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Oil and Fiscal Policy in Iraq

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Abstract

This report compares fiscal policy options for Iraq, given the anticipated large increase in oil revenues expected over the coming two decades. A stylised general equilibrium model of the Iraq economy is built and calibrated to Iraqi data. Five fiscal policy options are considered, comparing the effects on the economy of allocating the windfall (i) proportionately to existing spending, or towards increasing (ii) the government wage bill, (iii) domestic investment, (iv) foreign assets or (v) direct transfers. We find that investment in the capital stock leads to the largest increase in non-oil real GDP. Since the economy will suffer from absorption constraints if the entire windfall is invested immediately, a combination of a sovereign wealth fund used for temporarily parking funds abroad in conjunction with investment in domestic capital is recommended.

1. Introduction

For the past three decades Iraq has been mired in conflict. From 1980-1988 it was embroiled in the cross-border Iran-Iraq war which cost somewhere between 0.5 and 1.5 million lives on both sides. In the final stages of this war, from 1986-1989, the Iraqi regime under Saddam Hussein conducted the genocidal Al-Anfal Campaign against the Kurdish people of northern Iraq, leading to between 50,000-100,000 deaths. In 1990-1991 the Iraqi invasion of Kuwait lead to the first Gulf War, against a U.N.-sanctioned force from 34 nations and lead by the United States. This saw approximately 100,000 civilian and 20,000-30,000 combat Iraqi casualties. After a decade of relative peace, 2003 saw the beginning of the second Gulf War, which cost around 120,000 civilian deaths and 4.7 million refugees.

In late 2011 the United States withdrew the last of its troops from Iraq, marking the end of the most recent period of war. The second Gulf War was marked by initial early victories for coalition forces, culminating in the declaration of “Mission Accomplished” by then US President George W. Bush in May 2003, and the capture of Saddam Hussein in December 2003. These victories were followed by a period of stalemate and intense urban combat with the first and second battles for Fallujah in April and November of 2004, and heavy violence in Baghdad and northwest Iraq from May to August 2005. In early 2006, sectarian violence between Sunni and Shi’ite saw homicide rates in Baghdad rise

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from 11 to 33 per day, amid talks of the country descending into civil war. Coalition forces responded from January 2007 to March 2008 with a surge in troop numbers, peaking at 170,000 combat personnel. This surge was hailed as a success, with civilian monthly fatalities falling from 3,500 to 470 over the period. From the end of this surge the coalition began a slow reduction of force in the country, with troop numbers returning to pre-surge levels in December 2008, forces withdrawing from Iraqi cities in June 2009, and the last combat forces leaving the country in August 2010.

Although the war is now officially over, pockets of violence in Iraq remain. In 2011 there were 54 deaths of US military personnel. Only days after the withdrawal of US troops in December 2011 there was a barrage of over fifteen bombings that left dozens dead in Baghdad. A subsequent wave of Shi’ite targeted bombings in early January 2012 killed over 60 civilians. These attacks have been attributed to sectarian divisions, with the Shi’ite dominated government lead by Prime Minister Nouri al-Maliki clashing with Sunni provinces and officials. This has included seeking the arrest of Sunni Vice President Tareq al-Hashemi on accusations of targeted killings (WSJ, 23 Dec 2011).

Despite this violence, Iraq has made significant economic progress since the Transitional Government was established in 2005. Annual headline inflation has been reduced from over 60% p.a. to single digits. The Iraqi dinar has remained stable against the US dollar. Movements are being made towards debt sustainability. This started with an 80% reduction of Paris Club in 2004, and is continuing with negotiations with non-Paris Club creditors. Domestic fuel subsidies have been removed. Finally, the IMF has suggested that capacity is improving at both the Central Bank and the Ministry of Finance.

Iraq’s improving stability and economic progress have laid the foundation for a large increase in oil extraction. Oil production has been steadily been increasing from a low of 1.5mbpd in 2003, to 2.6mbpd in 2010 (IMF, 2010). In late 2009 and early 2010 the Central Government successfully auctioned nine service contracts, and estimates of potential output in 2030 range from 5.5mbpd (BP, 2011) to 12mbpd (Iraq Ministry of Petroleum). Such a dramatic increase in oil production will have a profound effect on the Iraqi economy, as oil production currently accounts for over half of GDP and 83% of government income (IMF, 2010).

This report evaluates a variety of options available to the Iraqi government for managing the anticipated increase in oil income. To do this, we construct a stylised model of the Iraqi economy. The model is calibrated to data from the Iraq economy in 2007, collected from a number of sources. It is then used to test the implications of five government spending scenarios: (i) increasing all spending proportionately; (ii) increasing government employment; (iii) increasing investment in public capital; (iv) increasing savings in foreign assets; and (v) increasing direct transfers to households. We find that investment in public capital has the most significant effect on real GDP. However, investing the entire windfall immediately is likely to incur large adjustment costs. For this reason we consider a combination of scenarios (iii) and (iv), making use of an offshore parking fund to delay some investment whilst absorption constraints are relaxed. We find that this policy leads to a large increase in non-oil real GDP, and also builds up a large stock of foreign assets for future use.

The report employs a simple general equilibrium model, which can later be used by policymakers. The model is designed to be simple, that is, without too much optimizing behaviour. This is consistent with the focus on positive, rather than normative, policy prescriptions, and allows
different policies to be tweaked and adjusted. The model is also designed to work in general equilibrium. This is done to give a broad feel for the effects of the oil windfall throughout the economy. Finally, the model is designed for later use by policymakers. It operates in a single Microsoft Excel spreadsheet, with a single visual basic routine for iteratively finding equilibrium in each period. Hence, it is very user-friendly, as documented in the Appendix.

The report continues as follows. Section 2 describes the most salient aspects of the Iraqi economy for our analysis. It covers oil, the government sector and fiscal policy, the private sector and output, and households and consumption. Observations on each aspect are described, and then translated into a representation in our stylized model. Section 3 then reports the results of our analysis. A collection of plots are used to illustrate the implication of each spending policy throughout the economy. Section 4 concludes. Three appendices support the analysis in the main body of the report with more technical details. Appendix A outlines the model formally. Appendix B describes the calibration to Iraqi data. Appendix C is a guide to the spreadsheet calculation of the model for future users.

