the short run.

Blanchard and Quah (1989), using the AD–AS model and long-run restrictions, argue that demand shocks are the primary sources of US business cycle fluctuations. Subsequently, Ahmed *et al.* (1993) found supply shocks to be very important in generating international business cycles, using a two-country specific model for large open economies. In another study, Ahmed and Park (1994) focus on seven Organisation for Economic Co-operation and Development (OECD) countries and report strong support for one of the propositions of the RBC theory; that is, supply-side changes explain the bulk of the movements in aggregate output. Ahmed and Murthy (1994) examined the key predictions of the RBC models, using a small open economy framework for Canada, and they found that domestic real supply shocks are the 'main driving force' for output fluctuations in the economy, rather than shocks originating externally. In addition, money represented by demand deposits responds significantly to output shocks in the short term. Thus, the causation from money to output is not supported by the data. In contrast, King *et al.* (1991) use a combination of short- and long-run restrictions in their VAR identification and find that nominal (or temporary) shocks explain over 50% of the fluctuations in the real variables; namely, output, consumption and investment in the US. In a similar fashion, Gali (1992) examines a structural VAR IS–LM model for the US economy and assumes three types of demand shocks and one supply shock. The results show that both types of shocks are important, but supply shocks account for approximately 70% of the Gross Domestic Product's (GDP) variability. Clarida and Gali (1994) extend the basic analysis of the structural VAR to include temporary nominal shocks and find that roughly 90% of output innovations and 60% of the real exchange rate innovations are attributed to real shocks. Prasad (1999) augments Clarida and Gali's (1994) model by explicitly incorporating a trade balance equation, and concludes that nominal shocks seem to have a considerable role in determining fluctuations in the trade variables in the G-7 countries. Also, Keating (1992) developed a structural VAR model with long-run identification restrictions based primarily on the assumption that monetary shocks are neutral. He finds that real shocks are the most important source of cyclical fluctuations. Moreover, his result shows that exogenous monetary policy shocks are also significant for short-run output fluctuations.

While the above studies are supportive of the RBC theory, there are several others that are not. For instance, Karras (1994), Bayoumi and Eichengreen (1992) and Whitt (1995) find their results to be less favourable of the RBC theory. Karras (1994) estimates VARs for three European countries and documents that RBC models are inadequate because aggregate demand is responsible for over half of the variability of output at a four-quarter horizon in France and Germany, and about 40% in the United Kingdom. Bayoumi and Eichengreen (1992) and Whitt (1995) estimate VAR with two variables; namely, output and price. Like Karras (1994), they find that aggregate demand shocks account for a substantial portion of output fluctuations in major European countries.

EMPIRICAL METHODOLOGY AND MODEL SPECIFICATION

Vector Autoregression (VAR) and Structural VAR

Consider a system of simultaneous equations represented in vector-form (omitting constant and deterministic terms) as follows:

$$Ay_t = B(L)y_t + u_t \quad (1)$$

where y_t is an $n \times 1$ vector of endogenous variables; $B(L)$ is a matrix polynomial in the lag operator L; and u_t is a white noise vector of the disturbance terms for each variable. This disturbance term captures any exogenous factors in the model. The squared $n \times n$ matrix A, where n is the number of variables, contains the structural parameters of the contemporaneous endogenous variables. The problem with the representation in equation (1) is that because the coefficients in the matrices are unknown and the variables have contemporaneous effects on each other, it is not possible to uniquely determine the values of the parameters in the model.

By multiplying equation (1) with A^{-1}, it is possible to transform equation (1) into a reduced-form model as shown in the following:

$$y_t = G(L)y_{t-1} + e_t \quad (2)$$

where $G(L) = A^{-1}B(L)$ and $e_t = (A_0)^{-1} u_t$. Note that the error term e_t is a linear combination of the structural form errors (u_t). As a result, even though the structural form errors are assumed to be uncorrelated with each other, reduced-form errors e_t will be correlated in general. The structural form variance-covariance matrix can be expressed as: $\sum_u = E(u_t u_t') = A_0 \Sigma_e A_0' Q$, where Σ_e is the variance-covariance matrix for the reduced-form error terms. It can be seen from this decomposition that if one knew the structural form matrix A_0, then it would be possible to solve for the structural form error variances from the reduced-form variance-covariance matrix Σ_e. Accordingly, the task is to impose identification restrictions on the contemporaneous coefficients matrix A_0 to recover the structural error series. Once the structural model is identified, interrelationships between the variables can be investigated via impulse response functions and forecast error variance decompositions, which show the nature of economic shocks through the system.

A common practice in identifying the structural system is to assume a lower triangular structure for the A_0 matrix. This type of identification has been widely used in the literature ever since it was proposed by Sims (1980) and became known as the Cholesky decomposition. It implies that the first variable responds only to its own exogenous shocks; the second variable responds to the exogenous shocks of the first and second variable; and so on. In other words, a recursive structure is being assumed. The results from VARs can be sensitive to the ordering imposed, which makes their interpretation quite difficult.[4] Unless there is a strong theoretical foundation for the ordering, it may be that the underlying shocks could be improperly identified. As such, the impulse response functions and variance decompositions resulting from the improper identification can be misleading. Nevertheless, the Cholesky decomposition is only one type of identification restrictions.

