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EXCHANGE RATE, MONETARY POLICY AND MANUFACTURING OUTPUT IN MALAYSIA

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The article builds small VAR systems to assess the dynamic responses of manufacturing output to exchange rate and monetary policy shocks in the case of Malaysia. To capture these responses, the authors employ generalised impulse response functions to avoid the "orthogonality" assumption that needs to be made under the traditional Cholesky decomposition method. As expected, they find that monetary tightening leads to negative responses from real activities. Furthermore, in their estimation, the responses of manufacturing output seem bigger in magnitude than those of aggregate output or output from other sectors (i.e., aggregate output less manufacturing output). In the case of exchange rate shocks, the authors find the temporal responses of real activities to be consistent with the presence of the J-curve effect. Again, the exchange rate shocks seem to have larger effects on the manufacturing output than on the aggregate output. The authors also note from the results that the temporal responses of manufacturing output seem to coincide with the aggregate output responses but precede other output reactions.

1. INTRODUCTION

The effects of financial and monetary shocks on real economic activities have long been a contentious issue in economics. Among the various focuses of existing studies, the influences of exchange rate and monetary policy shocks have captured enormous empirical interest from both economists and policymakers. In the case of the exchange rate, the main issue has been whether exchange rate depreciation shocks are expansionary or contractionary. According to conventional wisdom, currency depreciation stimulates real output by making a nation's exports more competitive in the global markets. However, it is also

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possible that exchange rate depreciation is contractionary through its effects on the costs of production, real balances, income distribution and trade balance (Krugman and Taylor, 1976 and Edwards, 1986). The second focus continues an old issue of monetary policy effectiveness by examining monetary transmission mechanisms. The recent emphasis of the literature has been placed on the credit channel as a complementary channel to the traditional liquidity channel through which monetary impulses are transmitted to and have amplified effects on the real sector. According to the credit view, the credit channel of monetary transmission mechanisms arises from financial market imperfections and firms' dependence on bank loans as sources of funds.

Recently, an important extension has been made in the discussion of exchange rate-real output and monetary policy–real output causal relations. Based on noted propagation mechanisms of financial and monetary shocks, some argue that sector-specific responses to these shocks may not be identical. In other words, these shocks may have distributional consequences. Most effects of the exchange rate changes alluded to earlier stress the central role of international trade as a conduit through which depreciation affects real economic activity. Accordingly, since different sectors of the economy have different degrees of openness or different exposure to international trade, they may react differently to exchange rate shocks (Bahmani-Oskooee and Mirzaie, 2000 and Kandil and Mirzaie, 2002). In the case of monetary policy, Carlino and Defina (1998) argue that liquidity and credit channels of transmission mechanisms lead naturally to potential differential effects of monetary shocks. Due to sector-specific characteristics, different sectors may react differently to interest rate changes. Moreover, there may be varying degrees of sectoral dependence on bank loans.

This sectoral effect of financial and monetary shocks is particularly pertinent for an economy such as that of Malaysia. Since independence, Malaysia has transformed its economy that once was heavily dependent on agriculture and primary commodities to one that is oriented toward manufacturing. Over the years, the manufacturing sector has assumed increasing dominance in the economy and become a key sector in the Malaysian economic success (see Table 1). This is also true for several other Muslim countries, particularly those whose shares of manufacturing have increased exceeding 50% of total exports (Mohd. Amin and Alavi, 2000).

Relevant to the current discussion, this development is propelled in great part by increasing international trade and the rising importance of the banking sector, particularly in Malaysia. Accordingly, in line with the noted propagation mechanisms, financial and monetary disturbances may amplify fluctuations in manufacturing output at a magnitude greater than aggregate fluctuations. Given the key role of the manufacturing sector, the presence of this amplified effect on it needs to be verified empirically.

Accordingly, this article seeks to examine the dynamic effects of exchange rate and monetary policy shocks on manufacturing output. Apart from the reason relevant to Malaysia as noted above, our focus on manufacturing output provides a unique opportunity to indirectly evaluate the distribution effects of monetary disturbances, a subject that has received much attention recently (Gertler and Gilchrist, 1993; Dale and Haldane, 1995; Carlino and DeFina, 1998; Ramaswamy and Slok, 1998; and Arnold and Vrugt, 2002). The results should also be relevant for other newly industrialised countries as well as Muslim countries that have progressed along a similar path of industrialisation and export-promotion strategies. Understanding specific responses of the manufacturing sector should prove useful for designing or making policy prescriptions especially during periods of adverse shocks such as the one observed during the 1997/1998 Asian crisis.

The rest of the article is organised as follows. In the next section, we provide background information on the Malaysian economy and its manufacturing sector. Section 3 describes the data and performs preliminary analysis. Estimation results are given in Section 4. Following the convention in the literature, we adopt a VAR approach to trace the dynamic responses of manufacturing output to exchange rate and monetary policy shocks. For comparative purposes, we also evaluate the responses of aggregate output to the two shocks. To capture these responses, we employ the generalised impulse response analysis as suggested by Pesaran and Shin (1998) to avoid the “orthogonality” assumption that needs to be made under the traditional Cholesky decomposition method. Lastly, Section 5 concludes with the main findings.

2. BACKGROUND INFORMATION

The historical economic performance of Malaysia is considered as a success story. Table 1 provides indicators of real activities for Malaysia. Over more than three decades from 1971 to 2002, the average annual growth rate of GDP was 6.29%. A decade of persistent high growth from 1987 and 1997, i.e. an average annual growth of 8.1%, is particularly impressive and interesting. The period is flanked by two recessions experienced by the country, namely the 1985 recession and the 1998 recession. The first recession was the result of the compounded influences of the second oil price shock, slowdown of the global economy in the early 1980s, adverse commodity terms of trade shocks and domestic fiscal restraints to contain rising fiscal deficits. In that year, Malaysia recorded a decline of output of 1.1%. Meanwhile, the 1998 recession was predominantly driven by adverse financial shocks, triggered by a speculative attack on the Thai baht and, subsequently, on other currencies in the region. As a result of the drastic drop in the value of the Ringgit and fall in stock prices and subsequent banking problems, real output contracted by 7.6% in 1998. These two recessions, thus, signify the vulnerability of the Malaysian economy to shocks – either trade shocks as in the former crisis or financial shocks as in the latter.