2. The Iraqi Economy

The salient features of the Iraqi economy can be described under five topics: oil production, the government sector and fiscal policy, the private sector and output, the labour market and households and demand. This section outlines our observations of each, and how they are represented in our stylized model. A more formal exposition of the model is presented in Appendix A. A description of the data and the calibration of the model are then given in Appendix B.

a. The Oil Sector

Observation

Iraq’s oil output has increased significantly from its nadir of 1.3mbpd in 2003. In 2010 oil production was estimated to have reached 2.6mbpd (IMF, 2010). This is expected to increase dramatically over the coming decades, with 2030 output forecasts ranging from 5.5mbpd (BP, 2011) to 12mbpd (Iraq Ministry of Petroleum). From June 2009 to February 2010 the Iraqi Ministry of Oil tendered for the award of service contracts to develop Iraq’s existing oil fields. If all of these contracts are fulfilled, Iraq’s crude oil production will increase to approximately 12mbpd as early as 2017. Concerns about stability and capacity have contributed to the wide range of forecasts. History suggests that increasing output is a slow process, with Russia taking ten years to increase output by 3.8mbpd and Saudi Arabia taking five years to increase output by 2 mbpd.

Oil revenue accounts for the vast majority of government income. In 2007 this amounted to 83% of government income (IMF, 2010). The oil sector also accounts for the majority of output. In 2007 it was responsible for 54% of value added (USAID, 2009).

Model

We consider oil to be an exogenous windfall, which accrues directly to the government. The size of the windfall is based on forecasts of Iraq’s crude oil production in BP’s Energy Outlook 2030 (2011). This suggests that production will rise from 3.1mbpd in 2012 to 4.5mbpd in 2020 and 5.5mbpd in
2030. This is at the conservative end of estimates. Oil revenue is based on a constant price per barrel of $US 70, and we ignore oil price volatility. To account for cost margins we take government oil income to be a constant proportion of total revenue, based on 2007 data.

Figure 1: Estimates of Iraq’s potential oil output vary, though it is expected to increase significantly in the coming two decades

b. The Government Sector and Fiscal Policy

Observation
As noted above, oil revenue accounts for the majority of government income. This income is spent across four main areas: government employment (approximately 30%), public capital accumulation (17%), saving in foreign assets (18%), and transfers and subsidies (35%).

Spending on government employment is high, due to both high wages and high government employment. The average wage in the government sector is higher than that of any other sector, at ID 493,000 per month. This significantly exceeded the average wage in the economy of ID 348,000 per month (Iraq Household Economic Survey 2007). The government sector is also the largest employer of any sector in the economy, accounting for 33% of the labour force in 2007 (USAID, 2009).

Public capital comprises the majority of Iraq’s capital stock, and is undergoing a reconstruction effort following decades of war. Reports by the Iraq Committee on Economic Policy suggest that 99.5% of the capital composition in 2007 was public capital (Paper of Committee on Economic Policy, 2009). Although there must be some private capital in the economy, this statistic indicates that the majority of capital in the major industries is government owned. Estimates of the total size of the capital
stock also vary widely, due to difficulties in estimating the amount of capital destroyed during years of conflict.

In 2010 Iraq holds an external stock of public debt approximately equal to 107 per cent of GDP (World Bank, 2011). This follows an 80% reduction of debt to Paris Club creditors in 2004. The Central Bank of Iraq has stated that approximately half of the remaining debt is currently subject to negotiation with non-Paris Club (mainly Gulf country) creditors.

**Model**

The model has three sources of government revenue. The first, and largest, is exogenous income from oil. In addition the government collects interest payments on foreign assets (which are initially negative), and profits on production and rents from government capital. These profits and rents accrue to the government in order to close the model.

The model allows government spending to be allocated variously between government employment, public capital accumulation, saving in foreign assets and transfers and subsidies. This dictates the five scenarios in our analysis, outlined in Section 3.

Spending on government employment is split between wages and number of employees. Government wages are set as a constant multiple (i.e., 5.4) of the wage in the informal sector. We assume that these workers produce non-traded public services that are consumed by the household. The value of this output is set equal to the wage bill, $w_g L_g$.

Public capital is the only form of capital in the model. We abstract from private capital. Public capital is used in production by the traded, non-traded and residual sectors. Rather than requiring that capital be allocated efficiently between each sector to equalize their marginal products, each sector uses the whole public capital stock in production. The government’s decision to accumulate capital determines how efficiently it is used. The relative efficiency of capital in each sector is measured by its marginal product.

We assume that investment in public capital incurs internal adjustment costs. This accounts for issues such as long planning procedures but also for corruption and poor project choice, which increase with the size of investment and decrease with the size of the existing capital stock. The extent of the adjustment costs are measured by the Public Investment Management Index (PIMI). This index measures the increase in capital stock for every dollar spent on investment by the government. A ballpark estimate for the PIMI in low and middle income countries is $\sim 0.5$. This implies that only half of spending on public investment translates into actual increases in the public sector capital stock.

**c. The Private Sector and Production**

**Observation**

Output in Iraq can be divided into four main categories, as illustrated in Figure 2. Output in the economy is dominated by crude oil production, which accounts for 54% of GDP in 2007. The non-traded service sector accounts for the next largest proportion of output, at 35% of GDP (both government and non-government services). Agriculture and industry together account for only 11% of output, but over 35% of employment. Thus, compared with oil production these sectors are labour intensive.
Model
The model separates the economy into five sectors: government, traded (manufacturing), non-traded (services), traded food and a residual non-traded sector that incorporates agriculture and the informal sector. Output in the government sector has constant returns to scale with labour as the only factor of production. Output in the traded, non-traded and residual sectors is produced by both labour and government capital. We suppose that total factor productivity in each of these sectors grows at a constant rate of 2% per period. The share of labour (and in turn capital) in each sector is calibrated using data on wages. This data suggests that the non-traded services sector is more capital intensive than the traded manufacturing sector. Output of the traded food sector is set to zero, so that this sector only accounts for food imports.

