Estimate Relative Factor Shares of Capital, Labor, and Energy of Iraq Economy

Ali Dawood, Auburn University

Abstract

Oil is considered one of the strategic resources in Iraq. Unfortunately, after looking carefully at the literature, there is no paper dealing with estimating the interaction effect between capital, labor, and energy for the Iraqi economy.

This study estimates these production factor demand elasticities with a particular focus on the oil sector in Iraq. Results from taking into account variation in the prices of input demand of the production function, using the Cobb-Douglas model, the interaction production function, and the translog production function. We prefer the first model because it is the only model provide significant coefficients. DW test indicates that there is no autocorrelation issue in this model. Moreover, model A provides more significant production elasticities compared to model B and C. The interpretation suggests that each one percent increase in the oil energy input will result in a large effect on the size of GDP. Energy input in Iraq is overpaid compared to other input factors, and the market is not competitive.

Introduction

Iraq is among the countries in the world that provide substantial oil energy to the global economy, accounting for about 4 percent of the world oil (figure 1). Such figure is attributed to the large oil deposits in the country and the intensive investment in the oil industry by the government of Iraq, which often devotes a large proportion of the nation's budget to finance oil production, leaving little funds for investment in other sectors of the economy. The oil industry is capital-intensive and uses little labor. As a result, the energy industry employs a paltry 1 percent of the labor force despite the massive budget (Manama, 2016).

