THE QUEST FOR DEVELOPMENT

Essays in Honour of Professor Akin Iwayemi at 70

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Oil Price Shocks and the Macroeconomy: Chronicles of Theory and Empirics

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Abstract

Understanding energy-economy interactions has occupied the attention of academics and policymakers for several decades. The preponderance of empirical attempts in this sphere has focused on the impact of oil price shocks on the aggregate economy in both developed and developing economies. This expansive literature has undoubtedly produced diverse and often conflicting results. In this paper, we therefore provide a survey of this vast literature on the oil shocks-macroeconomy relationship. In particular, we carefully document a considerably elaborate account of both the theoretical propositions as well as empirical exercises in this literature especially over the last three decades on the relationship in question. The core idea behind the foregoing *is the hope that this will help both academic researchers and policymakers in the quest for a better understanding of the oil price-macroeconomy nexus particularly in resource dependent settings.*

Keywords: Oil price shocks, Macroeconomy, Real output.

JEL codes: G12; E32; O53

18.1 Introduction

This chapter is devoted to a fairly detailed, albeit far from exhaustive, review of both the theoretical and empirical literature on the relationship between oil prices shocks and the macroeconomy. The review of theoretical issues, which is considered first in section 18.2, covers various channels of influence such as real balance, income transfer from oil importers to oil exporters, potential output movements, Dutch Disease, sectoral shifts as well as uncertainty and the attendant postponement of investment decisions. The subsequent section (18.3) then delves into diverse strands of the empirical literature on the effects of oil price shocks on the macroeconomy, while the fourth (18.4) and final section (18.5) closes with a brief conclusion emanating from the literature on the subject under scrutiny.

18.2 Theoretical Issues: Effects of Oil Price Shocks on the Macroeconomy

There are several channels via which an unanticipated change in the level of oil prices could affect the economy. First, an oil price increase results in an initial upward shift in the aggregate supply curve which raises prices and lowers output along a downward sloping aggregate demand curve. Energy price shocks alter firms optimal production plans by distorting the incentive to use energy resources. Energy-using capital becomes obsolete owing to the price increase and labour resources diverted to cut down on energy use, implying a shift to production with less energy intensive technologies. Hence, existing capital and labour do not produce output as before, resulting in a decline in potential or natural output. A second channel works through the effect of changes in net imports of oil on domestic aggregate demand. The extent and direction of such effects are based on a country's net oil export status. Countries that are net oil importers experience a decrease (increase) in aggregate demand when oil prices fall (rise) and those self-sufficient in oil remain unaffected. Net oil exporting countries respond such that for a rise (fall) in oil prices aggregate demand increases (decreases) [Rasche and Tatom (1977a)]. These alternative channels are looked at in turn.

18.2.1 The Real Balance Effect

One of the earliest insights offered by researchers for the aggregate economic impacts of oil price changes was the real balance effect. This channel posits that oil price increases lead to higher inflation, with a given money supply, which lowers the amount of real balances. The lower real balances then produce recessions via the familiar monetary channel – increased interest rates leading to depressed investment spending, reduced aggregate demand and a concomitant fall in output (see Pierce and Enzler 1974; and Hall and Taylor 1991). According to this theory, increases in oil prices result in higher money demand as agents seek to balance up their portfolio towards liquidity. In the event that the monetary authorities do not pursue a policy which gives a commensurate increase in money supply, the money demand growth leads to rising interest rates and retarding economic growth. The real balance however implicitly assumes symmetry in the relationship between oil price changes and macroeconomic indicators such as output growth and inflation.

18.2.2 International Income Transfers Channel

This channel focuses on the potential implications of increased integration and trade among countries. Under this theory, oil price increases lead to a transfer of income from net oil-importing economies to the oil-exporting countries. This leads to a reduction in consumption expenditure in the oil-importing countries since the purchasing power of consumers have been eroded by the oil price increase. This income redistribution leads to lower aggregate demand. Higher oil prices, under this scenario, can be viewed as akin to a tax imposed on oil-importing nations by oil producers. While purchasing power and consumer demand increase in oil-exporting countries, it is possible to have, on net, a lower consumer demand for the goods manufactured by the oil-importing nations depending on the marginal propensity to consume such goods by the oil-producing nations' consumers. Low marginal propensity to consume implies an increase in world savings. This stimulates investments through lower interest rates that considerably offset the losses in terms of consumption spending. Although the foregoing restores aggregate demand partially, the overall effect is still a reduction in aggregate demand and, hence, real output (Rasche and Tatom, 1981; Mork et al, 1994 and Dohner, 1981).

18.2.3 Endogenous Monetary Policy Response

Some researchers have opined that real output declines which usually characterize oil price increases are the result of counter-inflationary responses of monetary policy (Darby, 1982; Bohi, 1991). The severity of an oil price shock can be explained to a reasonable extent by the reaction function of the monetary authorities. Theoretically, in a case where the growth of nominal GDP is fixed, the rate at which real GDP reduces will depend largely on the rate of increase in inflation. Since the market is sluggish at adjusting to monetary surprises, pursuing an expansionary monetary policy via reduction in interest rates would lead, at least temporarily, to lower real GDP losses while inflationary pressure increases. Conversely, restrictive (counter-inflationary) monetary policy accomplished by reversing the direction of interest rate intensifies losses in real GDP although pressure on the domestic price level is markedly reduced. Thus, the argument is essentially that oil price increases do not entirely account for the observed recessions but it is the reaction of monetary policy that either triggers or reinforces the output declines.