The balance of payments is dictated by the current account, as we assume that there is no domestic private capital and the capital account is closed. Oil is the primary export. The traded manufacturing sector produces a good that is sold at the world price. This can be imported or exported depending on the level of domestic output and demand from both private consumption and public investment. The traded food sector refers to a food good that is highly substitutable with domestically produced agriculture. This food is not produced domestically, so only refers to food imports. The final component of the current account is earnings on foreign capital, which accrue directly to the government.

d. The Labour Market

Observation
Iraq’s labour force makes up a relatively small proportion of its population. As illustrated in figure 3, of the population of 31.7 million in 2011, 18.7m (59%) are aged 15 years or above. Of those, 7.9m are in the labour force. The remaining 10.8m of working age are considered economically inactive. The majority of those deemed economically inactive by this survey are women. However, there remain 1.4m males who are not in the labour force and, when asked, attribute this to a lack of education. This group of males are drawn into the labour force if the real wage falls or labour productivity improves.
Of the 7.9m in the labour force, the majority are employed by the government, followed by the non-traded service sector. The government also pays the highest wages, as mentioned above.

**Figure 3: Breakdown of Iraq’s labour force**

**Model**

The model adopts a stylised representation of the labour market. The government sets the wage for government workers as a constant mark-up over the wage in the residual sector. Wages in the traded and non-traded sectors are set as a constant proportion of the government wage. Labour moves between each sector to equate its marginal product with each sector’s wage. The residual sector is comprised of the low productivity non-traded agricultural sector and the group of males outside the labour force who may plausibly be drawn in if labour market conditions improve. The workers in the residual sector all produce a non-traded good, be it food, cigarettes or untraded services, which has a high elasticity of substitution with imported food. The wage in the residual sector adjusts to clear the labour market, driving wage movements in the formal sectors.

**e. Households and Demand**

**Observation**

Average household expenditure per capita each month is ID 132,000. The Iraqi household economic survey 2007 breaks this down across a bundle of goods. The majority of spending is on traded goods, followed by agriculture and foodstuffs, and non-traded services.

**Model**

To model household consumption, we first assume that households demand a subsistence level of food. This can be met by consuming a bundle comprising both imported food and output from the domestic residual sector. Only after the household satisfies this subsistence level of approximately ID 38,000 per capita each month (Paper of the Committee on Economic Policy 2009), does it begin to
demand other goods. Following a Stone-Geary Linear Expenditure System, we assume that the household spends a constant proportion of its income above the subsistence level on each good, which is calibrated to demand in 2007.

The price of the traded manufacturing and traded food is set exogenously at world prices. The prices of non-traded services and non-traded agriculture are set so that they equate supply and demand in each period.

3. Analysis

This section evaluates five scenarios available to the Iraqi government for managing its anticipated increase in oil income. It shows that the most effective way of boosting Iraq’s non-oil GDP is to invest in domestic capital while using an offshore parking fund to smooth adjustment costs. We begin by assuming that the government has four levers at its disposal: government employment, domestic investment, foreign savings and direct transfers. The first scenario traces the effects of increasing government spending on all four levers lever in proportion to their share of government spending in 2007. This is treated as a base case. It is extended in scenarios (ii)-(v) by focusing the incremental government revenue on each lever in turn. We find that scenario (iii), investing in domestic capital, increases non-oil GDP by the greatest margin. However, this strategy also incurs losses as adjustment costs need to be incurred when ramping up domestic investment. An appropriate balance is found by combining investment in domestic capital with an offshore parking fund. This reduces losses to adjustment costs leading to similar levels of domestic capital and real GDP, but far more foreign assets, than in the scenario without a parking fund.

Our analysis shows that non-oil GDP is raised by the greatest margin under scenario (iii): directing the windfall towards investment in domestic public capital. Scenario (i) uses the windfall to proportionally increase all spending categories and leads to a large increase in consumption, but only a moderate increase in output of primarily non-tradeables. Scenario (ii) uses the windfall to increase government employment, which leads to smaller rises in both output and consumption than scenario (i) and is accompanied by steep inflation in both wages and prices. Scenario (iv) directs the windfall to foreign savings with distribution of earnings. This leads to a very large increase in consumption, but again only a small increase in real output which comes primarily from the non-traded sector. Scenario (v) uses the windfall to boost direct transfers to households. This leads to similar increases in output and consumption as scenario (i). In contrast, scenario (iii) enjoys more than double the increase in real output as scenario (i). Real consumption increases by less, as the funds are directed towards capital accumulation.

However, investment in domestic capital incurs losses to adjustment costs. To counter this we investigate a hybrid scenario, i.e., (iiiib). In this scenario the windfall is invested in domestic capital while an offshore parking fund is used to smooth adjustment costs. The smaller adjustment costs in this scenario mean that both real GDP and the capital stock rise by an amount similar to that in scenario (iii) over the coming five decades in the model. Scenario (iiiib) is preferred though, as far more foreign assets are accumulated than in the scenario without a parking fund.
The charts in the remainder of this section use the following mnemonics:

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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<tbody>
<tr>
<td>T</td>
<td>Transfers</td>
</tr>
<tr>
<td>DeltaF</td>
<td>Foreign savings</td>
</tr>
<tr>
<td>bglg</td>
<td>Domestic investment (bg: price of investment, Ig: quantity of investment)</td>
</tr>
<tr>
<td>wgLg</td>
<td>Government wage bill (wg: government wage, Lg: government employment)</td>
</tr>
<tr>
<td>Kg</td>
<td>Government capital stock</td>
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<tr>
<td>F</td>
<td>Foreign assets</td>
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<td>Labour, Traded</td>
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<td>Labour, Non-traded</td>
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<tr>
<td>LR</td>
<td>Labour, Residual</td>
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<tr>
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<td>Output, Traded</td>
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<tr>
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<td>Output, Non-traded</td>
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<td>XR</td>
<td>Output, Residual</td>
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<td>C_T</td>
<td>Consumption: Traded</td>
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<tr>
<td>C_N</td>
<td>Consumption: Non-traded</td>
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<tr>
<td>C_F</td>
<td>Consumption: Food (aggregate)</td>
</tr>
<tr>
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<td>Price: non-traded services</td>
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<tr>
<td>pR</td>
<td>Price: non-traded residual</td>
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<tr>
<td>wR</td>
<td>Wage: non-traded residual</td>
</tr>
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**Table 1: Notation used in analysis**

(i) Using the windfall to increase all government spending proportionally
Increasing government spending on each lever proportionately leads to a moderate increase in capital and foreign assets, a large increase in real consumption, a moderate increase in real output of primarily non-traded goods, and moderate wage and price inflation. In this scenario the amount spent on each lever increases in proportion to its share of government spending in 2007. The amount spent on government employment is split between the wage, which is set at a constant mark-up over the agricultural wage, and the number of government employees. Transfers are used to redistribute any extra profits back to households.