Figure 1. Estimated share of world oil production

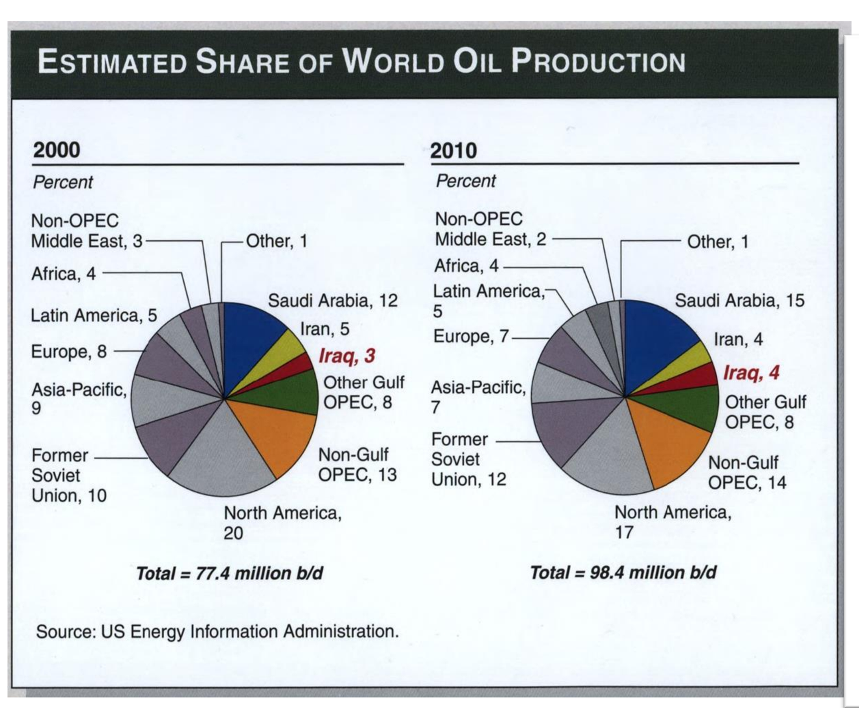

Figure 2. Share of total primary energy supply in 2015

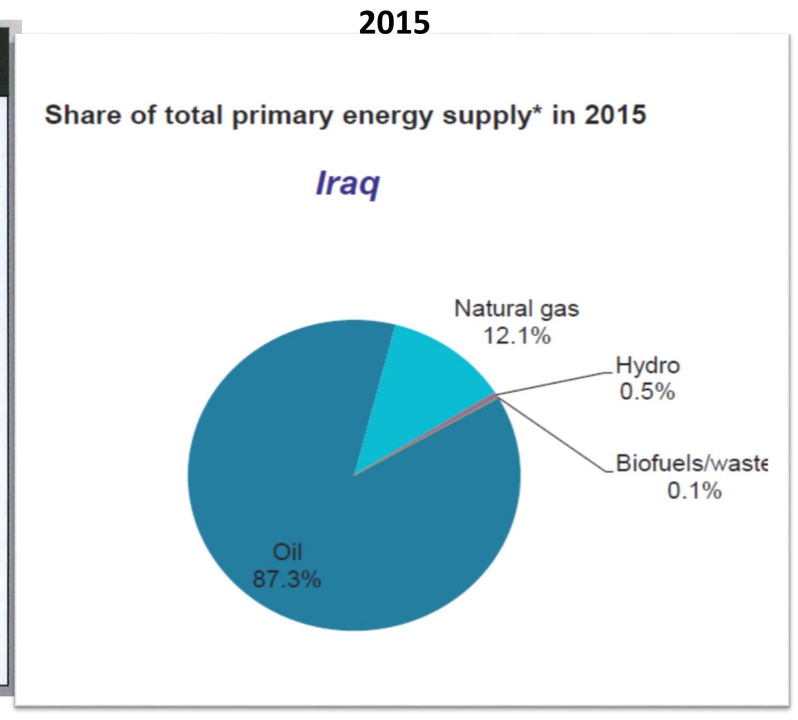

Table 1. Summary Statistics for GDP, Capital, labor, and Energy for Iraq (1980-2015)

Variable	N	Mean	Std Dev	Minimum	Maximum
Y	36	32,605,616,634.00	17,491,061,397.00	8,291,644,375.00	75,414,070,731.00
K	36	6,920,818,863.00	5,171,887,192.00	128,828,363.00	19,690,472,372.00
L	36	5,275,416.38	2,225,699.52	1,516,054.83	9,414,921.00
E	36	26.50	9.74	11.65	46.99

Methods and Materials

In this section, the objective is to estimate factor substitution elasticities assuming cost minimization given a neoclassical production function. As in Copeland and Thompson (2016) substitution elasticities are derived from production elasticities by inverting the matrix in the following equation:

$$\begin{bmatrix} \lambda f_{11} & \lambda f_{12} & \lambda f_{13} & f_1 \\ \lambda f_{21} & \lambda f_{22} & \lambda f_{13} & f_2 \\ \lambda f_{31} & \lambda f_{32} & \lambda f_{33} & f_3 \\ f_1 & f_2 & f_3 & 0 \end{bmatrix} \begin{bmatrix} dx_1 \\ dx_2 \\ dx_3 \\ d\lambda \end{bmatrix} = \begin{bmatrix} dp_1 \\ dp_1 \\ dp_1 \\ dy \end{bmatrix}.$$

In this equation, the $f_i = \partial y / \partial x_i$ are marginal products corresponding to the production function $y = f(x_1, x_2, x_3)$; the $f_{ii} = \partial^2 y / \partial x_i^2$ and $f_{ij} = \partial^2 y / \partial x_i x_j$ are derivatives of the marginal products; p_i is the price of the ith input; and λ is marginal cost obtained by minimizing the constrained cost function $L = \sum_{i=1}^{3} p_i x_i + \lambda\big(y - f(x_1, x_2, x_3)\big)$.

Contact

Ali Dawood
Auburn University
Email: amd0085@auburn.edu
Website: https://aers.auburn.edu/faculty-staff/
Phone: (269) 870-6807

Methods & Materials & Results

We estimated three models as Copeland and Thompson, (2016) used in their paper.