An important feature that characterises the Malaysian economy is its transformation from an agriculture-based economy to a manufacturing-based economy. The rising importance of the manufacturing sector is reflected by its increasing contributions to total output and total exports (see Table 1). In 1970, the agricultural sector was the most dominant, where its share in total output was 30.6%. Meanwhile, the manufacturing sector contributed only 13.4% to total production.[1] The heavy dependence of the economy on agriculture and primary commodities proved costly to the economy as it succumbed to the global economic slowdown and terms of trade shocks during the early 1980s. The sluggish performance of primary commodities at that time led to a shift in focus toward the manufacturing sector as a catalyst for growth. Since then, as may be observed from Table 1, the share of the manufacturing output in total output has been on the rise. By 1987, the

[1] In 1960, the role of the manufacturing sector is even more minimal accounting for only 8.5% of total output. Meanwhile, the agricultural sector contributed 40.7% (Institute of Strategic and International Studies (ISIS) Malaysia, 1994).

contribution of the manufacturing sector began to exceed that of the traditional agricultural sector. In 2002, the share of the manufacturing sector in total output was 35.9% while that of the agricultural sector fell to 8.7%.

The rapid growth of the manufacturing sector, an average of 9.38% during 1971-2002, has been propelled in great part by the export-promotion strategy adopted by the country. Over the period, the nominal average annual growth rate of the manufacturing exports was 19.35%, exceeding the corresponding nominal annual growth of total exports of 13.3%. The increasing contribution of the manufacturing sector to total exports has been drastic (Table 1). Its share in total exports increased from just 12.2% in 1970 to 84.3% in 2002. Thus, the manufacturing sector became heavily dependent on international trade, taking the place of primary commodities. This might mean that, as in the case of primary commodities during the early 1980s, the manufacturing sector can be excessively vulnerable to external shocks. The 1997/1998 Asian crisis tends to confirm this assertion. That is, the contraction of output following drastic depreciation shocks was felt most by the manufacturing sector. While total output contracted by 7.4% in 1998, the manufacturing output dropped by 13.4% (computed from Table 1).

The crisis also brings up the contention that disturbances emanating from financial or money markets may have disproportionate effects on various sectors of the economy, an issue that has received increasing emphasis in the money-income link literature. The theoretical basis for this differential effect lies in the monetary transmission mechanism that relates monetary shocks to real output through banks' balance sheets, the so-called money and credit views. In the traditional IS/LM framework, changes in monetary policy influence the transaction balances (or deposits) of the banking system and accordingly money supply. This, in turn, affects interest rates and the interest-sensitive components of aggregate demand such as investment. Then, the recent "credit view" introduces an additional or complementary channel through which banks play a role in the propagation of monetary shocks. According to this view, due to asymmetric information and capital market imperfections, banks' assets (for example loans and securities) are not perfect substitutes and they are special to some types of borrowers. Accordingly, to the extent that some borrowers are dependent on banks for finance and that the monetary policy can affect bank loan supply, the financial structure matters in amplifying the effects of monetary shocks on the economy. As argued by Carlino and DeFina (1998), these channels of transmission lead naturally to potential differential effects of monetary policy shocks since different sectors (or, in their work, regions) may respond differently to interest rate changes.

The financial scene that envelops the structural transformation of the Malaysian economy is the rising dominance of the banking sector as providers of firms' finance. According to Radiah (2000), the development of the domestic banking sector took about 35 years. In 1959, the year Bank Negara Malaysia was established, there were 18 foreign commercial banks with a total number of 99 branches operating in the country as opposed to only 8 domestic commercial banks with 12 branches. With restrictions on the establishments of new foreign banks and foreign banks' branches, domestic commercial banks' branches began to outnumber those of foreign banks' in 1966. The number of domestic commercial banks began to surpass that of foreign banks ten years later in 1976. By 1994, all foreign banks were domestically incorporated and the number of domestic banks' branches far exceeded that of foreign banks. With the successful transformation of the banking system, Bank Negara Malaysia played its part in attaining the industrialisation objective by regulating the volume as well as direction of bank lending to priority sectors. During 1990 - 1997, three sectors received 58% of total bank loans. These are manufacturing, broad property, and finance, insurance and business services. The manufacturing sector alone accounted for 20% of the total loans during the period (*Monthly Statistical Bulletin*, various issues).

The continuing growth and importance of the banking institutions together with the prevalent asymmetric information in the markets lead many firms to depend on bank loans as a source of finance. According to a survey conducted by Bank Negara Malaysia on 206 manufacturing companies in 1996, 67% of the manufacturing companies in Malaysia depend on bank loans for their working capital. Additionally, 44% of the 206 companies rely on bank financing for their export activities.[2] More importantly, reaffirming the central role of banks and probably the presence of asymmetric information, domestically-owned companies depend more on bank loans as a source of financing than foreign-owned

[2] The survey is quoted in Public Bank *Economic Review* (1998).

companies. Thus, the development of these banks' dependent sectors and firms suggests possible amplified effects of monetary shocks on manufacturing output.

In summary, the export orientation and dependence on bank loans of the manufacturing sector can potentially and disproportionately expose the sector to exchange rate and monetary shocks. Understanding the specific dynamics of the sector in response to these shocks is highly relevant not only in indirectly confirming the noted channels of monetary transmissions but also as an essential input to the stabilisation process. If the sector is more adversely affected than other sectors, then due attention should be given to it in the design of stabilisation policies. Moreover, long-run measures to reduce the unbalanced effects of shocks may need serious consideration so as to avoid potential increasing inequality in income distribution.