This scenario sees a moderate increase in public capital and foreign assets. Public capital accumulates in the scenario as the nominal amount of spending allocated to domestic investment increases with the windfall. Only a moderate amount of public capital is accumulated for three reasons. First, there is a moderate increase in the price of the non-traded good. This dilutes the amount of nominal spending that is converted to real investment. Second, investment in public capital suffers from adjustment costs. This is illustrated by the PIMI, which shows that as little as 50% of real investment leads to an increase in the capital stock. The PIMI rises slightly towards the end of the horizon. Third, public capital depreciates at 3% per annum. Foreign assets also rise moderately, because only a small fraction of government spending is allocated to foreign savings and the real return from these assets is distributed to the government each period.

There is also a large increase in real consumption, spread across food, traded, non-traded and public goods. Consumption of food rises slowly, due to the way we have specified preferences for it. Once
the subsistence level of food is reached, households spend a relatively small proportion of each incremental dinar on it. Demand for the non-traded good rises more quickly. It is met by increased production of the good, made possible by labour moving from the traded to the non-traded sector. It is also met by a rise in the price of non-traded goods, which corresponds to an appreciation of the
real exchange rate. In contrast, demand for the traded good rises very quickly. This is met largely by imports as increased demand for the traded good does not bid up its price, which is set exogenously on world markets. The associated contraction of the traded sector and expansion of the non-traded sector is known as “Dutch disease”. Consumption of the good produced by the government sector rises moderately, in line with higher government employment.

The increase in consumption is accompanied by a moderate increase in non-oil output. The increase in output is not shared evenly between sectors: the traded sector shrinks whilst the non-traded sector expands. This is due to the “Dutch disease” effects described above. Over time, the residual sector also shrinks as the increasing capital stock draws workers into more capital intensive industries. It is interesting to note that the traded sector shrinks before labour is drawn out of the residual non-traded sector. This is because the domestically produced traded good is a perfect substitute for the imported traded good. However, the residual good is imperfectly (albeit highly) substitutable with the imported food good.

Finally, prices in both the non-traded and the residual sectors rise. The price of non-traded goods initially rises in response to excess demand. Towards the end of the model’s horizon it falls again, due to smaller increases in oil output and improved productivity. The price of the residual good rises more slowly. It follows nearly exactly the residual wage, which rises in response to increased government employment and improvements in productivity.

(ii) Using the windfall to increase spending on government employment

Directing spending towards public employment leads to a huge state sector and crowding out of almost all domestic production. There is little accumulation of capital or foreign assets, a large rise in consumption by government workers, and a lower rise in real output than in scenario (i). Furthermore, there is steep inflation in prices and wages. In this scenario we assume that the government wage is a constant mark-up over the residual wage with the remainder of incremental revenue spent on increasing the number of employees. The increase in government employment quickly draws workers out of the traded and residual sectors, while all wages steadily increase for the duration of the analysis.

Heavy spending on government employment leads to little accumulation of public capital or foreign assets. The spending on public capital only suffices to maintain the existing capital stock once inflation in the non-traded sector, adjustment costs and depreciation are taken into account. Only a small stock of foreign assets is accumulated as most public spending is directed towards the government wage bill.

Spending on the government wage bill leads to a large rise in real consumption by government workers. Consumption is almost entirely directed towards imports, with real consumption of food and non-traded goods remaining relatively static. This is because more households are receiving higher government wages, leading to higher demand for both traded and non-traded goods. The demand for traded goods is met by imports, while the domestic traded sector shrinks. The demand for non-traded goods is met mostly by a steep rise in their price, as competition for workers from the government sector mean that there aren’t enough to move into this sector to increase production. Consumption of the government-produced public good rises, since the public sector eventually comprises nearly 80% of the economy. However, this is far less than the rise in real
Figure 5: (ii) Using the windfall to increase spending on government employment

Consumption of the traded good because much of the spending on government employment is taken up by wage inflation.
Real output also rises, but by less than in scenario (i). The large increase in government employment draws employees first from the traded and residual sectors, and then from the non-traded sector. As the government does not invest sufficiently in public capital, it declines. This further reduces non-oil output. Increases in output can only be attributed to our assumed exogenous improvement in total factor productivity.

Directing spending towards public employment also leads to a steep rise in prices and wages. The price of the non-traded good rises and the real exchange rate appreciates, because output of the non-traded good cannot rise to meet excess demand. Wages also rise more than any other scenario in this analysis as the government increases competition for workers.

(iii) Using the windfall to boost public investment
Spending Iraq’s oil windfall on investment in public capital will lead to a large rise in non-oil real GDP, with a moderate increase in consumption and a mild short-term real appreciation. If the policymaker’s focus is on output, rather than consumption, then the windfall should be directed towards increasing the capital stock. This model abstracts from the welfare implications of output over consumption, though some include the welfare benefits of employment, the positive externalities of an educated workforce, and the stability that comes from an economy with a more diversified exposure to oil prices. However, this scenario also shows that large increases in investment will incur some adjustment costs. This is illustrated in the large dip in the Public Investment Management Index (PIMI), which is a measure of how effectively and how much investment is translated into public capital. In scenario (iiib) we address these costs by considering the use of an offshore parking until absorption constraints are relaxed.

Focusing spending on capital accumulation will lead to a more modest increase in real consumption than in scenarios (i) and (ii). Consumption of the traded good rises immediately. This is met initially by imports, but by period 37 the economy starts exporting the traded good. Only scenarios (iii) and (iiib) result in eventual exports of the traded good. Consumption of the non-traded good also rises, despite demand from investment accounting for up to 50% of output of this good. Real consumption of the non-traded good still rises by more than in scenario (ii), because higher labour productivity and more available workers mean that output can respond more readily to demand, thus resulting in less inflation.