The traditional VARs, which use Cholesky decomposition, have come under strong attack from the economics profession (Cooley & LeRoy 1981).

In particular, the standard VAR approach has been criticised for being devoid of any economic content. As soon as the set of variables is determined, the procedure is almost mechanical. Of course, impulse response analysis and variance decomposition requires an ordering of the variables but the selection of ordering is generally *ad hoc* (Enders 1995). As a result, the 'structural VAR' methodology has been proposed to factor in the identification schemes that are based on economic theory (Bernanke 1986; Sims 1986; Blanchard & Quah 1989; King *et al.* 1991; Gali 1992).

This study adopts both the standard and structural VAR methods to analyse the macroeconomic business fluctuations within the traditional Keynesian framework. This is to ensure that the results based on the standard VAR are consistent with those of the structural VAR.

The analysis starts by applying the Cholesky decomposition in the identification of the VAR system. The ordering of the variables is consistent with the literature including Blanchard (1989), Sims (1986) and Bernanke (1986). Output is considered as the most exogenous variable; while the real exchange rate, as the most endogenous, because all economic conditions affect the real exchange rate within the same time period. Price level is considered as supply-related and more exogenous than money supply and interest rate which respond to the changing macroeconomic conditions.

To check for the robustness of the empirical results based on the standard VAR, the study adopts the structural VAR approach as advocated by Bernanke (1986) and Sims (1986). This approach is attractive since there is room for economic theory and empirical regularities to play some role in the analysis. Following the Bernanke–Sims methodology, the study sets up the identification restrictions based on the standard Keynesian macroeconomic theory. The identification restriction of the structural VAR for this study is specified as follows: because there are complex planning processes involved in changing production, this study postulates that the variations in the price level, nominal money stock, interest rate and exchange rate affect output only with a one-period lag. The price level is contemporaneously related to output and money supply. Expansionary monetary policy could have an instant effect on price level through an increase in liquidity. Also, in the short run, an increase in output results in a decline in the price level. In the money market, the demand for the real money balance depends on income and the opportunity cost of holding money; namely, the nominal interest rate. The interest rate as an instrument of monetary policy responds to the changing conditions; information on output and price are typically not available within the same period. While money aggregates data are available to the central bank within the same period, the monetary authority is assumed to respond to current money aggregates, exchange rate and all the lagged variables. This description is perfectly consistent with short-run policy objectives following the Keynesian approach. Finally, the real exchange rate is responding contemporaneously to all other variables. The identification of the contemporaneous equations is used to convert the correlated VAR residuals into structural innovations as in the following equation:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & a_{23} & 0 & 0 \\ a_{31} & -1 & 1 & a_{34} & 0 \\ 0 & 0 & a_{43} & 1 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} u_y \\ u_p \\ u_m \\ u_r \\ u_{er} \end{pmatrix} = \begin{pmatrix} e_y \\ e_p \\ e_m \\ e_r \\ e_{er} \end{pmatrix}$$

where y is output; p is price level; m is money supply; r is interest rate; and er is the real exchange rate. u_i are structural shocks, while e_i are reduced-form error terms.

TABLE 1
Unit root tests results

Series	ADF		KPSS	
	Level	First difference	Level	First difference
LY	–0.820	–6.788***	1.145**	0.1518
LP	–2.057	–2.311	1.130**	0.310*
*LM*1	–0.081	–3.139**	1.144**	0.069
R	–2.326	–8.043***	0.194	0.072
LER	–2.890*	–6.908***	0.213	0.073*

***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
Notes:
1. The lag lengths are selected according to the Schwartz information criterion (SIC).
2. The critical values for the ADF tests are based on MacKinnon (1996) and for KPSS are based on Kwiatkowski, Phillips, Schmidt and Shin (1992, Table 1).

DATA PRELIMINARIES

The VAR model comprises of five macroeconomic variables; namely *LY* (output, the real GDP), *LP* (price level, the consumer price index, CPI), *LM*1 (money supply, the M1 monetary aggregate), *R* (interest rate, the overnight inter-bank rate) and *LER* (real effective exchange rate).[5] The selection of these variables is based on the theoretical and empirical research in this area (e.g. Bernanke 1986; Sims 1986; Blanchard 1989). Quarterly data are used covering the period from 1978:Q1 to 2003:Q4. Since the data taken from the *International Financial Statistics* and the *Monthly Statistical Bulletin* of the Bank Negara Malaysia inherit different base years, they are all converted to a common base of 1987. All variables, except interest rate, are expressed in logarithmic form and are seasonally adjusted.

As a preliminary exercise to any VAR model, the study tests for the stochastic property of the time series. In particular, the Augmented Dickey Fuller (ADF) test developed by Dickey and Fuller (1979, 1981) is adopted to check for the unit root property of the data. The results of the unit root tests are summarised in Table 1. As shown in the table, the ADF test fails to reject the null hypothesis of unit root for all the variables, except for *LER*. After first differencing, however, these variables are found to be stationary, except for *LP*. The Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test is also used to re-affirm the results of the ADF test. As shown in Table 1, the KPSS test results confirm that of the ADF test that the first differences of *LY, LP, LM*1 and *R* are stationary. The KPSS test results, however, indicate that *LER* is stationary both at level and first difference.