18.2.4 Potential Output Channel

The correlation between oil prices and output is viewed, in this case, as a pure supply side phenomenon (see Berndt and Wood, 1979; Rasche and Tatom, 1977; Fischer, 1985; and Tatom, 1988). Higher energy prices are a reflection of the increased scarcity of a key input into the production process. The oil price increase lowers aggregate supply since higher prices imply lower energy purchases by firms. Hence, the productivity of a given amount of labour and capital declines resulting in a fall in potential output. If complementarities exist between oil and capital in production, then increasing oil prices result in lower productive capacity in the economy owing to the reduction in both oil and capital utilisation by agents. Where consumers expect the increase to be of a temporary nature, consumption smoothing, usually by borrowing more or saving less, becomes the first best option. This however results in higher real interest rates which, coupled with reduced output, implies that the price level increases in response to the induced fall in demand for the real cash balances (for a given rate of growth in money supply). Hence, increases in oil prices reduce real GDP, boost real interest rates and put upward pressure on the price level in this classic supply shock channel. More recent expositions in this tradition include the works of Rotemberg and Woodford (1996) and Finn (2000) which we now turn to in detail.

The Rotemberg and Woodford (1996) model is outlined as follows. Many firms possessing identical production functions produce a gross output and many identical households consume an aggregate consumption good and undertake investment. Money is absent from the model and there is no unemployment. The output market clearing condition is that the sum of all households' consumption and investment, plus government purchases, must equal aggregate output minus materials. The Lagrange multiplier from the first-order conditions on the production function is an endogenous mark-up variable. Collusive capacity throughout the entire economy permits producers to raise mark-ups beyond what perfect competition would permit. An oil price shock permits increases in mark-ups, depressing output following an oil shock in a magnitude and temporal pattern similar to the empirical path of output response to an oil price shock in impulse response functions. Finn (2000) in an alternative specification of an aggregate model avoids tying the magnitude result to non-competitive conditions. The outlines of Finn's model are similar, but she separates the quantity of capital installed in production from its utilisation, which is a function of energy use. Consumers allocate part of their consumption to investment, which is used to purchase new capital equipment, which in turn requires energy for its use. The household's problem is to maximise lifetime utility by choosing current consumption and labour supply, next-period capital, and current capital utilisation, the last of which implies both current investment and current energy consumption. An oil price shock causes sharp, simultaneous decreases in energy use and capital utilisation. The decline in energy use works through the representative firm's production function directly, reducing output and labour's marginal product. The fall in labour's marginal product reduces the wage, which in turn reduces labour supplied. A permanent rise in the oil price causes the lowering of energy use, capital utilisation and labour supply to be propagated into the future; working through the production function, these reductions depress capital's future marginal product, causing a fall in capital's future marginal return and reductions in investment and capital in the present but extending into the future. An indirect transmission channel, working through the capital stock, is related to capital's marginal energy cost, affecting returns on investment (ROI). This rise in capital's future marginal energy cost (since the price increase is permanent) prompts further reductions in ROI. The oil price increase's effects on output and wages are potentially significant even if the share of energy in output is low. These effects are potentially long-lived too, since they operate on the capital stock.

18.2.5 Dutch Disease

The general equilibrium effects of a booming oil sector on the rest of the economy in both developed as well as developing countries have also been systematically analysed within the Dutch Disease framework (Forsyth and Kay (1980), McKinnon (1976), Snapes (1977) and Enders and Herberg (1983). These Dutch Disease models have been used in understanding the reallocation of productive factors among different economic activities. The sectoral changes resulting from resource boom are often influenced by movements in relative prices (Oyejide, 1986). A typical model of this nature (Corden and Neary, 1982; Corden, 1984) assumes a small open economy producing both tradeables and non-tradeables. The tradeable goods which comprise importables and exportables have exogenously determined world prices while the non-tradeables have prices which are subject to changing domestic supply and demand conditions. One of the two tradeable sectors is labelled as the booming sector while the other represents the traditional export or import-competing sector. Hence, the rest of the economy and macroeconomic aggregates in general are influenced by changes in the booming sector via two distinct effects – the spending and resource-movement mechanisms.

The spending channel is often analysed using a model that considers the booming sector an enclave with no obvious supply-side links with the rest of the economy. Within this setting the booming sector does not use domestic factors of production but induces income received. Thus, changes in relative prices result as the higher level of income is spent on both tradeable and non-tradeable goods. Excess demand for the non- tradeable sector's output places upward pressure on prices within that sector whereas the increased demand in the tradeables sector is augmented through increased imports. This results in both a fall in output of the tradeable sector and expansion of activities in the non-tradeable sector. The resource-movement effect works where the booming sector has supply side interactions with the rest of the economy. A boom in this instance causes an upward shift in the demand curve for non-tradeables, implying an increase in relative prices. Since labour is assumed to be the only mobile factor, capital being sector-specific, the relative price change causes an upward movement in the wage rate of the traditional tradeables sector resulting in the flow of labour services to the other sectors. The excess labour requirement in the latter sectors is assumed to be drawn from the fixed total supply of labour in the economy. The structure of the Core Model is the focus of what follows. The typical economy comprises three sectors, namely, the Booming sector (B), the Traditional sector (T) and the Non-Tradeable sector (N). The prices of tradeable goods produced in the first two sectors are exogenously given. Output is produced within each sector through a combination of intersectoral mobile labour and another factor specific to each of the sectors. These factors of production are assumed to be immobile internationally while their prices within the domestic economy are flexible. A boom in B resulting, for instance, from an exogenous rise in the world price of the sectors output usually raises the aggregate income accruing to the factors employed in the sector. When some part of this extra income is directly spent by the owners of productive factors or is indirectly injected into the economy by way of increased government tax revenue and subsequent expenditure, real appreciation occurs as the price of N relative to the prices of tradeables (both B and T) rises. The standard implied condition being that the income elasticity of demand for N be positive. This real appreciation leads to a withdrawal of resources from B and T into N as well as a shifting of demand away from N towards B and T. This is the spending effect. Turning to the resource-movement effect of the boom, the marginal product of labour in B goes up such that given wages in terms of B and T, labour demand rises in B which triggers a movement of labour out of both T and N. This sequence of events can be decomposed into two parts. The component that excludes the market for Non-tradeables and, hence, does not involve real exchange rate appreciation leads to a lowering of output in T via an outflow of labour from the sector into the booming sector (B). This could be termed direct de-industrialisation. The other route involves the movement of labour out of N into B with the real exchange rate unchanged. This indirect de-industrialisation (as labour shifts from T to N) reinforces the effects resulting from the earlier direct channel. Consequently, the output of the non-tradeables sector could be higher or lower than before the boom as the spending effects which tends to make it rise is usually counteracted by the resource-movement effect which lowers it, thus leaving the net output effect theoretically ambiguous.