In contrast, spending on public capital translate into a large increase in real output because government employment stays fixed, freeing more labour for employment in the private traded and non-traded sectors. The increase in public capital also lifts the productivity of labour in both sectors. As demand for the non-traded good is more easily met because of the increased capital stock, labour is freed to move into the traded sector. The traded sector expands as it becomes more internationally competitive due to the higher capital stock, and the supply of labour that has been released from the non-traded sector. As a result, output from both the traded and non-traded sectors see a large expansion.

This scenario also sees a mild real appreciation, followed by a depreciation of the real exchange rate. For the first ten years the capital stock does not expand enough to allow the non-traded sector to meet all demand arising from both consumption and investment. However, as the capital stock rises demand for the non-traded goods will be more easily met, causing their prices to fall. Wages rise,
Figure 6: (iii) Using the windfall to boost public investment

but do so far less than in the previous scenarios where government employment was placing large pressures on the labour market. In the longer term the real depreciation helps to make the domestic traded sector more competitive internationally.
However, this scenario sees adjustment costs bind more than in previous scenarios, with a large fall in the PIMI. This happens because we assume investment is not converted directly into public capital. Instead, the effectiveness of investment will depend on how much is happening in any period. We assume that the more investment in a period, and the smaller the capital stock, the less than investment will be converted into capital. This accounts for the effects of long planning procedures as well as of embezzlement, poor project choice and the like. To reduce the effects of these costs, we consider the use of a temporary offshore parking fund in scenario (iiiib).

(iiib) Using the windfall to boost public investment with some parking abroad

Directing Iraq's windfall towards public capital while temporarily parking some of it abroad will reduce adjustment costs and lead to similar levels of real output and public capital, but far more foreign assets than in scenario (iii) where there is no parking of funds. The offshore parking fund holds some of the windfall abroad, reducing the losses due to adjustment costs. Although the PIMI again falls below 40%, this is delayed while the capital stock slowly accumulates. After period 25 an increasing amount of the windfall is directed towards capital accumulation. By this stage the stock is large enough to accommodate the higher investment. Over the fifty year horizon of the model the parking fund results in a capital stock 80% of that in scenario (iii), but a stock of foreign assets approximately 1000% that of scenario (iii).

Channelling some of the windfall into an offshore parking fund leads to a similar level of public capital as in scenario (iii). However, it results in far more foreign assets. This can be attributed to the effects of adjustment costs. In scenario (iii) a large amount of investment, relative to the capital stock, was undertaken in the early days of the windfall. Due to the small initial size of the capital stock it could not be absorbed, and so was effectively lost. In this scenario the investment that would have been lost to adjustment costs is redirected towards foreign savings. Thus, the capital stock at period 50 is 80%, and the stock of foreign assets is 1000% that of scenario (iii). These foreign assets provide both an extra income stream for the government, and a stock of funds that can be more efficiently spent on investment at a later date.

This scenario sees a similar, albeit delayed, increase in real consumption to that in scenario (iii). In this scenario consumption is delayed by up to 10 years due to the use of the offshore parking fund. As demand for non-traded goods, from both consumption and investment, is less than in scenario (iii) there is less upwards pressure on the price of non-traded goods.

Output in this scenario also increases more slowly than in scenario (iii). As the oil revenues are released more slowly into the economy, the abrupt expansion of the non-traded sector to meet consumption and investment demand in scenario (iii) happens over a longer period in this case. Over time the accumulation of public capital increases output in both the traded and the non-traded sector. However, as the price of non-traded goods (and thus the real exchange rate) appreciates less in this scenario, there is relatively more demand for the output of the non-traded sector. In turn, relatively more of the labour force is concentrated in the non-traded sector than in scenario (iii).

As mentioned previously, the use of an offshore parking fund places less upward pressure on the price of the non-traded good. This reduces the amount of the consumption basket that is weighted
Figure 7: (iiiib) Using the windfall to boost public investment with some parking abroad

towards the traded good, and means that the non-traded sector is relatively larger in this scenario than in scenario iii). The wage in the residual sector eventually rises higher than in scenario iii), but does so more gradually. This lifts wages in each sector. The price of the residual non-traded good follows that of the wage.
(vi) Using the windfall to invest in foreign assets

Saving the entire windfall in a fund holding foreign assets and transferring the earnings on the fund to households leads to a very large increase in real consumption, a small increase in output and a

Figure 8: (vi) Using the windfall to invest in foreign assets
moderate appreciation of the real exchange rate. In this scenario the government initially invests all oil income abroad. The 2.5 per cent real earnings on this are distributed to households as transfers, in a bird-in-hand style rule. Government employment and domestic investment stay constant. Although the stock of foreign assets increases rapidly, the stock of public capital stays constant. This fails to increase productivity in both the traded and non-traded sectors, and the country comes to resemble a rentier economy.

This scenario sees a very large and permanent increase in real consumption. This is funded mainly by transfers of interest earnings on the country’s offshore assets. The increase in real consumption is primarily directed towards consumption of imported tradable goods, whilst the consumption of domestic non-traded goods increases much less. This can be attributed to the behaviour of the production side of the economy.

Real output in this scenario increases, but does so much less than in the scenarios focused on domestic investment. This is because the stock of public capital stays constant. The large transfers to households increase consumption demand for both traded and non-traded goods. As capital is not accumulating the domestic traded sector becomes less competitive and demand for this good is met by imports. Demand for non-traded goods cannot be met by imports, and so it is met by a steep rise in their price and by drawing workers from the traded sector into the non-traded sector. This is an illustration of Dutch disease.

Spending the interest earnings on foreign assets while neglecting domestic capital accumulation leads to a steady inflation of both prices and wages. As productivity in the non-traded sector is not boosted by an increased capital stock, excess demand for non-traded goods is met by an increase in the price. The price increase drives up the wage and draws workers away from the uncompetitive traded sector.

(v) Using the windfall to boost government transfers

Transferring Iraq’s oil windfall directly to households leads to a large boost to consumption and a small increase in output. This is accompanied by moderate price and wage inflation. The results of this scenario depend heavily on the assumptions that households consume all their income in the period in which it is received and that there is no private capital accumulation. If these were relaxed, then the private sector may choose to save and accumulate capital, in turn boosting output.

