

Special Feature B

Analysing Oil Price Shocks and Their Impact on the Singapore Economy

Introduction

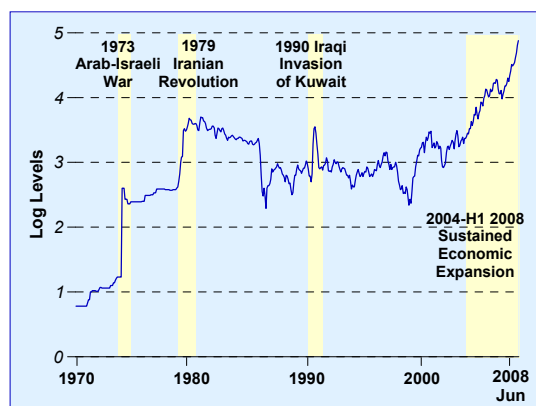
Before their recent decline, global oil prices hit a peak of around US\$145 in mid-July. Robust economic growth, especially in developing economies such as China and India, emerged as a key driver behind the oil price gains. As a result, the traditional production-based analysis, which treats oil price shocks as exogenous, may not be relevant. Indeed, there now appears to be reverse causality from macroeconomic aggregates to oil prices (Barsky and Kilian (2001)), which complicates the identification of the exogenous component of an oil price shock. In this special feature, the factors causing oil price shocks are briefly discussed, together with their implications for macroeconomic aggregates. The impact of such shocks on the Singapore economy are then analysed through both the production and consumption channels, as well as in a general equilibrium context.

A More Comprehensive Approach to Analysing Oil Price Shocks

The average global oil price in June 2008 was about 60 times higher than in 1970, having increased by around 18% p.a. over the past four decades. There was considerable volatility and sharp spikes were not uncommon. Moreover, the average annual increase in the price of oil between 2004 and H1 2008 was substantially higher than in the preceding period, at over 32% p.a. (Chart 1)

The economic literature on oil price shocks has typically focused on the major price spikes following exogenous geopolitical events: the 1973 Arab-Israeli war and the subsequent oil embargo; the 1979 Iranian revolution, followed by the Iran-Iraq war; and the 1990 Iraqi invasion of Kuwait. Nonetheless, the demand-led surge in oil prices between 2004 and mid-2008 can also be considered a major oil price shock episode. (Table 1)

Chart 1
Nominal Oil Prices



Note: The difference in logarithmic terms gives an approximation of the proportionate change in nominal prices.

Table 1
Price Dynamics in Each Oil Price Shock

Price Dynamics in Each Episode	1973-1974	1979-1980	1990	2004-H1 2008
Total increase (%)	293	187	133	340
Pace of increase	Within 1 month	Within 12 months	Within 4 months	Over 4½ years

Kilian (2008) argues that oil price shocks have different effects on macroeconomic aggregates depending on their underlying causes. He identifies three different sources of oil price increases: (a) unexpected supply disruptions; (b) increases in aggregate demand for all industrial commodities including oil; and (c) precautionary demand shocks specific to oil. (Table 2)

Drawing on detailed data work and econometric modelling to distinguish between these shocks over a four-decade period, Kilian identifies the broad characteristics of different shock-induced price hikes and their impact on macroeconomic aggregates.

First, positive global demand conditions can offset the adverse effects of higher commodity prices on economic growth, which are endogenous to those demand conditions. This explains why higher oil prices in 2004-H1 2008 have had less impact than in the early 1980s, and why they have co-existed with strong economic growth for a relatively long period.

Second, since market expectations adjust quickly to exogenous events, sharp increases in precautionary demand driven by uncertainty about future oil supply – rather than actual shortfalls in oil production – may well trigger immediate and large gains in oil prices.

For example, the increase in oil prices in 1990 after the invasion of Kuwait was almost entirely due to a spike in precautionary demand, not actual supply disruptions. Similarly, the 1979/80 oil price shock was not primarily due to supply disruptions as cutbacks associated with the Iranian revolution were largely offset by increased production elsewhere, although the outbreak of the Iran-Iraq war in 1980 did initially generate a significant supply disruption. Instead, there was a strong increase in precautionary demand during that period as political instability in Iran, coupled with the Iranian hostage crisis and the Soviet invasion of Afghanistan, heightened fears that the oil fields in Iran and Saudi Arabia might be destroyed.