18.2.6 Sectoral Shifts Hypothesis

Hamilton (1988) popularised the notion of reallocation of resources across sectors in response to oil price changes. This sectoral shifts hypothesis posits that changes in oil prices perform better in explaining observed variations in output growth (Loungani, 1986). Therefore, it is the magnitude of price changes (i.e., large changes which could be either positive or negative) that matter. In Hamilton's multisector model, shifting labour and capital inputs across sectors involves some labour mobility and retraining costs. Within his setting, oil price shocks lead to a temporary upsurge in aggregate unemployment since workers in adversely impacted sectors may opt for suffering frictional unemployment pending improvement in conditions in their sector rather than outright movement into positively affected sectors of the economy. In an earlier attempt, Lilien (1982) showed that a reasonable explanation for unemployment, and by implication output losses, can be found in sectoral shifts in demand and the attendant costs of reallocating labour. This mechanism is driven by exogenous allocative disturbances which determine the speed of reallocation. Davis (1987) and Loungani (1986) with variants of the sectoral shifts model conclude that the magnitude of an oil price shock is of more importance than the direction of the change as both positive and negative changes increase the amount of labour reallocation required. One key implication of this line of research is that aggregate unemployment rises (aggregate output falls) as a result of oil price shocks.

18.2.7 Uncertainty and Irreversible Investment

Another theoretical viewpoint focuses on the greater importance of oil price uncertainty in explaining variations in economic activity relative to the level of oil prices. Adjustment costs arising from energy augmented capital stock, for instance, may amplify the growth slowdown caused by rising oil prices. Bernanke (1983) demonstrates that firms find it optimal postponing investment expenditures, particularly irreversible ones, when there is uncertainty prevailing about future oil prices. Thus, firm choice as regards the addition of capital stock is influenced by the extent to which oil prices can be predicted. With increased uncertainty, there is an option value associated with waiting for the arrival of new information before irreversible investment commitments are made. By waiting for additional information, the firm sacrifices returns obtainable from quick commitment on the one hand but the chances of making the right investment decision rises on the other. When oil price uncertainty rises, this option value to delaying action increases and there is a decline in the incentive to invest (see Pindyck, 1991). Also, uncertainty about firm performance in an environment of higher oil prices may work to dampen investor confidence thus increasing firms' interest payments for capital. This effect, prima facie, leads to lower investment spending and a weakening of economic activity.

18.3 Empirical Review

18.3.1 Empirical Literature Review on Oil Prices and the Macroeconomy in Developed Countries

Since the events after the revelation of the new state of the world oil market in 1973, a substantial body of empirical work has evolved. The earlier attempts in the empirical literature were on investigating the economy's aggregate response to an unanticipated and permanent shock to oil prices (Rasche and Tatom, 1977, 1981; Bruno and Sachs, 1982, 1985; Eastwood, 1992). Rasche and Tatom (1977, 1981) estimated an aggregate production function of the Cobb-Douglas type for the

United States and five other OECD countries over the 1948-1978 period using real GNP as the dependent variable. The price of energy was used to proxy its quantity while the other arguments of the production function (labour and capital) were expressed in quantity terms. The estimates of long-run oil price-GNP elasticity were –0.035, -0.041, -0.070, -0.171 and -0.044 for the U.K., France, the United States, Japan and Canada, respectively.[4] The 7 per cent long-run reduction in GNP for the United States as a result of the oil price increase of 1973-74 was viewed to be unnecessarily high when the share of oil in GNP is accounted for (Tobin, 1980). Darby (1982) with data spanning a similar period for eight OECD countries found that the recession following the shock could be attributed to three distinct causal factors; the shock to oil prices, tight monetary policy targeted at combating inflation after the Bretton Woods system collapsed and the imposition and eventual removal of price controls from 1971-1975. The analyses identified alternative causes of the recession but the data failed with respect to distinguishing the effects of these causes. The oil price shock of 1979-1980 offered yet another opportunity for researchers who then began to view shocks differently with the emphasis gradually shifting from the earlier long-run perspectives to efforts geared towards explaining the role played by oil price shocks in real business cycles.

Hamilton's (1983) seminal article started the series of debates which preceded the emergence of the connection between real business cycle (RBC) models on the one hand, and oil price shocks on the other. In the short run, oil price shock seemed to be a potential mechanism for yielding the unanticipated but transitory supply shocks usually assumed by RBC models. Hamilton (1983) shifted the macroeconomic analysis of shocks to oil prices to the supply side employing the concept of Granger causality in testing the direction of effects of such shocks within a business cycle framework. Following the collapse in oil prices in 1986, national economies were expected to witness considerable booms which were not observed (Mork, 1989); the possibility of asymmetric macroeconomic response to oil price shocks then gained prominence in the literature. Mory (1993), using annual United States data for the 1951-90 periods, reported a GNP elasticity estimate of -0.107 for oil price increase. Mork et al (1994) obtained an estimate of -0.054 although their study was based on quarterly data over the range 1967:1-1992:4. An alternative approach to asymmetry in which oil prices above the previous maximum price lead to reduction in aggregate production while price changes below that threshold have little or no effect was supported by the findings of Smyth (1993).