This scenario sees a large rise in real consumption, financed by transfers directly to households. The rise in real consumption is comprised mainly of imported tradeable goods. The public capital stock declines as the government does not invest sufficiently in it, decreasing labour productivity in both the domestic traded and non-traded sectors. Demand for the non-traded good leads to a small rise in real consumption, but this is largely met by an increase in the goods price. The rise in consumption may be somewhat overstated, as we have assumed that households have no access to savings markets. As a result, all income earned by a household in a period is spent in that period. In reality households may choose to save some of these transfers, if only through informal means.

Output in this scenario rises modestly, and primarily in the non-traded sector. As the public capital stock steadily declines, labour productivity in both the traded and the non-traded sector falls. Household demand for traded goods is met by imports, and their demand for non-traded goods is met by an increase in their price and a movement of labour from the traded to the non-traded sector.
sector. It is interesting to note that labour is drawn from the traded to the non-traded sector, even with a large and unproductive residual sector. This can be attributed to the appreciation of the real exchange rate and relative decline in the productivity of the traded sector. It should also be noted that in our model we have assumed that only public capital is used in production. In reality there

Figure 9: (v) Using the windfall to boost government transfers
may also be private capital formation, which could improve the productivity of domestic output. This scenario abstracts from such a possibility.

Finally, the transfer of the windfall directly to consumers leads to a real appreciation. The inability to meet demand for the non-traded good by increasing production, due to the diminishing capital stock, despite the influx of labour, causes the price of the non-traded good to rise. The price of the residual non-traded good also rises, and along with it so too do wages. As the rate of oil extraction slows towards the end of the horizon, both prices and wages begin to fall.

4. Conclusion

Iraq has been in a state of conflict for the past three decades. With the formal conclusion of the second Gulf war at the end of 2011 and slowly improving security and governance, a foundation is being laid for reconstruction and economic development. This is lead in no small part by the rapid development of Iraq’s oil fields, which have seen an increase in output from 1.5mbpd in 2003 to 2.6mbp in 2010. With the successful auctioning of nine service contracts in late 2009 and early 2010, this robust growth in output is expected to continue. Estimates of potential output vary, but optimistic projections suggest that Iraq could be one of the largest oil producers in the world by 2030. Even conservative predictions suggest that the increased windfall could be transformational for the country.

The purpose of this project has been to evaluate a variety of fiscal policy options available for managing Iraq’s windfall. To do so, we developed a simple general equilibrium model that can be used by policymakers for analyzing the implications of future spending options. The model is simple, in the sense that it does not involve a large amount of optimizing behaviour. This allows for a range of policies to be tested. It is also consistent with our focus on positive, rather than normative prescriptions. The model also operates in general equilibrium, which allows the effects of a policy to be traced throughout the economy. The model is calibrated to data on the Iraqi economy in order to gain an understanding of the relative magnitudes of various effects.

We find that the most effective policy for increasing real GDP is to invest the windfall in domestic public capital and to use an offshore parking fund to reduce the losses associated with adjustment costs. Investment in public capital will raise labour productivity throughout the economy, lifting wages and sustainably increasing output and consumption. Using an offshore parking fund will serve to avoid the worst effects of adjustment costs. In developing and middle-income countries such costs can claim more than 50% of every dollar spent on public investment. By using a parking fund, domestic capital and foreign assets can both accumulate more than would be the case without one.

We envisage two extensions. First, the model could be extended to include not only hand-to-mouth consumer but also a fraction of households which have access to capital markets and make an intertemporal savings decision and to allow for private accumulation of capital. This introduces forward-looking behaviour and may become more relevant as Iraq’s develops a bigger affluent middle class. Second, our calibration can be improved with new and revised data when they become available. As Iraq is in a rapid state of flux, more recent and concrete data could improve our recommendations.
A. Appendix: A general equilibrium model of Iraq

This Appendix outlines formally the general equilibrium model of the Iraq economy used in this analysis. The model is comprised of five components: the oil sector, the government sector, the private sector, the labour market and household consumption. Changes in oil income or fiscal policy influence the remaining sectors in general equilibrium. The model is then calibrated to data on the Iraq economy, as described in Appendix B.

a. The Oil Sector
Oil is treated as an exogenous windfall $N$, accruing directly to the government. It increases steadily over time, in accordance with the average of a number of projections.

b. The Government Sector and Fiscal Policy
Government controls public employment $L_G$, the public wage $w_G$, transfers $T$, public investment $J_G$ and foreign assets in the next period $F_{t+1}$. The government budget constraint is given by:

$$\Delta F_t + b_G J_G + T + w_G L_G = r F + N + \text{GovernmentRents}$$

(1)

in which exogenous resource revenues are $N$. The stock of foreign assets is $F$, and the country is fully integrated into the world economy so the world interest rate $r$ is fixed. $b_G$ denotes the cost of one unit of investment (see equation (13) below). GovernmentRents denote profits and rents transferred to the government (see below).

The public capital stock $K_G$ moves according to the following relationship. Government spending on investment is $I_G$, but only a fraction of this, $I_G$, where $I_G = I_G + \frac{1}{2} \phi I^2 / K_G$, actually increases the public sector capital stock. This accounts for absorption constraints such as corruption and poor project choice, which increase with the size of investment and decrease with the size of the capital stock. The Public Investment Management Index, $PIMI = I / J$, is a measure of these absorption constraints. In low and middle income countries the PIMI is approximately 0.5-0.6. This implies that, in a steady state with depreciation of $\delta = 0.03$, the absorption parameter $\phi = 40$. Accumulation of the public sector capital stock is given by:

$$K_{G,t+1} - K_{G,t} = I_G - \delta K_{G,t}.\quad (2)$$
c. The Private Sector and Production

The private sector consists of four sectors, a traded sector \((T)\), a non-traded sector \((N)\) an imported agriculture sector \((I)\) and a non-traded residual sector \((R)\) incorporating agriculture and informal employment. Each sector \(j = [T, N, I, R]\) produces output \((X_j)\), priced at \((p_j)\), using technology \((A_j)\), public capital \((K_G)\) - which is common to all sectors, private capital \((K_j)\) – which is set exogenously (in agriculture it is thought of as land), and private labour \((L_j)\). Private capital is set to one in the \(T, N\) and \(R\) sectors, and \(K_i = 0\) so traded foodstuffs are only imported. This reflects the large component of imported foodstuffs in the Iraqi consumption bundle, and allows the subsistence level of consumption to be met if the domestic agricultural sector shrinks. Total factor productivity in each sector is calibrated to observed data, and is assumed to grow at a constant rate of 2\% per period.