3. DATA AND PRELIMINARIES

We use quarterly data from 1978.Q1 to 1999.Q4 to examine the responses of real manufacturing output (MFG) to exchange rate and monetary policy shocks. Following Arnold and Vrugt (2002), we also include aggregate output less manufacturing output (GDP–MFG) in the regression so as to increase the likelihood that shocks in monetary policy are similar across sectors. Moreover, the inclusion of aggregate output from other sectors seems necessary due to possible correlations and spillover effects across sectors of the economy. In the analysis, we consider two alternative exchange rate measures, nominal effective exchange rate (NEX) and real effective exchange rate (REX). An increase in the exchange rates reflects currency appreciation. For the monetary policy variable, we use the overnight interbank rate (INTERBANK). Domac (1999) also employs the interbank rate in his analysis of the effects of monetary policy for Malaysia. Moreover, the use of interest rate is in line with various studies on developed countries (Bernanke and Blinder, 1992; Iturriaga, 2000) and developing countries (Agung, 1998; Disyatat and Vongsinsirikul, 2003). In line with the existing studies, we also include the price level as represented by the consumer price index (CPI). Accordingly, our model consists of five variables – manufacturing output, GDP less manufacturing output, price level, exchange rate, and interbank rate. For comparative purposes, we start the analysis by aggregating all output and estimate a 4-variable model consisting of GDP, price level, exchange rate and interbank rate. All variables, except the interest rate, are in logarithmic forms. Given two alternative measures of the exchange rate, we estimate 4 systems of equations using VAR methodology.

As a preliminary step, we first subject these variables to unit root tests and the cointegration test. For the unit root test, we apply the commonly used Augmented Dickey-Fuller (ADF) as well as the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) unit root tests (Dickey and Fuller, 1979 and Kwiatkowski et al., 1992)[3] where we include a drift term and a time trend. The ADF test holds non-stationarity as the null and corrects for the temporal correlation of error terms by including lagged first differences of the variable under consideration in the regression. However, the test lacks power and tends to accept the unit root null too often. Accordingly, to complement and avoid some biases present in the ADF test, we also implement the KPSS test for unit root. The test uses a null hypothesis of stationarity against an alternative of unit root non-stationarity. For the cointegration test, we apply the test suggested by Johansen (1988) and Johansen and Juselius (1990). The Johansen-Juselius cointegration test is based on maximum likelihood estimation of a VAR system. In the implementation of the test, we set the lag length of the VAR such that the error terms are serially uncorrelated.

The results of these tests are given in Table 2. Except for the interbank rate and consumer price index, both unit root tests agree on the stochastic properties of the variables. That is they are integrated of order 1. The ADF test suggests the possibility of the interbank rate to be an I(2) process. Similarly, CPI is noted to be I(2) under the KPSS test. However, since the other test (KPSS for the interbank rate and ADF test for CPI) suggests the two variables to be I(1), we treat them to contain a unit root similar to other variables. Then, as may be observed from Table 2(b), the cointegration test statistics indicate that the four systems of variables under consideration are cointegrated. Only in the manufacturing system with REX the evidence of cointegration is at 10% significance level. In other words, they share a long-run equilibrium relationship.

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[3] The number of lagged first-differenced terms in the ADF test is chosen based on AIC. Meanwhile, we fix the bandwith using Barlett kernel in the KPSS test to 1.

4. VAR ANALYSIS

4.1. VAR Model

We rely on a vector auto-regression (VAR) model as a basis to assess the dynamic responses of real output to innovations in monetary policy as represented by the interbank rate and in exchange rate, nominal and real. To begin, a VAR model is specified as follows:

$$X_t = A_0 + \sum_{k=1}^{p} A_k X_{t-k} + e_t \qquad (1)$$

where X_t is a vector of n variables of interest, A_0 is an n × 1 vector of constant terms, A_k is an n × n matrix of coefficients, e_t is an n × 1 vector of error terms, and p is the order of autoregression. The lag order of the VAR (i.e., p), in line with the Johansen-Juselius cointegration test, is set such that the error terms are serially uncorrelated.

The interpretation of model (1) is normally based on its moving average representation. By inverting or successive substitution, VAR model (1) has a moving average representation as follows:

$$X_t = B + \sum_{k=0}^{\infty} B_k e_{t-k}. \qquad (2)$$

Thus, X_t is expressed as a linear combination of current and past innovations. Based on (2), impulse-response functions are simulated to reflect the dynamic responses of real activity to shocks.

As is well-known, results from unit root and cointegration tests bear important implications in specifying the VAR model. According to Engle and Granger (1987), the dynamic interactions of the cointegrated variables can be represented using a vector error correction model (VECM), which imposes long-run constraints among the levels of the variables as implied by their cointegrating vector. The model amounts to regressing a vector of first-differenced variables (i.e. ΔX_t) on its own lags and an error correction term obtained from the estimated cointegrating equation. Engle and Granger (1987) further note that these long-run constraints are also satisfied asymptotically in a level VAR model. This means that both approaches are appropriate specifications of the dynamic interactions among cointegrated time series.

However, it should be mentioned that whether a VAR in levels or a VECM is a better approach remains debatable. While the VECM conveniently combines the long-run behaviour of the variables and their short-run interactions and can, thus, better reflect the relationship among variables, the popularity of the VAR in levels lies in its low computational burden. Moreover, the current finding is still unclear on whether the VECM outperforms the level VAR at all forecasting horizons (Naka and Tufte, 1997). In the literature dealing with short-run dynamic interactions, estimating the level VAR for the cointegrated variables seems to be a normal approach. Ramaswamy and Slok (1998) outline several advantages of using the level VAR as opposed to the VECM. The most notable argument in favor of the level VAR is the economic interpretation attached to the impulse-response functions of both models. While the impulse-responses from the VECM tend to imply that the impacts of certain shocks are permanent, those from the level VAR allow history to decide on whether the effects of shocks are permanent or not.[4] The support for the use of the level VAR can also be found in Clements and Hendry (1995), Engle and Yoo (1987), and Hoffman and Rasche (1996). In the present analysis, with the findings of cointegration, we implement VAR using variables in level. That is, we estimate equation (1).