The approaches to examining the GNP impact of oil price shocks can be fitted into three broad groupings: aggregate production function approach, simulations using multiple equation macroeconomic models, and approaches along the lines of real business cycles. The microanalytic viewpoint of the first category informs a specification of gross output as a function of energy and some other arguments with obtaining estimates of the relationship between factors of production and GNP with particular interest in the effects of oil price shocks being the focus. Rasche and Tatom (1981) estimated a Cobb-Douglas production function and found an elasticity of -0.070 for the United States. Darby (1982) suggested that the earlier estimates were probably overstated due to the effects of included oil prices and the real money balances omitted from the analyses. The thrust of his suggestion was that the observed effects on energy prices were picked up from restrictive monetary shocks though the data failed to provide evidence to support his view. Bruno and Sachs (1985) and Toman (1993) pointed out that allowing for double deflation erodes the estimated effect of an oil-price increase on GNP.

Using a Cobb-Douglas production function with labour, private capital, public capital and energy price as arguments, Ram and Ramsey (1989) found statistically significant energy price-GNP elasticities of -0.074 and -0.069 for the period 1948-85. Smyth (1993) using the same inputs except public capital obtained a positive but not significant elasticity of 0.020 for price decreases, negative and insignificant elasticity for price increases less than the historic maximum (-0.018), and an elasticity of -0.052 (both negative and significant) for increase in prices above this maximum. This result points to the possibility that energy price changes within the scope of recent experience may have negligible effect on aggregate output while increases above that range could have a sharp negative impact. The adoption of aggregate production function approaches was consistent with the view that oil price shocks were permanent in nature and the corresponding focus on long-run (full employment) GNP losses. However, as the notion of transitory shocks and asymmetric effects with respect to the direction of price changes gained prominence, research emphasis moved towards more flexible approaches which allowed for varying degrees of rigidity, unemployment of productive factors and other adjustment cost mechanisms. Bruno and Sachs (1982) model shocks to supply and the adjustment process to the unemployment equilibrium in the labour market which is often characterised by contractually fixed wages. The adjustment costs resulting from this model were about 75 per cent more than the full employment case. Bruno and Sachs' (1985) explicit inclusion of a commodity market presented a general equilibrium model which formalised the costs of adjustment in the labour market although the precise mechanisms remained vague.

The next category comprises attempts in the 1980s to modify numerical macroeconomic models to incorporate energy and simulating in order to understand the implications of oil price shocks for the macroeconomy. Bruno and Sachs (1982) empirically estimated single and multiple equation regressions of factor prices, output and labour demand in the manufacturing sector for the U.K. for the period 1956-78 and conducted simulation on the model using estimates of parameters from the regressions. Three experiments were pursued viz; a 10 per cent unanticipated increase in energy prices in 1980 with full employment, the same rise in energy prices coupled with a sluggish real wage adjustment and a 10 per cent rise in energy prices pre announced in 1980 but taking effect from 1983 (the assumption about real wage adjustment in the second experiment was retained). Their simulated values for 1980,1985 and 1990 produced reductions in output of about 2.6 percentage points on the average with continuous full employment and decreases of 4.2, 4.4 and 4.5 percentage points in the case of slowly adjusting real wages. The last scenario had an effect on the value of Tobin's q in 1980 but reduced the growth rate of output in 1985 and 1990 by 4.7 and 4.8 percentage points respectively. Nasseh and Elyasiani (1984) employed an eight equation aggregate supply model which they estimated for Canada, the U.S., Germany, France and the U.K. using annual data. The simulation over the period 1973-79 replicated the behaviour of model variables for all countries apart from France which performed well only in terms of unemployment and energy demand. The model also indicated a positive effect on total employment owing to the substitution of labour for capital but considerably negative effects on both labour productivity and the rate of capital utilisation. This effort, however, has a major drawback since there was no inclusion of monetary and fiscal policy variables.

Attempts over the last two decades have been towards the representation of oil price shocks in real business cycle (RBC) models. Burbidge and Harrison (1984) conducted vector autoregressions (VAR) and computed impulse response to oil price changes using the variables of the VAR model. They then decompose the movements in output and prices over the 1973-82 period into several components including the impact of oil-price innovations. The contribution of shocks to oil prices to the behaviour of the CPI and industrial production was found to have had few similarities across the countries considered. Since their results were presented graphically, a direct comparison of findings with other studies is difficult. Gisser and Godwin (1986), using quarterly data (1961:1-1982:4), estimated independent models for four key macroeconomic variables, namely, real GNP, the unemployment rate, real investment and the general price level. They regressed each of these variables on the current and four lags of the M1 money supply, the high employment federal expenditure (a measure of fiscal policy) and the nominal price of crude oil. The coefficients on the current, third and fourth quarter lags of the price of oil were significant and positive for the price level and unemployment rate equations and negative but significant in the equations for investment and real GNP. Romer and Romer (1989, 1994) presented evidence that monetary policy explains the bulk of observed fluctuations in economic activity in the U.S. from 1947-87. Examining the contribution of monetary shocks using quarterly data series over 1954:1-1991:3, Dotsey and Reid (1992) found both tight monetary policy and oil price increases to be statistically associated with reductions in aggregate economic activity. Raymond and Rich (1995) employed a regime-switching model in investigating the role of oil price shocks in the cyclical downturns in the U.S. economy for the period 1952:2-1988:2. The result for both the univariate and bivariate VAR models is that the role of energy prices in business cycles may not be of primary importance. However, methods of dealing with the unanticipated component of oil price shocks and business cycles are emerging as crucial to isolating the macroeconomic impacts of oil price shocks.