We have the Cobb-Douglas production functions:

\[
X_j = X_j(A_j, K_G, K_j, L_j) = A_jK_G^{Y_j}K_j^{N_j}L_j^{\alpha_j}.
\]

Each sector is a wage taker, and wages may be sector specific. Private sector wages are given by \((w_j)\). Wages in the public and each private sector are set as a constant multiple of the residual sector wage \((w_R)\). This residual wage is determined endogenously to clear the labour market.

The private sector chooses employment to maximise instantaneous profits given this wage, so for each sector we obtain:

\[
L_j = \left[ \frac{p_jA_jK_G \omega_j^{1-\alpha_j}}{\omega_j(w_A)} \right]^{\frac{1}{\alpha_j(1-\alpha_j)}}, j = [T, N, I, R].
\]

Profits are in each sector \(j\) are given by:

\[
\pi_j = p_jA_jK_G^{Y_j}K_j^{N_j} \left[ \frac{p_jA_jK_G \omega_j^{1-\alpha_j}}{\omega_j(w_A)} \right]^{\alpha_j(1-\alpha_j)} - w_jL_j - rK_j.
\]

Profits and rents are distributed as outlined in table 2. Profit and rent from the residual sector is given to residual workers, to remove endogeneity in the determination of \(w_R\), making the model easier to solve.

<table>
<thead>
<tr>
<th>Profit/Rent</th>
<th>Government</th>
<th>(L_G)</th>
<th>(L_T)</th>
<th>(L_N)</th>
<th>(L_A)</th>
<th>Foreigners</th>
</tr>
</thead>
<tbody>
<tr>
<td>(\pi_i) (i = [T, N, R])</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(K_i) (i = [T, N, R])</td>
<td>Yes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(\pi_A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>(K_A)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 2: Distribution of profits and rents amongst each sector

d. The Labour Market

Wages in the public, traded and non-traded sectors are set as a constant multiple of the residual wage, \(w_k = \omega_kw_R\) where \(k = [G, T, N]\), and \(w_G > w_N > w_T > w_R\). The wage in the residual sector, \(w_R\) adjusts to clear the labour market, \(L_t = \sum_j L_{j,t}\). It is given by:
\( w_R = p_R \alpha R A_R K_R^{n} K_Y^{\gamma} / (L - L_G - L_T - L_N - L_I)^{1-\alpha} \).

\[ e. \text{Households and Demand} \]
Demand comes from two sources: consumption and investment. Consumption is allocated between traded, non-traded and food goods, with the latter being a bundle of domestic and imported agriculture. Investment demand comes from government investment in public capital, which uses both traded and non-traded goods.

There are four types of consumer, \( i = [G, T, N, R] \), based on the sector of their employment. Each consumer spends all income in the period in which it is received, \((w_i + T_i)L_i = M_i \forall i\). Consumers demand traded goods \((T)\), non-traded \((N)\) goods and food \((F)\). Food is a constant elasticity of substitution (CES) bundle of the domestically produced residual good \((R)\), and the imported food good \((I)\). This accounts for the large impact of food imports, and permits consumers a subsistence level of food if the domestic residual sector shrinks. Preferences for traded goods, non-traded goods and food are given by a Stone-Geary specification, with a subsistence level of demand by consumer \( i \) for good \( j \), \( S_{i,j} \). This gives rise to the following demand equations:

\[ C_i = \prod_j (C_{i,j} - S_{i,j})^{\delta_{i,j}} \]  
\[ M_i = \sum_j p_j C_{i,j} \]  

Minimising (9) subject to (8) gives the following demand function. We assume that \( S_{i,j} = 0 \) for \( j = (T, N) \) and \( S_{i,j} > 0 \) for \( j = (F) \). We thus have:

\[ C_{i,j} = S_{i,j} + \frac{\delta_{i,j}}{p_j} (M_i - \sum_j p_j S_{i,j}) \]  

The household demand for food is met by a combination of the non-traded residual good \((R)\) and imported food \((I)\), according to the following preferences:

\[ C_F = (\beta C_I^{1-\rho} + (1 - \beta) C_R^{1-\rho})^{-1/\rho} \]  

\( \beta = \frac{1-\sigma}{\sigma} \) and \( p_F C_F = p_I C_I + p_R C_R \).

The mix of \( C_I \) and \( C_R \) is chosen to minimize expenditure on food, subject to the above budget constraint. This yields the following demand functions and price index:

\[ C_I = \left( \frac{1-\beta}{p_I} \right)^{\sigma} (\beta^\sigma p_I^{1-\sigma} + (1 - \beta)^\sigma p_R^{1-\sigma})^{1-\sigma} C_F^* \]  
\[ C_R = \left( \frac{\beta}{p_R} \right)^{\sigma} (\beta^\sigma p_I^{1-\sigma} + (1 - \beta)^\sigma p_R^{1-\sigma})^{1-\sigma} C_F^* \]  
\[ p_F = (\beta^\sigma p_I^{1-\sigma} + (1 - \beta)^\sigma p_R^{1-\sigma})^{1/\sigma} \].

Demand also comes from investment in public capital, \( J_G \). (private capital is assumed to be exogenous and constant). One unit of investment in public capital uses \( \beta \) units of the traded good and \( (1 - \beta) \) units of the non-traded good. The investment demand for non-traded goods is thus \( D_{I,N} = (1 - \beta) J_G \). The cost of 1 unit of investment is given by:

\[ b_G = \beta p_T + (1 - \beta) p_N \]  

(13)
f. The Goods Markets
This model considers four goods markets: traded, non-traded, domestic agriculture and imported agriculture. The traded sector is set as the numeraire with \( p_T = 1 \). Equilibrium on the market for non-traded goods requires that supply of non-tradables equals consumer and investment demand of non-tradables and is realized by adjustments of \( p_N \):

\[
X_N = \sum_i C_{i,N} + (1 - \beta)J_G
\]

Clearing of the market for the non-traded residual good endogenously determines the residual good price, \( p_R \):

\[
X_R = \sum_i C_{i,R}
\]

The traded agricultural good’s price is set exogenously by world food prices, so \( p_R = \text{constant} = 1 \).