Another aspect that needs to be pointed out, which pertains to the generation of impulse-response functions, is that innovations in (2) may be contemporaneously correlated. This means that a shock in one variable may work through the contemporaneous correlation with innovations in other variables. Since isolated shocks to individual variables cannot be identified due to a contemporaneous correlation, the responses of a variable to innovations in another variable of interest cannot be adequately represented (Lutkepohl, 1991). To solve this identification problem, Sims (1980) suggest an empirical strategy that orthogonalises the innovations using the so-called Choleski factorisation. However, given the nature of the Choleski factorisation, results from impulse response functions may be sensitive to the ordering of the variables in the decomposition. Recently, Koop et al. (1996) and Pesaran and Shin (1998) developed generalised impulse response

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[4] Ramaswamy and Slok (1998) further note that if there is no a priori theory to suggest the number of cointegrating vectors and how to interpret them, the VAR model in level for cointegrated series is a reasonable approach.

functions to circumvent the ordering problem inherent in the orthogonalised impulse responses suggested by Sims (1980). Accordingly, in the present analysis, we adopt the generalised response functions as suggested by Pesaran and Shin (1998).

4.2. Results

We first estimate VAR models consisting of real output, price level, interest rate and a measure of the exchange rate (alternatively, nominal and real effective exchange rates). The lag order of the VAR is set to 5. Table 3 reports residual diagnostics statistics for serial correlation and normality. As may be observed from the table, the residuals for all equations in the VAR are serially uncorrelated. The Ljung-Box Pierce statistics testing for the fourth-order serial correlation (LB(4)) and twelfth-order serial correlation (LB(12)) are not significant at even 10% significant level. Thus, the lag length of 5 meets our requirement that the error terms must be serially uncorrelated. Moreover, except for price and exchange rate equations, the error terms are also found to be normally distributed. Note that, given our framework and focus on dynamic interactions among variables, the non-normality of the error terms in the price and exchange rate equations should not pose a problem (see also Caporale and Howells, 2001 and Hammoudeh and Li, 2005).

From the estimation, we simulate generalised impulse response functions to assess the dynamic interactions among the variables. These functions capture the temporal responses of a variable to one-standard deviation shocks in other variables. Figures 1 and 2 respectively present the results for the two aggregate systems. Note that we include in the figures two standard deviation bands. Generally, if the bands do not include the zero line, then the responses of the variables are significantly different from zero.

From the figures, we may observe that the results are robust to alternative measures of the exchange rate. Moreover, the directional responses of the variables in the system to shocks in other variables are theoretically identifiable. The only puzzling result that we obtain is the positive response of the nominal as well as real effective exchange rates to CPI shocks. In other words, in response to positive shocks in the price level, the exchange rates appreciate. While this result seems counterintuitive, we note that explaining fluctuations in the exchange rate proves empirically difficult. Indeed, various empirical studies of the exchange rate fail to estimate model coefficients with the signs as predicted by such models as monetary models of the exchange rate. Given the small system that we utilise together with theoretically identifiable responses of most variables, we find our results satisfactory. In what follows, we leave aside various interesting results and focus only on the dynamic responses of real output to monetary policy and exchange rate shocks.

As expected, from Figure 1, real output contracts in response to monetary tightening. The contraction reaches its bottom after 16 quarters. To be more specific, an increase in the interbank rate by about 1.8 percentage points leads to a reduction in output of about 1.2% after 16 quarters. With regards to shocks in the nominal exchange rate, we note that a one-standard deviation appreciation shock, which amounts to an increase in the nominal effective exchange rate by roughly 12.6%, leads to immediate and significant positive responses from the output at the 2-quarter to 6-quarter horizons, where real output expands by about 0.7% to 1.3%. The responses then subside to zero and turn significantly negative after 13 quarters and reach their bottom after 18-quarters, where the real output contracts by 1.9%. Stated differently, the real output first contracts in response to depreciation shocks and then adjusts favorably over time. This temporal pattern of responses is consistent with the presence of the J-curve effect. In response to depreciation shocks, the trade balance worsens leading to contraction in real activity. As currency depreciation indicates an increasing competitiveness of domestically-produced goods in the global markets, trade balance later improves, leading to expansion in the real output. Note that we obtain similar temporal responses of real output to monetary policy and exchange rate shocks when we use the real effective exchange rate in place of the nominal effective one (Figure 2).

Having correctly identified the temporal responses of aggregate output, we proceed to 5-VAR models partitioning aggregate output into manufacturing output and other output (i.e. GDP less manufacturing output) to evaluate our central theme that manufacturing output is disproportionately affected by shocks in the interbank and the exchange rates. Similar to the aggregate systems, we find the lag order of 5 to be sufficient to render the VAR error terms serially uncorrelated. Given our interest, we focus only on the responses of manufacturing output to the two shocks in the system. For comparative purposes, we also look at the responses of aggregate output as well as aggregate output less manufacturing output. Table 4 provides the size of the output responses after 1 and 2 years as well as the maximum reduction in output after the initial shocks in the interest and exchange rates. Meanwhile, Figures 3 and 4 fully plot the temporal responses of the three output measures to respectively the interest rate shocks and the exchange rate shocks.

We may note from Table 4 that the maximum decline in the aggregate output or real gross domestic product (GDP) is roughly 0.9% to 1.2%, depending on which measure of the exchange rate is used. This maximum effect is felt after roughly 3 to 4 years after the initial shock to the interest rate. The responses of the manufacturing output, while they tend to have similar temporal patterns, seem to be more amplified. Roughly after 1 to 2 years of the initial shock, the manufacturing output declines by 0.7% to 0.9%, as compared to only 0.5% reduction in the aggregate output and 0.01% to 0.02% reduction in other output (GDP less manufacturing output). Like the aggregate output, the maximum decline in the manufacturing output is achieved after 3 to 4 years (i.e. 13 to 16 quarters). In this case, the manufacturing output declines by 1.67% to 2.2%, which is almost double the reduction in the aggregate output. The maximum reduction in other output is roughly 0.7% to 0.9%. Interestingly, this is attained after 15-18 quarters. Figure 3 clearly demonstrates that the manufacturing output reacts more strongly to the interest rate shocks.

