The Ownership of Oil, Democracy, and Iraq's Past, Present, and Future

Razzak, Weshah

Massey University PN

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W A Razzak

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School of Economics and Finance, Massey University, New Zealand

Abstract

Effectively, the government of Iraq, not the Iraqi people, owns the oil wealth; the oil industry is a government monopoly. We make the case against such monopoly and for a competitive oil industry. We estimate the share of oil in real output to be relatively large, and show that most macroeconomic variables are highly associated with the price of oil. This oil dependence is consistent with the rentier economy. In addition, the elasticity of oil production with respect to global oil consumption is greater than one. Such monopolistic industry would not be suitable for the future in a zero carbon state of the world. We estimate the dynamics of real oil prices and quantity; human capital, the stock of capital, labor, and real GDP, and conduct stress tests by producing dynamic stochastic projections for the period from 2020 to 2050 under the baseline and two adverse counterfactual scenarios. Permanent income is higher under a competitive scenario than a monopolistic one. A quick transfer of ownership of oil to the Iraqi people should guarantee a competitive market economy, a functional democracy, and a better future for the Iraqis.

Keywords Iraq, oil share, private ownership, FM-OLS, VAR, Stress testing

JEL Classifications C1, C53, D24, E17, Q3, Q34

1. Introduction

Since its inception in March 1921, oil played a major role in the story of Iraq's past, present, and future.[1] Iraq has a relatively vast oil wealth. Figure (1) plots the proven reserves in a number of countries including Iraq. Oil wealth has been under total control of successive autocratic governments all that time. Prior to 1970, successive governments contracted multinational oil firms for the exploration, the production, and the marketing of oil. The governments used oil revenues to provide services, invested in education, health, roads, power stations, drinking water, dams, and maintained a large bureaucracy among more public spending. Oil revenues have been a state business, and the people had no say in public spending because they paid no or very little taxes, but mainly because Iraq was not a democracy. The autocratic government nationalized oil in 1970, which gave it absolute dictatorial powers over the production, the marketing, the revenues of oil, public spending, and over all political decisions.

In 2003, the U.S. invaded Iraq and smashed the political system. The Polity project recognizes Iraq as a democracy now. The irony is that the elected political elite continue to have total control over oil wealth. The democratic constitution's two articles confirm it. Article 109 of the constitution states,

"Oil and gas is the property of all Iraqi people in all the regions and provinces."

Article 110, says,

"The federal government and the governments of the producing regions and provinces together will draw up the necessary strategic policies to develop oil and gas wealth to bring the greatest benefit for the Iraqi people, relying on the most modern techniques of market principles and encouraging investment."

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[1] Churchill announced the creation of Iraq in Cairo in 1921. Although it is not entirely clear that British involvement in Iraq early in the 20th century was only about oil, Colonel A. T. Wilson, the English acting ruler wrote in his later memoirs that in late 1918 "oil is the only immediately available asset of the Occupied Territories, the only real security…,"Catherwood (2005). "In 1944, then-President Roosevelt showed the British ambassador a rough sketch he had made of the Middle East. Persian oil, he told the ambassador, is yours. We share the oil of Iraq and Kuwait. As for Saudi Arabian oil, it's ours," the American historian Daniel Yergin described the exchange, see Shah (2004, p. 14) and Vitalis (2002). That said, oil has been a curse for Iraq.

The multinational oil companies have returned to exploring, producing, and selling the oil more than before 1970. The Constitution gives the government the right to control, manage oil revenues, and redistribute the *rent* in a fashion similar to what has been happening in the past 85 years or so; i.e., maintaining the old rules under the old assumptions of government agent's benevolence and omniscience. Boettke *et al*. (2006) and Buchanan (1969, p. 77-92) questioned such assumptions.

The economic institutions from 1958 to 2003 were functional albeit inefficient socialist structures. Iraq became a democracy in 2003; however, the institutions have been both dysfunctional and inefficient. The government of Iraq's White Paper (2020) explains the economic inefficiency.[2] Political and economic institutions matter for economic growth and prosperity (e.g., Acemoglu *et al.* 2005). However, oil-dependent rentier economies, whether democracies or not, experience severe problems, after negative oil price shocks (negative terms of trade shock) because their oil revenues fall below the stubbornly high expenditures (i.e., budget deficits), exports, which is mostly oil, falls below their typically high imports (i.e., trade account deficits), and saving falls below investment spending (i.e., current account deficits). The adverse oil price shock in March 2014 caused a twin deficit and costly external borrowing.

We study the data from 1970 to 2019; however, we are concerned more with the *future* of Iraq, the next 30 years. The objective of this paper is to make the case against the government oil monopoly and for market competition because we believe there would be tremendous pressures on the Iraqi economy in a zero-carbon state of the world, where market institutions would have better outcomes. We also believe that total government control over oil wealth is inconsistent with, and not conducive for, democracy.

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[2] It says, "The imbalance in the economic structure is the sum of accumulated public and economic policies since the 1970s – employing the growing oil revenues as a tool to amplify the role of the state in the economy and society through expanding: (i) the public sector; (ii) direct and indirect control of the economy by the state; and (iii) the rentier role of the state in public service delivery to the society. Opportunities have existed to change this course in 2003. However, the new political regime wasted and misused those opportunities, as it was unable to create a free and diversified economy in accordance with the principles approved by the constitution, and continued to apply the previous philosophy, with the emergence of new power centers, and trends towards…etc."

In principle, there are some global public and government commitments to reach zero-carbon in 2050. Such expectations drive almost all economic decisions about resource allocations, spending, savings, etc. There are reasons to expect the global demand for oil to decline permanently in the next 30 years or so.[3] The historical data show that Iraq is an oil-dependent-rentier economy. Most of the macroeconomic variables are highly associated with oil price. We estimate the share of oil in real output to be nearly 60 percent. In addition, its oil production is very sensitive to global oil consumption; the estimated elasticity is 1.5. Oil prices are also highly sensitive to changes in global oil consumption; the estimated elasticity of oil price with respect to global oil consumption is 0.77.

We accomplish our objective by (1) estimating an unrestricted VAR using a sample from 1970 to 2019, which summarizes the dynamic of real GDP, capital, labor, human capital and oil revenues, and making baseline dynamic stochastic projections of real GDP over the period 2020 to 2050, i.e. permanent income. (2) Conduct stress tests under two counterfactual scenarios. We assume that the hypothetical shock in both counterfactual scenarios is a severe, 40 percent annual decline in global oil consumption due to climate change. Such shock reduces both the price and the quantity of oil. We examine two different responses to the shock, a government oil monopoly and a competitive oil industry. In theory, when faced with a negative demand shock, the monopolist cuts oil production (quantity) more than the producers in a competitive market do in order to prevent the relatively higher monopolist price from falling to the market's level. The

[3] Global demand for hydrocarbon products is expected to fall between now and 2050. The U.S. government introduced more than 4 trillion dollars in subsidies to sectors that are affected by the cut in hydrocarbon, International Renewable Energy Agency (IRENA). See the IAE latest flagship report (2021), which says, "By 2035, there are no sales of new internal combustion engine passenger cars, and by 2040, the global electricity sector has already reached net-zero emissions." Investments in alternative energy are also trending up, including in China, see Bloomberg NEF Clean Energy Investment Trends (2020). The Economist magazine May 22, 2021 edition has a story entitled, "The Green Meme, a Green Bubble? We Dissect The Investment Boom," where they show that "Since the start of 2020 our portfolio, when companies are equally weighted, has more than doubled; when firms are weighted by market capitalization, our portfolio has jumped by more than half. The reason for that difference is that many green firms are small—their median market capitalization is about $6bn…. The smallest 25% of the firms have risen by an average of 152% since January 2020. Firms that derive a greater share of their revenue from green activities, such as EV-makers and fuel-cell companies, have also outperformed. The greenest 25% of firms saw their share prices rise by 110%."

competitive producers are price takers. Conversely, they would take a lower price of oil when demand falls. (3) We make baseline dynamic stochastic projections of real GDP over the period 2020-2050, i.e. an estimate of permanent income. (4) Then we make dynamic stochastic projections of real GDP under the scenarios of a government oil monopoly and under a competitive oil market. (5) We show that the deviations of real GDP dynamic stochastic projections from the baseline under the former are significantly lower than the deviations under the latter. Hence, higher permanent income and higher welfare are associated with a competitive oil market.

We argue that the future of Iraq's democracy under the current political and economic institutions, particularly the ownership of oil, is uncertain. Public policy, institutional and cultural changes needed to carry the country into the 21 century and to ensure the survival of democracy. Optimally, there should be an immediate transfer of oil wealth from the government to every Iraqi citizen, which would end the government monopoly on oil and establish a competitive oil industry owned by the people.

We provide the empirical evidence in the next section. Section (3) provides an argument for the people's ownership of oil and an end to government control based on the evidence we present. Section (4) is a conclusion.

2. The Rentier Economy and Oil Dependency

2.1 The actual historical data

The Iraqi economy has been very dependent on oil since 1921. Most importantly, the government controls oil wealth, i.e., a government oil monopoly. As a result, Iraq has been a typical rentier economy. Vast proven oil reserves (see figure 1) notwithstanding, the Iraqi people have not been wealthy. The data are not available from 1921; however, the situation did not change after the establishment of democratic political system in 2003 either. Figure (2) plots the percentage of urban population living in slumps (World Bank Poverty Statistics). Poverty does not seem to have declined over time.

In 1990, a year after the end of the long Iraq-Iran war, there were 3 million Iraqis living in slums (16.9 percent of the population). The number increased to about 15 million people in 2005, a staggering 52.8 percent, and to more than 17 million people in 2014, 47.2 percent. These statistics suggest that Iraq is an oil-rich country and poor people.[4]

The typical characteristics of the rentier economy i.e., high oil rent in this case, are widespread corruption, poverty, and inefficiency, which are indications of wrong incentives structure, weak institutions, and bad economic policies. According to Transparency International (2021), Iraq is a highly corrupt country. It ranks 160 / 180. Figure (3) plots the Conference Board (2020) data of total factor productivity growth. There has been no growth. There are two odd positive observations between 2003-2005, when Iraq was under a military invasion and fighting was taking all over the country. The only possible interpretation of these data is that the growth in those two years was a result of much lower productivity the years before. Figure (4) plots the World Bank data of oil rent as a percent of GDP, which is relatively high. There are a number of theories for the Resource Curse. For evidence in the Arab, oil-producing countries see for example, Elbadawi and Gelb (2010), Elbadawi, and Soto (2012).

Most intriguing is that most of the key macroeconomic variables from 2003 to 2019 are highly correlated with the price of oil (in log differences).[5] Figures 5-11 show very high positive correlations between the growth rates of the price of oil on one hand and the growth rates of nominal GDP, inflation, the growth rate of revenues, expenditures, savings, and the current account balance. The correlation is negative with the rate of growth of gross debt.

The collapse of the oil price in March 2014 resulted in a sharp and sudden budget deficit, which reduced social welfare payments, a difficulty to pay wages, salaries, and pensions

[4] The World Bank Gini Index estimate for Iraq was up to 2012, and it showed upward slope over time. The last observation was 29.5 percent.

[5] The real price of oil measured by the USD price of oil deflated by the U.S. CPI index (2017=100), and the nominal price of oil are highly correlated during the period 2003 to 2019 because of the lack of inflation. The growth rates are nearly identical.

to millions of Iraqis, and high unemployment especially among young people. The government's White Paper (2020) stated, "*The official figures for unemployment are 13.8% for 2018, and youth unemployment for those between (15-24) years is 27.5%. It is likely that these percentages have increased in the recent period."* Figure (12) plots the budget deficit and current account as percent of GDP since the invasion.[6] The popular uprising in October 2019 was a response to the dire economic conditions. Then COVID-19 delivered the final blow; it exposed the weakness of the Iraqi institutions. Although statistics are unreliable, the rate of vaccination in Iraq does not exceed 20 percent by the best estimates. The country has been without regular electricity supply since 2003. The government's White Paper (2020) provides some technical figures about this failed sector. The health and education systems are dysfunctional. The list of socioeconomic problems is long. Next, we estimate the share of oil in GDP.