Since the ADF and KPSS tests can very likely have a bias in favour of the unit root process in the event of structural breaks (Perron 1989, 1990; Perron & Vogelsang 1992), the Zivot and Andrews (1992) test is applied and the results are presented in Table 2 (opposite). The results clearly show that the null of unit root hypothesis cannot be rejected for the entire time

TABLE 2
Unit root test results using structural break model

Series	Model	T_B	k	δ	μ	γ
LY	C	1993:Q2	1	0.016 (2.19) **	0.001 (–2.99) ***	–0.098 (–2.99)
LP	C	1984:Q2	2	–0.013 (–3.77)***	0.001 (3.00) ***	–0.088 (–3.12)
*LM*1	C	1992:Q4	0	0.060 (2.82) ***	0.060 (2.98)***	–0.143 (–3.21)
R	A	1998:Q3	3	–0.020 (–3.17)***		–0.079(–2.80)
LER	C	1992:Q1	1	–0.050 (–3.1) ***	–0.001 (–1.2)	–0.092 (–4.21)

***, **and * indicate significance at the 1%, 5% and 10% level, respectively.
Notes:
1. Numbers in parentheses are *t*-ratios.
2. T_Bs are the dates showing the time points when the structural change occurs.
3. Models A, B and C are tests for the null hypothesis of a unit root conditional on:
(A) an exogenous change in the level of the series;
(B) an exogenous change in the rate of growth; and
(C) exogenous changes in both the level and the rate of growth.

Model A: $\Delta y_t = \alpha^A + \beta^A t + \gamma^A y_{t-1} + \delta^A DU_t(\lambda) + \sum_{i=1}^{k-1} \theta_i^A \Delta y_{t-i} + \varepsilon_t$

Model B: $\Delta y_t = \alpha^B + \beta^B t + \gamma^B y_{t-1} + \mu^B DT_t(\lambda) + \sum_{i=1}^{k-1} \theta_i^B \Delta y_{t-i} + \varepsilon_t$

Model C: $\Delta y_t = \alpha^C + \beta^C t + \gamma^C y_{t-1} + \delta^C DU_t(\lambda) + \mu^C DU_t(\lambda) + \sum_{i=1}^{k-1} \theta_i^C \Delta y_{t-i} + \varepsilon_t$

series even after the structural break is allowed. Given these results, all the series are treated as I(1) process. In other words, their first differences are treated as stationary, and it is assumed that the levels of each of these variables are potentially cointegrated at their levels. If these variables are cointegrated, a VAR model in first differences is mis-specificed since it omits the error correction mechanism.

Next, the Johansen-Juselius (1992) cointegration test is applied to determine if the variables are cointegrated with lag 3 and lag 8 as indicated by the Final Prediction Error (FPE) and sequential modified LR test statistic, respectively. As shown in Table 3 (p. 66), both the Trace and Max-Eigenvalue statistics indicate at least two cointegrating vectors at the 5% significance level when lag 8 is used, but none of the variables are cointegrated when lag 3 is used. Given the mixed results, the strategy of this paper is to accept the nonstationarity altogether and to do the analysis in levels. This approach allows for implicit cointegrating relationships in the data and still has consistent estimated parameters that describe the system's dynamics.[6,7] With regard to the lag length selection in the estimation of the VAR, although lag length tests suggest 3 lags, the study sets the lag length at 4 in the VAR estimation to make sure the error terms are serially uncorrelated.[8]

TABLE 3
Cointegration tests results

Hypothesised no. of CE(s)	Trace statistics (lag 3)	Max-Eigen statistics (lag 3)	Trace statistics (lag 8)	Max-Eigen statistics (lag 8)
None	62.16	28.24	105.41**	49.41***
At most 1	33.92	17.50	55.99**	30.69**
At most 2	16.43	10.74	25.30	14.78
At most 3	5.68	4.93	10.31	10.41
At most 4	0.75	0.75	0.12	0.12

**and * indicate significance at the 1% and 5% level, respectively.
Note: The critical values of the tests are from Osterwald-Lenum (1992).

EMPIRICAL FINDINGS AND DISCUSSION

Impulse Response Functions

Figure 1 (p. 68) and Figure 2 (p. 69) display the impulse response functions of real output, price level, money supply, interest rate and real exchange rate to a one-standard deviation shock to each macroeconomic variable. To provide some idea of uncertainty surrounding the estimated responses, following the recommendation of Sims and Zha (1999), one-standard deviation of confidence bands around the point estimates have been estimated for the impulse response functions using the Monte Carlo integration based on 10,000 draws.

OUTPUT SHOCK

A shock to output is considered as an aggregate supply shock that captures exogenous events that permanently affect the level of real GDP. Some observable events that are likely candidates of output shocks are changes in energy prices, increase in productivity due to technology advancement and changes in regulatory earnings. A favourable shock to technology, for instance, shifts the production function upward. In addition, it results in a steeper production function for any level of input. Since the slope of the production function is the marginal product of the production factor, the positive technology shock tends to increase the marginal productivity of the factors of production. As a result, higher level of output can be produced by the same level of the factor input which, in turn, leads to a decrease in price and an appreciation in exchange rate.