As in the case of the interest rate shocks, the manufacturing output also responds more strongly to the exchange rate shocks. However, in line with the J-curve effect, the responses are initially positive and then turn negative after roughly 2 years.[5] After 1 year, the manufacturing output increases by about 2%, as compared to only a 1.3% increase in the aggregate output. This increase is, indeed, the maximum positive responses of real output measures to the exchange rate shocks.

[5] Readers may note from the figures that the three output measures initially exhibit positive reaction to interbank rate shocks. However, it should be pointed out that the initial responses of output to the interest rate shocks are statistically insignificant. However, for the case of the exchange rate shock, the initial positive responses are significantly different from zero.

Afterwards, the positive responses subside toward zero. We may observe that, after 2 years, the responses are close to zero. All output measures contract eventually. It takes roughly 18 quarters for the exchange rate shock to have a maximum negative impact on the aggregate and manufacturing outputs. The contraction in the manufacturing output is deeper as compared to the aggregate output. While the aggregate output contracts by more than 1.8%, the manufacturing output declines by more than 3.6%. Other output declines by a maximum of 1.5% after 21-22 quarters.

Thus, the results are generally supportive of our contention that shocks in the interest and exchange rates have significant effects on manufacturing output in magnitudes greater than their influences on aggregate output or output of other sectors. A plausible explanation of these results, as we have highlighted above, is the manufacturing firms' increasing dependence on bank loans as a source of finance as well as increasing reliance on international trade. The former is in line with the prediction of the credit view of the monetary transmission mechanism.[6] Moreover, we note that the manufacturing sector, in line with the observed evolution of the Malaysian economic structure, is the driving force of the Malaysian business cycles, where the maximum reduction in the manufacturing output coincides with that of the aggregate output. In the words of the business cycle literature, the manufacturing output is a coincident indicator of the business cycle. Currently used by policy makers, this confirmation of the manufacturing output is fruitful as information on the manufacturing output is available to policy makers faster than that on the aggregate output. Note also that the maximum reduction in the manufacturing output precedes the maximum decline in other output. Thus, the shocks seem to be absorbed first by the manufacturing output and then have a spillover effect on other output. This, again, signifies the important role of the manufacturing sector in the Malaysian economy. Lastly, both exchange and interest rate shocks can have a distributional consequence. Policymakers need to keep this consequence in mind when designing stabilisation policies so as to avoid a wider income inequality.

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[6] Our conclusion here is only tentative and conforms only to the description we provide in section 2. To be more concrete on this transmission mechanism issue, we believe that further studies are needed.

5. CONCLUSION

This article examines the dynamic responses of manufacturing output to exchange rate and monetary policy shocks in the case of Malaysia. With the rising importance of the sector in the nation's development process against the backdrop of increasing dominance of the banking sector as well as the adoption of export-promotion strategies, we assess whether the sector is disproportionately affected by disturbances emanating from the foreign exchange and money markets. In the article, we estimate VAR models for two systems of variables – aggregate systems and manufacturing output systems. The aggregate systems consist of aggregate GDP, price level, interbank rate, and an exchange rate measure. In the manufacturing output systems, we partition aggregate GDP into manufacturing output and other output. Two alternative exchange rate measures are used – nominal effective exchange rate and real effective exchange rate. From the VAR models, we simulate generalised impulse response functions as a basis for inferences. The responses we obtain are generally theoretically identifiable and, thus, make our small VAR models satisfactory.

The results are generally supportive of our contention that shocks in the interest and exchange rates have significant effects on manufacturing output in magnitudes greater than their influences on aggregate output or output of other sectors. As expected, real activities contract in response to monetary tightening as captured by positive shocks in the interbank rate. Meanwhile, the responses of the output series to the exchange rate shocks resemble the J-curve effect. They first increase (decrease) and then decrease (increase) at longer horizons after the initial appreciation (depreciation) shocks. In the case of the interbank rate shocks, the maximum contraction is achieved after roughly 3-4 years for both the aggregate output and the manufacturing output. The maximum reduction in other output, however, comes after 4-5 years of the initial shocks. The manufacturing and aggregate outputs also peak at roughly the same time after the initial shocks in the exchange rate. After a currency appreciation shock, the maximum positive reaction of the two output series is attained after 1 year. Then, they subside toward zero and turn significantly negative reaching their minimum at 18 quarters. Again, while following the same pattern, the reduction in other output reaches its peak at a longer horizon, i.e. 22 quarters.

Our results, thus, highlight the important role of the manufacturing sector in the Malaysian economy. The evidence tends to confirm the useful role of the manufacturing production as a coincident indicator of the business cycle. Moreover, a reduction in the manufacturing output tends to anticipate a reduction in other output. More importantly, our results suggest sector-specific responses to monetary policy and exchange rate shocks. In the face of adverse financial and monetary disturbances, certain sectors may be more adversely affected, which may bear important implications for the nation's income distribution. While we offer an increasing dominance of the banking sector and the rising importance of international trade as important factors contributing to these disproportionate effects, we believe that more research needs to be done for arriving at concrete answers.

The results of this article are relevant and may also be applicable to countries other than Malaysia that possess similar structural patterns with manufacturing being the dominant sector in the economy. For instance, an increasing number of Muslim countries are moving from agricultural-based to industrial-based economies. With the recent declining trend in FDI inflows into these countries,[7] which is a major stimulant to industrial development, it is expected that the manufacturing sector will become more and more reliant on banks as a source of finance. In addition, the increasing trade openness and higher share of manufacturing to total exports in many of these countries closely resemble those of the Malaysian experience. Hence, the effects of shocks in the interest and exchange rates may similarly have a significant impact on manufacturing output. As such, on the whole, the dynamics that we document should prove useful for policymakers in designing stabilisation policies not only in the case of Malaysia but also for other countries.

[7] See Mohd. Amin, Hamid and Md. Saad (2004).

