Three Essays in Applied Economics

By

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Abstract

Since the 1920s Iraq has experienced a prolonged period of war which has adversely affect the country's economic, affecting the political as well as social aspects of the lives of people living in the nation. This dissertation contains three chapters discussing issues related to the Iraqi economy. The first chapter focuses on source-specific demand elasticities of dates in international trade. In this chapter, a Rotterdam model is used to estimate demand elasticities for dates differentiated by place of production. Separate equations are estimated for the six major exporting countries, namely Iran, Iraq, Saudi Arabia, United Arab Emigrants, Pakistan, and Rest of World; Results suggest imports demands are inelastic with respect to price and unitary elasticity with respect to total date expenditure for some countries. The demand for dates from the various exporting countries will grow at different levels along with the changes in total world expenditures on dates. An increase in the price of dates from a particular exporting country will increase the value of its dates in international trade.

In the second chapter, we have examined the impact of armed conflicts/violence on health in Iraq. In this chapter, we used a nationally representative sample of the Iraqi population with an interview called the Iraq Household Socio-Economic Survey (IHSES) 2006-2007 and Iraq Body Count (IBC) datasets to investigate the impact of conflict on the health service of Iraq. Iraqi provinces considered in this paper as a natural experiment by divided provinces with high intensity of violence as a treaded group and low intensity of violence as a control group. After controlling for individuals, households, city, dwelling characteristics and comparing with the literature, the study concludes the following; first, we find that the expected mean change of health outcomes is affected by time treatment, specifically after 2003 for provinces with high-

intensity violence level. Second, the children who are most likely to face violence are living in high-intensity provinces as opposed to those living in low-intensity violence provinces. Finally, health services are weak in all provinces of Iraq. Kids are getting bad health service (less vaccination) in all provinces. However the health service is becoming worse after the 2003 war, and that is clearly manifested in DID coefficients of high and medium provinces, but not in the low intensity violence provinces.

In the third chapter, we estimate production factor demand elasticities with a particular focus on the oil sector in Iraq. Results from taking into account variation in the prices of inputs demand of the production function, using types of production function forms — for example, the Cobb-Douglas, the interaction production function, and the translog production function. We prefer the first model because it is the only model that provides significant coefficients. D.W. 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 capital and labor inputs will result in a substantial effect on the size of GDP. The estimation of the production function is experiencing a constant return to scale, and the market is not competitive.

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Chapter 1. Source –Specific Demand Elasticities for Dates in International Trade

Abstract

Dates are indispensable goods for people living in arid areas because of their nutritional value for the communities residing there. Market shares of trade volumes for date crops growing in the Middle East and North Africa are considerable. There are a large number of articles that estimate different kinds of elasticities for various types of goods produced in the Middle East and North Africa, but very few articles mention the estimation of demand elasticities of the most important agricultural commodities such as dates in these regions. In this article, a Rotterdam model is applied for world demand for dates with a particular focus on Iraq. Major exporters of dates are used with time-series data (1961-2016). The estimated Marshallian own- price elasticities suggest that world demand for dates from the United Arab Emirates and Pakistan is more price sensitive in comparison to dates from other countries. One of the policy implication that can be taken is that the world demand would prefer to increase their demand for dates from other countries other than paying high price dates for the United Arab Emirates and ROW. The marginal budget share indicates dates from Iraq have a relatively large marginal share, which is to be expected since it is the largest supplier of dates to the world, but significantly smaller for the rest of the world. Moreover, the results show that estimated expenditure elasticities are positive, so the dates are a normal good.

I. Introduction

Date palm is considered one of the oldest fruit trees in the Middle East and plays a vital role in the life of the people there. Dates are marketed all over the world as a high-value confectionery and as fresh fruit. Moreover, they remain an important subsistence crop in most arid areas (Elashry et al., 2010). As shown in Table 1.1 and figure 1.1, on average, over the period 1961-2016, the Middle East countries exported two-thirds of all dates to the entire world. Iraq had almost half of the market share of date exports in the world. Nevertheless, international trade in dates can be volatile because there are many factors that impact the price of dates. Particularly, the trade values for the case study group have significant price fluctuations. Consequently, the ambiguity about how exported quantities respond to price variations. By the same token, changes are often associated with political and economic instability in the main producing countries. (Zaid and Jiménez, 1999).

The importance of Iraq as a major exporter of dates is not reflected in the amount of return it receives from its export of dates. According to the summary of the descriptive statistics (Table 1.3), the price of dates ranges from 150.18 $US/per ton for ROW to 727.92 $US/per ton for Saudi Arabia. Given the radically different prices across the supply sources, Figure 1.2 shows proportions of prices to the whole world; if we excluding Iraq and ROW, the other countries cover 83% of prices, Iraq and ROW are 11% and 6% respectively (Figure 1.2).

From Table 1.1, If Iraq is excluded, the sum of market shares for all countries including ROW is only 0.60, but the market shares values "return" are 89% in terms of the return they received from their exports. However, the market share for Iraq is 0.40 (Figure 1.1), but the average value of the return is only 11% (figure 1.2). The rest of the returns are to the other exporting countries. From these numbers, the distinction in prices between the leaders in date exports is obvious. In addition, most of the differences in prices are due to the differences in quality among dates from each country. Besides, each country has different policies regulating export procedures.

For these reasons, it is not difficult to find literature that addresses goods differentiated by origin. For instance, Armington's model, which considers a simple approach, combines products differentiated by their country of origin. However, it has been widely critiqued in the literature. For example, Winter (1984), and Alston et al. (1990) argue that the functional form of Armington's model is too restrictive and nonhomothetic (Hertel et al., 1997). Moreover, a paper by Andrew Muhammad (2012) introduces a list of studies that used Armington's framework to analyze of agricultural imports, and he posits in his paper that the purposes behind source differentiation are not generally obvious. Muhammad in his paper used many examples of some agricultural and nonagricultural commodities differentiated by origin. For example, he used wine, by stating that the source of wine is clearly differentiated because the country of origin is an important attribute. The argument here is the source differentiation is clear in agricultural commodities like cotton, meat, etc. Our paper argues for using a demand system such as the Rotterdam model to set up a system to estimate the world demand of dates in international trade. In this model, quantity exported disaggregated via source is usually exactly as a system in which the total expenditure throughout all sources and then source-specific prices are normally the only explanatory variables. While these specs have been empirically profitable in that prices yet aggregated expenditure often provide an explanation for a vast piece of the variability between quantities demanded (Muhammad, 2012).

Currently, no paper addresses the estimation of elasticities for dates concerning world demand for dates. Usually, papers published in agricultural journals deal with crops in the United States and European Markets with little regard to the crops like dates produced by the Middle Eastern. However, Middle Eastern countries are the first countries to have an advantage in the production and exportation of dates over American and European markets. This paper tries to discover the factors that affect the export of the Iraq date market, giving special attention to the international trade of dates. This study focuses on estimating world demand for dates, one of the most significant products in the Middle East. Dates are one of the staple foods for some Middle Eastern countries, especially countries that have suffered from war and economic regimes. For example, Iraq and Iran's dates are considered one of the valuable goods across their markets because dates are a consumer good that is available in the market in times of scarcity when the prices of other basic food commodities sharply rise. According to the data, not every country producing an enormous amount of dates considers itself a net exporter. For example, Eygpt, one of the top producers of dates, is a net importer after taking into account the size of its population. However, the date was considered to be Iraq's second largest national export after oil.[1]Estimating the elasticities of demand is essential because it provides a better view of demand status in importing countries. In addition, government policies, such as subsidizing or taxing dates, can be formulated for the date market to see their effect on the demand curve in future studies. Most importantly, by estimating the demand elasticities, potential monopolistic powers in the dates market can be identified.

The primary objective of this study is coming in three points: first, fill in the gap in the literature by providing an estimation of world demand elasticities of dates in international trade

[1] Data about the market shares for different countries exporting dates will be discussed later in the data section.

by using a well-known world demand model. Second, this study is trying to discover if there is any market power is playing any rule in dates market in the Middle East region. Third, this study is an attempt to open the door to redirect the focus on critical agricultural commodities that have a large budget share and at the same time has very little representation among the academic works. Therefore, this study attempts to provide a better view of global price elasticity. Also, since the literature is less informative about estimating the demand elasticity of dates, this paper will estimate the price elasticities of demand by using one of the famous models that conduct demand for dates. Furthermore, it might be interesting to see the effect of world price variables for each country on the quantity exported. For example, the effects of the price of dates in Saudi Arabia on the endogenous variable or the quantity exported by Iraq; in the case of small open economies, the prices of exported goods are exogenous.

The next section discusses the background of the agricultural sector in Iraq, following by a discussion of various papers to understand how different researchers have tried different ways and ideas to estimate the elasticities. Particularly, it will discuss the estimation of demand elasticities in Middle Eastern countries. The following sections will present the model used; next, the data and empirical results will be described, followed by a brief summary of key findings.

II. Background of the Agricultural Sector in Iraq

Looking at Table 1.1 again, Iraq had a boom in date exports back in 1961 through 1980, and the market share for this period is three-quarters compared with other countries. According to the data available, more than 70% of global date exports came from the Middle East between 1961 and 2016. More than half of the exported quantities of dates are from Iraq, and rest are from other countries. The data of the market shares of trade volumes, which concentrated dependence on quantities exported only, clearly indicates that most of the world's date exports are concentrated in a few countries in the same region. However, in the years after the Iraq-Iran war[2], Saddam Hussein's government started another war with Kuwait. One month after Hussein's invasion of Kuwait, the UN ordered sanctions on Iraq. The UN was able to gather an alliance of more than thirty countries to bomb Iraq's army and force them out of Kuwait. In this period, the domestic food insecurity in Iraq increased dramatically. Between 1991 and 1996, Iraq's economy was almost entirely closed to world markets. Three-quarters of Iraqi people were starving and faced other humanitarian crises to the point that the UN applied the Oil-For-Food program in Iraq (Blanchard, 2010; Foote and et al. 2004). This program exported oil under the monitoring of the UN and imported food and medical needs for the Iraqi people. Iraq's domestic agricultural production in this period boomed because the Iraqi people relied heavily on their own crops to meet their nutritional needs rather than imported foods.