As shown in both Figure 1 (p. 68) and Figure 2 (p. 69), a positive output shock immediately increases output steadily until a peak is reached at fifteen quarters; thereafter, output plateaus out at the longer horizons. The instantaneous increase in output by output shocks is one of most robust findings of literature on business cycles, having being documented by Blanchard (1989), Turner (1993), Karras (1994) and Funke (1997) for the major industrialised nations. The responses of

money supply, interest rate and exchange rate to output shock are also consistent with the prediction based on the standard Keynesian aggregate demand – aggregate supply framework. The response of price to output shock is puzzling, however; although there is an immediate decrease of price due to output shock, it then increases permanently in response to output shock (similar results were also found in Ibrahim 2007). Regardless of this, in the case of output shock, the VAR analysis provides some support for the traditional Keynesian interpretation of macroeconomic business fluctuation in the Malaysian case.

PRICE SHOCK

According to the standard Keynesian model, a positive price shock leads to a temporary decrease in output. The quantity of labour supplied is a function of expected real wage; that is, an increase in the money wage for a given value of the expected price level increases labour supply, while an increase in the expected price level decreases labour supply. Usually, labour's expectation about the future price level depends on the past behaviour of prices; hence, it's given in the short run. Over time, workers will adjust their price expectation accordingly as new information becomes available.

When there is a positive price shock, as a result of the observed increases in the aggregate price level, workers' expectation of the price level rises. Accordingly, the labour supply schedule would then shift to the left because less labour is being supplied at each level of money wage. Assuming a fixed aggregate demand schedule, a leftward shift in the aggregate supply schedule results in a reduction in output and an increase in the unemployment rate and price level. An increase in the price level exerts upward pressure on wages through labour bargaining power. As for firms, the higher labour costs result in more workers being laid off and lower output.

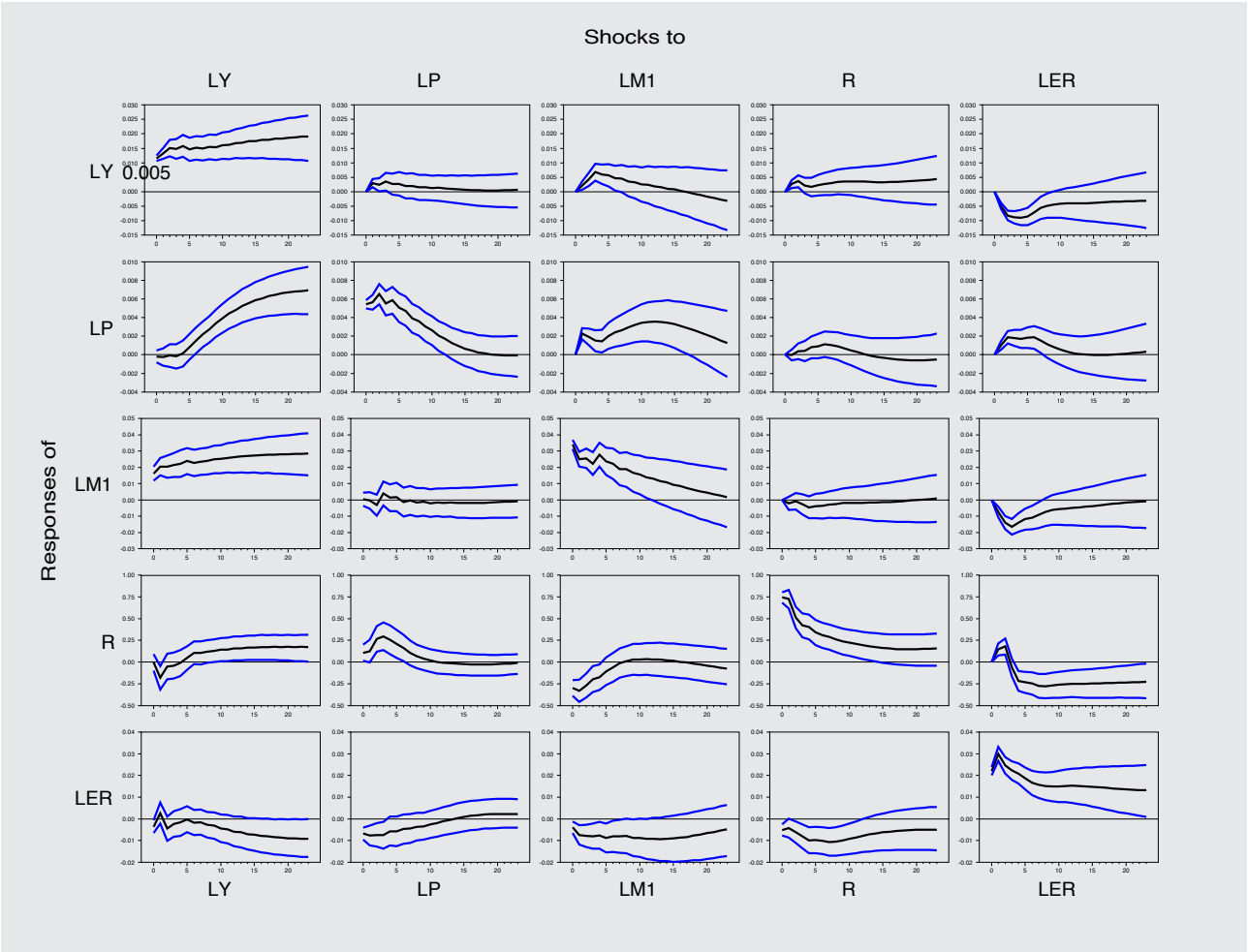
An increase in the price level increases the money value of the marginal product of labour corresponding to any level of employment and, therefore, increases labour demand for a given money wage. The labour demand schedule shifts to the right along the labour supply schedule, and employment increases. As employment increases, aggregate supply increases along the aggregate demand. Therefore, for a given aggregate demand, an increase in aggregate supply tends to increase output and decrease the unemployment rate. As for the impact of a price shock on the real exchange rate, an increase in price would depreciate the real exchange rate.