Model A: is Cobb-Douglas

$$\Delta \ln y = c_0 + c_1 \Delta \ln x_1 + c_2 \Delta \ln x_2 + b_3 \Delta \ln x_3 + \epsilon_A$$

Model B: Includes interaction terms

$$\Delta \ln y = b_0 + b_1 \Delta \ln x_1 + b_2 \Delta \ln x_2 + b_3 \Delta \ln x_3 + b_{12} \Delta (\ln x_1 \ln x_2) + b_{13} \Delta (\ln x_1 \ln x_3) + b_{23} \Delta (\ln x_2 \ln x_3) + \epsilon_A$$

Model C : Full translog production function

$$\Delta \ln y = a_0 + a_1 \Delta \ln x_1 + a_2 \Delta \ln x_2 + a_3 \Delta \ln x_3 + a_{12} \Delta (\ln x_1 \ln x_2) + a_{13} \Delta (\ln x_1 \ln x_3) + a_{23} \Delta (\ln x_2 \ln x_3) + 1/2\, a_{11} \Delta (ln\, x_1)^2 + 1/2\, a_{22} \Delta (ln\, x_2)^2 + 1/2\, a_{33} \Delta (ln\, x_3)^2 + \epsilon_A$$

Where y is the Gross domestic product of Iraq, x_1 consumption of fixed capital, x_2 is the size of the labor force, and x_3 is the energy consummation, all measured with respect to the Iraqi economy.

Table 2. Estimators of Model A

Model A		estimate	Std. Err	t value	P-value
	a_0	0.003	0.046	0.070	0.943
	a_1	0.100	0.039	2.580	0.015
	a_2	-0.757	0.651	-1.160	0.253
	a_3	1.620	0.283	5.720	<.0001
D-W	2.087				
R^2	0.56				

Table 3. Estimators of Model B

Model B		estimate	Std. Err	t value	P-value
	a_0	-0.004	0.058	-0.070	0.946
	a_1	-4.974	3.810	-1.310	0.202
	a_2	-12.046	7.521	-1.600	0.121
	a_3	4.974	15.886	0.310	0.757
	a_{12}	0.446	0.327	1.360	0.183
	a_{13}	-0.549	0.403	-1.360	0.184
	a_{23}	0.562	0.808	0.700	0.493
D-W	1.777				
R^2	0.59				

Table 4. Estimators of Model C

Model C		estimate	Std. Err	t value	P-value
	a_0	0.003	0.072	0.040	0.965
	a_1	-5.260	4.149	-1.270	0.217
	a_2	19.969	30.668	0.650	0.521
	a_3	-39.014	38.192	-1.020	0.317
	a_{12}	0.408	0.382	1.070	0.296
	a_{13}	-0.385	0.481	-0.800	0.431
	a_{23}	4.093	3.064	1.340	0.194
	a_{11}	0.015	0.036	0.410	0.682
	a_{22}	-2.761	2.383	-1.160	0.257
	a_{33}	-4.471	3.855	-1.160	0.257
D-W	1.852				
R^2	0.62				

Discussion

We started our estimation by doing a regression analysis for the three models A, B, and C equation as shown above. All estimated coefficients are not significant at any level except the coefficient for the first model "Model A" for the two parameters (see tables 2, 3, and 4). The coefficient of capital is significant at 5% and for coefficient for energy is significant at 1%. The interpretation of these two coefficients is that, if the fixed capital increase by one percent, the GDP will increase by 0.100 per year.

Optimization of cost minimization yields that output elasticities should equal to its usual factor cost share, while in our case results are not consistent to this condition. One economic implication is that because of technology constraints there is some shadow price here; also it implies that labor and energy markets are not perfectly competitive as we assumed, probably there is monopoly power in those two markets. This results also indicate that this production function is not CRTS or homogeneous in (K, L, E), because $\sum_{i=1}^{3} \alpha_i \neq 1$ according to above tests. This assumption can be imposed in estimates for future analysis.

Conclusions

1. All estimated coefficients are not significant at any level except the coefficient for the first model "Model A" for the two parameters.
2. test 1 and test 2 fail to reject the null hypothesis, while test 3 would reject null hypothesis, indicating production elasticity of capital and labor is equal to its assumed factor share, but production elasticity of energy is not equal to its factor share.
3. Optimization of cost minimization yields that output elasticities should equal to its usual factor cost share, while in our case results are not consistent to this condition
4. This results also indicate that this production function is not CRTS or homogeneous in (K, L, E), because $\sum_{i=1}^{3} \alpha_i \neq 1$ according to above tests.

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