Third, oil prices typically respond to a mix of shocks whose composition shifts over time. For instance, the rapid rise in oil prices after the Iranian revolution was motivated by both a rise in precautionary demand in 1979 and a gradual but strong increase in economic activity that started two years earlier. While the cumulative effect of the precautionary demand shock peaked prior to the Iran-Iraq war and gradually subsided in the early 1980s, robust economic activity continued to sustain high oil prices. Supply disruptions thus only served to intensify some of these demand-led price dynamics during this period. (Table 3)

Table 2
Types of Oil Price Shock and Their Impact on Macroeconomic Aggregates

Impact on Key Macroeconomic Variables	Types of Shocks to Oil Prices		
	Unexpected Supply Disruptions	Increases in Aggregate Demand for All Industrial Commodities	Precautionary Demand Shocks Specific to Oil
Real Oil Price	Small, sharp and transitory increase	Large and persistent increase with some delay	Immediate, large and persistent increase with some overshooting
US CPI Inflation	Largely flat	Sustained increase with largest deviation in the third year	Sustained increase
US GDP Growth	Small and transitory decline	Increase in the first year but below trend from second year onwards	Gradual decline with largest deviation in the third year

Source: Kilian (2008)

Table 3
Relative Contributions from the Three Sources of Oil Shocks

Relative Contribution in Each Episode	1973-1974	1979-1980	1990	2004-H1 2008
Supply Disruptions	Modest	Modest	Small	Small
Increase in Aggregate Demand	Key driver	Key driver	Small	Key driver
Precautionary Demand Specific to Crude Oil	Small	Key driver	Key driver	Small

Note: Relative contributions based on Kilian (2008).

Impact of oil price shocks on the Singapore economy

As a small open economy, Singapore is naturally vulnerable to global oil price shocks. Thus far, however, oil price shocks have not been associated with recession in Singapore, although inflation rates rose significantly, particularly in the 1970s and in the recent episode. (Table 4)

The magnitude of the oil price rise between 2004 and H1 2008 has surpassed that of previous episodes even though it was built up over a longer period. In US\$ terms, crude oil prices rose nearly threefold but MAS' tighter monetary policy stance during the period, effected through an appreciation of the trade-weighted S\$NEER, has cushioned the effects of higher oil prices. Thus, in S\$ terms, the increase in crude oil prices was around 140% between 2004 and H1 2008. (Chart 2)

The transmission of an oil price shock to the domestic economy depends on Singapore's oil dependence, across both industries and households. Higher oil prices raise the marginal cost of production, thereby resulting in a reduction in output. Using Input-Output Tables, estimates of intermediate oil inputs into the domestic production process are obtained after adjusting for the large oil refining industry, which exports almost all of its output.

Chart 2
Nominal Oil Prices in US\$ and S\$

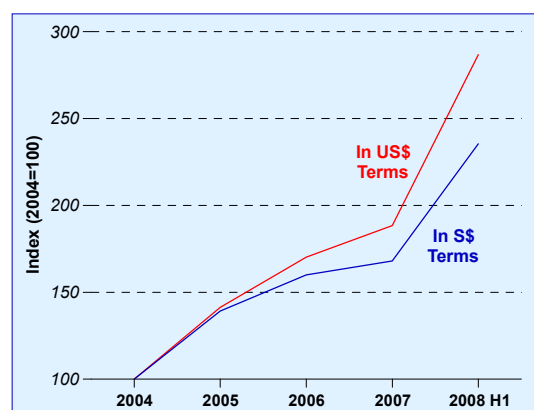


Table 4
Singapore's Average GDP Growth and CPI Inflation during Oil Price Shocks

Episodes	1973-1974	1979-1980	1990	2004-2007	H1 2008
GDP Growth	8.6% (13%)	9.6% (8.2%)	9.2% (11%)	8.0% (3.8%)	4.7%
CPI Inflation	21% (2.0%)	6.3% (3.6%)	3.4% (1.9%)	1.3% (0.0%)	7.1%
Direct Oil-related CPI Inflation	- (-)	23% (-)	11% (-0.1%)	6.9% (-3.1%)	27%