18.3.2 Asymmetric Effects of Oil Price Shocks

Conventional wisdom posits symmetry in the response of the macroeconomy to both increases and decreases in oil prices. The failure of the oil price collapse of 1986 to result in economic boom for most countries served as a basis for growing scepticism on the attribution of recessions or their deepening in the past to positive shocks to oil prices. The efforts to address this issue have led to the investigation of the different mechanisms via which oil price shocks affect the macroeconomy. Mork et al (1994) using data spanning 1967:3-1992:4 for seven OECD countries found that all the countries except Norway experienced negative association between oil price increases and GDP growth. The bivariate regression estimated included GDP and current and lagged oil prices while the multivariate model included other variables such as the inflation rate, short-term interest rate, the unemployment rate and the growth rate of industrial production.

Federer (1996) explored the impact of oil price volatility on macroeconomic outcomes using monthly data for the U.S. The VAR impulse response functions and variance decompositions indicated that a significant proportion of the movements in the growth of industrial production are explained by oil price volatility (see Lillien, 1982 and Hamilton, 1988). Karras (1993) estimated a SVAR of real GNP, the real federal deficit, the GDP deflator, the M2 money supply, the U.S. dollar-SDR exchange rate and the price of oil for the period 1973:1-1989:4. In the variance decomposition, monetary shocks accounted for larger proportions of forecast error variance than do oil price innovations at 1 and 4 months tapering off at around 8 and 20 months. This approach, however, identifies shocks through the structure of errors in the data series and oil price shocks defined as such explain only little of the variations in GNP. Keane and Prasad (1996) used primary data from the National Longitudinal Survey of Young Men with a sample size of 4,439. The real price of refined petroleum products was used as the oil price variable and it was observed that increases in oil prices reduced real wages to all workers in the sample although in relative terms skilled workers were better off. The probability of employment rises for skilled workers following an oil price spike which suggests a probable role for skilled labour as a substitute for energy in most of the industries under study. They concluded that considerable labour reallocation takes place across industries but the implications differ depending on skill levels. Carruth et.al (1998) use an error correction model (ECM) of long-run unemployment in which oil prices play a major role. An increase in oil prices lowers the profit margins of firms, hence adjustment must take place to correct the disequilibrium induced by the price shock. Firms can only influence the wage rate by reducing employment in order to take advantage of the no-shirking condition in the efficiency wage model. Using a symmetric oil price variable, unemployment rate, real interest rate and error correction terms, they find a positive and significant oil price effect on unemployment. The interest rate variable was, however, not significant at the conventional levels.

Davis and Haltiwanger (2001) using quarterly data (1972:2-1988:4) on capital per employee, employment, energy use, age and structure of plant and durability of products in a VAR examined the response of both job creation and losses to shocks to oil-prices (positive and negative). They found that shocks to oil-prices and monetary aggregates resulted in larger responses in job destruction than job creation in almost all industrial sectors. However, they failed to find evidence for the notion that positive and negative oil price shocks cause the same level of reallocative response across sectors. Hunt, et al (2002) conduct simulations with the IMF's multi-country model, MULTIMOD. The simulations described responses of real GDP and inflation to oil price shocks of different duration. They compared the model's responses to both transitory and permanent oil price shocks under two alternative structures of the wage-price nexus and also illustrated how asymmetric responses by microeconomic agents to changes in their real wages might help explain the nonlinear relationship between oil prices and macroeconomic activity. Their findings suggest that oil price shocks significantly impacted differently on different economies. For instance, the simulated effects were larger for the United States than in the United Kingdom. On the effects of oil price shocks on core inflation, the conclusion is that with temporary shocks, the responses of output and inflation under the two wage-price structures are similar. The most significant differences are, however, in the core inflation outcomes for countries that have relatively large estimated real wage catch-up effects, as in the United States.

Jimenez-Rodrigruez and Sanchez (2005) in an empirical investigation of the effects of oil price shocks on real economic activity using a multivariate VAR for a sample of seven OECD countries revealed that oil price increases have a larger impact on the growth of GDP when compared to declines in oil prices. These oil price increases affect economic activity in an oil importing country negatively (and significantly) while the effect for oil exporters was found to be ambiguous. Cavallo and Wu (2006) used a VAR model of the three variables namely output, inflation and oil prices to estimate the effects of oil-price shocks on output and prices for the U.S. economy. The study found that following an oil-price shock, output declined and prices increased. They also found that the decline in output implied by one of their constructed measures was larger than the one implied by another conventional measure of oil-price shocks proposed in the literature.

Gronwald (2008) examined the macroeconomics of oil prices for the United States economy. Within a standard VAR framework and using a new Markov switching based oil price specification, he found that the impact of oil price shocks on real GDP growth was attributable to the three "large" increases of 1973, 1979 and 1991. However, variables like import and consumer prices are affected by "normal" oil price increases. Lardic and Mignon (2006) investigate the existence of a long run relationship between oil prices and GDP in 12 European countries using quarterly data from 1970:1 to 2003:4. To account for possible asymmetry in the linkage between oil price shocks and economic activity, they employ both the standard cointegration and a variant- asymmetric cointegration. From the results, only asymmetry cointegration exists between oil prices and GDP in most of the countries considered. This suggests that rising oil prices appear to retard economic growth by more than declining prices stimulate it. Extending the scope of their earlier work, Lardic and Mignon (2008) use the same asymmetric cointegration approach but, in addition to the 12 European countries, include the U.S., the G7 and Euro area economies. The results indicate that while standard cointegration breaks down, there is ample evidence of cointegration, although asymmetric, between oil prices and GDP for all the countries considered.