2.2 Estimating the share of oil in real GDP

The Cobb-Douglas production function is a typical microeconomic model often used in macro modeling of production real GDP because it is consistent with the Statistics of the National Account data because the shares of capital and labor are gross operating surplus / nominal GDP and compensations to employees / nominal GDP ratios respectively. Because the SNA data are not readily available for Iraq, we estimate the shares by estimating the following log-linear Cobb-Douglas production function:

$$lnY_t = \alpha_1 \ln K_t + \alpha_2 \ln L_t + \alpha_3 lnH_t + \alpha_4 lnq_t^o + e_t, \qquad (1)$$

where Y_t is real GDP; K_t is the real stock of capital; L_t is labor; H_t is the human capital stock (based on the average years of schooling and the Minceran return to education); q_t^o is the real production of oil in barrels; and e_t is an error term with the usual classical

[6] The current account deficit is a more serious problem under a fixed exchange rate than a floating currency system. The deficit could threaten the peg. Without a huge amount of foreign reserves, traders could attack the currency. The remedies are limited and hard. They include external borrowing in foreign currency; devaluation; completely floating and abandoning the peg like the European Monetary System in the 1990s; or hope for the oil price to increase again. Alternatively, the government may think of reducing public sector wages and pensions.

assumptions. The first two explanatory variables, i.e., capital and labor, needs no further explanation. Human capital is an intangible capital; e.g., Mankiw *et al.* (1992) explain the importance of the inclusion of human capital in the Solow model production function. The last variable, i.e. oil production, is rather the most important in the case of oil-producing countries and in Iraq in particular, because oil revenues are used in the creation of capital, labor, and human capital. Stiglitz (1974) for example, measures it as the ratio of resource utilization to the stock of natural resources, while Solow and Wan (1976) only use the flow of oil. The appendix has the data sources and measurement units.

2.2.1 Testing for unit root

Before we estimate equation (1), we examine the time series properties of the data, i.e., the nature of trend and cointegration. We assume that the Cobb-Douglas production function equation is correctly specified. Figure (13) plots the data. Visually, all variables exhibit trends, Real GDP fell sharply during the Gulf War I in 1990, and again upon the U.S. led invasion in 2003. Oil production plummeted in 1980 (the Iran – Iraq war), in 1990 (Gulf War I), and in 2003-2004 upon the U.S. invasion.[7] We test for trend and unit root using a number of commonly used tests, e.g., the Dickey - Fuller (1979) – Augmented Dickey-Fuller (Said and Dickey, 1984), the GLS (Elliot, Rothenberg, and Stock, 1996), and Phillips-Perron (1988). We also used the Ng – Perron (2001) test, which is a modified Phillips – Perron, two test statistics Z_α and Z_t, Bhargava (1986), and finally the ADF with breakpoint.

In applying these tests, we considered a number of different specifications for robustness. We run the regressions without a constant, with a constant, and with a constant and linear trend. The parameter estimates under these specifications have different distributions. We also used a variety of Information Criteria – e.g., the AIC, SIC, HQ (and some

[7] The trend could be either deterministic or stochastic. A time series, which exhibits a deterministic trend, is trend-stationary, i.e., I(0) after de-trending it. A time series that exhibits a stochastic trend – i.e., a unit root, is said to be integrated of order (1), hence, I(1), and is differenced-stationary because the first difference operator removes the unit root, hence renders it stationary, I(0).

modified versions of these criteria) to determine the lag structure.[8] The outputs of these tests are quite large, therefore, we do not report these tables; however, they are available on request. None of these tests rejects the null hypothesis of unit root. We have to emphasize that these tests are weak – i.e., have low power against stationary alternatives, i.e., do not reject the null too often. There is a very large literature on the power of unit root tests.[9] Nonetheless, economists seem to agree that variables such as real GDP, capital, labor and human capital, are likely to exhibit unit root (the trend is stochastic). We find the coefficient of the deterministic trend regressor only marginally significantly different from zero, which probably gives confidence in the unit root case.[10]

2.2.2 Testing for cointegration

Having found evidence of unit roots, next we test whether, or not, these five variables in equation (1) share a long run common trend, i.e., cointegrated – that is a stationary linear combination of the five variables. Because this is a multivariate case, we use the Johansen's Maximum Likelihood Test, Johansen (1988, 1991 and 1995) and Johansen and Juselius (1990), λ- max (or maximum eigenvalue test) and the Trace statistics. We assume that there is no deterministic trend in the data. We fit an intercept only (without trend) in the cointegration relationship. The MacKinnon – Haug – Michelis (1999) P values indicate that there is at most one significant cointegration relationship. The Trace test suggests more than one cointegration relationship. The P values are 0.0012, 0.0296, 0.1718, 0.1038, and 0.0851 for 0, at most 1, at most 2, at most 3, and at most 4 cointegration relationships. The P values of the λ- max test are 0.0190, 0.0828, 0.6654,

[8] The bandwidth parameter is l for the kernel-based estimators of f_0, which is the Newey-West (1994). They use AR1. So we choose the lag length p to minimize these criteria AIC -2 $\left(\frac{l}{T}\right) + 2k/T$); the SIC $-2\left(\frac{l}{T}\right) + kln(T)/T$; HQ $-2\left(\frac{l}{T}\right) + 2kln(\ln(T))/T$. The modifications add $\tau$to every k and $\tau = \alpha^2 \sum_t y_{t-1}^2 / \sigma_\varepsilon^2$.

[9] In addition, Stock (1991), Cochrane (1991), Rudebusch (1993), and Christiano and Eichenbaum (1990) argued that these tests could not distinguish between a root of one and 0.98 for example.

[10] Unlike all other tests for unit root, the KPSS test's null hypothesis is I(0), not I(1), therefore we cannot compare the power of the test to others.

0.3419, and 0.0851 respectively. Therefore, there is at most one sensible cointegration relationship between$ln\ (P_t^o)$; $ln\ (H_t)$; $ln\ (K_t)$; $ln(L_t)$ and $ln\ (Y_t)$.

2.2.3 Estimating the production function

Having tested the time series properties of the data, now we are ready to estimate the production function. Cointegration suggests that we could estimate the production function using an OLS in log-levels and Fully Modified OLS, i.e., FM-OLS (Phillips and Hansen, 1990), which is highly efficient, and accounts for endogeneity and serial correlation in the residuals.[11] Table (1) reports the FM-OLS results of the estimated shares using a sample from 1970 to 2019. We report two regressions, one with human capital as an additional factor and one without. The results indicate that the share of oil in real GDP is significantly large, 0.51 to 0.55. The share of the stock of capital is high, 0.30 to 0.40. However, the share of labor input is lower than capital and oil, 0.14 when human capital is included, and increases to 0.50 when human capital is not included because of the multicollinearity. The correlation between these two variables is very high, 0.98 percent with a P value of 0.0000; therefore, the regression without human capital is more realiable. For FM-OLS estimator in particular, $R^2$is usually high because the explanatory variables include many lags, which induce over-fitting.

2.3 Estimating the relationship between oil production and global oil consumption

Similar to most OPEC countries, because oil is the only source of income, the Iraqi economy is vulnerable to oil shocks. If global demand for oil declines, the government of Iraq cuts oil production, otherwise, the price will plummet to a level below the monopolist price, and that would have a significant adverse effect on revenues. To estimate the responsiveness of Iraq's oil production to global oil consumption (as a proxy for global demand), we test the null hypothesis "no cointegration" between Iraq oil

[11] Dynamic – two-sided – OLS (Phillips – Loretan, 1991, Saikkonen 1991, and Stock and Watson, 1993) could not be used because the sample is short, which would not allow us to search for the optimal lag and the width of the kernel to correct for the standard errors.

production and global oil consumption using the bivarite Engle-Granger (1987) test. There are typically three steps. First, we regress the log of Iraq oil production on log global oil consumption using OLS. Table (2a) reports the results.

Second, we output the residuals from the above regression and test them for unit root using the ADF test. If the null hypothesis of a unit root is rejected then the two variables are cointegrated, i.e., there is a stationary linear combination of these two variables. Table (2b) reports the results. We reject the unit root in the residuals; hence, we reject the null hypothesis that oil production and global oil consumption are not cointegrated. Thus, the two variables share a common long run trend. Finally and most importantly, we test for cointegration by estimating an error-correction equation and test the hypothesis that the error correction term – i.e., the lagged residuals from the first regression, is zero. Table (2c) reports the results. The error correction term is statistically significantly different from zero. This result confirms the existence of the long run relationship.

2.3.1 Estimating the responsiveness of oil production to global consumption

Given that Iraq's oil production and global oil consumption are cointegrated, we then estimate the point elasticity of Iraq's oil production with respect to global oil consumption to be 1.5. It suggests that a one percent increase (decrease) in global oil consumption leads to 1.5 percent increase (decrease) in Iraq's oil production. Table (3) reports the FM-OLS estimator's results. Recall that FM-OLS estimates the levels and the dynamics jointly.[12] There is a relationship between lagged values of the growth rates of the explanatory variables, capital, labor, human capital, and oil production, and the dependent variable, i.e., current real GDP. Thus, the estimated production function by FM-OLD indicates that there is a strong relationship between the level and the growth rate of real GDP with the level and the growth rate of oil production in Iraq. Figure (14) plots the strong association between growth-rates of these two variables.

[12] The regression of Y on a vector of explanatory variables x looks like
$y_t = \alpha + \beta x_t + \delta_i \Delta x_{t-i} + \rho(y_{t-1} - \alpha - \beta x_{t-1}) + u_t$.

The Iraqi economy, particularly oil, has been fully state-controlled since 1958. A higher (lower) oil production increases (decreases) revenues at any given price of oil, which increases (decreases) spending on education from grade school to graduate school and pays for training of the labor force. Thus, human capital increases (decreases). Similarly, an increase (decrease) in capital spending on infrastructure projects such as power generations, roads, schools, and hospitals etc. increases (decreases) real GDP and labor productivity. Human capital increases (decreases) real GDP, and productivity via its effect on technical progress growth. Employment also increases (decreases) in response.

2.4 Counterfactual scenario

2.4.1 Theory

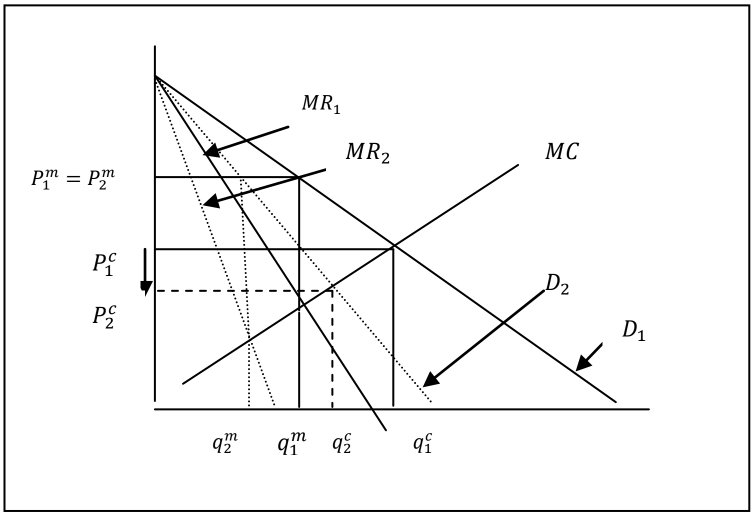
The scenario involves a severe decline in global oil consumption by 40 percent annually from 2020 to 2050. The objective is to stress testing the Iraqi economy. We examine the dynamic stochastic projections of real GDP over the period 2020 to 2050, i.e., permanent income under two different oil regimes, a government oil monopoly and a competitive oil industry.

Sketch (1) illustrates the theoretical changes in prices and quantities under the monopolistic and competitive case scenarios.[13] The monopolist's price $P_1^m$and quantity $q_1^m$are determined by the intersection of the marginal revenue curve (MR_1) with the marginal cost (MC). The competitive equilibrium occurs at the intersection of demand and the MC (supply) at a lower price $P_1^c$and a higher quantityq_1^c. The sudden and severe decline in global oil consumption causes the demand curve $D_1$to shift down to D_2. Depending on the magnitude of the shift in, and the elasticity of, the demand curve, the government oil monopoly may be able to reduce the quantity significantly, from $q_1^m$to q_2^msuch that the price of oil received before the shock remains unchanged, i.e., $P_1^m = P_2^m$.