In 2003, the United States's army took over Iraq[3]. This period is considered a significant change in the Iraqi people's lives. However, after 2003, the borders opened since there was no formal government. There were no taxes, subsidies, or other economic policies. In this period, Iraq's consumption went up because traders were importing more since there were shortages but also increased income. Iraq's domestic agricultural commodities during this time became unable to compete with agricultural food products imported to Iraq (Schnepf, 2004). Iraqi farmers in this period neglected to cultivate their land because their crops were unable to compete with the lower prices of imported food. Water scarcity was also worse than previous times of conflict, so this discouraged land cultivation by farmers as well. In summary, the agricultural sector in Iraq after the 2003 war represented varying degrees of government policy intervention to promote

[2] Note the Iraqi export of dates decreased by half after 1980_s.
[4] Dummy variable used for periods of war between Iraq-Iran, Iraq-Kuwait, and Iraq-US.

and control agricultural production. Adding more of the population dynamics has been influential in determining the role and importance of Iraq's agricultural sector in the global economy (Schnepf, 2003).

III. Literature Review

The literature review will be discussed in two directions. The first group of papers discusses the estimates of the demand elasticity for different agricultural commodities across the world. The second group will be discussing the estimation of supply and demand elasticities in the Middle East countries. The 1956 paper by Nerlove is considered one of the papers that made a substantial contribution in the formulation and application of price expectations models. Nerlove estimated the elasticities for some agricultural commodities by discussing farmer expectations and the role the relative prices play in shaping their decisions. The paper developed a supply function that can deduce how many acres each farmer has to devote to each crop. The findings of the paper show that farmers revise the price they expect to prevail in the coming year in proportion to the error they made in predicting price period. King, in his 1956 paper, proved the findings above by estimating the elasticity of acreage with respect to expected price for cotton, wheat, and corn by introducing what the paper called a special method which was restricted and a general method which was unrestricted by allowing data determine the coefficients of expectation. Khan and Goldstein made another contribution in the estimation of supply and demand elasticity in 1978. The authors examined the elasticity of determinants of export demand and supply for a sample of eight countries. The paper simply estimated the elasticities for the supply and demand by taking into account the simultaneous relationship between the quantities of exports and their prices for eight countries: Belgium, France, Germany, Italy, Japan, Netherlands, United Kingdom, and the United States for which they used a simultaneous approach (2SLS). The paper found large export price elasticities of demand with the medium-term effect of the independent variables on the adjustment of exports and also explained world income as a significant component of export demand. A similar approach has been used by Cooper (2003) to investigate the price elasticity of demand for crude oil in 23 countries. This study used the standard energy demand model to derive both short and long-run elasticities of price and income. The findings of the paper were all estimated elasticities in the short-run that propose oil prices are highly price inelastic, but in the long-run, the elasticities are greater than the corresponding short-run values.

Furthermore, after working through the papers that estimated the elasticities, we should also consider the paper by Soderbery in 2015. This paper introduced an econometrics technique to estimate the elasticities. He suggested the hybrid estimator which combined Limited Information Maximum Likelihood LIML with constrained nonlinear LIML routine to estimate elasticities of substitution between varieties that used by proviso paper's methods. Moving forward with developing techniques that used theory to estimate elasticities, Duffy et al. (1990) used the Armington trade model, provides an insight into the international trade theory. In the above paper, the authors estimated the total export demand elasticity for the United States cotton by using the above model by considering a way to account for the fact that commodities are differentiated by place of origins. The finding of the paper proposed that the export demand facing the United States is probably elastic.

A study by Xie et al. 2009 used data from Norway, UK, Chile, ROW, and world, four demand models to estimate five systems of equations for Salmon market in world trade. One similarity that can be mentioned is that this study is using the same kind of model to estimate the demand elasticities of dates in international trade even though the arguments are different because each one is limited for a different market. Rotterdam model is one of the models used in Xie and et al. paper; all the general restrictions have been checked. The study found that the price elasticity of salmon is less elastic, but it is not inelastic because of the monopoly power that could be observed in the long-run. The expenditure elasticity is unitary, which means the impact of change in total exporting countries will be affected by the same size on changing the prices of importing countries. The 2009 Xie et al. study and my own differ in that my research treats dates and the former looks at salmon. In addition, I examine Middle Eastern and North African countries, while Xie et al. focus on European nations. I adopted the discussion used in this study to interoperate the conditional Hicksian and Marshallian elasticities.

The second part of the literature reviews is about the papers that addressed some agricultural commodities produced by Middle East countries. It should be noted that date palm (*Phoenix dactylifera L.*) has long been one of the most important fruit crops in the arid regions of the Middle East and North Africa. The top post-2000 date-producing countries were Egypt, Saudi Arabia, Iran, United Arab Emirates (UAE), Pakistan, Algeria, Sudan, Oman, Libyan Arab Jamahiriya, and Tunisia (Chao and et al. 2007).

Most of the Middle East nations in the group are unique because they have large oil reserves, a mild climate, and diverse terrain; all these factors help these countries grow many of their strategic crops like dates. Most of the existing studies on demand for dates focus on the individual markets, such as the markets in Saudi Arabia and the United Arab Emirates UAE. The first paper by Al-Shreed et al. (2012) is a descriptive study explaining the major countries producing, importing, and exporting dates. The study does not have an estimation for any elasticity, but it is still important for the Middle Eastern countries because the authors try to analyze the data about the world date market.

Moreover, Al-Shareed et al.'s paper sought to identify the lead exporters and importers of dates. Studies like Al-Shareed et al.'s do not follow a rigorous approach in estimating the demand for dates and instead follow a so-called *ad-hoc* approach. By the same token, papers by (Elashry *et al.*, 2010; Alshuaibi, 2011) follow the same approach. Still, these studies have been useful in revealing the importance of country-specific demand elasticities. Absent from the literature, however, is an estimate of global demand elasticities of dates. An exception is Ali et al. (2014). The following discussion is limited to discussing estimating world demand of dates done by Ali et al. (2014) who estimate what is called external elasticities (export elasticities) for the export of dates in seven countries that import dates only from Saudi Arabia. These countries are Germany, Yemen, Jordan, India, Turkey, Pakistan, and the United States. The authors computed the external elasticities by calculating the weighted average of the import demand elasticities for the above countries. The findings of the paper are that the price elasticity of demand is greater than one for the countries of Germany, India, the United States, and Pakistan. That means it is not possible to increase the price of dates in these countries because the consumers will stop purchasing the good. On the other hand, the paper finds the demand is inelastic for the rest of the countries in this study.

IV. The Model

In this paper, the Rotterdam model was used to investigate factors affecting world demand for dates. This model was selected for estimation because it is consistent with demand theory and is derived from the consumer utility function. Also, the model is considered a local functional form. It permits testing the theoretical restrictions of homogeneity and symmetry without imposing any functional form specification (Xiao et al., 1999). The Rotterdam model has proved popular in applied work. The first two researchers to find the basic establishment of the model were Theil (1965) and Barten (1964). Clements and Gao in 2015 made a rigorous, selective overview of the model and its restrictions.

In this study, the Rotterdam model in Equation (A6) in Appendix I is extended to include a constant term, which serves as a trend effect and a dummy variable to account for structure shock in the Middle Eastern countries, specifically the wars between Iraq –Iran, Iraq-Kuwait, and Iraq-US. The estimated demand system for dates consists of five equations[4] and uses the dates (for Iran, Iraq, Pakistan, Saudi Arabia, United Arab Emirates, and ROW) in the augmented form. It is specified as:

$$\bar{R}_{it}\Delta q_{it} = \alpha_i + \sum_{j}^{6} \beta_{ij}\Delta p_{jt} + \emptyset_{it}S_{it} + \mu_i \Delta Q_t + \varepsilon_{it} \qquad (1)$$

In which $\alpha_i, \beta, and \emptyset,$ are estimation parameters, n=6 is number of goods in the system, T=38 (1978-2016) in the sample size, $\bar{R}_{it}\Delta q_{it} = (\bar{R}_{it} + \bar{R}_{it-1})/2$, and

$d(\ln Q) = d(\ln y) - \sum_{j=1}^{n} R_i \, d(\ln p_j)$ or $d \ln Q = \sum_{n=1}^{n} R_n \, d \log q_n$. S_{it} denotes the dummy variable for war years between Iraq and Iran (1988-1991), Iraq and Kuwait (1990-1991), and

[4] Equation for Iran is excluded from the demand system to avoid singularity in the variance–covariance matrix.

Iraq and the US (2003-2013). All the variables in the Rotterdam demand system are specified as discrete change and approximated by replacing logarithmic differentials with log differences in model estimation. For example, $\Delta p_{jt} = (log\, p_t - log\, p_{t-1})$, $\Delta q_{it} = (\ln q_t - \ln q_{t-1})$

The budget shares R_{it} are replaced with the moving average of the market share of good *i* $\bar{R}_{it}$. So In this model, $\bar{R}_{it}\Delta q_{it} = (\bar{R}_{it} + \bar{R}_{it-1})/2$ denotes the two-period moving average of the budget share of good *i* in year *t*. (Xie et al., 2009).

The parameters of which satisfy the adding-up constraints by the implied budget constraint:

$$\sum_{i=1}^{6} \mu_i = 1 \quad (1a)$$

Given that the price responses in the Rotterdam model are hicksain, demand homogeneity means that an equiproportional increase in all prices has no effect on quantities consumed (Clem-ents and Gao, 2015). This implies:

$$\sum_{j=1}^{6} \beta_{ij} = 0, i = 1,2, \ldots ,6 \quad (2b)$$

Slutsky symmetry states that the compensated substitution effects are symmetric in *i* and *j*. That is, $\beta_{ij} = \beta_{ji}$ or $\beta_{ij} = \beta_{ji} \forall i, j i \neq j (3c)$

Cournot: $\sum_{i=1}^{6} \beta_{ij} = 0 j = 1,2, \ldots ., 6$ (4d)

Elasticities are calculated using the following expressions:

(*Expenditure elasticities*) $E_i^Y = b_i / R_i$

(*Conditional Hicksian elasticities*) $E_{ij}^* = \mu_{ij} / R_i$

(*Conditional Marshallian elasticities*) $E_{ij} = E_{ij}^* - R_j E_i^Y$

Expenditure elasticities are expected to be positive, own-price elasticities negative, and generally, the Hicksian cross-price elasticities are expected to be positive. The Marshallian own-price elasticities are expected to be negative; the Marshallian cross-price elasticities are expected to be positive since date products are generally considered to be normal goods and substitutes for each other.