Cunado and Perez de Garcia (2003) analyse the oil price-macroeconomy nexus specifically focusing on the effects of oil prices on inflation and industrial production in 15 European countries. They employ quarterly data covering the entire period 1960-1999. The key results from their analysis suggest that the effects of oil prices on inflation are permanent while production growth is only affected asymmetrically in the short run. However, significant variations were found with respect to the responses of the countries to the oil price shocks. Focusing attention on some Asian economies, Cunado and Perez de Garcia (2005) examine the impact of oil price shocks on both economic activity and the consumer price indexes of Japan, Singapore, Thailand, Philippines, Malaysia and South Korea. Using quarterly data spanning 1975:1-2002:2, the results indicate that oil prices have a significant effect on both economic activity and prices indexes. This effect is however restricted not only to the short run but also defining the oil price shocks in local currencies. In addition, they found evidence in support of asymmetries in the oil price-macroeconomy relationship for some of the countries. Jimenez-Rodriguez and Sanchez (2005) examine the relationship between oil prices and GDP for selected OECD countries. They find that an increase in oil price has an impact, on GDP, larger in magnitude than a comparable fall in oil price. The pattern that emerges is a negative association between the variables for all oil importing countries apart from Japan. They also find, among the oil exporting countries, that an oil price increase dampens output growth in the UK while Norway benefits as regard GDP performance. Lardic and Mignon (2008) examine the differential impact, on output, of oil price increases and decreases for the US and G7 countries. They adopt an asymmetric cointegration approach since standard cointegration was rejected. Asymmetric cointegration was found for all countries included in their analysis. A panel technique is employed in Kim and Willet (2000) study on various panels of OECD countries with the conclusion that a strong inverse relationship exists between oil prices and economic growth. Glasure and Lee (2002) also arrive at a similar conclusion for the case of Korea. Using a different, vector autoregressive (VAR) methodology, Rautava (2004) delves into the relationship between real GDP, federal government receipts and oil prices in Russia. Like most other studies, he finds a negative impact of oil price fluctuations on both government revenues and real GDP.

Some studies link the oil price-macroeconomy relationship to trade relations and the attendant external sector performance implications. In this genre, Levin and Lougani (1996) show that the response of a country to oil prices is driven to some extent by the choices of rules adopted by the country vis-a-vis its trading partners. Berument and Ceylan (2005) argue that the impact of oil price fluctuations hinges on economic structure and the country's status as either a net oil exporter or importer. The net exporters of oil should benefit from the windfall profits and fiscal revenues created by oil price hikes, while net importers should experience this situation as additional burdens on their economies. On the contrary, Abeysinghe (2001) maintains that even net oil exporters cannot escape the negative influence of high oil prices. Based on an assessment of the impact of oil prices and growth on 12 economies, the author revealed that while the direct impact of high oil prices on net oil exporters is positive, a negative effect is transmitted indirectly through a trade matrix. Hence, net exporters cannot escape the contractionary effect which is passed on through their trading partners. This adverse consequence on trading partners works to mitigate the positive effects of high oil prices in the long run. Furthermore, he notes that the transmission effect of oil prices on growth may not be as important for a large economy, for instance the US, as for a small open economy. Blanchard and Ghali (2007) opine that the events of the past decade indicate that oil prices are not a significant source of economic fluctuations. They find that there are at least four reasons for the milder effects on inflation and economic activity of the recent increase in the price of oil, namely, the absence of concurrent adverse shocks, smaller share of oil in production as a result of technology induced fuel substitution, more flexibility in labour market arrangements and improvements in the conduct of monetary policy. Killian's (2008) empirical study found that some countries (especially Italy, France and Japan) have fared much better in terms of cumulative inflation and growth than others (like Germany) when faced with exogenous oil price shocks. Segal (2007) assesses several arguments as to why high oil prices during the mid-2000s did not lead to a slowing of the world economy. The most important are (i) that oil prices have never been as important as commonly thought; and (ii) that high oil prices did not restrain growth because they no longer pass through to core inflation, which obviates the typical need for monetary tightening in response to a positive oil price shock. Recently, Huang et al (2005) used a multivariate threshold model to analyse the impacts of an oil price change and its volatility on economic activities in USA, Canada and Japan during the period from 1970 to 2002. The most important finding is that in the two-regime model, responses of economic activities are rather more pronounced in the regime where an oil price change or its volatility exceeds its threshold level.

18.3.3 Monetary Policy Stance and Oil Price Shocks

Bernanke, Gertler and Watson (1997) examined the importance of monetary policy in discontinuities in the oil price-GDP relationship. Using Hamilton's net oil price increase (NOPI) specification of the oil price shock they carried out a counterfactual analysis of the implications of fixing the federal funds rate at a constant level. Inspecting the impulse response functions for the oil price shock for the variables in their VAR, they concluded that most of the reductions in U.S. GDP during the recessions that followed the 1973, 1979-80 and 1990 episodes were attributable to monetary policy and not the oil price shocks. Hamilton and Herrera (2001) re-examined this conclusion calculating the changes in monetary policy required to maintain the federal funds rate at its pre-oil shock level when other VAR variables are changing. Impulse response functions using simulated monetary policy (as in BGW 1997) with 12-month lag indicated that alternative policy can do little to reduce the real impacts of the oil price shock when the impact is allowed over the full period.

Hooker (1999) examined the stability of the oil price-GDP relationship over the period 1954-1995 considering bivariate and multivariate VAR specifications. An interest rate variable was included in the post-1979 sub-sample which eliminated the significance of the oil price variables implying that oil prices operated on GDP indirectly during this period thus in line with the view that monetary policy which influences interest rates was affected by oil price shocks. Hence, while oil prices had direct effect on GDP in the pre-1980 period, they appear to have operated via monetary and some other indirect channels afterwards. The statistical insignificance of the oil shock variables in the presence of interest rate variables is reversed when a three-year NOPI specification is used for the oil price shock. Hooker (2000) studied the influence of oil prices on core inflation. Analogous to the structural break he found in the oil price-GDP relationship around 1980, he identified a break in the U.S. Phillips curve relationship, augmented with oil prices, around the same time, with oil price changes making a substantial contribution to core inflation before that date but little thereafter. He explored the suitability of three alternative hypotheses for this break: declining energy share, deregulation of energy- producing and - consuming industries, and changes in monetary policy. None of the three explanations could account for the decrease in pass-through after 1980; in fact, he found that monetary policy as represented by the federal funds rate displayed smaller, rather than larger, responses to oil price changes after 1979, despite its greater sensitivity to inflation.