Table 1: Manufacturing Production, 1970–2002

		Manufacturing Sector		Agriculture Sector		Manufacturing Sector	
Year	**GDP[a]**	**Output[a]**	**% of GDP**	**% of GDP**	**Exports[b]**	**Exports[b]**	**% of Total**
1970	20924	2805	13.4	30.6	5020	612	12.2
1975	29521	4845	16.4	28.4	9057	1978	21.8
1980	44512	8742	19.6	23.4	28013	6101	21.8
1985	57150	11263	19.7	20.8	37576	12111	32.2
1990	79455	21340	26.9	16.3	79646	46841	58.8
1995	120272	39790	33.1	10.3	184987	147253	79.6
1996	130621	44684	34.2	9.8	197026	158540	80.5
1997	140684	50270	35.7	9.2	220890	178945	81.0
1998	130330	43525	33.4	9.6	286563	237649	82.9
1999	138330	48605	35.1	9.1	321560	271730	84.5
2000	150156	57506	38.3	8.9	373270	317908	85.2
2001	150643	54168	36.0	8.8	334284	285316	85.3
2002	156843	56358	35.9	8.7	354475	298925	84.3
Average Growth 1971 - 2002	6.29%	9.38%	--	--	13.30%	19.35%	--

a: RM million at 1978 prices; b: RM million at current prices.
Source: Institute of Strategic and International Studies (ISIS) Malaysia, 1994, and Bank Negara Malaysia's *Monthly Statistical Bulletin* (various issues).

Table 2: Unit Root and Cointegration Tests

(a) Unit Root Tests

Variables	**ADF Test**		**KPSS Tests**	
	X	**ΔX**	**X**	**ΔX**
GDP	-2.0406	-3.8947**	0.4930*	0.0352
MFG	-2.0208	-4.2295*	0.5233*	0.0435
GDP-MFG	-2.0113	-3.8662**	0.3598*	0.0333
INTERBANK	-3.0347	-3.0323	0.1223***	0.0414
NEX	-2.4629	-4.3391*	0.2392*	0.0700
REX	-2.5465	-4.3683*	0.2738*	0.0641
CPI	-1.9720	-10.025*	0.4137*	0.1936**

(b) Cointegration Tests – Trace (*Max Eigenvalue*)

Null	**I**	**II**	**III**	**IV**
r = 0	54.65* (*26.50*)	58.63* (*30.11***)	70.71** (*24.31*)	67.09 (*25.64*)
r ≤ 1	28.15 (*14.22*)	28.51 (*17.30*)	46.40 (*20.88*)	41.46 (*22.14*)
r ≤ 2	13.92 (*11.08*)	11.22 (*10.32*)	25.52 (*19.23*)	19.32 (*11.50*)
r ≤ 3	2.84 (*2.84*)	0.90 (*0.90*)	6.29 (*5.78*)	7.82 (*7.46*)
r ≤ 4	--	--	0.51 (*0.51*)	0.35 (*0.35*)

Note: *, ** and *** denote significance at the 1%, 5% and 10% levels respectively.
System I = (GDP, INTERBANK, NEX, CPI).
System II = (GDP, INTERBANK, REX, CPI).
System III = (GDP – MFG, MFG, INTERBANK, NEX, CPI).
System IV = (GDP – MFG, MFG, INTERBANK, REX, CPI).

Table 3: Residual Diagnostic Tests

Equation	Residual Test Statistics		
	LB(4)	LB(12)	JB
	(a) GDP, CPI, INTERBANK, NEX		
GDP	0.919 (0.992)	11.80 (0.462)	1.176 (0.555)
CPI	2.853 (0.583)	8.262 (0.764)	374.2 (0.000)
INTERBANK	1.176 (0.882)	15.92 (0.195)	2.322 (0.313)
NEX	0.722 (0.949)	7.708 (0.808)	237.5 (0.000)
	(b) GDP, CPI, INTERBANK, REX		
GDP	1.076 (0.898)	12.63 (0.397)	0.408 (0.816)
CPI	2.392 (0.664)	6.824 (0.869)	397.0 (0.000)
INTERBANK	0.863 (0.930)	13.66 (0.323)	4.355 (0113)
REX	0.694 (0.952)	7.981 (0.787)	133.8 (0.000)

Notes: LB is Ljung-Box-Pierce test for serial correlation of order up to 4 (LB(4)) and 12 (LB(12)). JB is Jarque-Bera test for normality. The numbers in parentheses are p-values.

Table 4: Output Responses to Monetary and Exchange Rate Shocks

Output	After 1 year (Percent)	After 2 years (Percent)	Maximum Reduction	
			Percent	Quarter
		Output Responses to Interbank Rate Shock		
(a) System using NEX				
GDP	-0.45	-0.47	-1.16	16
GDP-MFG	-0.02	-0.01	-0.88	18
MFG	-0.94	-0.70	-2.20	16
(b) System using REX				
GDP	-0.38	-0.62	-0.87	13
GDP-MFG	-0.04	0.02	-0.74	15
MFG	-0.99	-0.70	-1.67	13
		Output Responses to Exchange Rate Shock		
(a) System using NEX				
GDP	1.32	0.13	-1.90	18
GDP-MFG	0.82	0.16	-1.60	22
MFG	2.13	-0.18	-3.60	19
(b) System using REX				
GDP	1.20	-0.09	-1.88	18
GDP-MFG	0.89	0.11	-1.50	21
MFG	1.90	-0.57	-3.83	18

Figure 1: Generalised Impulse Responses (System I: GDP, CPI, INTERBANK, NEX)