V. Data Description

This paper will examine five countries plus ROW exporting dates to the global market and focuses on the total exports of dates from the Middle East and North East. The specific countries for this case study are Iran, Iraq, Pakistan, Saudi Arabia, United Arab Emirates, and the Rest of the World (ROW). The above countries represent the supply side of the dates market, according to the UN Food & Agriculture Organization (FAO). There is one source for the data, which is the UN Food & Agriculture Organization Statistics Division (FAOSTAT); this is considered an advantage for this study to keep the dataset consistent. All trade values are in Free-On-Board (FOB). In addition, in this section, a brief explanation about the data that has been collected (see descriptive statistics Table 1.3).

According to the data, the five countries above are considered net exporters for date production across the world. Each year one of the Middle Eastern countries leads the world in producing and exporting dates because of the changes in the economic conditions and global trade agreements.

By reviewing the data for trade values and market shares, this paper finds Iraq’s market share was about 75% of world market shares for the period 1961-1980. Historically, Iraq is seen as the birthplace of the palm tree (Zabar and Borowy, 2012). Yet, Iraq receives the lowest average price for dates, 11% percent compared to the other countries in this case study (see table 1.1 and figure1. 2). After 1980, the Iraqi price for dates, decreased by half until it reached 3% and 5% market shares in the 1990s and 2000s respectively (table 1.2). On the other hand, market shares for other countries increased. For example, the market shares for Iran, Saudi Arabia, United Arab Emirates were 6%, 1%, and 1% in 1961 and became 14%, 6%, and 13% in 1991-2000 respectively (Table 1.2). One of the reasons that Iraq's prices fell was due to the use of advanced technology for cleaning, processing, manufacturing, and packaging of dates in other countries. Iraq's exports fell sharply in the 1990s after Iraq invaded Kuwait in 1991. The fluctuation of Iraqi date prices compared to the prices of dates in the other case study countries existed in spite of the superior quality and the natural sweetness of Iraqi dates.

VI. Estimation Procedure

Equation (1) was estimated using Seemingly Unrelated Regression (SUR) routine in SAS 9.4. The model is estimated first without imposing any theoretical restrictions. The second step of the estimation is done by imposing homogeneity and symmetry restrictions in the model[5]. As previously stated, the ROW's equation is dropped from the system to avoid the singularity of the variance-covariance matrix. The adding-up restrictions are used to recover the coefficients of the omitted equation. The model tested whether the theoretical restrictions of homogeneity and symmetry are compatible with the data or not.

[5] We discussed only the restricted model because it is more realistic to represent the behavior of parameters estimated. However, all raw results (unrestricted estimates) and SAS codes are available in the appendix IV at the end of this chapter.

Finally, the study checked whether the study model provides a better fit to the data or not. Restrictions are equal to zero for each demand equation. The null hypothesis tests the conditions of homogeneity and symmetry hold. Therefore, the null hypothesis statement is that the restricted model is statistically equivalent to the unrestricted model. A Wald test used to check for compatibility at a 5% level for k=5 and n=38 we fail to reject the null hypothesis that the restricted model is statistically equivalent to the unrestricted model. In other words, testing the restrictions for the model reveal that this study fails to reject the null hypothesis and concludes that the restrictions are compatible with the data. The conditional demand model run through the Rotterdam model is compatible with data for almost every equation except the demand equation for ROW. (Table 1.5).

VII. Results

I. Price and Expenditure Effects

In this section, the quality of the results is discussed by looking at the estimated parameters and to see whether or not they are significant and to look at the signs for each of them. As seen in Table 1.4, some of the estimated parameters related to own-price effects are statistically significant at 1% confidence level, while some are not. For example, the own-price effects for Pakistan and ROW are significant at a 1% confidence level. The own-price effects are significant at 5% confidence level for the United Arab Emirates, but the own-price effect for Iraq is not significant at any confidence level. The rest of the own-price effects are not significant at any level. However, the own-price effects of the Rotterdam model are not elasticities. The coefficients of price effect terms are equal to $R_i E_{ij}^*$ (i.e., budget share-weighted Hicksian elasticity and coefficients of income effect terms) are equal to $R_i E_i^Y$ (i.e., share-weighted income elasticity). Both of these elasticities are evaluated at sample means.

In terms of signs, the coefficients of price effects are negative along the diagonal, which represent the downward sloping demand curve. ROW demand for dates is inelastic at -0.07. Specifically for the case study countries, point estimates range from smallest to largest price effects: -0.14 for United Arab Emirates and Pakistan Iran and -0.07 for Iraq and ROW. The price effects for Saudi Arabia and Iran is -0.04 for both.

Estimated expenditure effects are significant at 1% for Iraq and the United Arab Emirates, but expenditure coefficients are not significant at any level for the rest of the countries. More specifically, the largest expenditure coefficients estimated are for Iraq at (0.42) and the United Arab Emirates at (0.31). The smallest expenditure coefficient estimated is for ROW at (0.01) and Iran. These results indicate that the dates have positive signs and significant expenditure coefficients across each equation, implying that date exports do change in response to group expenditure change. Thus, an increase in total group expenditure will lead to an increase in the quantity of dates exported by the respective percentage change per year.

The intercept in the Rotterdam model may be interpreted as the change in budget share due to gradual changes in tastes and preferences (Xie et al., 2009). None of the intercepts are significant at any level. The intercepts in the Rotterdam model have to be divided by the budget share to see if there is a trend effect over time as budget shares change. This means that in the absence of any changes in relative prices and real income, per capita date demand is expected to increase by 0.3%, 0.3%, and 0.01% per annum respectively for Pakistan, Saudi Arabia, and the

United Arab Emirates. Otherwise, there would be a decrease by 0.9, to Iraq, per year (trend effect). Since the intercepts for all countries are not significant, the trend effect is unrepresented. This suggests that structural change may not be at work, specifically for the negative intercepts associated with Iraq.

Also, the dummy variable is incorporated in the same way as a quantitative variable is included (as an explanatory variable) in the Rotterdam model. For example, the model considered a dummy variable equal to one in the war years between Iraq –Iran, Iraq- Kuwait, and Iraq-US and zero otherwise. The sign is expected to be negative because these war years affected Iraq's exports, but the value of the dummy variable is positive for Iraq, indicating that holding the prices of other countries constant, the years of wars decrease the quantities exported by almost no change. Also, the dummy values for Saudi Arabia and Iran are positive compared to other countries. This is unsurprising considering the war between Iraq and Iran. The country of Saudi Arabia was involved in the war because it was supporting Iraq against Iran; there might have been some adverse impact on the exporting of dates by 0.001 for both countries. Obviously, none of the dummy variables are significant at any level.

The R^2 values range from 0.25 to 0.60; the lowest R^2 is for Pakistan and Saudia Arabia, and the highest is for the United Arab Emirates, Iraq, and ROW. Therefore, we can say the demand equations for the United Arab Emirates, Iraq, and ROW are worth closely examining. The values of R^2 of these equations are close to 0.50 and 0.60, respectively. In fact, that reflects 50% and 60% of the total variation in the response can be explained by this model. A serial correlation has been checked by applying the Durbin-Watson test since. It is known that for a strong positive serial correlation, D.W should equal zero. If there is a strong negative serial correlation, then D.W should equal to four. If no serial correlation is found, then D.W. should be around two.

On the other hand, lower and upper critical bounds can also be provided to test for serial correlation. These critical bounds vary by level of significance, the number of observations, and the number of predictors in the regression equation. In this model, the critical bounds are used to test the *null* hypothesis of zero autocorrelation against the *alternative* of positive first-order autocorrelation in the residuals. Specifically, we use a two-tail test ($\rho \neq 0$. In the present study, the values of D.W. for demand equations lie around 1.99 to 2.80. Also, k = 6 and n = 38 and d_L =0.966 and d_U =1.658. therefore, based on both a one-tail and two-tail test, we fail to reject the null for all estimated equations.

II. conditional Hicksian Elasticities

Conditional Hicksian and Marshallian elasticities were computed from the restricted model after imposing the homogeneity and symmetry restrictions (Table 1.6). The advantage of imposing restrictions is that the number of parameters to be estimated can be reduced; more specifically, parameters can be estimated with more precision.

The Slutsky equation is $\frac{\partial q_i}{\partial p_i} = \left(\frac{\partial q_i}{\partial p_i}\right)^* - q_j \frac{\partial q_i}{\partial y}$, in which $\left(\frac{\partial q_i}{\partial p_i}\right)^*$ is the substitution effect that holds real income constant. Thus, the above the Slutsky equation formula means the total effect is equal to the substitution effect plus income effect. In other words, the price effect for Marshallian demand is equal to the price effect for Hicksian demand. It gives us a substitution effect plus the derivative of a Marshallian demand with respect to income, and when multiplied by the quantity, it gives us income effect. Price effect for Hicksian demand is derivative of Hicksian demand with respect to price. This gives the substitution effect, which is always negative as one moves on the same indifference curve. Therefore, price effects will always have a negative relationship.

The conditional own-price estimates are presented along with the diagonal in Table 1.6. All are negative own-price elasticities. These estimates are best understood when converted to elasticities. The uncompensated own-price elasticities indicate that world demand of date is particularly sensitive to Pakistan date price (-0.99) comparison to other countries. In addition, the world demand is sensitive in lower degrees to Iraq (-0.33), Saudi Arabia (-0.29), Iran (-0.18), and the United Arab Emirates and ROW (-0.82, -0.76) date prices respectively.