Balke et al (2002) used statistical tests to determine what third variable statistically explained why oil price increases had a larger effect on growth than price decreases. They concluded that interest rates could explain the asymmetry. They hypothesised that the role played by interest rates could reflect the "pricing in" of oil shock effects by forward looking financial markets or delays in capital investment and balance sheet effects due to oil price uncertainty. Jacquinot et al (2009) explore the links between oil prices and inflation in the euro area using a Dynamic Stochastic General Equilibrium (DSGE) model which reflects the structure of the euro area energy markets. Their short and medium run analysis focused on inflation and its energy component. The key finding is that changes in oil prices are crucial for explaining inflation especially in the short-run. However, at longer horizons the impact on inflation is both complicated to understand and dependent on the initial shock implying that difficulties might arise when attempts are made to dissociate oil price increases from their origins.

18.3.4 Oil Price Shocks and the Macroeconomy in Developing Countries

Although emphasis with respect to research has been on net oil importing and industrial economies a few recent studies have focused on the effects of oil price changes on the macroeconomy of developing countries (Obadan et. al 2007). Semboja (1994) calibrates a Computable General Equilibrium (CGE) model to examine the effect of oil price changes on the Kenyan economy. The impact responses suggest that increasing oil prices lead to deterioration in both the terms of trade and trade balance. The consequence of this decline in output and the price index. Eltony and Al-Awadi (2001) found evidence that linear oil price shocks were important explanations for fluctuations in macroeconomic variables in Kuwait. Their results showed that government expenditure, which is the major determinant of economic activity in the country, was significantly influenced by shocks to oil prices. De Santis (2003) using a CGE model for Saudi Arabia, attempts an explanation of the fluctuations in oil prices via crude oil demand and supply shocks, and their impact on overall prices, output, profits and welfare. His results support the view that there is an overshooting effect on prices while output converges steadily on its long-run equilibrium level. The welfare effects on Saudi Arabia were found to be, compared to results in the CGE literature, very large suggesting that supply shocks to the oil market through increased production quotas will be avoided by the Saudi authorities.

Wakeford (2006) employs a political economy orientation which relies on historical analysis of the impact of oil price shocks on the South African economy. He concludes that the effects of recent shocks were only beginning to manifest in rising inflation and interest rates as well as a slowing down of economic growth. Swanepoel (2006) uses a VAR model to investigate the impact of external (oil price) shocks on the imports prices, producer prices and consumer inflation rates in South Africa. He finds a negative response of non-oil import prices to oil price shocks. For producer prices and consumer prices, the shock had significant positive (at least on impact) and insignificant positive (irrespective of the number of lags considered) effects, respectively. Raguindin and Reyes (2005) examined the effects of oil price shocks on the Philippine economy. Their impulse response functions for a linear specification of oil prices revealed that oil price shocks lead to prolonged declines in real GDP. In the non-linear VAR, however, oil price decreases play a greater role in fluctuations of model variables than oil price increases. They used data covering the period 1981-2003. Chang and Wong (2003) using quarterly data from 1978:1-2000:3, within a vector error correction model (VECM), on oil prices, GDP, consumer price index and unemployment rate find a marginal impact of oil price shocks on the Singaporean economy. Both impulse response and variance decomposition analysis provide reasonable basis for their conclusion that the adverse effect of oil prices on GDP, inflation and unemployment rates in Singapore was minimal. They however conclude that this impact, though small, should not be interpreted as negligible.

Anshasy et al (2005) investigated the effects of oil price shocks on Venezuela's economic performance from 1950-2001, employing general to specific modelling (VAR and VECM). They examined the relationship between oil prices, government revenues, government spending on consumption, investment and GDP and found two long-run associations consistent with economic growth and fiscal balance. These relationships were important for both long run performance and shorter-term fluctuations. Ayadi et al (2000) examined the effects of oil production shocks on a net oil exporting country, Nigeria. Using a standard VAR which includes oil production, output, the real exchange rate and inflation over the 1975-1992 period, the impact responses show that a positive oil production shock was followed by rise in output, reduction in inflation and a depreciation of the domestic currency. With the same methodology and set of variables (except that oil price replaces its level of production), Ayadi (2005) finds negligible responses of output, inflation and the real exchange rate following an oil price shock. Olomola and Adejumo (2006) examined the effects of oil price shocks on output, inflation, real exchange rate and money supply in Nigeria within a VAR framework. They found no substantial role for oil price shocks in explaining movements in output and inflation. Only the long-run money supply and the real exchange rate are significantly affected following a shock to oil prices. Farzanegan and Markwardt (2009) analyse the dynamic relationship between oil price shocks and major macroeconomic variables of the Iranian economy by applying a VAR approach. Their study points out the asymmetric effects of oil price shocks; for instance, positive as well as negative oil price shocks significantly increase inflation. They also find a strong positive relationship between positive oil price changes and industrial output growth. However, they surprisingly find only a marginal impact of oil price fluctuations on real government expenditures. Furthermore, the Dutch Disease syndrome through significant real effective exchange rate appreciation appears to be supported by the relevant data for Iran. Jbir and Zouari-Ghorbel (2009) study the oil prices – macroeconomy relationship by analysing the role of subsidy policy in Tunisia. The vector autoregression (VAR) methodology was employed to analyse the data over the period 1993:Q1 2007:Q3. The results of the model, using both linear and non-linear specifications, indicate no direct impact of oil price shock on economic activity. The shocks to oil prices affect economic activity indirectly. The major channel via which the effects of the shock are transmitted is the government's spending. Another insightful paper by Iwayemi and Fowowe (2010) examined the relationship between alternative measures of oil price shocks and economic performance indicators using Nigerian data.