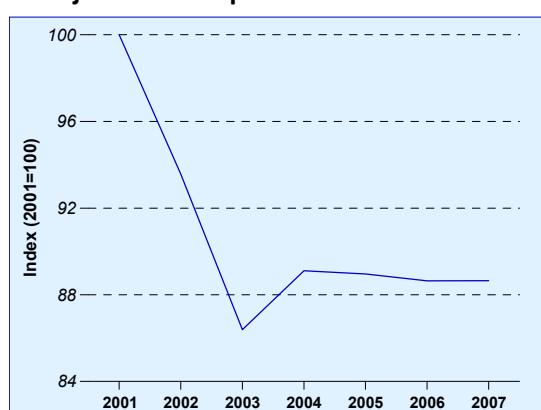
Note: Figures in parenthesis are averages over the two years preceding each episode.

Direct oil-related CPI series starts from 1978.

EPD calculates that Singapore's oil dependence in production, i.e. the amount of oil used as intermediate inputs into the production process for each US\$1 of real GDP, has declined by more than 10% since 2001. (Chart 3) In addition, Singapore's overall oil dependence, i.e. the amount of oil used to produce US\$1 of real GDP, is one of the lowest in the region, although it is higher than in other advanced economies which utilise more diverse sources of energy. (Chart 4)

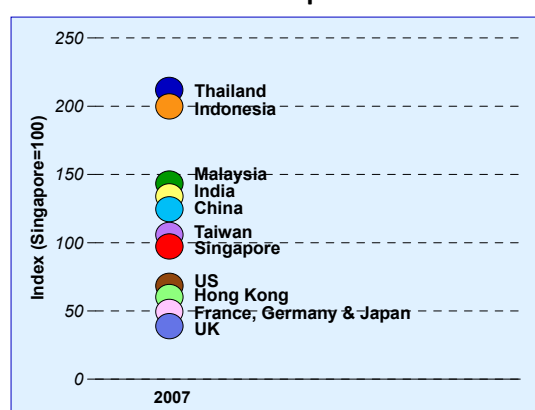
Similarly, higher oil prices affect household consumption decisions by eroding their purchasing power. The degree to which this occurs is dependent on the share of oil-related consumption in total household spending. This is estimated to have risen only slightly since 1993. (Chart 5) Compared to other economies, such as developing countries and those with colder climates, oil-related items make up a relatively small part of Singapore's CPI basket. (Chart 6)

Chart 3
Adjusted Oil Dependence in Production



Source: BP Statistical Review, Singapore Input-Output Tables 2000, and EPD, MAS estimates

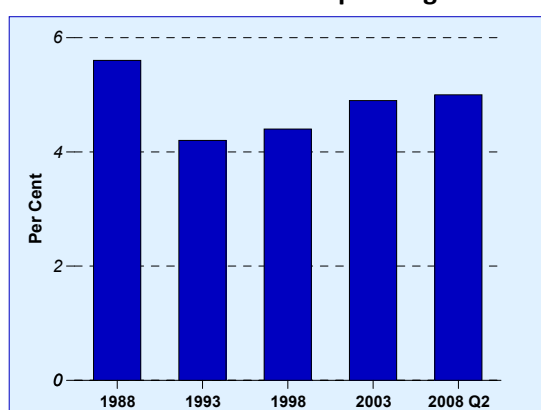
Chart 4
Overall Oil Dependence



Source: BP Statistical Review, Singapore Input-Output Tables 2000, CEIC and EPD, MAS estimates

Note: The figure for Singapore was adjusted to remove requirements of the domestic oil refining industry.