In this study's model, all own-price Hicksian elasticities are negative, which is consistent with the theory of the downward sloping of the demand curve. When the own-price elasticity is less than one, the demand is less elastic or inelastic. In other words, the own- price elasticities suggest that date demand is price inelastic in all equations.

The marginal budget share (*Rj*) indicates a positive between the Divisia index and date exports from each source. Note that the marginal share is relatively large for Iraq and Iran (0.22), which is to be expected since it is, the largest supplier of date to the world, but significantly smaller for the remaining countries: Pakistan (0.14), Saudi Arabia (0.15), United Arab Emirates (0.17), and ROW (0.09). These estimates indicate that for every dollar increase in total foreign date expenditures, about $0.22 was spent on Iraq and Iran dates and $0.14 on Pakistan date, while only $0.15– $0.17 Saudi Arabia and the United Arab Emirates, and the remaining estimate went to date from each of the remaining sources ROW.

On the other hand, if the last term of the Slutsky equation is positive, then it means that dates are normal goods. In this model, from table1.6, all income elasticities are positive; that indicates that date good in all countries in the case of study are normal goods. However, these estimates are best understood when converted to elasticities. So, in table 1.6, The expenditure elasticities (ei^x), which measure the responsiveness of date exports by a source to a percentage change in total foreign date expenditures. The expenditure elasticities are found to be highly inelastic for dates from Pakistan, Saudi Arabia, and ROW, but elastic for dates from Iraq, United Arab Emirates. So an increase in world expenditure on dates has a minimal effect on dates come from Pakistan, Saudi Arabia, and ROW, but a positive impact on dates come from Iraq and the United Arab Emirates. Therefore, this suggests that there is a degree of expenditure proportionality in the world demand of date. Technically, Iraq and the United Arab Emirates gain the most benefit from positive changes in world expenditure on dates.

Technically, Hicksian elasticities should be used to classify goods as substitutes, complements, and independent goods. However, there is also the Marshallian definition for these goods. It is possible for two goods to be substitutes on the Hicksian definition and compliments on the Marshallian measure. To avoid any ambiguity, the terms net and gross are introduced. For example, if $E_{ij}^{*} > 0$ and $E_{ij} < 0$ … I in which * denotes Hicksian, one can say that *i* and *j* are gross complements but also net substitutes. The good is considered as a substitute good if the sign of cross elasticity of demand is positive, meaning the good's demand is increased when the price of another good is increased. Conversely, a good with a negative cross elasticity of demand means the good’s demand is increased when the price of another good is increased. Out of 30 cross-price elasticities, 24 are positive, indicating net substitutes. The rest are negative, indicating that gross complements. However, two of the negative values correspond to Iran at a significant level with Iraq. The other two correspond to the United Arab Emirates at a low level with Saudi Arabia.

III. Conditional Marshallian Elasticities

The conditional Marshallian elasticities tell us dates are gross complements but net substitutes (Table 1.6). As Marshallian, elasticities contain income effects; they obscure the true nature of price effects. In other words, the income effect for date products plays a very important role. Marshallian definitions of substitutes complement, and independent goods are based on uncompensated cross-price effects. If $dq_i/dp_j > 0$, *i* and *j* are gross substitutes, and if $dq_i/dp_j < 0$, it means they are gross complements. From Table 1.6, conditional elasticities treat expenditure as exogenous because expenditure, in general, will change in response to a change in price or income. The results for conditional Marshallian elasticities do not largely differ from the Hicksian's results in signs, but they do differ in magnitude. For example, the Hicksian own-price elasticities from the smallest to the largest are (-0.99, -0.82, -0.76,-0.33, -0.29, -0.18) for countries Pakistan, United Arab Emirates, ROW, Iraq, Saudi Arabia, and Iran respectively. In Marshallian own-price elasticities from the smallest to the largest are (-1.14, -1.03, -0.77, -0.75, -0.34, -0.34) for countries the United Arab Emirates, Pakistan, ROW, Iraq, Iran, Saudi Arabia respectively. The estimated Marshallian own- price elasticities suggest that world demand for dates from the United Arab Emirates and Pakistan is more price sensitive in comparison to dates from other countries, particularly the own-price is elastic for the United Arab Emirates and Pakistan at (-1.14, -1.03) respectively. An opposite for the rest of the countries, namely, Iraq, Iran, Saudi Arabia, and ROW respectively. The world demand for dates is inelastic in between (-0.77_ -0.34). None of the six equations has pure positive cross-price elasticities. However, we can say the

ROW, and United Arab Emirates dates face more competition in global markets, so a 1% decrease in prices of dates in Iran, Iraq, Pakistan, will decrease the quantity demand of dates by 0.34, 0.03, and 0.12 percent, respectively for United Arab Emirates and 0.10,016, and 0.10 for ROW. Cross- price elasticities are almost not held because out of 30, there are 13 negative, and that indicates that the dates are gross complements. Iran equation is associated with 7 out of 13 negative cross-price elasticities. One of the policy implication that can be taken from table 1.6 is that the world demand (consumers) would prefer to increase their demand for dates from other countries other than paying high price dates for the United Arab Emirates and ROW. Overall, we cannot determine exactly the status of competition in international trade of dates because there are 13 negative cross-price elasticities, but we can indicate that United Arab Emirates, Saudi Arabia, and Pakistan, and ROW are competing with each other.

To present and comprehensive estimates for world demand of dates an Almost Ideal Demand System AIDS, this model provides an arbitrary first-order approximation of any demand system of equations. The purpose of presenting the results of this model is exploring the similarities and differences between Rotterdam and AIDS models. The results of own-price elasticities and expenditure elasticities for dates in world trade from the AIDS model are presented in table 1.7. These results computed without imposing any restrictions. All uncompensated own price elasticities are negative in levels and log differentials. The world demand is more price sensitive for dates from the United Arab Emirates (-1.54) and less sensitive for dates from Iran (-0.14). The conditional expenditure elasticities for dates are all positive. The results suggest that dates from Iraq and the United Arab Emirates are income elastic at 1.92 and 1.48, respectively. However, the expenditure elasticities for dates are inelastic for other countries. Therefore, an increase in the world dates market size due to income benefits, the dates from Iraq and the United Arab Emirates than the dates come from Pakistan, Saudi Arabia, and ROW. The results from the two models are close to each other. For example, from the Rotterdam model, we find the world demand of dates is more sensitive for dates from the United Arab Emirates and Pakistan (-1.14, -1.03) respectively. Also, the world demand is less sensitive for dates from Iran and Saudi Arabia (-.034) for both. Whereas, in the AIDS model, the results suggest that the world demand is sensitive for dates from the United Arab Emirates and Pakistan plus Iraq and ROW.

Nevertheless, the world demand is less sensitive for dates from Iran at (-0.18, -0.22) for Rotterdam and AIDS, respectively. The expenditure elasticities for both models follow the same order exactly. The world demand is elastic for dates from Iraq and the United Arab Emirates (1.92, 1.48) respectively.

VIII. Conclusion

Dates are indispensable goods for people living in arid areas because of their nutritional value for the communities residing there. As shown above, market shares for date crops growing in the Middle East and North East are considerable. The study aims to estimate source-specific demand elasticities for dates in international trade. Source-specific is obvious for less homogenous goods like dates. As shown above, the demand for dates products could be disaggregated by source given a price and group expenditure, which vary across trading partners. The basic theme of this paper is to apply a world-demand system to estimate the global demand for dates for the time series data of 1961-2016. The results showed that the own-price elasticities are negative, and the world demand is inelastic. The uncompensated own-price elasticities indicate that world demand of date is particularly sensitive to the United Arab Emirates and Pakistani dates (-1.14, -1.03) respectively, and less sensitive to Iraq and Saudi Arabia dates. Also, the world demand is sensitive in lower degrees to the rest of the countries. The marginal budget share indicates Iraq has a relatively large marginal share (0.21), which is to be expected since it is, the largest supplier of date to the world, but significantly smaller for the rest of the countries. This indicates that for every dollar increase in total foreign date expenditures, about $0.21 was spent on Iraq date. Moreover, the results show that estimate income elasticities are positive, and then it means that dates are normal goods. The expenditure elasticities suggest that there is a degree of expenditure proportionality in the world demand of date, Iraq and the United Arab Emirates are gain the most benefit from an increase in world expenditure, whereas, an increase in the world expenditure has almost no impact o dates from ROW.

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Appendix I: derivation of the Rotterdam model

The basic specification for the Rotterdam model started by letting p_1 and q_i be the price and quantity demanded of good i, *i = 1,… , n*. The consumer exercises control over choice variables, which is quantity $q_1, \dots, q_n$ to maximize the utility function:

$$Max\ u(q_1, \dots, q_n) \qquad \text{(A1)}$$

s.t $y = \sum_{i=1}^{n} p_i q_i$

In which y is total expenditure. The demand equation for good *i* is going to be in the form $q_i = (p_1, \dots, p_n, y)$. As income is held constant, this is the Marshallian demand equation. The differential of this demand equation is:

$$dln\ q_i = \sum_{j=1}^{n} \frac{\partial q_i}{\partial p_j} d\ p_j + \frac{\partial q_i}{\partial y} d\ y \qquad \text{(A2)}$$

The total effect on the consumption of good *i* of a change in the price of good *j*, $\frac{\partial q_i}{\partial p_j}$, can be decomposed into the income and substitution effects according to the Slutsky equation, $\frac{\partial q_i}{\partial p_i} = \left(\frac{\partial q_i}{\partial p_i}\right)^* - q_i \frac{\partial q_i}{\partial y}$, in which $\left(\frac{\partial q_i}{\partial p_i}\right)^*$ is the substitution effect that holds real income constant.