[13] Since the monopolist sets the price, where the marginal revenue curve intersects the marginal cost, and cost is a function of quantity, the profit function is written in terms of quantity. $\pi = P(q).q - C(q)$. Maximized profit is $0 = \partial q = P(q) + qP^{'}(q) - C^{'}(q)$.

Even if the monopolist price declines below P_1^m it must remain above the market price. The competitive producers, however, take the lower market price P_2^c and produce q_2^c.

Sketch (1)
Government oil monopoly and competitive oil producer



2.4.2 *The design of the counterfactual scenarios*

The objective is measure the change in *permanent income*, i.e., expected future income, before and after a severe adverse global oil demand shock under two scenarios. The first scenario is that the oil industry in Iraq is a government monopoly as it has been. The second scenario is that the oil industry is a competitive market industry. As shown above, the responses, i.e., changes in quantity and prices, are different.

First, we summarize the dynamics of the variables ($ln(P_t^o q_t^o)$, lnH_t, lnK_t, $ln\mathrm{L_t}$, lnY_t) by estimating a model using the actual data from 1970 to 2019. Second, we solve the model. Third, we make baseline dynamic stochastic projections from 2020 to 2050. Third, we re-estimate the model using the monopolist response to the shock, which is a 40 percent annual decline in global oil consumption from 2020 to 2050. The monopolist responds by reducing q_t^m. Previously, we estimated that a 1 percent decline in global oil consumption induces a 1.5 percent reduction in the quantity of oil produced. Therefore, the monopolist's reduction in oil production is 60 percent annually from 2020 to 2050. There is no change in the price. Fourth, we solve this model and make new dynamic stochastic projections from 2020 to 2050. Fifth, we compute the deviations of the monopolist's dynamic projections from the baseline projection.

Sixth, we repeat all the steps above under the assumption of a competitive oil market. We could estimate the response in oil prices to a decline in global oil consumption, but we do not know by how much the competitive market oil production will decline in response to the shock because Iraq's production has been strictly under a state monopoly. As shown in the Sketch above the quantity reduction q_1^c to q_2^c is smaller than q_1^m to q_2^m, therefore, we make an assumption and conduct a sensitivity analysis.

2.4.3 Two estimation methods

2.4.3.1 Vector Autoregression, VAR

Before we estimate the dynamics, we test the null hypothesis that the variables $ln(P_t^o q_t^o)$, lnH_t, lnK_t, $ln\mathrm{L}_\mathrm{t}$, lnY_t are not cointegrated. We use the Johansen test to test. The only difference from the previous test is that the vector includes the price of oil P_t^o in the form of a product $P_t^o q_t^o$, i.e., oil revenues. We test two specifications, a model with no trend and a model with a linear trend. In both regressions, we have an intercept only in the cointegration relationship. The MacKinnon – Haug – Michelis (1999) 5-percent level P values of the Trace statistic are 0.0001, 0.0022, 0.0327, 0.0230, and 0.0268. The P values of the λ - max statistic are 0.0203, 0.0301, 0.4434, 0.1813, and 0.0268. These P values may indicate that there exist two meaningful cointegration relationships only. Given that the variables are cointegrated, there are two possible ways to estimate the dynamics. One is an unrestricted VAR and the other is a restricted VECM.

First, we begin with the *unrestricted* VAR is in the standard form (Hamilton (1994, p. 291) to stress testing the economy using the counterfactual scenarios described above.[14]

[14] The Central Bank of Iraq Financial Stability Report provides linear OLS regressions at most. They do not provide dynamic stochastic projections as we did here.

$$y_t = A_1 y_{t-1} \cdots A_p y_{t-p} + \varepsilon_t, \quad (2)$$

where $y_t = (y_1, y_{2t}, \cdots y_{kt})'$ is a $k \times 1$ vector of endogenous variables. There is also an exogenous constant term, $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t}, \cdots \varepsilon_{kt})'$ is a $k \times 1$ vector of white-noise innovations with $(\varepsilon_t) = 0$; $E(\varepsilon_t \varepsilon_t') = \sum \varepsilon$, and $E(\varepsilon_t \varepsilon_s') = 0$ for $t \neq s$.

Let $(pk + d) \times 1$ vector:

$$Z_t = (y_{t-1}' \cdots y_{t-p}')',$$

And write the VAR is a compact form:

$$Y_t = BZ_t + \epsilon_t \;. \quad (3)$$

The vector y includes $(ln(P_t^o q_t^o), lnH_t, lnK_t, ln\mathrm{L_t}, lnY_t)$ and ϵ is $(\epsilon_{1t}, \quad \epsilon_{2t}, \quad \epsilon_{3t} \cdots \epsilon_{5t})$ both, are matrices of the endogenous variables are the innovations. P_t^o is oil price, q_t^o is oil production (i.e., oil revenues), H_t is human capital, L_t is labor measured by working age population (15-64 year), and Y_t is real GDP. The matrices $B = (A_1, \quad A_{2,} \quad A_{3,} \cdots A_5, \text{constant})$ and $Z = (Z_{1t}, \quad Z_{2t}, \quad Z_{3t} \cdots Z_{5t})$ are the matrix of coefficients and matrix of regressors respectively.

We estimate a VAR ($k = 5$) from 1970 to 2019.[15] We test for the number of lags using a variety of Information Criteria (sequential modified LR tests, final prediction error, AIC, SIC, and HQIC), and a Chi-squared lag exclusion test. We found that the Information Criteria suggest two lags, thus, ($p = 2$). The chi-squared test for the hypothesis that lags equal are *jointly* zero is rejected with p values, 0 for the first lag and the second lag. The test for the first lag and the second lag *in each equation* also rejected the hypothesis,

[15] Thus, the product of oil production and oil price depends on its own lags only; human capital depends on its own lags and lagged oil production, etc. and real GDP depends on its own lags and the lags of all other variables in the system.

except for the second lag in the real GDP equation, which is only marginally significant. The residuals are serially uncorrelated and homoskedastic.[16]

Figure (15a) is the variance Cholesky decomposition with the order of the variables in the VAR as specified above. The standard errors are estimated using a Monte Carlo with 10000 repetitions. Figure (15b) focuses the light on the most important variances of the variables due to the product $P_t^o q_t^o$ (oil revenues). The variance of human capital due to $P_t^o q_t^o$ is close to zero; the variance of the capital stock is more than 60 percent; and the variance of working age population variance is nearly 20 percent. However, the variance of real GDP due to $P_t^o q_t^o$ is more than 60 percent. Figure (16) plots the *generalized impulse response functions*, Pesaran and Yongcheol (1998), which conveys the same information of the variance decomposition.[17]

Second, we solve the model (see technical appendix for description of the solver). Third, we generate *baseline* dynamic stochastic projections of the endogenous variables from 2020 to 2050. We plot the mean projections of the 1000 iterations and their standard errors in figure (17).

Fourth, to conduct the stress test we re-estimate the VAR under the counterfactual assumption, whereby we replace the variable $P_t^o q_t^o$ by the monopolist's response to the severe adverse shock. The monopolist reduces q_t^o by 60 percent annually from 2020 to 2050, without a change in the price. Thus, we normalize P_t^o to one from 2020 to 2050. We re-estimate the VAR from 1970 to 2019, solve it, and generate dynamic stochastic

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[16] We test the residuals serial correlation using the LM test. The null hypothesis of no serial correlation at lag 1, 2, and 3 could not be rejected with P values 0.2816, 0.2949, and 0.8143. The null hypothesis at lag 1 to 3 also cannot be rejected with P values 0.2816, 0.1263, and 0.0980. The joint chi-squared test for the null hypothesis of heteroskedasticity (levels and squares) has a P value of 0.1055. All roots are inside the unit circle, i.e., a stable system.

[17] We used different orders of the variables in the VAR and found no significant changes in the results.Further, Koop, Pesaran and Potter (1996) and Isakin and Ngo (2020) show that when models are linear, traditional IRFs and variance decomposition.

projections from 2020 to 2050. Finally, we compute the deviations of these projections from the baseline projections.

Fifth, we repeat all the steps above under the counterfactual scenario of a competitive oil market, whereby both the price of oil and the quantity of production decline in response to the severe adverse demand shock. We estimate the responsiveness of the price of oil to changes in global oil consumption. Table (4) reports the regression result. A one percent increase (decrease) in global oil consumption increases (decreases) the oil price by 0.77 percent. However, we do not know by how much the quantity of oil production would be reduced under the competitive oil industry scenario. Since $q_2^m < q_2^c$, therefore, we use a sensitivity analysis and simulate three values, a reduction of 10, 20, and 30 percent in the quantity of oil produced in response to a 40 percent decline in global oil consumption. We re-estimate the VAR under these scenarios, solve the model, and generate three dynamic stochastic projections of real GDP from 2020 to 2050.

Figure (18) plots the deviations of the dynamic stochastic projections of real GDP 2020-2050, i.e., permanent income, from the baseline under the cases described. It shows that deviation of permanent income from the baseline projection falls significantly more under the oil monopoly scenario.

2.4.4 *Vector error correction, VECM*

For robustness, we redo the same *unrestricted* VAR steps above using VECM. See Hamilton (1994, p. 580) for details. VECM is *a restricted* VAR. The VECM has cointegration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge to their cointegrating relationships while allowing for short-run adjustment dynamics. The cointegration term is the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments.

$$lny_t = \theta_1 \Delta lny_{t-1} + \theta_2 \Delta lny_{t-2} \cdots \theta_{p-1} \Delta lny_{t-p+1} + \alpha + \rho lny_{t-1} + \varepsilon_t \qquad (4)$$

The vector y_t is $(ln(P_t^o q_t^o), lnH_t, lnK_t, ln\mathrm{L_t}, lnY_t)$. $\rho \equiv \Phi_1 + \Phi_2 + \cdots + \Phi_p$ and $\theta_s \equiv -[\Phi_{s+1} + \Phi_{s+2} + \cdots + \Phi_p]$, where $s = 1, 2, \cdots p - 1$. Subtracting lny_{t-1} from both sides of equation (4) gives:

$$\Delta lny_t = \theta_1 \Delta lny_{t-1} + \theta_2 \Delta lny_{t-2} \cdots \theta_{p-1} \Delta lny_{t-p+1} + \alpha + \theta_0 lny_{t-1} + \varepsilon_t, \qquad (5)$$

where,

$$\theta_0 \equiv \rho - I_n = -(I_n - \Phi_1 - \Phi_2 - \cdots - \Phi_p) = -\Phi(1). \qquad (6)$$

The vector y_t has h cointegrating vectors. In our case 2 vectors as tested earlier. Substituting $\Phi(1) = BA'$, and equation (6) in (5) gives:

$$\Delta lny_t = \theta_1 \Delta lny_{t-1} + \theta_2 \Delta lny_{t-2} + \cdots + \theta_{p-1} \Delta lny_{t-p+1} + \alpha - BA' lny_{t-1} + \varepsilon_t. \qquad (7)$$

As before, $Z_t \equiv A' lny_t$, whereby Z_t is $(h \times 1)$ vector. Therefore, (7) becomes:

$$\Delta lny_t = \theta_1 \Delta lny_{t-1} + \theta_2 \Delta lny_{t-2} \cdots \theta_{p-1} \Delta lny_{t-p+1} + \alpha - BZ_{t-1} + \varepsilon_t \qquad (8)$$

We first estimate the VECM, solve it, and generate *baseline* dynamic stochastic projections of real GDP over the period 2020 to 2050.[18] Re-estimate the system under the assumption of a government oil monopoly, and generate dynamic stochastic projections of real GDP over the period 2020 to 2050. Compute the deviations from baseline. Repeat the same steps under the assumption of a competitive oil industry and compute the deviations from the baseline. Figure (19) plots the deviations of the dynamic stochastic projections of real GDP 2020-2050, i.e., permanent income, from the VECM baseline projections. As in figure (18), the monopolist's permanent income deviations from baseline decline sharply compared with the deviations under the competitive oil market scenario.