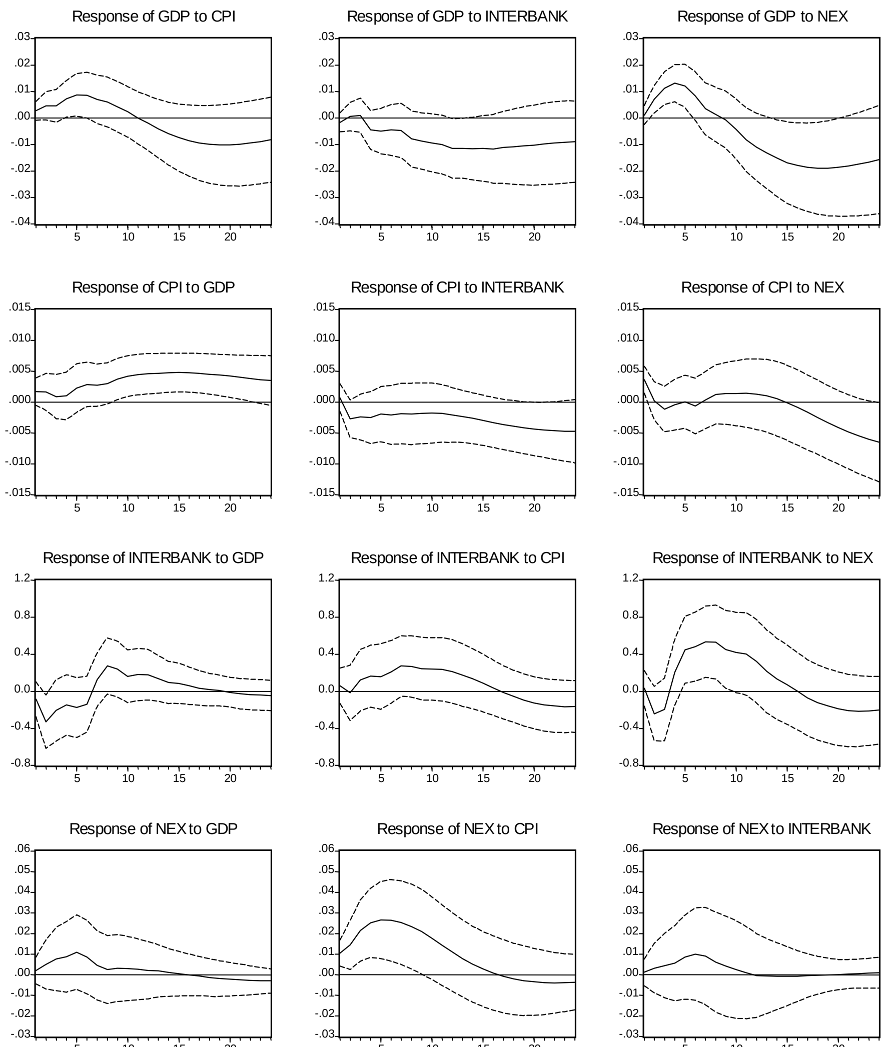


Figure 2: Generalised Impulse Responses (System II: GDP, CPI, INTERBANK, REX)

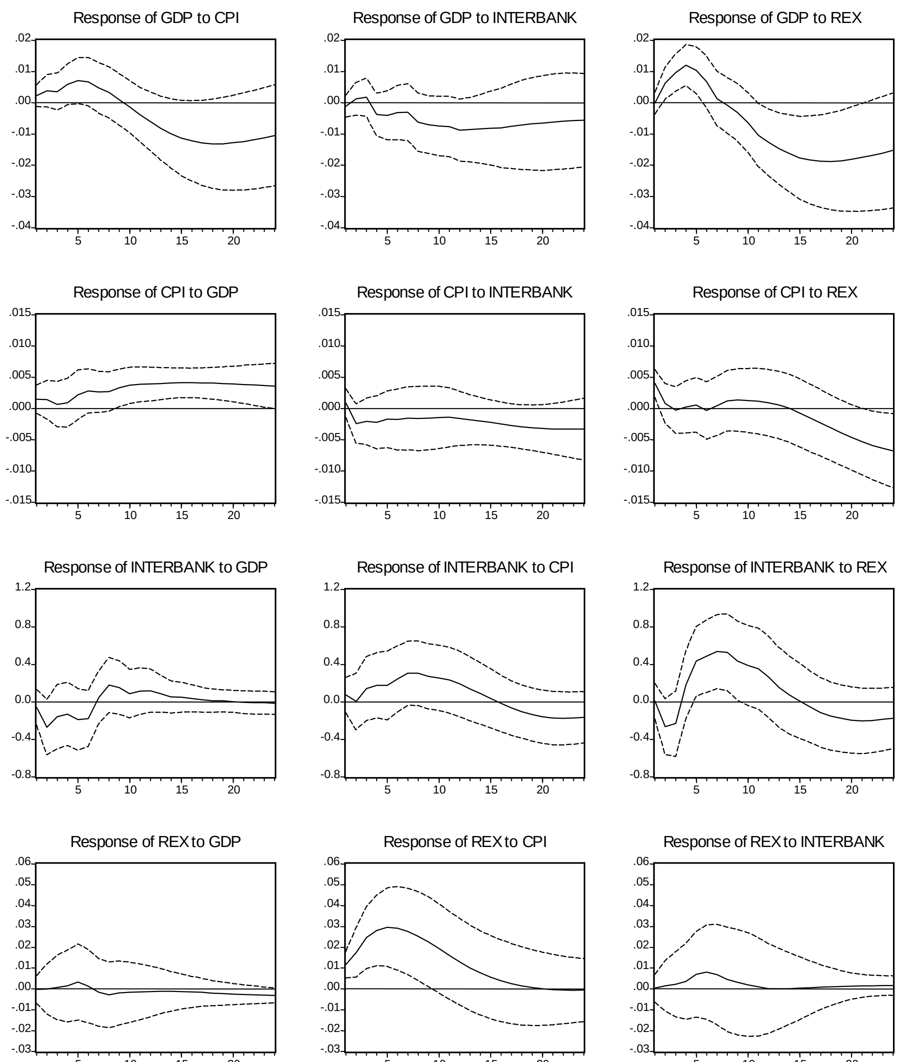
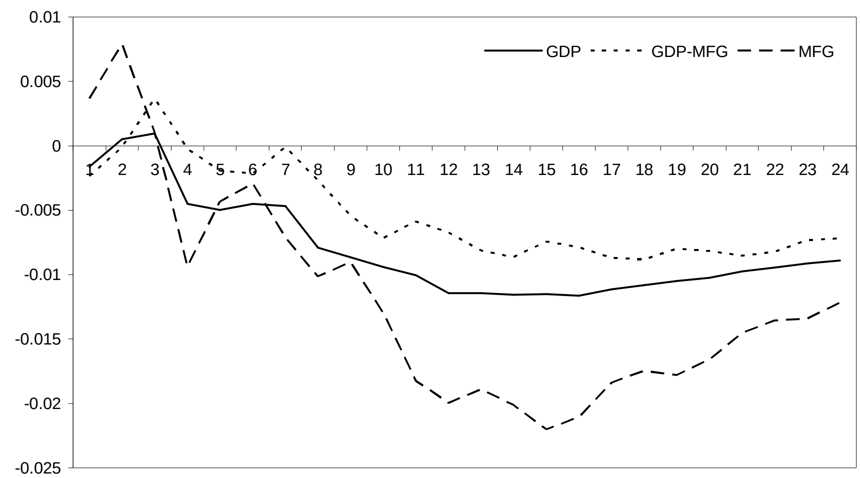