Noting that $\left(\frac{\partial q_i}{\partial p_i} = \left(\frac{\partial q_i}{\partial p_i}\right)^* - q_i \frac{\partial q_i}{\partial y}\right) \equiv\ E_{ij} = E_{ij}^* - R_j A_i$

Substituting the Slutsky equation in equation (A2) yields:

$$d\ lnq_i = \sum_{j=1}^{n} \left(\left(\frac{\partial q_i}{\partial p_i}\right)^* - q_i \frac{\partial q_i}{\partial y}\right) d\ p_j + \frac{\partial q_i}{\partial y} d\ y \qquad \text{(A3)}$$

Noting the above equation can be written alternatively as:

$$dln\ q_i = \left(\frac{\partial q_1}{\partial p_1}\right)^* d\ p_j + \left(\frac{\partial q_2}{\partial p_2}\right)^* d\ p_2 + \cdots + \left(\frac{\partial q_n}{\partial p_n}\right)^* d\ p_n - q_1 \frac{\partial q_1}{\partial y} d\ p_1 - q_2 \frac{\partial q_2}{\partial y} d\ p_2 - \cdots - q_n \frac{\partial q_n}{\partial y} d\ p_n + \frac{\partial q_i}{\partial y} d\ y$$

Which, upon combining terms, yields:

$$dln\, q_i = \left(\frac{\partial q_1}{\partial p_1}\right)^* d\, p_j + \left(\frac{\partial q_2}{\partial p_2}\right)^* d\, p_2 + \cdots + \left(\frac{\partial q_n}{\partial p_n}\right)^* d\, p_n + \frac{\partial q_i}{\partial y}\left(dlny - \sum_{j=1}^{n} \partial lnq_j\, dlnp_j\right) \quad \text{(A4)}$$

Using the identity $d(\ln q_i) = dx/x$, thus, Equation (A4) can be expressed as

$$dlnq_i = \sum_{j=1}^{n} E_{ij}^*\, dlnp_j + \frac{\partial q_i}{\partial y}\left(dy - \sum_{j=1}^{n} \partial q_j\, dlnp_j\right) \quad \text{(A5)}$$

The term in brackets in equation (A5) is the change in money income deflated by the income effects of the *n* price changes, which represents the change in real income.

Where $\sum_{j=1}^{n} d \ln p_j = R_1\, d \ln p_1 + R_2\, d \ln p_2 + \cdots + R_n\, d \ln p_n$ is the stone price index in log differnational form multiplied by the budget shares, noting that $R_i = p_i q_i / y$ is the budget share of good *i*.

Multiplying equation (A5) by R_i yields the form suggested by Theil: Yields:

$$R_i d \ln q_i = \sum_{j=1}^{n} R_i\, E_{ij}{}^*\, d \ln p_j + R_i\, \frac{\partial q_i}{\partial y}\left[d \ln y - \sum_{j=1}^{n} \frac{p_j q_j}{y}\, d \ln p_j\right] \quad \text{(A6)}$$

We can write equation (A6) in more simple form:

$$R_i dln\, q_i = \sum_{j=1}^{n} \theta_{ij}\; d\; ln\, p_j + \mu_i\, d\; lnQ$$

In which is $\theta_{ij} = R_i E_{ij}^*$ is budget share-weighted Hicksian elasticity (income compensated) or we can write $E_{ij}^* = \theta_{ij}/R_i$. The price elasticity (income compensated) for *i =1… n*, is a system of *n* demand equations, the parameters of which satisfy the adding-up constraints implied by the budget constraint. Where the Divisia volume index of the change in real income and prices:

$$d(\ln Q) = d(\ln y) - \sum_{j=1}^{n} R_i\, d(\ln p_j)$$

Or

$$d \ln Q = \sum_{n=1}^{n} R_n\, d \log q_n$$

To estimate the model, continuous changes are replaced by discrete changes. Specifically, the equation (A6) will be:

$$R_i \, \Delta \, l \, n \, q_{it} = \sum_{j=1}^{n} \theta_{ij} \;\; \Delta p_{jt} + \mu_i dlnQ_t + \varepsilon_{it} \qquad \text{(A7)}$$

In which Δ denotes the *log- change* operator $\Delta q_{it} = (\ln q_t - \ln q_{t-1})$ and ε_{it} is the error term. R_i is the budget share; $d \; ln \; Q$ is the Divisia Volume index $dlnQ = \sum_j (\bar{R}_j dlnq_j)$); and $dln \; q_j$and $dln \; p_j$ are the log differential of the price and quantity for good i, respectively. μ_i and θ_{ij} denote demand parameters, in which μ_i is the marginal expenditure share for good i, and θ_{ij} is a compensated price effect. The Rotterdam model shows how budget shares change in response to changes in prices and income. Theil, in his paper 1965, added a constant term to allow for evaluation of how the change in the budget shares vary due to the shifts in preferences and tastes. In addition, the Rotterdam estimated model in equation A7 is extended to include a dummy variable to assess for the structural shocks during the years of war. Therefore, the final Rotterdam model estimated equation is specified as:

$$\bar{R}_{it} \Delta q_{it} = \alpha_i + \sum_{j}^{6} \beta_{ij} \Delta p_{jt} + \emptyset_{it} S_{it} + \mu_i \Delta Q_t + \varepsilon_{it} \qquad (A8)$$

Where the budget shares $R_{it}$are replaced with a moving average of the market share of good i as introduced in (Xie et al. 2009)

Appendix II: Tables

Table 1.1 Trade volumes and the market shares of dates 1961-2016

year	*Iran*	*Iraq*	*Pakistan*	*Saudi Arabia*	*United Arab Emirates*	*ROW*	*All*
			Volumes (thousands metric tons) by Exporter				
1961-1970	27,301	278,319	49	6,659	-	48,139	360,467
1971-1980	27,858	251,996	88	10,440	6,590	44,693	341,666
1981-1990	17,952	129,171	19,439	26,798	20,754	61,485	275,600
1991-2000	103,393	42,200	50,040	22,218	122,973	76,362	417,186
2001-2010	112,042	107,610	88,746	46,771	169,619	124,821	649,608
2011-2016	116,254	151,757	143,155	95,943	181,322	281,467	969,897
Average/56	67,467	160,176	50,253	34,805	83,543	106,161	502,404
			Market Share				
1961-1970	0.08	0.77	0.00	0.02	0.00	0.13	1.00
1971-1980	0.08	0.74	0.00	0.03	0.02	0.13	1.00
1981-1990	0.07	0.47	0.07	0.10	0.08	0.22	1.00
1991-2000	0.25	0.10	0.12	0.05	0.29	0.18	1.00
2001-2010	0.17	0.17	0.14	0.07	0.26	0.19	1.00
2011-2016	0.12	0.16	0.15	0.10	0.19	0.29	1.00
Average/56	0.13	0.40	0.08	0.06	0.14	0.19	1.00

Source: Own calculation from FAOSTAT data.

Table 1. 2 Trade values and market shares of dates 1961-2016

	Iran	*Iraq*	*Pakistan*	*Saudi Arabia*	*United Arab Emirates*	*ROW*	*All*
Values (US Dollar) by Exporter							
1961-1970	2,230	18,863	8	381	-	18,005	39,487
1971-1980	5,847	37,200	36	2,744	1,814	39,865	87,506
1981-1990	11,319	43,419	10,103	12,903	6,185	94,840	178,769
1991-2000	40,099	8,170	21,448	17,108	36,255	155,752	278,831
2001-2010	66,994	22,880	32,349	37,990	41,126	270,938	472,277
2011-2016	97,768	51,064	82,728	106,927	104,801	617,181	1,060,467
Average/56	37,376	30,266	24,445	29,676	31,697	199,430	352,890
Market share							
1961-1970	0.06	0.48	0.00	0.01	0.00	0.46	1.00
1971-1980	0.07	0.43	0.00	0.03	0.02	0.46	1.00
1981-1990	0.06	0.24	0.06	0.07	0.03	0.53	1.00
1991-2000	0.14	0.03	0.08	0.06	0.13	0.56	1.00
2001-2010	0.14	0.05	0.07	0.08	0.09	0.57	1.00
2011-2016	0.09	0.05	0.08	0.10	0.10	0.58	1.00
Average/56	0.09	0.21	0.05	0.06	0.06	0.53	*1.00*

Source: Own calculation from FAOSTAT data

Table 1.3 Descriptive Statistics for model variables (1978-2016)[6][7]

Variable	N	Mean	Std Dev	Minimum	Maximum
Quantities Export by Country (thousands metrics tons)					
Iran	39	79,545	50,424	586	200,000
Iraq	39	110,393	77,754	4,000	296,642
Pakistan	39	62,608	47,778	105	169,159
Saudi Arabia	39	40,238	29,038	7,100	131,977
United Arab Emirates	39	109,931	105,554	600	318,085
ROW	39	114,444	82,243	45,922	360,265
Prices by Country (US dollars per ton)					
Iran	39	581	303	149	1,430
Iraq	39	277	106	137	600
Pakistan	39	467	98	335	678
Saudi Arabia	39	728	283	303	1,429
United Arab Emirates	39	369	152	176	763
ROW	39	150	67	35	273
Dummy variable1(war 1980-1988)	39	0.23	0.43	0	1
Dummy variable2(war 1990-1991)	39	0.05	0.22	0	1
Dummy variable3(war 2003-2016)	39	0.36	0.49	0	1

[6] All the data is annual and obtained from the FAOSTAT Statistics Database. The direct website to the data is http://www.fao.org/faostat/en/#data/TP.

[7] We have removed years from 1961-1977 in our estimation to get rid of missing values and to avoid disturbances in our estimation.