18.3.5 Oil Price-Macroeconomy Relationship: Some Further Extensions

More recently and in addition to the plethora of aforementioned studies on the impact of oil prices on various macroeconomic variables, there are studies that have specifically modelled the impact of oil prices on stock prices (or stock returns). These studies include Jones and Kaul

(1996), Huang et al. (1996), Sadorsky (1999), Papapetrou (2001) and El-Sharif et al (2005). Jones and Kaul (1996) investigate the impact of oil prices on stock returns for the United States (1947-1991), Canada (1960-1991), Japan (1970-1991), and the UK (1962-1991) using simple regression models and find that oil prices have a negative effect on stock returns for all countries. Papapetrou (2001) uses a vector error correction model to examine the impact of oil price on stock returns in Greece for the monthly period 1989:1-1996:6. The variance decomposition analysis reveals that an oil price shock has a negative effect on stock returns. El-Sharif et al. (2005) investigate the relationship between the price of crude oil and equity values in the oil and gas sectors of the UK using a multi-factor model using daily data for the period 01/1/1989 to 30/6/2001. They find that a rise in oil prices raises the returns in the oil and gas markets. Sadorsky (1999) examines the relationship between oil prices and stock returns for the USA by using monthly data for the period 1947:1-1996:4. His variance decomposition analysis reveals that stock returns fall in the short-term in response to a rise in oil prices. Kaul and Seyhun (1990) regressed oil price volatility on the rates of return on assets listed on the New York Stock Exchange (NYSE) using annual data from 1949-1984. Other variables such as inflation, expected inflation and industrial production growth were also included. In keeping with expectations, insignificant coefficients were obtained on both inflation measures while a positive and significant coefficient was obtained for industrial production. Oil prices had a negative and statistically significant effect on stock market returns in the full sample. However, contrary to Hamilton (1983), this variable was insignificant in the sub-period 1949-1965 but significant in 1966-1984. Sakellaris (1997) examined the relationship between stock prices and excess returns in four 3-digit SIC industries over the 1959-85 period. Average excess returns, on an annual basis, of firms ranged from a low of -80 per cent to a maximum of +100 per cent. The average excess asset return for this group of firms stood at -13 per cent. Thus, in response to oil price shocks, some firm's assets values appreciate while those of others plunged culminating in a negative net effect on the average.

In a similar vein, there is a burgeoning literature on the nonlinear impacts of oil price shocks on economic activity. However, due to the differences in the degree of economic development, energy dependence, and the efficiency of energy use in each country, the level of economic tolerance and speed of economic response to a positive oil price change and its shock are expected to be different. Huang et al. (2005) employed the multivariate threshold autoregressive model (MVTAR) of Tsay (1998) to find the threshold value of an oil price change and its shock in each country. They arrived at a number of interesting conclusions. First, the most appropriate threshold value appears to vary according to an economy's degree of dependence on imported oil and its attitude towards adopting energy-saving technology. Second, an oil price shock has a limited impact on the economy if the change is below the critical threshold levels for a given economy. Third, if the change is above the threshold levels, it appears that the change in the oil price explains the macroeconomic variables better than the shock caused by the oil price. Finally, an oil price change above the threshold level explains the variation in GDP growth better than the real interest rate.

Huang et al. (2005) have also taken into consideration the economic tolerance of the impact of an oil price change and its shock based on different natural endowments in each country. However, only three countries (the U.S., Canada, and Japan) are included in the study and no statistical tests are used to verify its validity. More countries and more refined statistical techniques are needed to test the relationship between the economic tolerance emanating from the impact of an oil price change and the degree of dependence on crude oil.

Newer vintage empirical investigations on the oil shock-macroeconomy relationship have pushed the debate in the direction of non-linearity modelling. Such studies have more recently become the norm in empirical research circles. Here, we point to a few papers to buttress the unarguable notion that the discourse on the oil-economy nexus has grown in leaps and bounds. Nusair (2016) examined the impact of oil shocks on GDP in the Gulf Cooperation Council (GCC) economies using the non-linear ARDL approach. Overall, the results indicated the importance of asymmetries with positive price changes having larger impact than negative changes in absolute terms. Cologni and Manera (2013) had, in an earlier paper on GCC countries, found that oil shocks cause reallocation of economic activity between the private and public sectors. Also, Hamdi and Sbia (2013) focus their research on the Bahrain economy using annual observations spanning 1960 to 2010, and found oil shocks to affect economic growth via fluctuations in oil revenue on the one hand, and a significant contributor to government finances, on the other. Melichar (2016) investigated the influence of diverse fuel price shocks on GDP at the state level for the United States of America. It is clear to surmise from the findings that distinct measures of energy price shocks produced divergent patterns of impulse responses implying that more accurate modelling can be achieved with the deployment of alternative energy price series.

18.4 Conclusion

This chapter attempts a systematic review of the literature related to the macroeconomic impacts of oil price shocks. Theoretically, channels such as real balance effect, income transfer from oil importers to oil exporters, potential output movements, Dutch Disease, sectoral shifts as well as uncertainty and the attendant postponement of investment decisions were explicated in turn. On the empirical front, detailed assessment on issues such as asymmetry and non-linearity were documented. Also, the evidence for both industrialised as well as developing economies was probed. It is envisaged that the research covered in this survey provided a useful compendium of the evidence base which should encourage economists to further probe into the alternative ways through which oil price shocks work to affect macroeconomic aggregates.

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