[18] We impose cointegrating relationships because we tested for it earlier. An intercept (no trend) is fit in the model. The lag structure is tested to be 2 lags. The VEC Granger causality / block exogeneity Wald test are distributed Chi-squared with the P values of the five equations of the system being 0.1024, 0.0275, 0.2314, 0.8094, and 0.6931 for the oil revenue equation, human capital, stock of capital, working age population, and real GDP respectively. We cannot reject the null. Three unit roots imposed on the system, and all other roots seem to be inside the unit circle, i.e., a stable system.

3. Needed: a competitive oil industry for the future

We have shown that the Iraqi economy has been oil-dependent since the creation of the country. Oil production shares a long run common trend with, and highly sensitive to, global oil consumption. There is evidence that the world is slowly moving away from hydrocarbons in the 21 century, i.e., zero-carbon by 2050, which makes the Iraqi economy very vulnerable. Stress tests to measure the response of the economy to a severe adverse shock to global oil consumption show that future real GDP dynamic stochastic projection from 2020 to 2050, i.e., permanent income, falls significantly under the current government oil monopoly. Conversely, no decline in permanent income is shown under the assumption of a competitive oil industry.

In addition to the political and policy problems described earlier, the Iraqi government's White Paper (2020) points to economic and demographic pressures on the government's finances. The trend in public sector's employment reached more than 3 millions in 2020, 30 percent of total labor force. The wage bill is approximately 15 percent of GDP and rising. In real terms, public sector salaries and pensions increased by 350 percent between 2006 and 2020. The payroll payments expenditures increased by more than 360 percent, and pensions expenditures increased by more than 30 percent. Population grew 53 percent from 2004 to 2020. Young population (under 30 year) makes up 66 percent, which puts a strong pressure on public spending. Population is expected to grow by 25 percent by 2030; population under 30 years expected to grow at 17 percent. The government has to, but it cannot, create 5 million jobs, all in the public sector, between 2020 and 2030.

To deal with the expected decline in the global demand for oil and the expected fall in *trend* oil prices, government revenues, and the enlargement of the public sector, we argue for a complete and immediate change in the political and economic institutions. Here is the point, oil is the property of the Iraqi people therefore; the Iraqis must own it, not the government.

From an economic standpoint, *people's ownership* is associated with political and economic freedom, and democracy. See for example, Hayek (1944), Friedman (1962), Pipes (2000), and O'Driscoll and Hoskibs (2003). Sound economic development requires market institutions and most importantly private property rights. There is reliable empirical evidence on the significance of private ownership on GDP growth. For example, historians North and Thomas (1973), and Rosenberg and Birdzell (1986) presented evidence that private property played a major role in enriching the West. Barro (1991) used proxies for the quality of private property to test the effect on GDP growth. Kormendi and MeGuire (1985) used measures of political freedom and civil liberties to proxy the quality of property rights and reported positive association with GDP growth. Heitger (2003) illustrates the same point.[19]

Ross (2001) examines the effect of oil on democracy empirically. He examined a panel of 113 countries over the period from 1970 to 1997. Testing several hypotheses (the rent state, the repression effect, and the modernization effect) revealed that oil adversely affects democracy and more so in poorer countries. Elbadawi and Makdisi (2011) provide evidence that oil is one of the main reasons for the lack of democracy in the Arab countries. Rotunda (2004), Wolf (2005) and Razzak (2006) proposed privatization of oil for Iraq. It means immediate transfers of the oil wealth to the Iraqi people *per se*.

In most market-oriented democracies, the people own the resources and the factors of production. All the Eastern European countries (e.g., Russia, Poland, Hungary, the Czech Republic, etc), which became democracies after the fall of the USSR, changed their economies rather quickly albeit with many problems. Iraq could do the same if the political climate and the culture change, but the method could be different depending on the objectives and the economic and political conditions. The Russian and the Czech Republic, for example, privatization processes were different from Poland or Hungary or even the U.K. The distribution of the oil wealth is different in Alaska from Norway. That is beside the point now. Most Iraqis agree that since 2003, (1) economic development has

[19] It might be worth mentioning that the solution of the neoclassical growth model, Ramsey (1928)-Cass (1965) - Koopmans (1965) under the social planner is the same as under the private market.

never occurred; (2) oil wealth has been squandered; and as a result, the Iraqi people have been impoverished. Ending the economic hegemony and control of the state is the only solution to free the economy and the people now.

It is only natural that the Iraqi people own their natural resources, mainly oil. Oil shares must be distributed to all the Iraqi people *equally*. Each eligible individual receives one share. It is essential that shares are tradable in a free market immediately so ordinary Iraqis can benefit from buying and selling these oil shares, thus oil wealth could generate oil income. One expects that some Iraqis who need cash would sell their shares to other Iraqi buyers who want to buy at an agreeable price for the share. Allowing free exchange of shares guarantees the establishment of a functional market.[20] When the Iraqi people own their oil, no one can steal it any more.

In Russia, the government handed shares in state-owned companies to the people directly. In the Czech Republic, people were given vouchers (each included 1000 investment points) then they bid on shares in a large number of the state-owned companies. The bid-offer process converted these points into share prices. The Czech Republic objective of the privatization was to establish a free market economy. In the UK, state-owned companies were sold directly to the public. In Russia, the Oligarch went door-to-door offering to buy the shares from the people. However, Iraq could learn from others' experiences. The mistakes that occurred in those experiences must be avoided by appropriate regulations.

Regulations are necessary to protect people; however, the current political structure is not a reliable one for regulating the process because they are implicated in squandering the oil wealth. There is no obvious way to deal with regulations in this case. One possibility is to establish an independent court, perhaps under an international supervision, to manage the process of ownerships, sales, transfer, and inheritance of the oil shares, to

[20] We would argue that the ownership of government-controlled assets in general and government-controlled lands should also be transferred to people *a la* the Homestead Act in the U.S. (1862), and many other countries (e.g., Anderson 2011).

safeguard the integrity of the process. It is necessary to protect women, the elderly, and the sick shareholders from exploitations.

Eventually, the shareholders will have to establish a private oil company or companies with a sound governance system to manage their own wealth. Private ownership will enhance democratic practices and contribute to the building of market institutions such as the banking system, the tax system to replace oil revenues with more sensible tax revenues, the share market etc. that are required to achieve efficiency in the distribution of wealth. Iraq has an old functioning tax system with expertise and rules. Even a significant large communist country like China has adopted market-oriented structures, which has already benefited the people. The incentive structure will be set properly, which will help allocate resources efficiently. Reforms of such magnitude and depth would take time to work, but it would work eventually. New Zealand, which is a democracy that enjoyed political and judicial stability, took a long time to realize the fruits of its market-oriented policy and institutional reforms of 1984, e.g. Evans *et al.* (1996).

Transferring the oil wealth to the people will make the Iraqi people better off by providing them with the financial means and the right incentives to make their own investments and businesses. As a result, we envisage some rearrangements of public sector employment. Government employees who receive a share in oil either voluntarily exit from the public sector to pursue private businesses; laid-off, or, reassigned, albeit with different negotiated contracts whereby wages are consistent with productivity. This will reduce the swelling of the inefficient public sector, and decrease waste and public spending significantly.

When Iraqis begin to receive dividends from oil shares they will become more interested in the performance of the oil industry as a whole regardless of the regions because when any one regional company makes profits all Iraqis will benefit. Sharing oil wealth and the independence of the oil business will unify the country, as the people of Iraq will recognize that they own and share their country. It might also eliminate the need for federalism.

Private property laws reduce corruption and thus, increase potential growth. The strategy will make the Iraqis rich. There is evidence about the negative correlation between corruption and economic growth, for example see, Chafuen and Guzman (1996). High-expected rate of regulations makes corruption more possible. Private individuals who bribe government officials increase in order to have their contracts honored. Iraq is one of the worst countries in the world in terms of freedom from repudiation of contracts. Iraq also scored high on almost all corruption indices, Easterly (2002).

Finally, peoples' ownership of oil is more consistent with Islam because it encourages investments in stocks and equity rather than receiving interest income so buyers and sellers share the gains and losses. The Iraqi shareholders will benefit when their oil company, or any regional company, does well and the share price increases. However, if the government of Iraq elects to pursue the old policies and keeps control over oil it will eventually become another authoritarian government and economic development will stall. This has been happening already.

The political elite will strongly oppose our proposed strategy to save Iraq as a country in the 21 century because they have entrenched interests in the status quo. Many of the educated Iraqis who have grown under military socialist dictatorship will also oppose it because they have learnt nothing better than social welfare benefits. They like to have a free education and health benefits, a secure public job, and a fully funded retirement pension regardless. This is the only game played in Iraq historically and despite the disastrous outcomes, many people cannot learn to play another game. There is one big hope, however, that the new generation, which did not grow up under dictatorships, and is more outward and forward looking, may be able to force the change.

4. Conclusion

Iraq is an oil rich country. It has large proven oil reserves, about 150 billion barrels, and an enormous amount of natural gas. The share of oil in real output is approximately 60 percent and the production of oil is highly responsive to global oil demand. We estimated that a percent increase (decrease) in global oil consumption increases (decreases) oil production by 1.5. Furthermore, it is estimated that a one percent increase (decrease) in global oil consumption increases (decreases) the price of oil by 0.77 percent. Thus, Iraq is an oil-dependent economy. Furthermore, the data suggest that Iraq is a rentier economy. Poverty has been high, and has not decreased after the U.S. invasion and the establishment of democracy. Productivity growth has been absent for decades. We argued that Iraq is very vulnerable to oil shocks

There are valid reasons to believe that the world is moving away from hydrocarbon. There has been a global change of taste and policies against it arising from concerns about global warming, i.e., the zero-carbon (2050), could reduce Iraq's real oil production, real GDP over the period from 2020 to 2050, i.e. lower permanent income.

Oil production, marketing, and revenues have been under total control by governments since 1921. From 1970 to 2003, the government had absolute total control. We described this as an oil monopoly. After 2003, the governments continued to have total control over oil revenues. We argued that if Iraq continues to be oil-dependent and have oil wealth under the control of the government, it would be a very poor country by 2050. Stress tests for scenarios of severe adverse global consumption shock show that permanent income measured by dynamic stochastic projections over the period 2020 to 2050 falls significantly under a government oil monopoly as compared with a competitive oil industry.

We proposed an immediate transfer of oil wealth to the Iraqi people in equal share per person. The shares would have to be tradable – freely exchangeable – such that people can sell and buy them at a market price. This enriches the Iraqi people because they could make investments in various economic activities when oil prices begin to decline, e.g., someone without a home could build one. The process, however, requires an optimal and sensible regulations, and management by an independent court; not by the political elite because most of them are untrustworthy, to ensure fairness, protect the integrity of the process, to protect the women, the elderly and the vulnerable. Democracy cannot flourish and progress if a few politicians and businesses continue to control the economy and steal the wealth of the people.

A change in ownership of oil and income diversification constitutes a significant socioeconomic change, a significant shock to the system. Expected prices, wages, and income adjustment would take some time. This dynamic is hard to predict. The time lag is a function of the ability and speed of the society to adapt and the speed at which new sound institutions replace the old ones. Therefore, we anticipate high variability at the beginning and for some time.

Those who have entrenched interests in the status quo system, however, will resist the idea of transferring ownership of oil and government assets to people. There are cultural and institutional hurdles. The cultural hurdles include, at least, (i) the political elites who currently control revenues since 2003, those who collect the rent and vote for the politicians, and foreign beneficiaries who buy smuggled oil and collect rent for supporting the system; and (ii) a strong belief in social welfare policies among some people. Although people have not received adequate services such as schooling, health, water and power supply, housing, roads, etc. since 2003, some people are so used to governments providing free services for them with the majority of workers being tax-exempt, may still believe in this old system.

There will be difficulties and strong resistance to the idea of oil wealth transfers because of the abovementioned hurdles, but there is a change in demography, where people aged 15 to 24 are forward looking and untarnished by past experiences. Unlike Russia in 1991, this group of Iraqi people has not lived under dictatorship and socialism. They have not been recipients of rent and social welfare, highly connected with the rest of the world and are aware of democratic practices, institutions, and culture. They may be the key to change. We believe that cultural change in Iraq is necessary to ensure a better development model for Iraq, however, how oil ownership policy, political, and economic institutional changes can induce cultural change remains unquantifiable and the subject of more research.