Both Figures 1 and 2 (pp. 68 and 69, respectively) show that a price shock results in output increasing initially and then returning to its pre-shock level as predicted by the Keynesian theory. Similarly, price shows a temporary increase immediately after the shock and subsequently returns to its pre-shock level. Real money balance shows an instant decrease in response to a price shock both in the standard VAR and structural VAR. The nominal interest rate rises in response to the price shock, which is interpreted as an adverse supply shock, implying an easy monetary policy in response to the adverse supply shock. Meanwhile, the exchange rate depreciates as expected.

MONEY SHOCK

According to the IS–LM model, a rise in money supply due to a rightward shift in the LM curve results in an excess liquidity condition in the economy, reduces the prevailing interest rate level, and thereby stimulates consumption and investment spending. The increase in aggregate demand could result in higher output and prices, depending on the nature of the aggregate supply schedule. In the classical case, since the aggregate supply schedule is vertical, the increase in aggregate demand is being absorbed by prices. In the traditional Keynesian framework, however, the

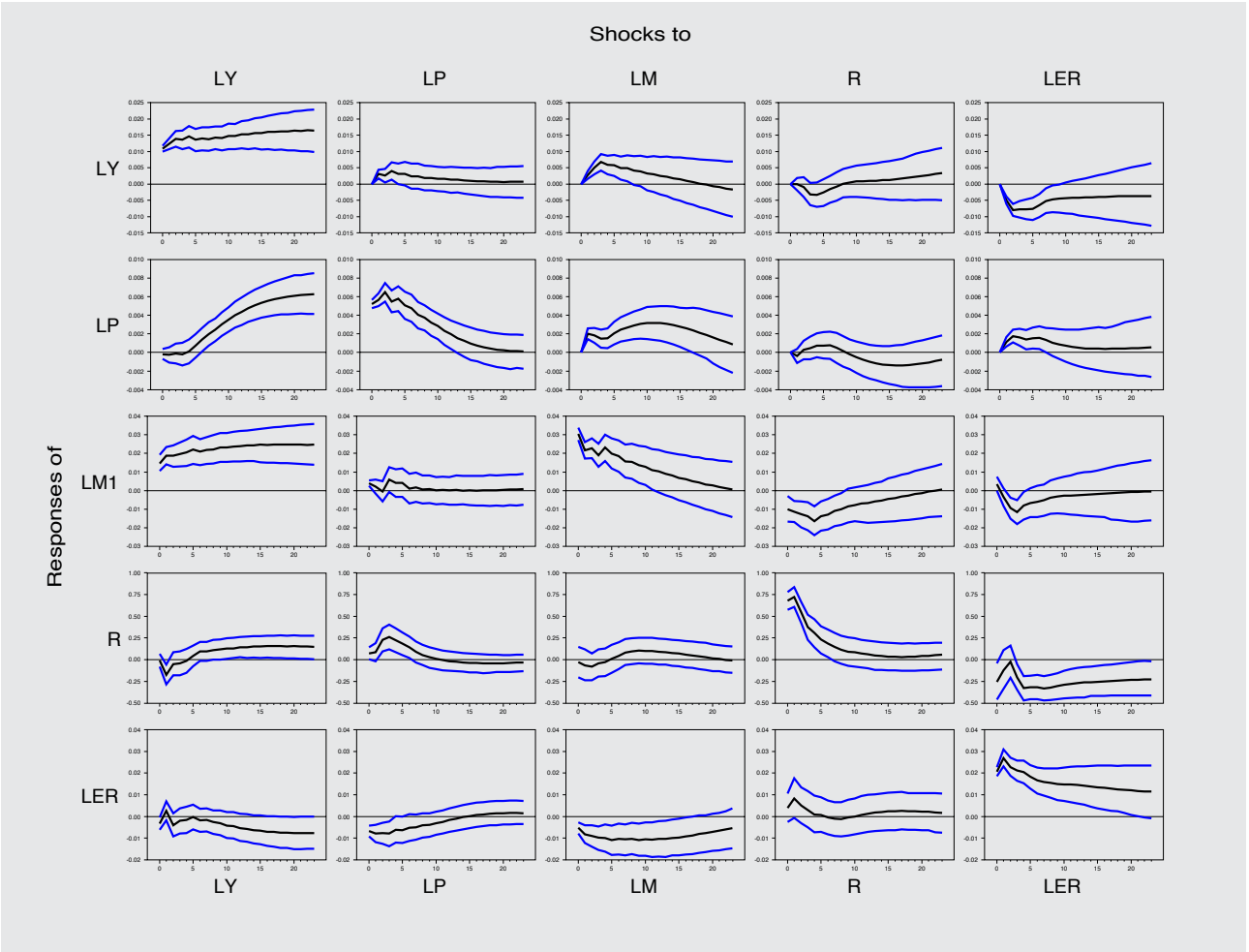
FIGURE 1
Impulse responses from standard VAR



upward-sloping aggregate supply schedule drives up output and prices simultaneously. A higher domestic price induced by a positive shock in money supply causes the real exchange rate to depreciate.