Table 1.4 SUR Estimates of the Rotterdam Model with Homogeneity and Symmetry imposed

	Own and cross price coefficients										
Equation	*pIR*	*pIQ*	*pPK*	*pSA*	*pAE*	*pROW*	*Expend.coef.*	*Intercept*	*Dummy*	R^2	*D.W*
Iran	-0.040 (-)						0.01 (-)	0.033 (-)	0.01 (-)	-	-
Iraq	-0.114 (-2.05)**	-0.071 (-0.88)					0.42 (4.81)***	-0.0093 (-0.86)	0.0021 (0.10)	0.50	2.44
Pakistan	0.002 (-0.100)	(-2.810)**	-0.137 (-4.65)***				0.041 (1.14)	0.0030 (0.99)	0.0082 (0.000)	0.25	2.67
Saudi Arabia.	0.045 (-2.810)*	0.024 (-0.820)	-0.010 (-.44)	-0.044 (-1.39)			0.053 (1.71)	0.0030 (0.77)	-0.0005 (-0.06)	0.25	2.43
United Arab Emirates	0.014 (-1.940)	0.073 (-1.350)	0.064 (-2.780)**	-0.029 (-1.45)*	-0.139 (-2.53)**		0.315 (5.09) ***	0.0005 (0.06)	0.0001 (0.000)	0.59	2.81
Rest of the world	0.012 (-0.820)	0.017 (-1.750)*	0.010 (-0.950)	0.015 (-1.470)	0.017 (-1.750)*	-0.072 (-6.34)***	0.010 (0.95)	-0.001 (-0.87)	0.0018 (0.77)	0.58	2.00

Note: Numbers in parenthesis are the *t- values* for the parameter estimates

Table 1.5 Test of Restrictions on the Conditional Demand Equations

Parameter Estimates

Symmetry restrictions				
Test Results				
Test	**Type**	**Statistic**	**Pr > ChiSq**	**Label**
Test0	Wald	8.44	0.0037	b12=b21
Test1	Wald	0.20	0.6512	b13=b31
Test2	Wald	0.71	0.3996	b14=b41
Test3	Wald	0.07	0.7967	b15=b51
Test4	Wald	1.37	0.2416	b16=b61
Test5	Wald	0.69	0.4074	b23=b32
Test6	Wald	1.59	0.2075	b24=b42
Test7	Wald	0.16	0.6860	b25=b52
Test8	Wald	1.17	0.2793	b36=b63
Test9	Wald	1.87	0.1717	b34=b43
Test10	Wald	0.00	0.9968	b35=b53
Test11	Wald	0.32	0.5742	b45=b54
Test12	Wald	0.62	0.4318	b46=b64
Test13	Wald	0.06	0.7994	b56=b65
Homogeneity restrictions				
Test14	Wald	6.03	0.0141	b11+b12+b13+b14+b15+b16=0
Test15	Wald	0.42	0.5194	b31+b32+b33+b34+b35+b36=0
Test16	Wald	0.09	0.7654	b41+b42+b43+b44+b45+b46=0
Test17	Wald	0.10	0.7526	b51+b52+b53+b54+b55+b56=0
Test18	Wald	25.31	<.0001	b61+b62+b63+b64+b65+b66=0

Table 1.6 Estimated Conditional Hisksian and Marshallian Elasticities

	Conditional Hicksian Elasticities							
Country	*Iran*	*Iraq*	*Pakistan*	*Saudi Arabia*	*United Arab Emirates*	*ROW*	*ei^x*	*R_j*
Iran	-0.18	-0.50	0.01	0.20	0.06	0.05	0.70	0.23
Iraq	-0.53	-0.33	0.33	0.11	0.34	0.081	1.96	0.21
Pakistan	0.02	0.51	-0.99	-0.07	0.46	0.08	0.29	0.14
Saudi Arabia	0.29	0.15	-0.07	-0.29	-0.19	0.10	0.35	0.15
United Arab Emirates	0.09	0.43	0.38	-0.17	-0.82	0.10	1.86	0.17
ROW	0.13	0.183	0.11	0.16	0.18	-0.76	0.11	0.09

Conditional Marshallian Elasticities

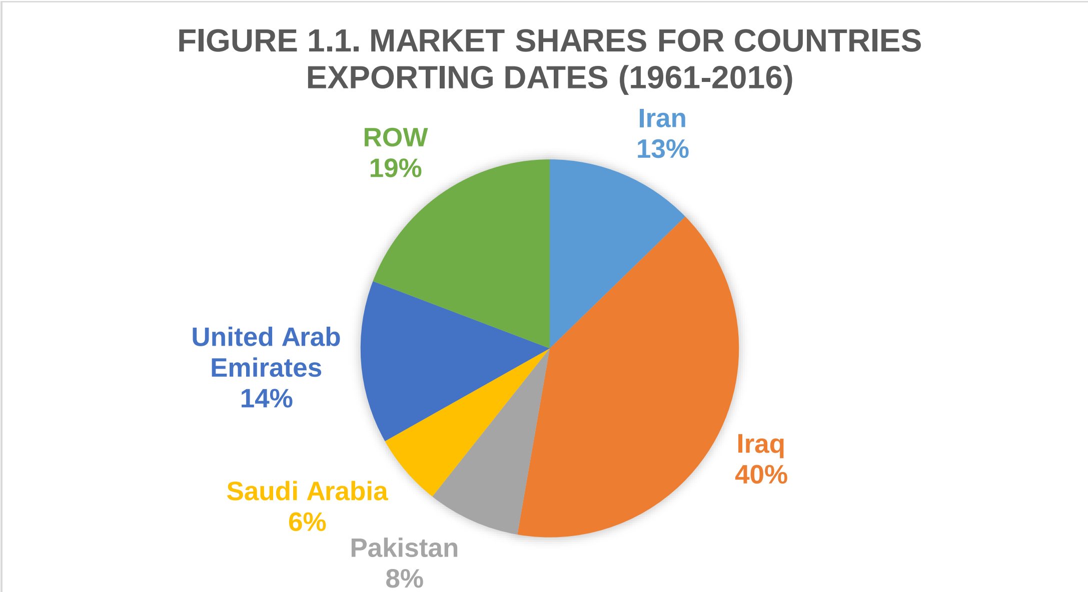
Country	*Iran*	*Iraq*	*Pakistan*	*Saudi Arabia*	*United Arab Emirates*	*ROW*
Iran	-0.34	-0.65	-0.09	0.09	-0.06	-0.01
Iraq	-0.98	-0.75	0.06	-0.19	0.01	-0.10
Pakistan	-0.05	0.44	-1.03	-0.12	0.41	0.05
Saudi Arabia	0.21	0.08	-0.11	-0.34	-0.36	0.07
United Arab Emir-ates	-0.34	0.03	0.12	-0.46	-1.14	-0.08
ROW	0.10	0.16	0.10	0.14	0.16	-0.77

Table 1.7. Own-Price Elasticities and Expenditure Elasticities for Dates in World Trade from the AIDS Model With no Restrictions

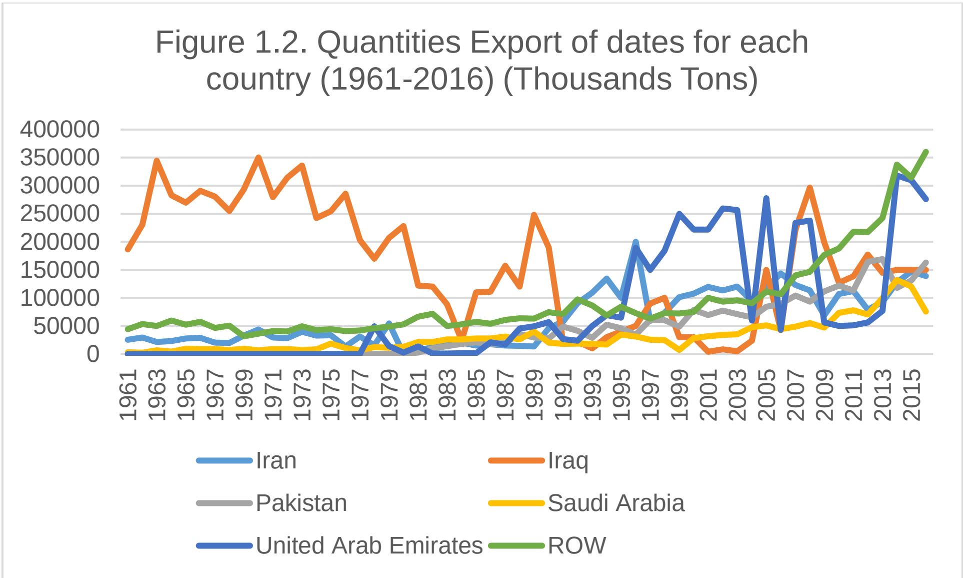
Commodity	Budget share*	Own-price coef.	Expenditure coef.	own price elas-ticty	Expenditure elasticity
LEVELS LAIDS:					
Iran	0.22	0.18	-0.04	-0.14	0.80
Iraq	0.22	0.04	0.19	-0.99	1.87
Pakistan	0.14	-0.08	-0.08	-1.51	0.45
Saudi Arabia	0.15	0.05	-0.07	-0.58	0.54
United Arab Emirates	0.17	-0.08	0.06	-1.54	1.36
ROW	0.09	0.00	-0.05	-0.94	0.41
DIFFERENTIAL LAIDS:					
Iran	0.22	0.17	-0.01	-0.22	0.94
Iraq	0.22	0.01	0.20	-1.16	1.92
Pakistan	0.14	-0.03	-0.08	-1.11	0.46
Saudi Arabia	0.15	0.08	-0.11	-0.35	0.24
United Arab Emirates	0.17	-0.05	0.08	-1.37	1.48
ROW	0.09	-0.02	-0.09	-1.18	0.04