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Table (1) Fully Modified OLS Estimator – 1970-2019

$$lnY_t = \alpha_1 \ln K_t + \alpha_2 \ln L_t + \alpha_3 lnH_t + \alpha_4 lnq_t^o + e_t \quad \text{(i)}$$

Production function with human capital i			Production function without human capital ii	
Coefficient	Estimate	P values	Estimate	P values
α_1	0.40	0.0000	0.30	0.0151
α_2	0.13	0.0023	0.51	0.0055
α_3	0.51	0.0000	-	-
α_4	0.57	0.0000	0.55	0.0000
σ	0.18		0.16	
$\bar{R}^2$	0.89		0.91	

Y_t denotes real GDP constant 2011 national prices (in mil. 2011US$); K_t denotes the stock of capital at constant 2011 national prices (in mil. 2011US$); L_t denotes labor measured by working age population (age 15-64); H_t is the human capital index, 2017=1 based on years of schooling and returns to education; see Human capital in PT 10.0; and q_t^o is oil production (thousands BD).

(i) The cointegration relationship includes a dummy for the 1973 oil price shock and the Gulf War I 1990-1992. Dummy variables, which take a value of one during the first oil shock in 1973, the Iran – War period 1980-1989, and the Gulf War in 1990, and zero elsewhere. The long run covariance estimate includes prep whitening, with lags=2 from AIC with a maxlag =3, Bartlett kernel, Newey-West automatic bandwidth = 14.2003, NW automatic lag length = 3.

(ii) Long run covariance estimate, pre whitening with lags=2 from AIC, max lag=3, Bartlett kernel, Newey-West automatic bandwidth = 1.2620, NW automatic lag length = 3.

Table (2a)
The Engle-Granger (1987) Test for Cointegration
OLS: $lnq_t^o = \gamma lnC_t^o + u_t$
1970-2019

Variable	Coefficient	Std. Error	t-Statistic	P Values
γ	1.5	0.05	29.9	0.0000

R-squared	0.17	Mean dependent var.	7.52
Adjusted R-squared	0.17	S.D. dependent var.	0.64
S.E. of regression	0.58	Akaike info criterion	1.78
Sum squared res.	16.7	Schwarz criterion	1.81
Log likelihood	-43.54	Hannan-Quinn criterion	1.79
Durbin-Watson stat	0.439		

HAC standard errors and covariance, pre-whitening with lags=1 from AIC maximum lag=3, Bartlett kernel, Newey-West automatic bandwidth 2.9803, NW automatic lag length=3

Table (2b) - ADF Unit Root Test of the residuals u_t

$$\Delta u_t = \rho u_{t-1} + \sum_{i=1}^{k} \Delta u_{t-i} + \nu_t$$

Variable	Coefficient	Std. Error	t-Statistic	P Values
ρ	-0.22	0.09	-2.43	0.0188

R-squared	0.10	Mean dependent var.	0.001
Adjusted R-squared	0.10	S.D. dependent var.	0.391
S.E. of regression	0.36	Akaike info criterion	0.865
Sum squared res.	6.54	Schwarz criterion	0.903
Log likelihood	-20.1	Hannan-Quinn criterion	0.879
Durbin-Watson stat	1.83		

Trend and constant terms found significant. Zero lagged differenced residuals found in the search

Table (2c)

OLS Error Correction

$$\Delta lnq_t^o = \delta_0 + \delta_1 \Delta lnC_t^o + \delta_2 u_{t-1} + \eta_t$$

Variable	Coefficient	Std. Error	t-Statistic	P Values
δ_0	-0.05	0.07	-0.7	0.5002
δ_1	5.17	1.68	3.0	0.0035
δ_2	-0.22	0.05	-3.8	0.0003

R-squared	0.19	Mean dependent var.	0.023
Adjusted R-squared	0.16	S.D. dependent var.	0.400
S.E. of regression	0.36	Akaike info criterion	0.891
Sum squared res.	6.19	Schwarz criterion	1.007
Log likelihood	-18.8	Hannan-Quinn criterion	0.935
F-statistic	5.54	Durbin-Watson stat	1.868
Prob (F-statistic)	0.007		

HAC standard errors and covariance, pre-whitening with lags=2 from AIC maximum lag=3, Bartlett kernel, Newey-West automatic bandwidth 2.6668, NW automatic lag length=3

Table (3)
FM-OLS estimates

$$lnq_t^o = \beta_0 + \beta_1 lnC_t^o + \varepsilon_t$$

Coefficient	Estimates	Std errors	t-Stats	P values
β_1	1.52	0.02	68.1	0.0000
D_{1973}	-4.36	0.67	-6.4	0.0000
D_{79-88}	-2.59	0.40	-6.5	0.0000
D_{90-92}	-0.40	0.24	-1.7	0.0909
S.E. of regression			1.012101	
Long-run variance			0.445448	
Mean dependent var.			7.531556	
S.D. dependent var.			0.648780	
Sum squared res.			46.09568	

q_t^o is Iraq's oil production and C_t^o is global oil consumption. The sample is adjusted, 1971-2019 and is 49 observations after adjustments. The cointegration equation includes dummies deterministic D_{1973}; D_{79-88}; D_{90-92}. The long run covariance estimate includes pre whitening with lags =1 from AIC maximum lag =3, Bartlett kernel, Newey-West with automatic bandwidth chosen to be 21.5989, and automatic lag length = 3.

Table (4)
FM-OLS estimates
$lnP_t^o = \beta_0 + \beta_1 lnC_t^o + \varepsilon_t$

Coefficient	Estimates	Std errors	t-Stats	P values
β_1	0.77	0.03	24.0	0.0000
D_{1973}	-3.89	0.97	-4.00	0.0002
D_{79-88}	0.13	0.34	0.37	0.7072
D_{90-92}	-1.25	0.57	-2.13	0.0382
S.E. of regression			0.7492	
Long-run variance			0.9242	
Mean dependent var.			3.9440	
S.D. dependent var.			0.5637	
Sum squared res.			25.258	

$p_t^o$is the price of oil and $C_t^o$is global oil consumption. The sample is adjusted, 1971-2019 and is 49 observations after adjustments. The cointegration equation includes dummies deterministicD_{1973}; D_{79-88}; D_{90-92}. The long run covariance estimate includes pre whitening with lags =1 from AIC maximum lag =3, Bartlett kernel, Newey-West with automatic bandwidth chosen to be 25.7876, and automatic lag length = 3.

Figure (1)
Proven Oil Reserves (Thousand Million Barrels)