The results from both Figures 1 and 2 (above and opposite, respectively) show that the impact of a money shock on output and price is consistent with the Keynesian framework. A positive shock to money supply results in an initial increase in the real money balance, which has statistically significant impact on output for the first seven quarters. This result concurs well with that of Ansari and Ahmed (2007), which supports the importance of money in determining the output in the case of Mexico. This result, however, is not in line with the finding of monetary ineffectiveness by Ansari (2002). A positive shock to the money market equilibrium is followed by an immediate increase in the nominal money stock. The impact of money supply

FIGURE 2
Impulse responses from structural VAR



shock on price is significant and persistent. The response of the nominal interest rate is consistent with the liquidity effect: the nominal interest rate drops as a result of an increase in the real money balance for the first five quarters, after which income and price or expected inflation begin to drive interest rates upwards. Since the domestic interest rates decrease due to expected inflation, the exchange rate depreciates in response to money supply shocks.

INTEREST RATE SHOCK

A positive shock on the interest rate, which can be interpreted as a contractionary monetary policy brought about by a significant one-time increase in the interest rate, results in interest rates increasing. The increase in the interest rate lasts for only five quarters and then the interest rate declines gradually over time. It is quite obvious that the negative impact of interest shocks on price is statistically significant

instantaneously, then becomes insignificant in the medium and long run under the structural VAR, but is not significant under the standard VAR; similarly, output shows a clear negative response under the structural VAR but a positive response under the standard VAR. It should also be noted that many VAR studies have problems in generating plausible responses of prices following a monetary shock (known as the 'price puzzle'). The negative response of output starts with lags after the shock and is statistically significant in the second to seventh quarter under the structural VAR. This result is consistent with Bernanke and Blinder (1992) and Bernanke and Gertler (1995). It shows, however, an initial positive response of output following a monetary shock under standard VAR, which is consistent with Bernanke and Gertler (1995). As expected, the exchange rate shows a significant response and appreciates instantaneously but it turns to become insignificant in the long run. Finally, money shows an immediate significant negative response after the monetary tightening under the structural VAR but it is not significant under the standard VAR. Despite the inconsistencies, all the significant responses are in line with the prediction of the traditional Keynesian framework.

EXCHANGE RATE SHOCK

Since the Malaysian economy depends heavily on the export sector, the effect of the real exchange rate on the economy is, indeed, very crucial. Following a real depreciation of the exchange rate, Malaysia's exports would become more competitive in world markets, while imports would become relatively more expensive. By convention, the trade balance would improve and aggregate demand increase. This is reflected by a rightward shift in the IS curve, resulting in a rise in the domestic interest rate. In response, the central bank would purchase foreign exchange which increases the domestic money supply, thus, shifting the LM curve to the right. Consequently, real depreciation is effective in increasing aggregate demand.

The study's results show that, following a depreciation, output contracted immediately; while the price level increases due to the double impacts of an increased demand and import prices. Over time, output increases due to the export expansion, which puts downward pressure on the price level. Eventually, the output effect overwhelms the price effect, resulting in the price level declining substantially over time. Expansion in the economy eliminates the need for further policy stimuli, reflected in the decline in money supply over time.

Variance Decompositions

While impulse responses are useful in assessing the signs and magnitudes of responses to specific shocks, the relative importance of different shocks for a particular variable's fluctuations can be gauged only through the variance decomposition analysis. Thus, the impacts of the shocks on the macroeconomic variables are also analysed through the variance decompositions of the forecast errors based on the standard VAR (Table 4, p. 72) and structural VAR (Table 5, p. 73).

The results based on the variance decomposition analysis are supportive of the earlier findings based on the impulse response functions. As shown in the tables, the contribution of output in explaining the forecast error variances in itself remained significant throughout the time horizon. More importantly, the results show that the significance of output in explaining the forecast error variance in itself becomes increasingly significant at longer time horizons. The contribution of exchange rate in accounting for the forecast error variance of output

is also significant, accounting for 15% in the first eight quarters and gradually diminishing in the subsequent quarters. The significant effects of the real exchange rate imply that being an open economy, Malaysia is susceptible to the foreign sector. The contribution of innovations in money supply in accounting for the forecast error variance of output is about 7% but becomes about 5% in the medium and long run.

Similarly, variations in price are largely explained by its own innovations, accounting for more than 80% in the shorter time period. The contribution of output, however, in explaining the forecast error variance of price becomes more important in the longer time horizon. The contributions of money supply and exchange rate in explaining the forecast error variance of price are significant in the long run, consistent with the prediction of the aggregate demand and aggregate supply framework.