*sample mean

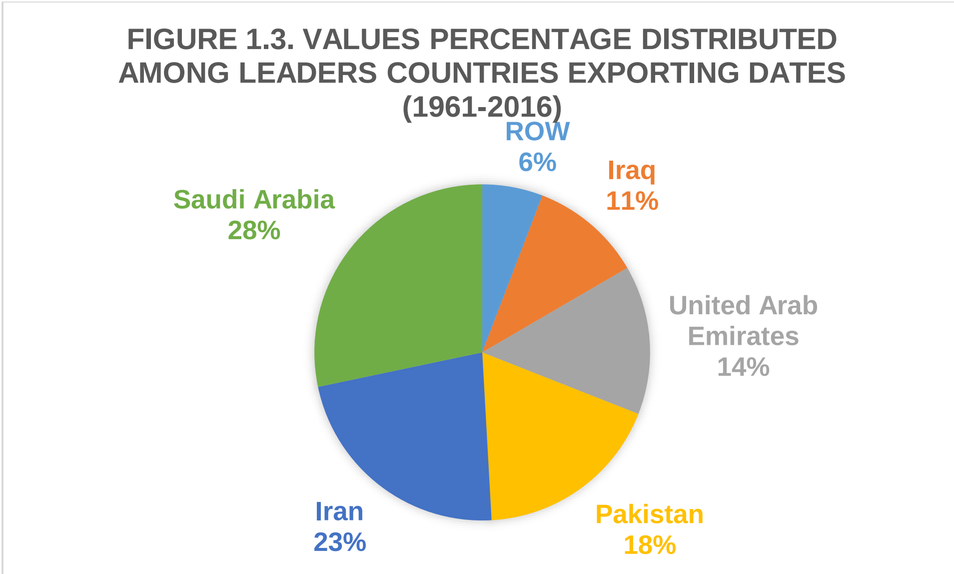
Appendix III: Figures



Source: Author's own calculation from FAOSTAT database

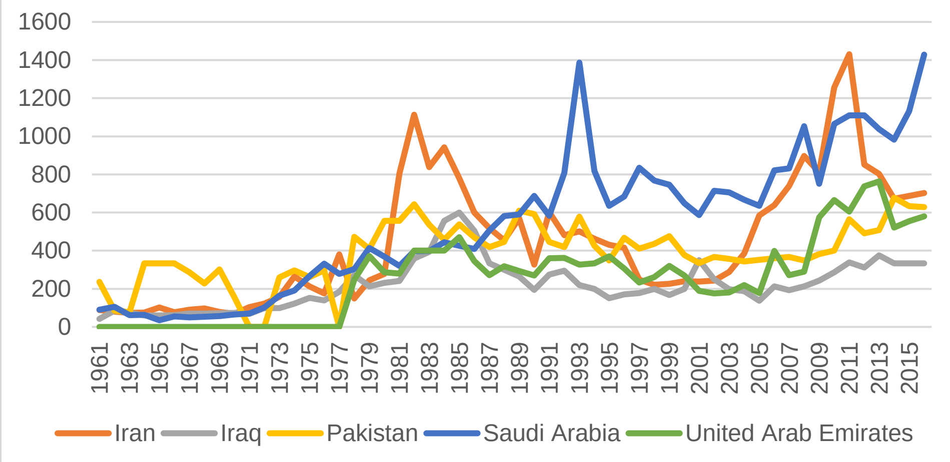


Source: Author's own calculation from FAOSTAT database



Source: Author's own calculation from FAOSTAT database

Figure 1.4. Pricese of Exported dates for each country (1961-2016) ($US per metric ton)



Source: Author’s own calculation from FAOSTAT database

Appendix IV: SAS codes and results of unrestricted model

Table 1.1.1 SUR Estimates of the Rotterdam Model without any restrictions imposed

Parameter	Estimate	Approx Std Err
c1	-0.00392	0.00775
c2	-0.00801	0
c3	0.007549	0.00279
c4	0.002269	0.00370
c5	0.0027	0.00674
c6	-0.00059	0.000603
b11	0.088273	0.0541
b12	0.082502	0.0761
b13	-0.1488	0.1021
b14	0.155838	0.0829
b15	0.118058	0.0706
b16	0.06267	0.1140
b21	-0.16198	0
b22	-0.09701	0
b23	0.193292	0
b24	-0.03827	0
b25	0.1316	0
b26	0.001617	0
b31	0.011663	0.0195
b32	0.031444	0.0274
b33	-0.10614	0.0368
b34	-0.02606	0.0299
b35	0.012415	0.0255
b36	0.060071	0.0411
b41	0.050869	0.0258
b42	0.031988	0.0363
b43	-0.01866	0.0488
b44	-0.04117	0.0396

Parameter	Estimate	Approx Std Err
b45	-0.03672	0.0337
b46	-0.00662	0.0544
b51	0.002878	0.0471
b52	-0.04671	0.0662
b53	0.087284	0.0888
b54	-0.05579	0.0720
b55	-0.22677	0.0614
b56	-0.01982	0.0991
b61	0.008295	0.00421
b62	-0.00221	0.00592
b63	-0.00698	0.00795
b64	0.005461	0.00645
b65	0.001421	0.00550
b66	-0.09792	0.00888
a1	0.301187	0.0757
a2	0.412367	0
a3	0.004751	0.0273
a4	0.052065	0.0362
a5	0.232233	0.0658
a6	-0.0026	0.00590
d1	0.0001	0
d2	0.0001	0
d3	0.0001	0
d4	0.0001	0
d5	0.0001	0
d6	0.0001	0

SAS codes:

```
ods rtf file = 'C:\Users\amd0085\Desktop\data for dates papers\results.rtf';
run;
libname Rotter "C:\Users\amd0085\Desktop\data for dates papers\my final ver-
sion of data for the final defense.csv";
run;
data data2;set work.data1;
array a(*) _numeric_;
do i=1 to dim(a);
if a(i) = . then delete;
end;
drop i;
run;
proc means data=work.data2; run;
data data3; set work.data2;
exp1=q1*p1;
exp2=q2*p2;
exp3=q3*p3;
exp4=q4*p4;
exp5=q5*p5;
exp6=q6*p6;
texp = exp1+ exp2+ exp3 + exp4 + exp5 + exp6;
R1 = exp1/texp ;
R2 = exp2/texp ;
R3 = exp3/texp ;
R4 = exp4/texp;
R5 = exp5/texp;
R6 = exp6/texp;
run;
data data4 ; set work.data3 ;

logp1=log10(p1);
logp2=log10(p2);
logp3=log10(p3);
logp4=log10(p4);
logp5=log10(p5);
logp6=log10(p6);
logq1=log10(q1);
logq2=log10(q2);
logq3=log10(q3);
logq4=log10(q4);
logq5=log10(q5);
logq6=log10(q6);
y=log(texp);
run;
proc print data=work.data4;run;
proc means data=work.data4; run;
data data5;set work.data4;
r11=lag(R1);
r22=lag(R2);
r33=lag(R3);
r44=lag(R4);
```

```
r55=lag(R5);
r66=lag(R6);

q11=lag(logq1);
q22=lag(logq2);
q33=lag(logq3);
q44=lag(logq4);
q55=lag(logq5);
q66=lag(logq6);

p11=lag(logp1);
p22=lag(logp2);
p33=lag(logp3);
p44=lag(logp4);
p55=lag(logp5);
p66=lag(logp6);

drir=(R1+r11)/2;
driq=(R2+r22)/2;
drpa=(R3+r33)/2;
drsa=(R4+r44)/2;
drua=(R5+r55)/2;
drro=(R6+r66)/2;

dqir=logq1-q11;
dqiq=logq2-q22;
dqpa=logq3-q33;
dqsa=logq4-q44;
dqua=logq5-q55;
dqro=logq6-q66;

dpir=logp1-p11;
dpiq=logp2-p22;
dppa=logp3-p33;
dpsa=logp4-p44;
dpua=logp5-p55;
dpro=logp6-p66;
run;
data data6; set work.data5;
dqirn=drir*dqir;
dqirq=driq*dqiq;
dqpak=drpa*dqpa;
dqsad=drsa*dqsa;
dquae=drua*dqua;
dqrow=drro*dqro;
dlnQ=dqirn+dqirq+dqpak+dqsad+dquae+dqrow;
run;
proc model data= work.data6 outparms=parms;
parms a1-a6 b11-b16 b21-b26 b31-b36 b41-b46 b51-b56 b61-b66 c1-c6 d1-d6 m1-m6
y1-y6 ;
dqirn =c1+b11*dpir+b12*dpiq+b13*dppa+b14*dpsa+b15*dpua+
b16*dpro+d1*d1+m1*d2+y1*d3+a1*dlnQ;
dqirq =c2+b21*dpir+b22*dpiq+b23*dppa+b24*dpsa+b25*dpua+
b26*dpro+d2*d1+m2*d2+y2*d3+a2*dlnQ;
dqpak =c3+b31*dpir+b32*dpiq+b33*dppa+b34*dpsa+b35*dpua+
b36*dpro+d3*d1+m3*d2+y3*d3+a3*dlnQ;
```

```
dqsad =c4+b41*dpir+b42*dpiq+b43*dppa+b44*dpsa+b45*dpua+
b46*dpro+d4*d1+m4*d2+y4*d3+a4*dlnQ;
dquae =c5+b51*dpir+b52*dpiq+b53*dppa+b54*dpsa+b55*dpua+
b56*dpro+d5*d1+m5*d2+y5*d3+a5*dlnQ;
dqrow =c6+b61*dpir+b62*dpiq+b63*dppa+b64*dpsa+b65*dpua+
b66*dpro+d6*d1+m6*d2+y6*d3+a6*dlnQ;

fit dqirn dqirq dqpak dqsad dquae dqrow/dw sur;
run;
proc means data=work.data6 ;
var r1 r2 r3 r4 r5 r6;
run;
proc print data=parms;
run;
proc model data=work.data6 outparms=parms ;
parms  a1-a6 b11-b16 b21-b26 b31-b36 b41-b46 b51-b56 c1-c6 d1-d6 ;
endogenous dqirn dqirq dqpak dqsad dquae ;
*SYMMETRY;
restrict b12=b21;
restrict b13=b31;
restrict b14=b41;
restrict b15=b51;
*restrict b16=b61;

restrict b23=b32;
restrict b24=b42;
restrict b25=b52;
*restrict b26=b62;

restrict b34=b43;
restrict b35=b53;
*restrict b36=b63;

restrict b45=b54;
*restrict b46=b64;
*restrict b56=b65;

*HOMOGENEITY;
restrict b11+b12+b13+b14+b15+b16=0;
restrict b21+b22+b23+b24+b25+b26=0;
restrict b31+b32+b33+b34+b35+b36=0;
restrict b41+b42+b43+b44+b45+b46=0;
restrict b51+b52+b53+b54+b55+b56=0;
*restrict b61+b62+b63+b64+b65+b66=0;

dqirn =c1+b11*dpir+b12*dpiq+b13*dppa+b14*dpsa+b15*dpua+
b16*dpro+d1*d1+a1*dlnQ;
dqirq =c2+b21*dpir+b22*dpiq+b23*dppa+b24*dpsa+b25*dpua+
b26*dpro+d2*d1+a2*dlnQ;
dqpak =c3+b31*dpir+b32*dpiq+b33*dppa+b34*dpsa+b35*dpua+
b36*dpro+d3*d1+a3*dlnQ;
dqsad =c4+b41*dpir+b42*dpiq+b43*dppa+b44*dpsa+b45*dpua+
b46*dpro+d4*d1+a4*dlnQ;
dquae =c5+b51*dpir+b52*dpiq+b53*dppa+b54*dpsa+b55*dpua+
b56*dpro+d5*d1+a5*dlnQ;
*dqrow =c6+b61*dpir+b62*dpiq+b63*dppa+b64*dpsa+b65*dpua+
b66*dpro+d6*d1+m6*d2+y6*d3+a6*dlnQ;
```

```
fit dqirn dqirq dqpak dqsad dquae/dw sur;
test b12=b21;
test b13=b31;
test b14=b41;
test b15=b51;
test b23=b32;
test b24=b42;
test b25=b52;
test b34=b43;
test b35=b53;
test b45=b54;
test b11+b12+b13+b14+b15+b16=0;
test b21+b22+b23+b24+b25+b26=0;
test b31+b32+b33+b34+b35+b36=0;
test b41+b42+b43+b44+b45+b46=0;
test b51+b52+b53+b54+b55+b56=0;
test b61+b62+b63+b64+b65+b66=0;
run;
ods rtf close;

*******************************************end of codes*******************
```