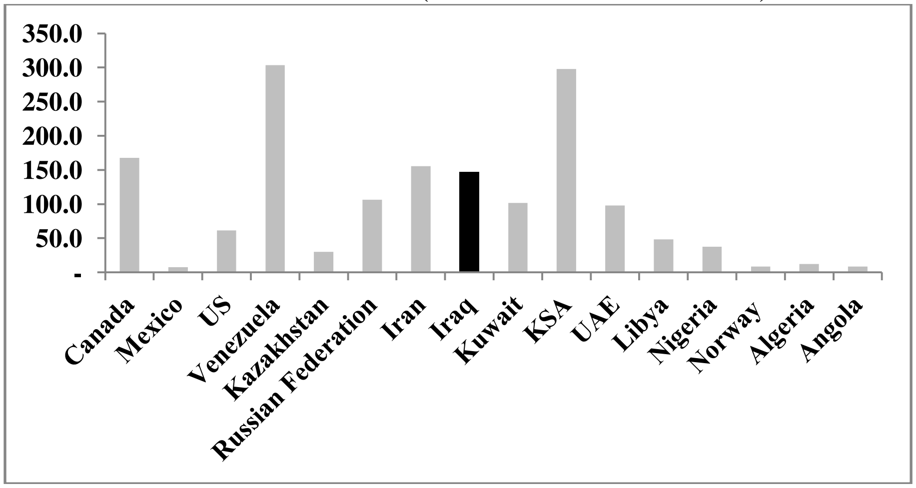


Figure (2)
Percent of Urban Population Living in Slumps

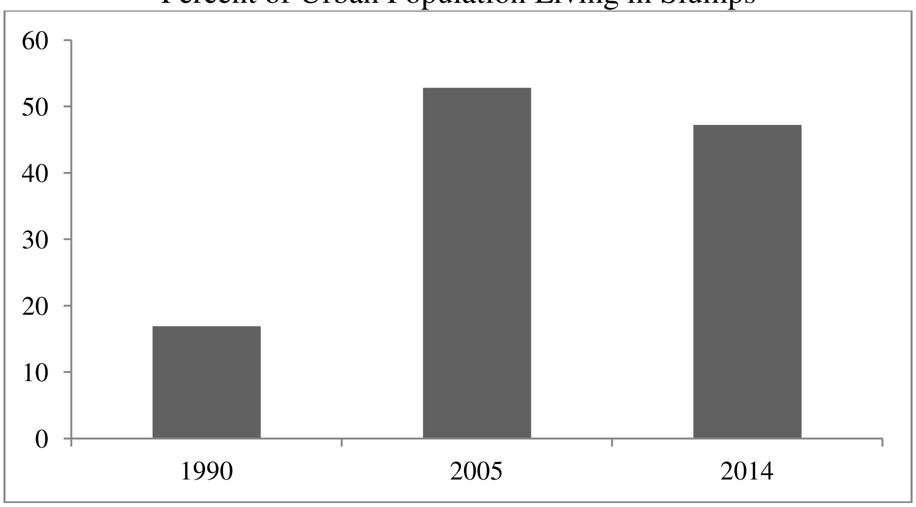


Figure (3)
Total Factor Productivity Growth

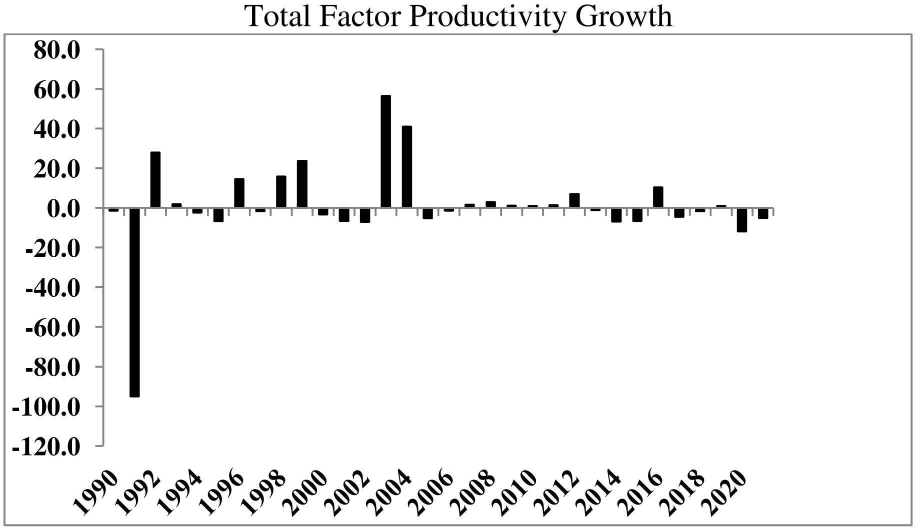


Figure (4)
Oil Rent as a Percent of GDP

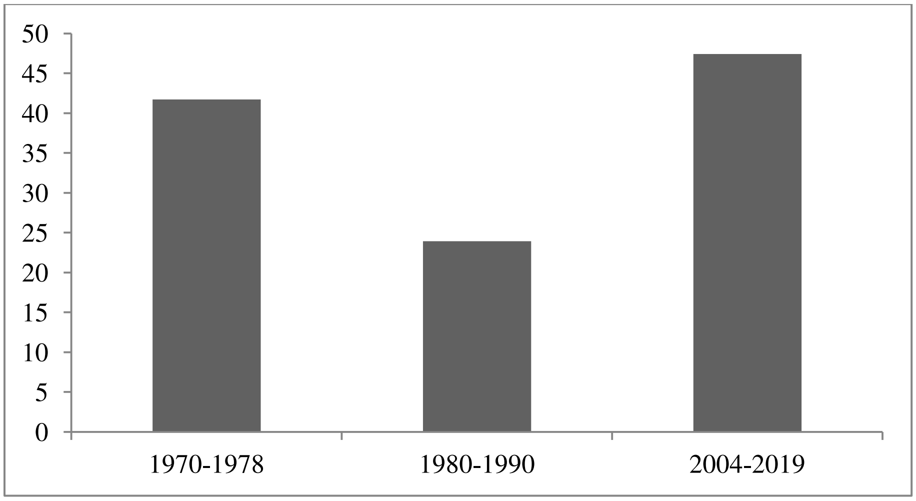


Figure (5)
Growth Rates of Oil Prices and Nominal GDP

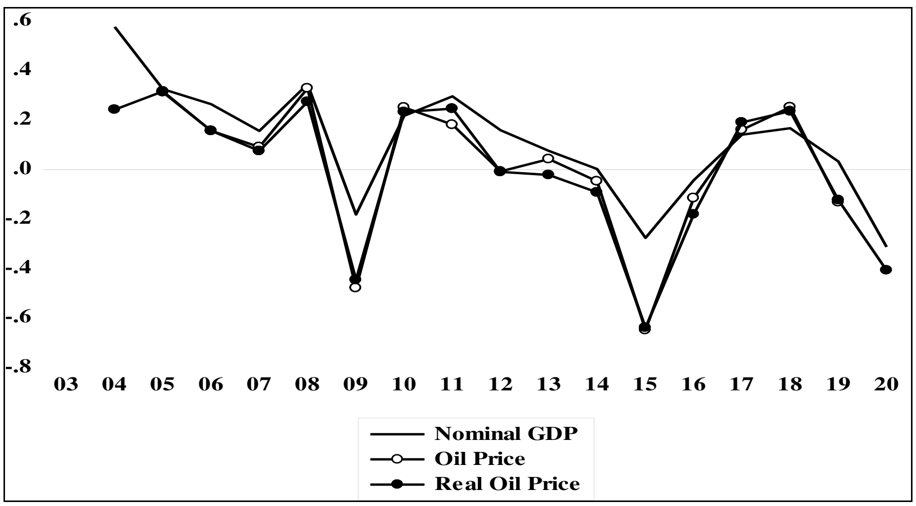


Figure (6)
Growth Rate of Oil Prices and Domestic Inflation

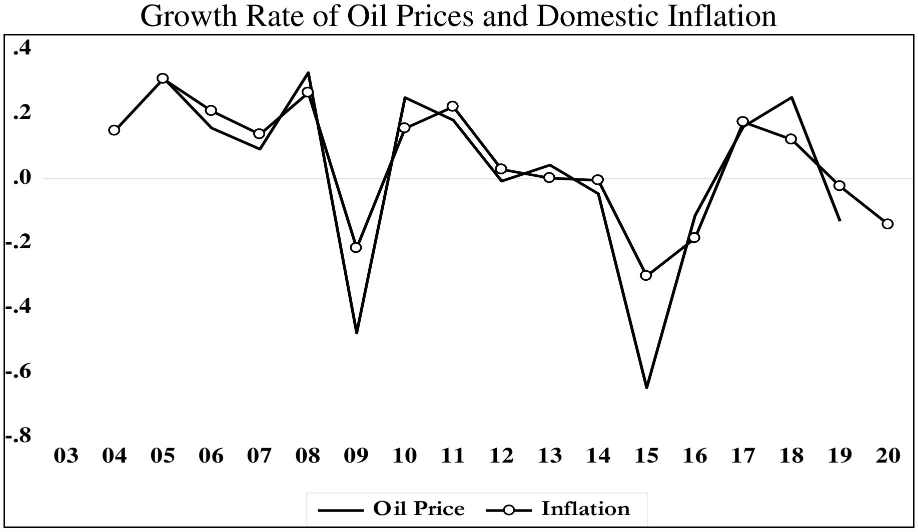


Figure (7)
Growth Rates of Oil Price and Government Revenues

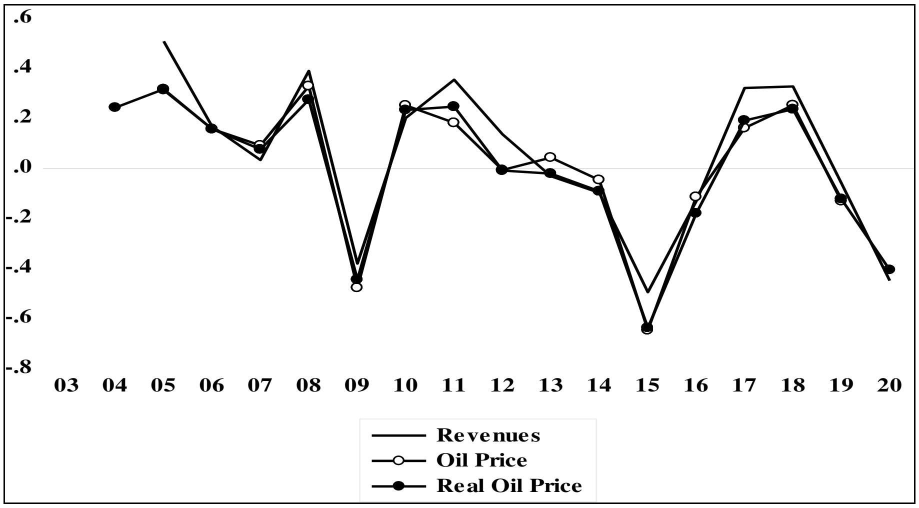


Figure (8)
Growth Rates of Oil Price and Government Expenditures

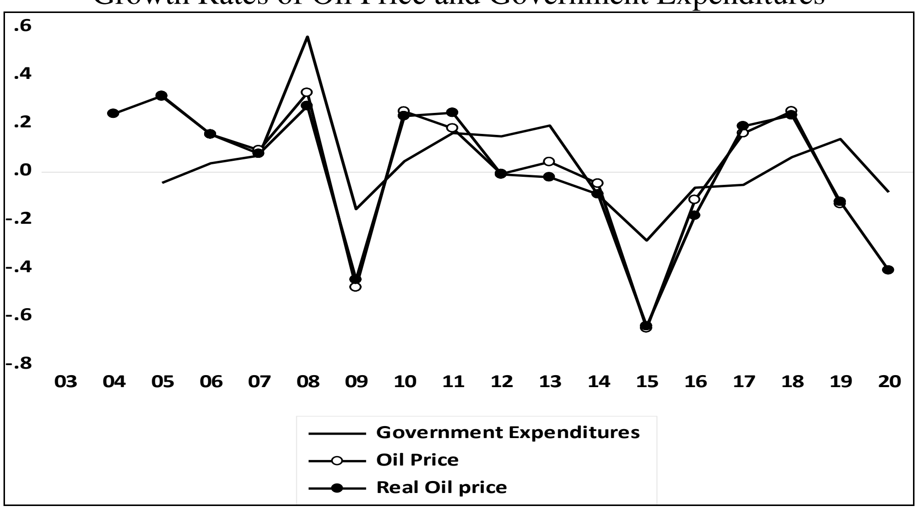


Figure (9)
Growth Rates of Oil Price and Savings

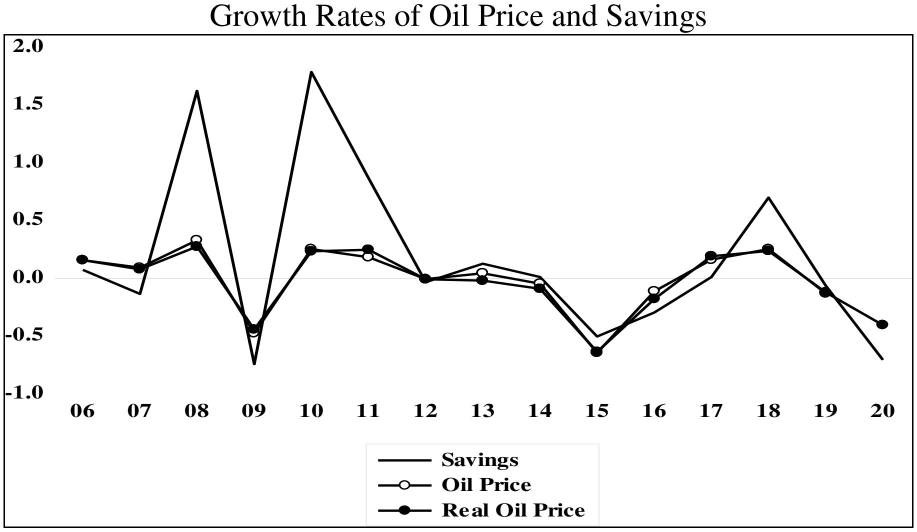


Figure (10)
Growth Rated of Oil Prices and External Debt