As for variations in money supply, apart from the significant contribution of its own innovations, the contribution of output in explaining the forecast error variance of money supply is also significant, particularly in the longer term. The interest rate shock provides an alternative explanation to that of the movement of money; the negative effect is more significant in the structural VAR than that in the standard VAR. The impact of exchange rate and price innovations on money supply, however, is immaterial.

Apart from the innovations factor in itself, variations in interest rate are mainly explained by exchange rate shocks. In particular, innovations in money are significant in the shorter term, while innovations in exchange rate are more significant in the long run. It is remarkable that variations in real exchange rate in itself contributed up to 80% in the short run and more than 60% in the long run.

In the context of the aggregate demand – aggregate supply analysis, the study focuses on the long-run analysis beyond the eighteen-quarter horizon. Findings on the effects on output of demand side innovations, which include innovations in money and real exchange rate, are quite interesting. Innovations in real exchange rate account for 8% of the variations in output, while the impact of innovation in money supply is smaller, at around 3%. This reflects the significant influence of the export sector on the Malaysian economy. Meanwhile, the supply-side innovation, which is innovation in output, has a more long-run effect on output than that of the demand-side innovations. The supply-side innovations account for more than 85% at the twenty-four–quarter horizon, whereas demand-side innovations account for only around 12% in explaining the variation in output.

In summary, the study finds that supply-side innovations dominate long-run fluctuations in output, while demand-side innovations dominate long-run fluctuations in prices. Neither domestic demand nor supply innovations has a significant imprint in the fluctuations of real exchange rate. These results are consistent with the traditional Keynesian interpretation of macroeconomic fluctuations.

CONCLUSION

This paper analyses the joint behaviour of key Malaysian macroeconomic variables and determines if it is consistent with the traditional Keynesian interpretation of macroeconomic business fluctuations. The traditional Keynesian interpretation of macroeconomic business fluctuations proposes that aggregate demand shocks move output and prices in the same direction, whereas aggregate supply shocks move output and prices in the opposite direction in the short run. Also, aggregate demand shocks are reflected mostly in prices in the long run, while aggregate supply shocks are more likely to have long-run effects on output.

TABLE 4
Variance decomposition analysis based on the standard VAR

Forecast error in	Forecast horizon (quarters)	Percentage of the variance attribute to				
		Output	Price	Money	Interest rate	Real exchange rate
Output	1	100.00	0.00	0.00	0.00	0.00
	4	71.17	2.63	6.72	2.45	17.03
	8	69.81	2.20	7.77	2.09	18.13
	12	74.74	1.75	6.32	2.70	14.49
	16	79.01	1.39	4.92	2.77	11.92
	20	82.30	1.12	3.92	2.68	9.98
	24	84.55	0.94	3.44	2.62	8.45
Price	1	0.11	99.89	0.00	0.00	0.00
	4	0.07	86.93	7.46	0.21	5.33
	8	0.07	86.52	7.08	0.51	5.81
	12	2.83	78.03	10.58	1.48	7.08
	16	14.68	60.94	17.57	1.39	5.42
	20	29.92	44.66	20.45	1.05	3.92
	24	43.04	33.95	19.04	0.98	2.99
Money	1	17.77	0.01	82.22	0.00	0.00
	4	29.99	0.54	58.48	0.24	10.76
	8	35.99	0.36	51.69	0.72	11.25
	12	44.16	0.31	45.33	0.67	9.53
	16	52.02	0.29	38.93	0.60	8.16
	20	58.68	0.26	33.50	0.53	7.04
	24	63.87	0.23	29.29	0.47	6.15
Interest rate	1	0.00	1.71	13.25	85.04	0.00
	4	1.72	8.49	14.34	72.66	2.79
	8	2.02	10.58	11.51	65.85	10.04
	12	3.45	9.09	9.98	61.18	16.31
	16	5.06	8.26	9.28	57.23	20.17
	20	6.49	7.84	8.81	54.19	22.68
	24	7.57	7.62	8.44	52.26	24.12
Real exchange rate	1	2.10	7.72	2.47	4.47	83.25
	4	1.38	6.87	6.18	4.73	80.85
	8	0.95	6.13	8.78	10.55	73.60
	12	1.43	5.18	11.18	13.14	69.07
	16	2.89	4.32	13.43	12.81	66.55
	20	4.67	3.97	14.66	11.98	64.72
	24	6.39	3.91	14.97	11.33	63.41

Notes: 1. The results are based on the VAR model with four lags as described in the text.
2. Numbers may not add up to 100% at each forecast horizon due to rounding errors.