Figure 3: Responses of Real Output to Shocks in Interbank Rate

(a) Systems using NEX



(b) Systems using REX

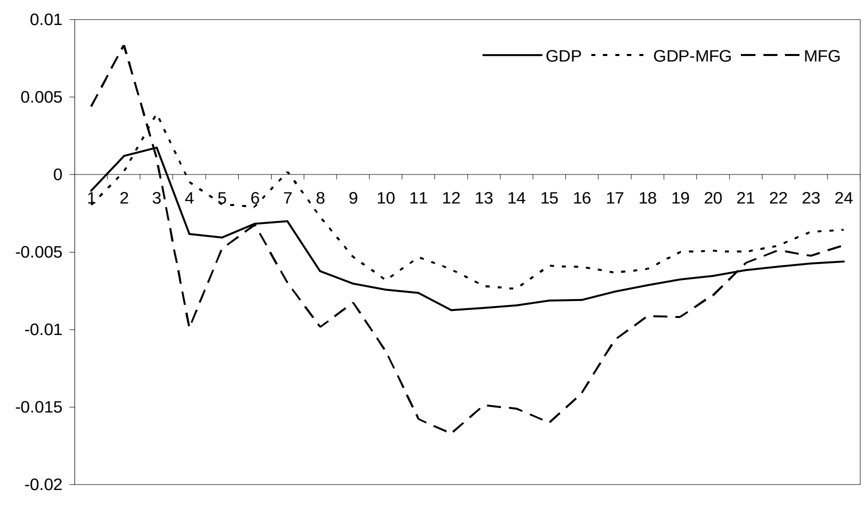
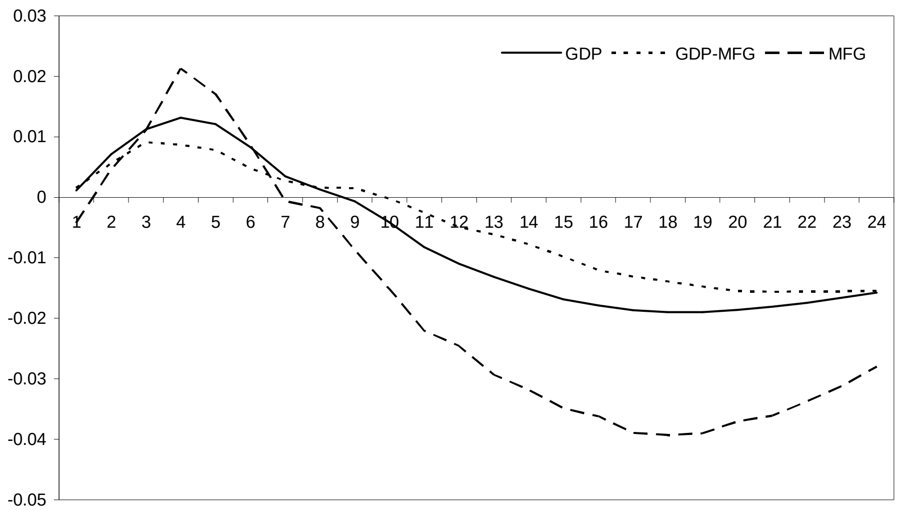
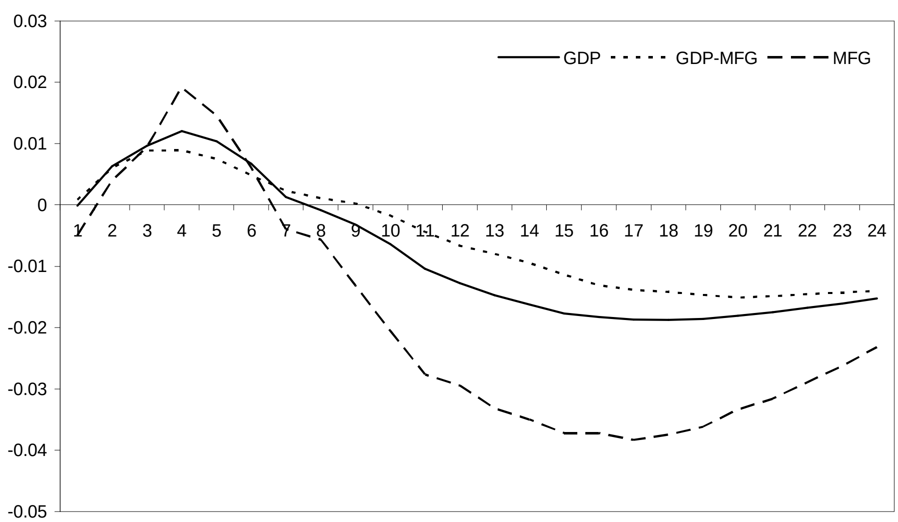


Figure 4: Responses of Real Output to Shocks in Exchange Rates

(a) Systems using NEX



Systems using REX



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