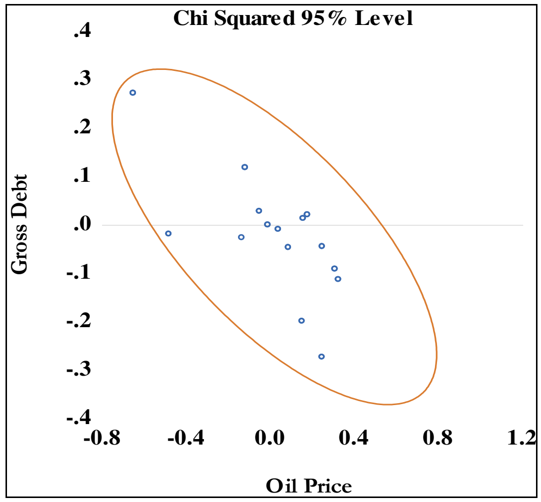


Figure (11)
Growth Rates of Oil Price and the Current Account

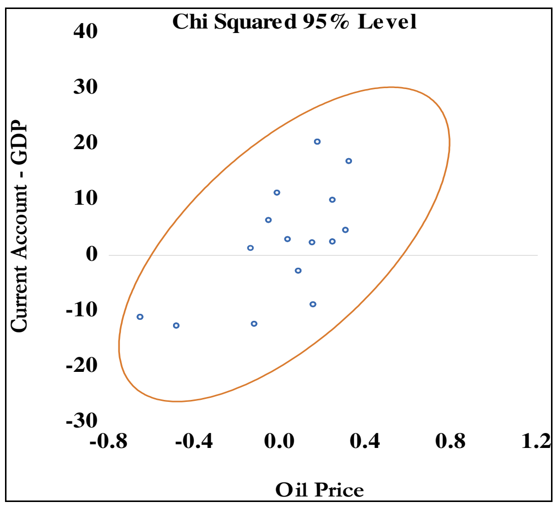


Figure (12)
The Budget and Current Account Deficits as percent of GDP

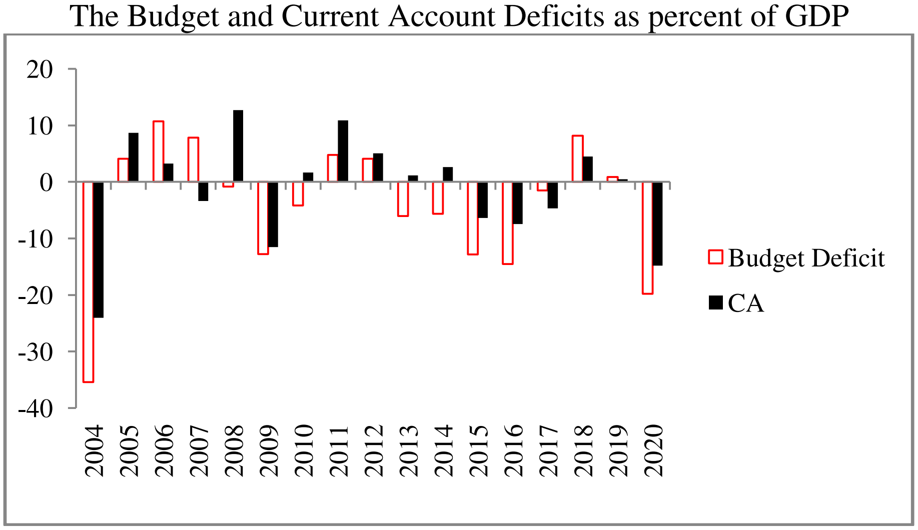


Figure (13)
The Data of the Production Function
The Penn World Table 10.0, 2021

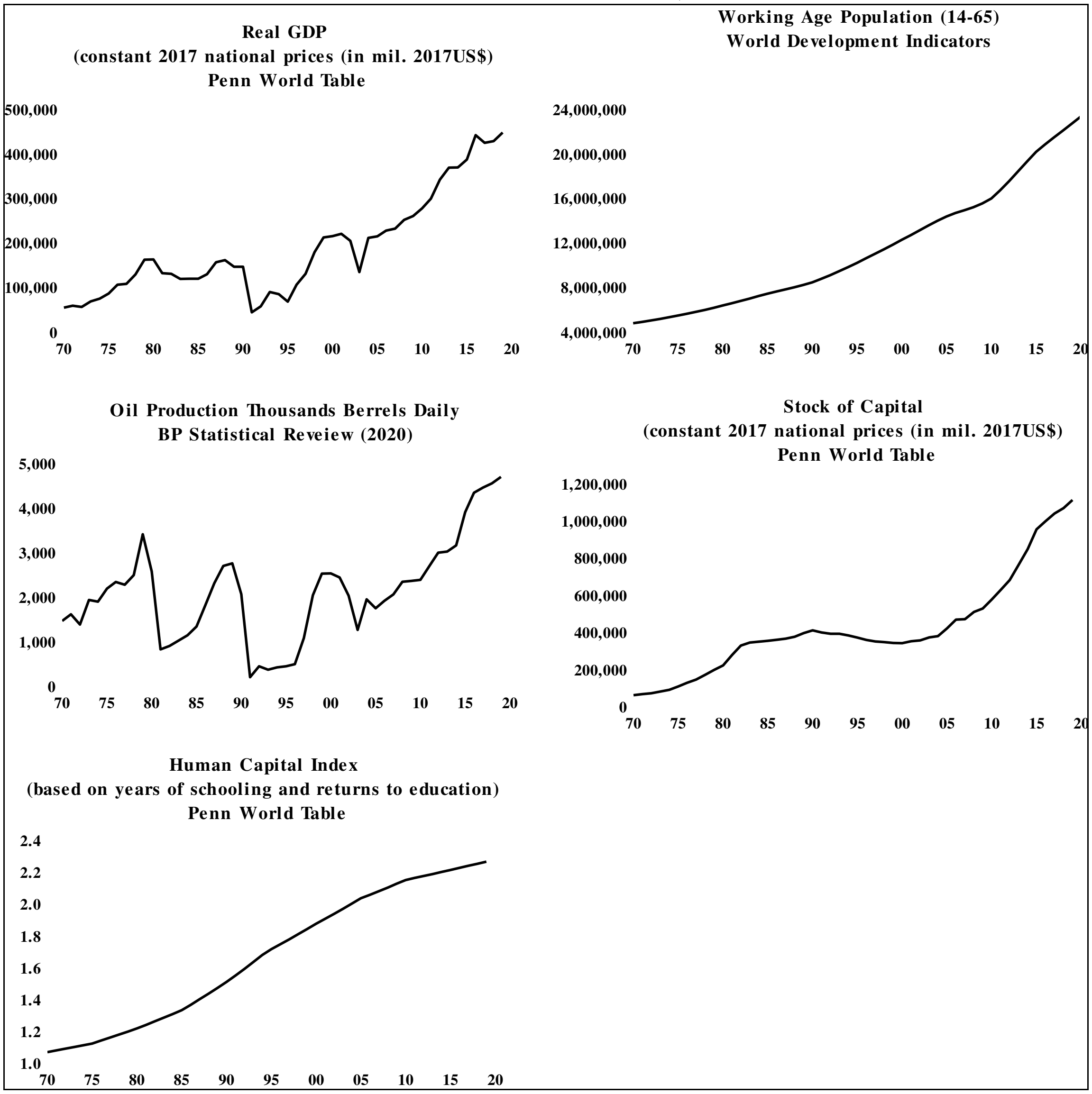


Figure (14)
The Relationship between Oil Production and Real GDP in Iraq

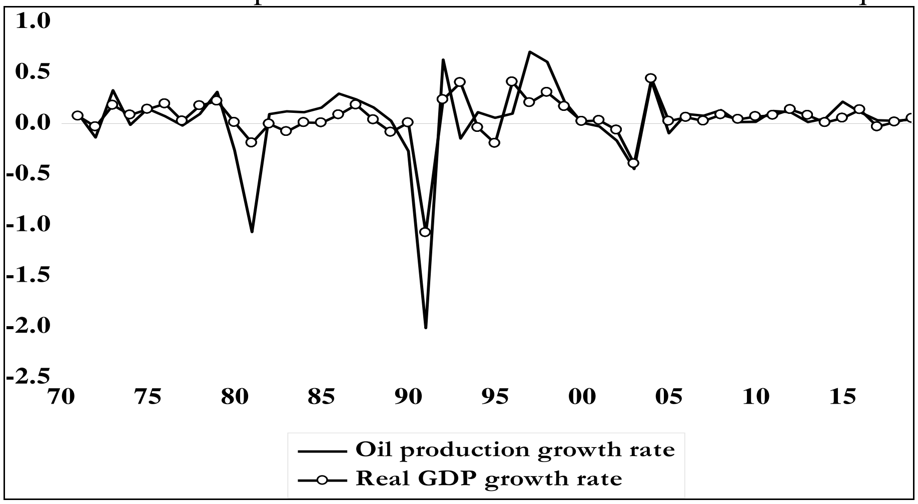
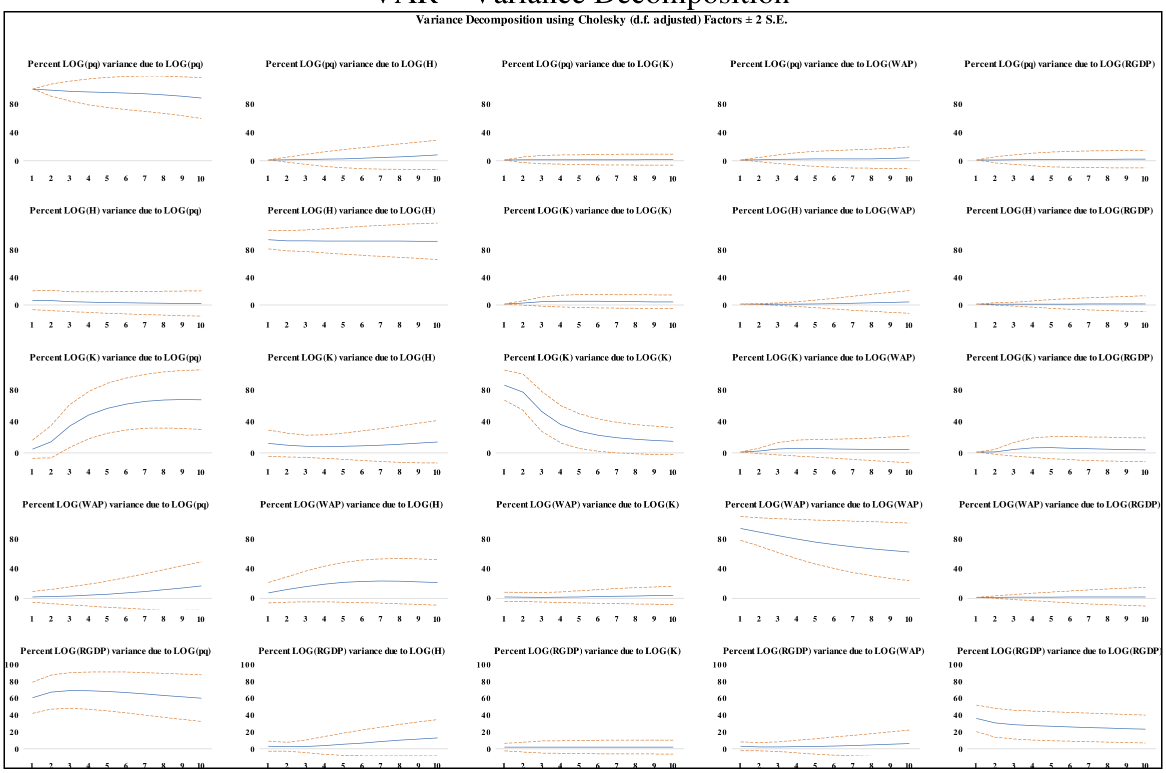


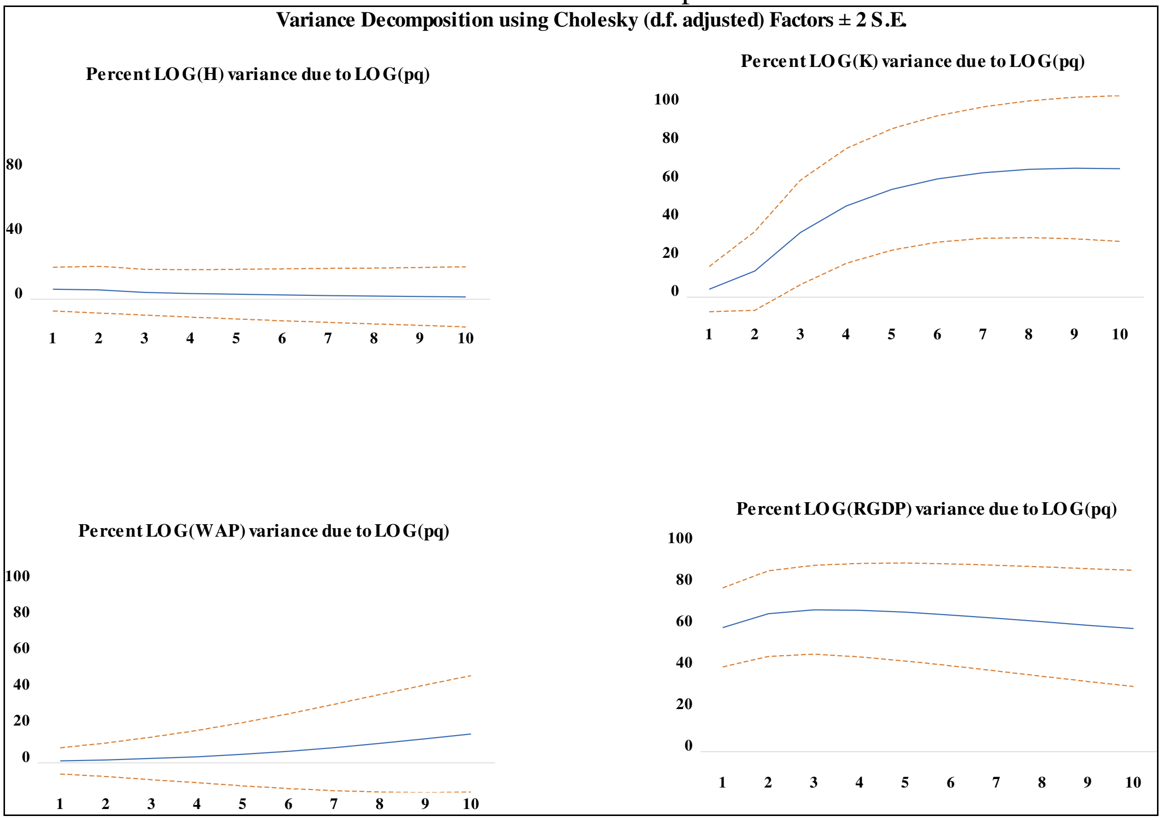
Figure (15a)
VAR – Variance Decomposition



pq is the product of oil price and oil production; oil is oil production, H is human capital, K is capital stock, WAP is working age population, and RGDP is real GDP.
Standard errors generated by 10000 Monte Carlo