TABLE 5
Variance decomposition results based on the structural VAR

Forecast error in	Forecast horizon (quarters)	Percentage of the variance attribute to				
		Output	Price	Money	Interest rate	Real exchange rate
Output	1	100.00	0.00	0.00	0.00	0.00
	4	70.12	3.60	8.77	2.45	15.07
	8	68.70	3.16	9.74	3.11	15.28
	12	73.84	2.55	8.55	2.14	12.91
	16	78.29	2.03	6.96	1.62	11.10
	20	81.72	1.64	5.61	1.38	9.65
	24	84.09	1.37	4.68	1.40	8.47
Price	1	0.11	99.89	0.00	0.00	0.00
	4	0.07	87.44	6.65	0.41	5.43
	8	2.75	79.09	11.05	1.01	6.11
	12	13.85	62.90	17.14	1.06	5.06
	16	28.33	47.04	18.54	2.16	3.94
	20	41.19	36.22	16.62	2.79	3.18
	24	51.37	29.30	13.96	2.66	2.71
Money	1	16.63	0.89	69.10	11.01	2.36
	4	28.42	1.08	48.05	18.19	4.26
	8	34.27	0.91	40.81	20.64	3.37
	12	42.56	0.68	35.70	18.39	2.67
	16	50.60	0.56	30.62	15.99	2.23
	20	57.44	0.48	26.34	13.82	1.92
	24	62.81	0.42	23.01	12.08	1.68
Interest rate	1	0.06	1.63	0.08	80.91	17.32
	4	1.25	8.16	0.14	79.71	10.75
	8	1.77	10.45	0.73	62.05	25.01
	12	3.28	9.03	2.36	52.98	32.36
	16	4.92	8.16	3.35	47.68	35.89
	20	6.35	7.69	3.76	44.36	37.84
	24	7.43	7.44	3.85	42.31	38.96
Real exchange rate	1	1.86	8.89	5.47	7.00	76.79
	4	1.28	8.39	10.03	8.88	71.41
	8	0.88	7.91	16.09	5.80	69.33
	12	1.34	6.96	20.32	4.67	66.72
	16	2.72	5.85	22.78	4.67	63.98
	20	4.41	5.22	23.69	5.05	61.64
	24	6.05	4.95	23.67	5.32	60.01

Notes: 1. The results are based on the structural VAR model with four lags as described in the text.
2. Numbers may not add up to 100% at each forecast horizon due to rounding errors.

The paper adopts both the standard and structural VAR approaches in the estimation. While in most cases the results from both approaches are supportive of each other; in certain circumstances the results based on the structural VAR are found to be different from those of the standard VAR.

The results of this study show that the joint behaviour of the key macroeconomic variables in Malaysia is consistent with the dynamic transmission of demand and supply shocks through the mechanisms described in the Keynesian model. Positive supply shocks increase output, and negative supply shocks contract output and increase price level. Demand-side shocks (which include money supply shock and real exchange rate shock) move output and prices in the same direction in the short run; that is, a money supply shock stimulates output and increases the price level. A shock to real exchange rate is shown to boost price and contract output simultaneously in the short run. These results are further supported by the variance decomposition analysis. The effects of demand shocks are reflected more in prices than in output. The results also show that supply shocks have more weight on output than demand shocks in the long run. In conclusion, the empirical findings of this study lend support to the relevance of the traditional Keynesian framework in the macroeconomic policy-making considerations in the Malaysian case.

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ENDNOTES

1. Prominent papers such as Blanchard and Quah (1989), King *et al.* (1991) and Gali (1992) explored the source of US macroeconomic fluctuations using time-series techniques and were soon followed by studies of other major economies. These are, *inter alia*, Turner (1993) for the United Kingdom; Funke (1997) for Germany; Giannini, Lanzarotti and Seghelini (1995) for Italy; Mellander, Vredin and Warne (1992) for Sweden; and Huh (1999) for Australia; multi-country studies include Karras (1994), Fiorito and Kollintzas (1994) and Bergman (1996).

2. This study documented a wide set of findings of cyclical variability and covariance for twelve developing countries including Malaysia.

3. Expectations are formed on the basis of all the available relevant information concerning the variable being predicted. Furthermore, individuals use available information intelligently.

4. The choice of ordering is unlikely to be important if the correlation between the residuals is low (Enders 1995).

5. Ibrahim (2007) argues that, for a small open economy such as Malaysia, fluctuations in the real exchange rate rather than the nominal exchange rate influence the competitiveness of the country's exports and economy.

6. Sims (1980) and Doan (2004) state that the main goal of VAR analysis is to determine the interrelationships among the variables and learn about the historical dynamics of the economy. Thus, they do not recommend differencing even if the variables contain a unit root, as differencing throws away too much information concerning co-movements between variables. For Box-Jenkins modelling, differencing to ensure stationarity is, however, important when confronted with integrated data, since most algorithms used for fitting ARIMA models will fail (Doan 2004).

7. As Hamilton (1994: 652) notes, this strategy has three desirable features: 'First, the parameters that describe the system's dynamics are estimated consistently. Second, even if the true model is a VAR in difference, certain functions of the parameters and hypothesis tests based on a VAR in levels have the same asymptotic distribution as would estimates based on differenced data. Third, a Bayesian motivation can be given for the usual t or F distributions for test statistics, even when the classical asymptotic theory for these statistics is non-standard.' In fact, as shown by Hamilton (1994: 454–60),

the OLS estimator of the parameters in a VAR model is not only consistent but superconsistent. The superconsistency comes out because a parameter value different from its true value will give rise to an 1(1) error term, which will have an infinite variance and, therefore, generate a very high sum of squared errors; the true parameter value will give rise to an I(0) error term, which will have finite variance and, thus, produce a small sum of squared errors. As the sample size increases, the OLS estimator converges in distribution to its true value at a rate proportional to the sample size.

8. The study also estimated with lag 8, but the results qualitatively remain the same. Results are available upon request.

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