Given some rules for setting the public control instruments and initial values of variables, equations (1) – (14) completely determine the path of the economy.

To check that the economy is in equilibrium: in each period the following national accounting identity should hold:

\[
N + \sum_j p_j X_j + rF = \Delta F + \sum_l M_l + b_{G|G}
\]

As metrics for the development of the economy, we track real GDP, \( \text{RealGDP}_t = \sum_j p_{0,j} X_{t,j} \), using base year prices for each good \( j \).

B. Appendix: Model calibration

a. Parameters from the Data
Calibration is divided into parameters that are taken directly from the data, and those that are fit to impose equilibrium. As the data is taken from multiple sources, some adjustments are needed to make it internally consistent:

- Government spending shares – The amount spent on wages was adjusted from ID 8,431b to ID 12,305b, so that it was consistent with the wage bill implied by the labour force share and the wage data described above. The difference was taken from direct transfers, which was calculated as a balancing item.
- Consumption shares – The amount spent on goods from the T, N and R sectors was found by allocating items from the Iraq household economic survey 2007, tables 8-3 and 8-4. The consumption share of \( R \) was reduced from 42.9% (total spending on food and beverages in the household survey) to 12.5% (implied by total output of the residual sector as a share of total household income at the aggregate level). This can be justified as much food and beverage consumption may come from imported foodstuffs. The difference was allocated to the imported food sector.
### b. Calibrated Parameters

The calibrated parameters were calculated to impose equilibrium on the model, so that the data was consistent with the observations above.

**Production**

Labour share in production, \( \alpha_i \), was found by assuming that labour earns its marginal product in each sector, \( \frac{\alpha_i P_i Y_i}{L_i} = w_i \), where \( P_i Y_i \) is the value added in sector \( i \). We find that the labour share in the traded sector is higher than that in the non-traded sector. Capital in the manufacturing and industrial sectors was heavily hit by the war.

Other factors of production were calculated as follows. Sector specific capital was set to 1 in each sector. The share of public capital in output was set to \((1 - \alpha_i). A_N \) and \( p_N \) are set to 1, choosing units. The traded good is the numeraire so that \( p_T = 1 \) for all periods. As we have imposed \( p_T = p_N = 1 \) in the first period, \( A_N \) and \( A_T \) are backed out to let \( P_i Y_i = P_i A_i K_G^{1-\alpha_i} L_i^{\alpha_i} \) in each sector, where \( P_i, Y_i, K_G, L_i, \alpha_i \) are all taken from the data.

All the profits and rents on capital are allocated to the government, except from the informal sector which are allocated directly to that sector’s workers.

**Consumption**
All the consumption shares are directly taken from the data – subject to some adjustments for consistency – as described above.

**Equilibrium**

Residual sector:

The wage is found endogenously as 
\[ w_R = \alpha R p_R A_R K_G^{1-a_R} / (\bar{L} - L_G - L_T - L_N - L_I)^{1-a_R}, \]
which imposes equilibrium in the labour market.

To set \( w_R \) equal to that observed in reality we adjust the preference for imported food in the food consumption bundle \( (\beta_T) \). This is done numerically.

The price is set numerically to bring the agricultural sector into equilibrium.

Non-traded sector:

The wage is set exogenously as a multiple of the residual wage. The non-traded price is initially set to unity and non-traded technology, \( A_N \), is chosen to allow non-traded labour and output to equal that observed in the data.

The equilibrium condition in the N sector is given by 
\[ p_N X_N = p_N C_N + (1 - \beta) p_N I. \] The value of non-traded output, \( p_N X_N \), is observed. The value of non-traded consumption is also observed, as a fraction of household income. This leaves \( \beta \) and \( I \), which must both satisfy the above equilibrium condition and also the constraint 
\[ s_i G = (\beta p_T + (1 - \beta) p_N) I. \] \( s_i G \) is the share of government spending going to investment, which is known. However, this must be consistent with overall equilibrium in the non-traded sector, so \( \beta \) and \( I \) solve these two equations simultaneously.

**Appendix C: User Guide**

This report was prepared with the use of a simple model developed in Microsoft Excel and contained in the file “Iraq_Model.xls”. It is designed for future use by policymakers and other interested parties. It takes hardcoded inputs in green cells, produces output in blue cells, checks the results in red cells and runs using a simple “Solve” algorithm written in Microsoft Visual Basic for Applications (VBA).

**Inputs**

Inputs are entered in green cells. Each input refers to a parameter or variable described in the previous two appendices. There are six sections of inputs, colored in green. The first is “Core Parameters”. This includes a number of basic parameters and calibrated wage and government spending ratios. The second is “Production”, which includes factor shares, technology and growth parameters calibrated to Iraqi data. The third is “Rent allocation”. This is a matrix of cells referring to each source of profit or rent to capital, which records a 1 in the cell of the agent receiving the rent and a 0 otherwise. By default all rents and capital returns go to the government, except those from the residual sector which are retained by residual workers. The fourth is “Demand”, which describes a number of consumption and investment parameters calibrated to Iraqi housing data. The fifth is the series “N”, which describes the exogenous path of the resource windfall. The sixth are the series...
describing government expenditure. These include formulas describing the behaviour of the
government in each of the tested scenarios.

**Solve**
To solve the model click the button “Solve” at the bottom of the model, in cells A190-A191. This calls
a simple macro that chooses a price that sets equilibrium in one period in the non-traded, residual
and labour markets. It then uses these prices as the starting point for finding equilibrium in each
market in the next period. These prices are output as hard-coded values in the series “pN”, “pR”, and
“wR”.

**Outputs**
Outputs are given in the blue cells. They are functions of the inputs, the solved values and one
another. Each variable is described in the preceding two appendices. These outputs are also plotted
in the charts at the top of the spreadsheet.

**Checks**
Checks are entered in red text. These should always equal zero after the “Solve” algorithm has been
run. They check things such as household consumption equals household income and government
income equals government expenditure.