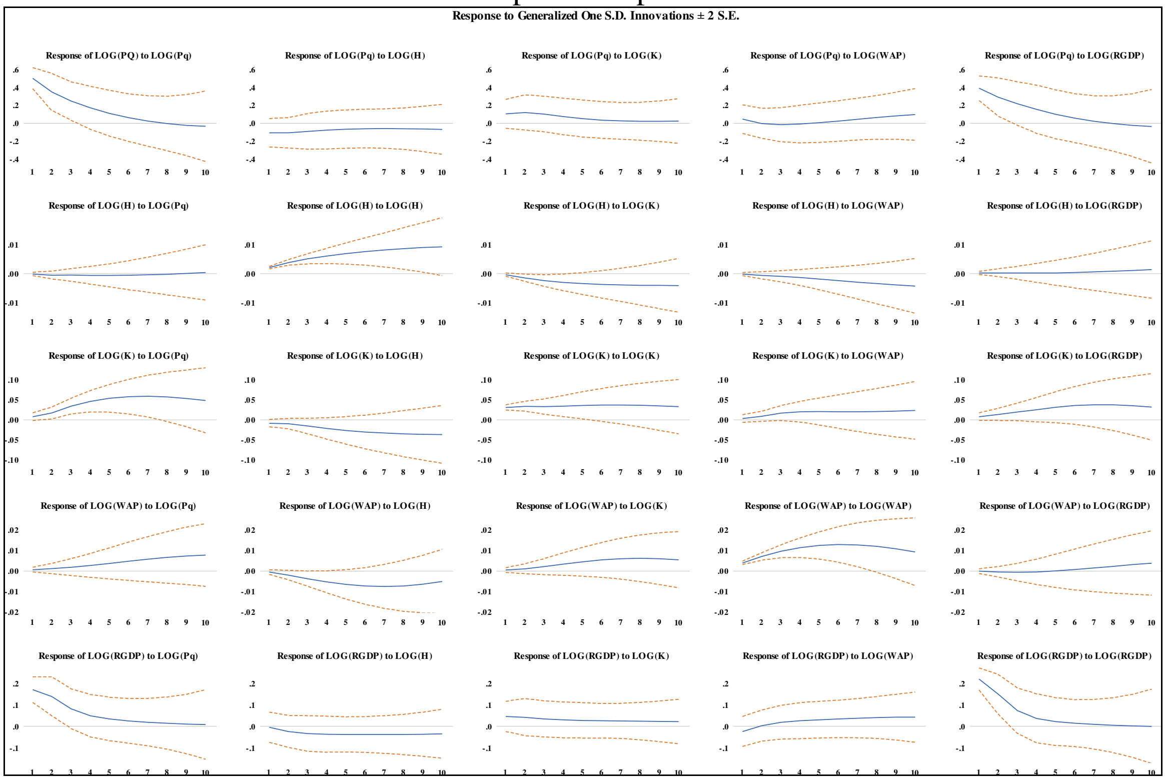
Figure (15b)

VAR –Variance Decomposition



Standard errors generated by 10000 Monte Carlo

Figure (16)
Generalized Impulse Response Functions



Standard errors generated by 10000 Monte Carlo

Figure (17)
Mean Dynamic Stochastic Baseline Projections

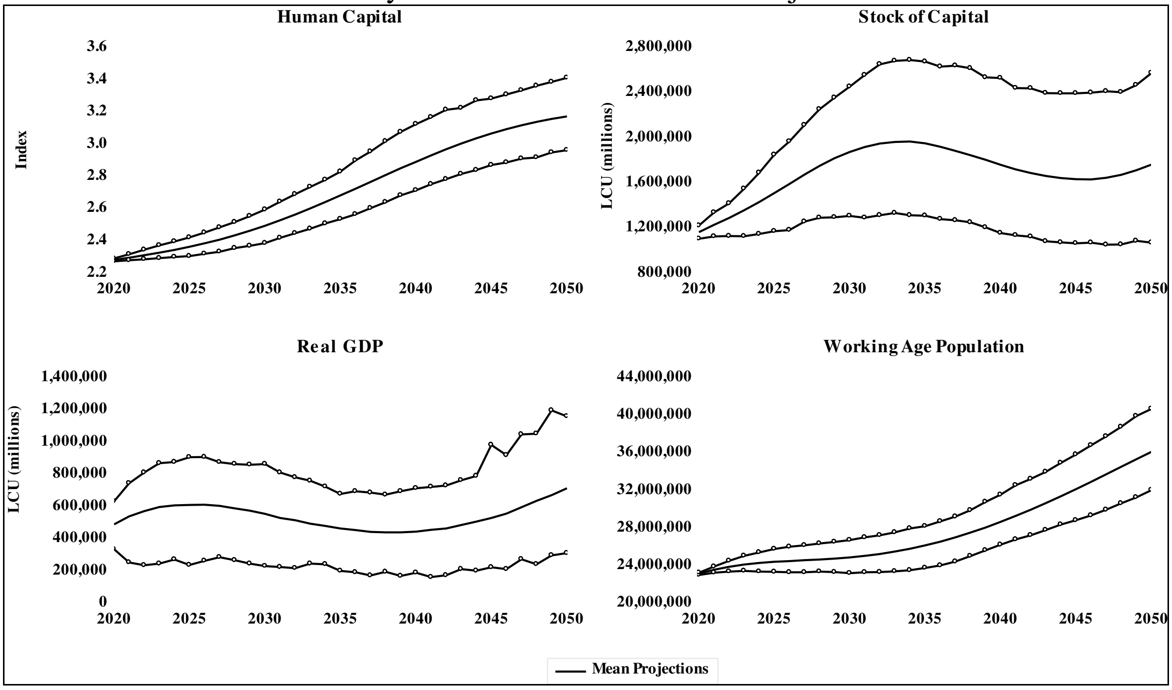
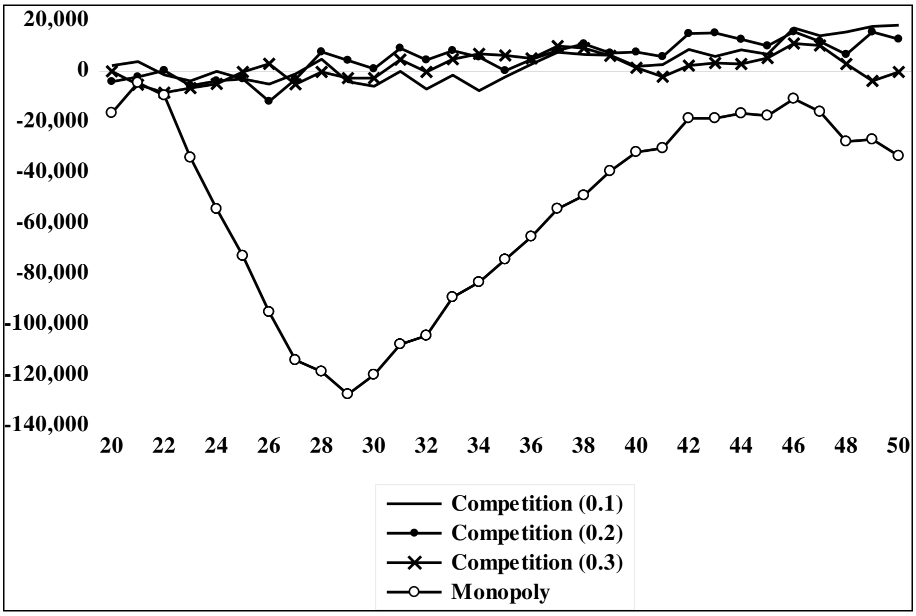


Figure (18)
VAR Counterfactual Scenarios
Deviations of mean Dynamic Stochastic Projections of real GDP
Under Competition and Monopoly from Baseline Projections

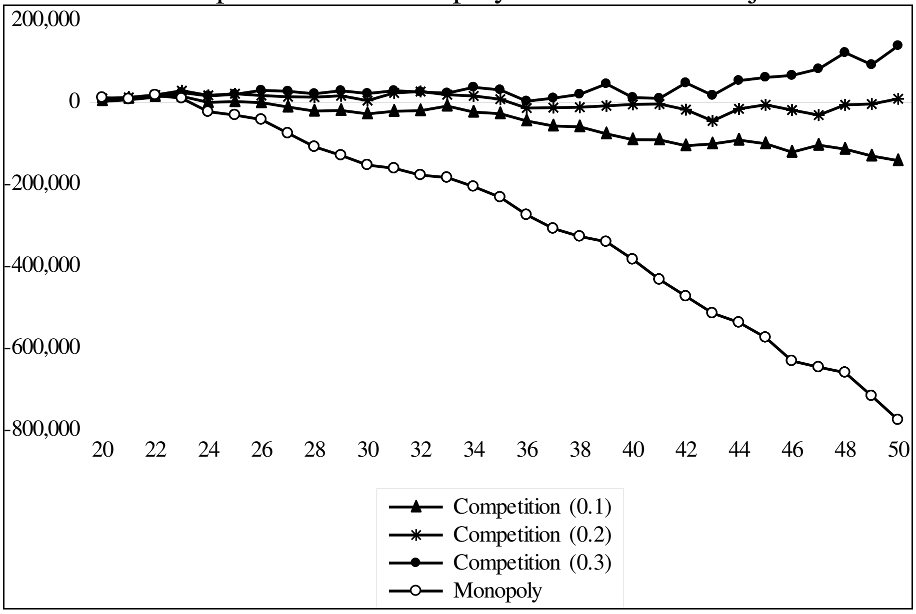


- Competition (0.1) denotes a 10 percent reduction in oil production in response to the shock;
- Competition (0.2) denotes 20 percent reduction in oil production in response to the shock
- Competition (0.3) denotes 30 percent decline in oil production in response to the shock
- Monopoly response to the shock
- The shock is 40 percent decline in global oil consumption.

Figure (19)

VECM Counterfactual Scenarios

Deviations of mean Dynamic Stochastic Projections of real GDP Under Competition and Monopoly from Baseline Projections



Data Appendix

		Data 1970 to 2019	
Y_t	Real GDP	Millions national currency in 2011 prices	Penn World Table 10.0
L_t	Labor	Working age population, 15-64	World Development Indicators
H_t	Human Capital	Index, 2017=1	Penn World Table 10.0
K_t	Stock of capital	Millions national currency in 2011 prices	Penn World Table 10.0
$\hat{P}_t$	Oil production	Thousands barrels a day	BP Statistical Review, 2020
P_t	Oil Price	USD	BP Statistical Review, 2020
C_t^O	Global oil consumption	Exajoule	BP Statistical Review, 2020
		Date for Figures 5 to 12	
Real average oil price		USD nominal average price of Brent, Dubai, and TWI deflated by the US CPI.	IMF – WEO, October 2021
Revenues		Billion LCU	IMF – WEO, October 2021
Expenditures		Billion LCU	IMF – WEO, October 2021
Nominal GDP		Billion LCU	IMF – WEO, October 2021
Savings		Billion LCU	IMF – WEO, October 2021
CA			IMF-WEO, October 2021
Gross Debt			IMF-WEO, October 2021

Technical Appendix – the Solver

The method is described in Eviews software 10.0

We solve the VAR using Broyden's method, which is a modified Newton's method. It uses an *approximation* instead of the true Jacobian when linearizing the model. We update the approximation at every iteration of the 5000 iterations by comparing the residuals from the new trial values of the endogenous variables with the residuals predicted by the linear model based on the current Jacobian approximation. In addition, we use analytic derivatives with the starting values being the actual values. Then we solve the model in both directions. We stop solving when we hit a missing value. In a stochastic simulation, we solve the equations of the model such that the residuals (1000 iterations bootstrapped innovations) match to randomly drawn errors, and the coefficients and exogenous variables of the model change randomly. The solution generates a distribution of outcomes for the endogenous variables in every period. We approximate the distribution by solving the model many times using different draws (1000) or the random components in the model then calculating statistics over all the different outcomes. Only values of the endogenous variables from before the solution sample are used in the dynamic solution of the projections. Lagged endogenous variables are calculated using the solutions calculated in previous periods, i.e., not from actual historical values. A series for the mean is calculated. We consider one thousand repetitions reasonable to capture the true values; however, some random variation may be present between adjacent observations. The 95 percent confidence intervals are computed using an updating algorithm. For the diagonal covariance matrix, the diagonal elements are set to zero. We do not scale the variances.