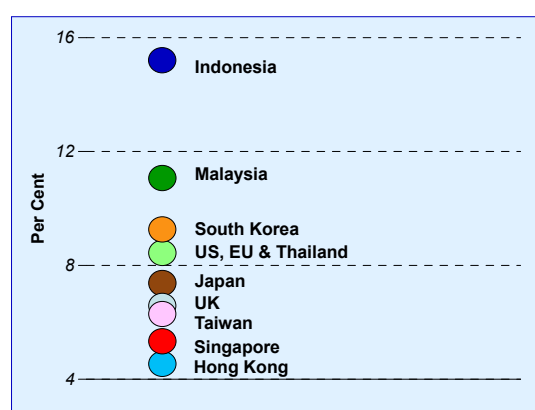
Chart 5
Share of Energy Consumption in Total Household Spending



Source: Household Expenditure Surveys, DOS

Note: The figure for 2008 Q2 is based on EPD, MAS estimates.

Chart 6
Share of Oil-related Items in CPI Basket



Source: CEIC and EPD, MAS estimates

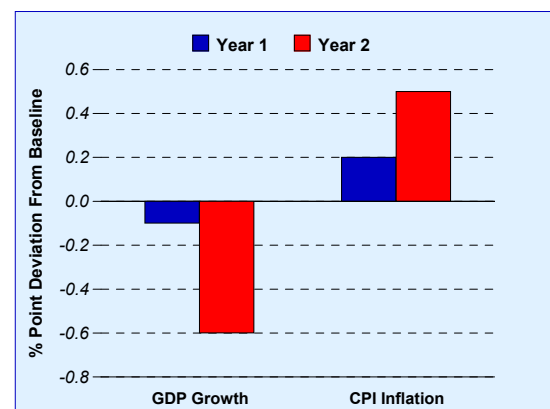
Note: Shares are based on weights of electricity, gas, LPG, and petrol in the CPI basket.

Simulating the impact of a 10% increase in oil prices

Drawing on Kilian's insights on the nature of oil price shocks, EPD derived some impact multiplier estimates for key macroeconomic indicators of Singapore arising from an oil price shock. Specifically, a 10% increase in oil prices over four quarters was simulated using the Monetary Model of Singapore (MMS). Model inputs for external growth and inflation were adjusted using Kilian's characterisation of recent and past oil shocks and their impact on macroeconomic aggregates. Given its computable general equilibrium characteristics, MMS was able to produce consistent estimates of the impact of higher oil prices on the production and consumption decisions of economic agents, including second-round effects from capital and labour reallocation across sectors due to cutbacks in consumption expenditures and production.

Chart 7 summarises the results. A 10% increase will reduce GDP growth by 0.1% point in year 1 as higher import costs dampen private consumption. Growth declines a further 0.6% point in year 2 as producers cut output owing to higher input costs and lower final demand. CPI inflation rises by 0.2% point in year 1 as prices of oil-related items in the CPI basket increase. In year 2, CPI inflation rises by another 0.5% point as businesses pass on the higher costs to consumers.¹

Chart 7
Impact on GDP Growth and CPI Inflation
from a 10% Increase in Oil Prices
over 4 Quarters



Sum-up

It is clear that the impact of oil price shocks on the global economy can vary with their underlying causes. In addition, the identification of the production and consumption channels, together with estimates of changing oil dependence over time, can provide a richer perspective to interpret the impact of oil price shocks on the economy. This special feature provides some evidence that Singapore's dependence on oil on the output side has declined in recent years. In comparison, consumption dependence has largely remained the same. Finally, our simulations confirm the negative impact of a global oil price shock on Singapore's growth and inflation dynamics, once suitable allowance is made for time lags.

¹ IEA (2004) found that a sustained US\$10 per barrel increase from a base scenario of US\$25 per barrel would depress OECD GDP growth by 0.4% point in both the first and second year, and raise the OECD CPI inflation rate by 0.5% point and 0.6% point in the first and second year, respectively.

References

Barsky, R.B. and Kilian, L. (2001), "Do We Really Know that Oil Caused the Great Stagflation? A Monetary Alternative", in Bernanke, B. and Rogoff, K. (eds.), *NBER Macroeconomics Annual 2001*, pp. 137-183.

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