The Impact of Armed Conflicts/Violence on Health in Iraq: Evidence from Microdata

Abstract

Terrorism has become a global phenomenon; of a serious negative nature to the economies of many countries around the world. Violent conflict is one theme of terrorism in Iraq. After looking carefully at the literature, I find that there is a few number of articles estimating the impact of conflict on health services in Iraq. This paper uses a nationally representative sample of the Iraqi population by employing an interview called the *Iraq Household Socio-Economic Survey (IHSES) 2006-2007* and *Iraq Body Count (IBC)* datasets to investigate the impact of conflict on the health service (vaccination indicators) of Iraq. Iraqi provinces considered in this paper as a natural experiment by divided provinces with high intensity of violence as a treaded group and low intensity of violence as a control group. After controlling for individuals, households, city, dwelling characteristics and along with the literature, the study concludes that first, we find that the expected mean change of health outcomes are affected by time treatment, specifically after 2003 for provinces with high-intensity violence level. Second, the children living in high-intensity violence provinces are more likely to face violence than children residing in low-intensity violence provinces. Finally, health services are weak in all provinces of Iraq. Kids are getting bad health service (less vaccination) in all provinces. However, the health service is becoming worse after the war 2003, and that is clearly manifested in DID coefficients of high and medium provinces, but not in the low-intensity violence provinces.

Keywords: war, conflict, health, Iraq
JEL Classification: I00, H56, D74, N15.

The Impact of Conflict on Health in Iraq: Evidence from Microdata

I. Introduction

For the longest time in its history, Iraq has been experiencing war, something that has significantly affected the nation's day to day operations. Since the 1920s Iraq has experienced a prolonged period of war which has adversely affected the country's economic, political, and social aspects of the lives of those residing in the country. Before the start of the 2003 war, the nation recorded high performance in better health systems as well as enhanced infrastructure. However, these have been adversely affected by the war (Plümper & Neumayer, 2006). It is important to indicate that war in Iraq has to lead to insecurity, loss of lives, and loss of property, as well as human suffering.

Different regions of Iraq are affected differently by the violence and war experienced in the whole nation. Importantly, the south and the central part of the nations are the most affected regions, and hence, the health system in these two regions is worse when compared with other regions. Also, different ages are affected differently by exposure to the war, with children and women being the groups most vulnerable to physical injuries, death rates as well as stagnated growth (Guerrero Serdan, 2009). Existing literature indicates that war has adverse effects on the children's psychological well-being depending on the children's age when they were first exposed to violence. For example, after the US invasion in Iraq, more than 50% of children under the age of five years were reported to suffer from post-traumatic stress disorder, and the number was likely to increase with time (Ismael, 2007). Certainly, war affects the availability of food which in turn adversely impacts the health of young children. Statistics indicate that the first two years of development are essential as they determine the general well-being of the child ranging from physical, social, emotional as well as cognitive well –being (Burnham et al., 2012).

Indeed, the war in Iraq has adversely affected food security which has, in turn, lead to malnutrition for the young and old generations. Existing literature about Iraq indicates that children born in an area with high levels of violence are 0.8 cm shorter when compared with children with less violence (Ismael, 2007).

Throughout the Iraq- Kuwait war period 1990-1991, the Iraqi population has been unable to access quality health services due to the destruction of hospitals and other public buildings, lack of adequate health workers to cater for the increasing number of individuals with different health needs as well as lack of medical resources such as medicine (Iqbal, 2006). For example, based on existing literature, after the 1991 gulf war, Iraqi hospitals and health facilities were widely destroyed, and up to 1996, the facilities were poorly maintained (Garfield et al., 2003). Additionally, the war in Iraq had adversely impacted the availability of food and medicine which further deteriorated the health system in the nation. For example, after the 1990 sanction and the 1991 gulf war, the nation reported a massive decline in the availability of medicine and drugs for imports as it had dropped by 85-90% (Garfield et al., 2003). Also, the war lead to a decreased number of health professionals which further adversely affected the health status of the Iraq nation. For example, in 1999, in the south and central regions of the nation, which was the most affected by violence, the ratio of the physician to population was one physician to 1926 individuals. Additionally, the war also reduced the number of nurses to the extent that one nurse served twenty-four physicians and the ratio of nurses to the population was 2:100,000 individuals (Garfield et al., 2003). The rate demonstrates a significant deficiency in the human resource sector in the health industry, and this explains the effects of war on the health sector in Iraq.

The primary objective of this chapter is coming in three points: first, I fill in the gap in the literature by providing an estimation of the impact of conflict on primary health services using micro-level data. Second, this chapter extends the literature by examining the early childhood shocks on health. Third, this chapter is an attempt to redirect the focus on critical empirical research regarding the conflict in Iraq, which has very little representation among the academic works.

The next section discusses the literature review of conflict and some background information on health services in Iraq, following by a discussion of our data analysis. The following sections will present the identification and empirical strategies. Finally, the discussion of the empirical results will be described, followed by a brief summary of key findings.

II. Literature Review

Existing literature significantly demonstrates a strong relationship between the deteriorating health and economic status of the Iraq nation with the continued war experienced in the nation (Plümper & Neumayer, 2006). In addition to malnutrition which leads to stunted growth, wasting and underweight among children, it is also important to indicate that from previous literature, it is evident that war in Iraq significantly contributes to increased mortality for infants and young children (Ismael, 2007). For example, based on a case study that was carried out in an Iraqi household, it was found that infant and child mortality increased more than threefold between January and August of 1991 when compared to child and infant mortality rate with previous six years (Ascherio et al., 1992). The war in Iraq has adversely impacted children's physical well-being over the war period. For example, in 2002, the Iraq government reported to the UN that more than 1,614,303 people had died, among them 667, 773 children whose cause of death is unknown but related to sanctions experienced in the nations (Guerrero Serdan, 2009). In addition to death mortality rate, the war also brings about physical, emotional, social and economic suffering to women as well as to men (Nordhaus, 2002). Unquestionably, the existing literature on war indicates that war has an indirect effect on women as it reduces women life expectancy when compared to men expectancy rate (Plümper & Neumayer, 2006). Additionally, because of displacement and social disorder experienced during the war, women suffer displacement, emotionally and physically which adversely affects their general well-being. It is also important to indicate that the mortality rate increased significantly for the whole population after the 2003 invasion. However, there were more deaths for women and children who died as a result of a coalition force (Burnham et al., 2012).

Initially, before the 2003 invasion of Iraq, the primary cause of death included myocardial infarction, cerebrovascular accident as well as deaths which resulted from chronic disorders (Roberts et al., 2004). However, after the attack, the majority of the deaths reported in Iraq resulted from violence and specifically from coalition use of force. The risk of deaths that occurred from destruction after the invasion was approximately 58 times higher compared to the risk of deaths from violence before the invasion (Roberts et al., 2004). Additionally, more deaths also resulted from military actions such as gun shooting, for example, in Baghdad which had a population of five million people, more than three hundred deaths from gunshots were reported in the first eight months of 2004 (Roberts et al., 2004). (see figures 2.1 and 2.4).

Undoubtedly, before the Iraq-Iran war, Iraq was one of the developed nations in the Middle East with adequate infrastructure, hospital, and buildings. However, the start of the war significantly leads to a decline in infrastructure and health system. During the 2003 invasion of Iraq by the US army, the nation recorded very high levels of robbery, looting, and destruction in public institutions such as schools and hospitals (Iqbal, 2006). Further, the war leads to the destruction of electric power which was key is pumping clean water for drinking and use in the household. Iraq is a flat nation and electricity is essential for pumping wastewater and affecting water treatment processes to provide clean water (Guerrero Serdan, 2009). It is essential to indicate that up to 2007; the nation had not managed to restore its normal electricity operations which further illustrated the malfunction status of the water plant in the nation. Because of the destruction of power, the nation suffered inadequate clean water supply for drinking which posed a health risk to the Iraq population as the population was vulnerable to water-borne diseases such as cholera and Bilharzia (Guerrero Serdan, 2009).

Additionally, because of poor sanitation, the nation suffered inappropriate drainage systems and inappropriate disposal of waste, whereby most of the waste was channeled to the rivers which further posed a health risk to the nation (Guerrero Serdan, 2009). Because of the gulf war, many deaths were reported from diarrhea and injuries. For example, years before the onset of the gulf war, the mortality rate from diarrhea was approximate 2. 1 in 1000 people, years after the onset of the war, mortality rates due to diarrhea rose to 11.9 per 1000 people (Ascherio et al., 1992). Further statistics indicates that military conflict has a significant effect on the general well-being of the population. For example, military conflict in a nation significantly reduces the accessibility of clean water, adequate food, accessibility of health services as well as exposure to the unhygienic environment which poses a health risk to such a population (Plümper & Neumayer, 2006).

More importantly, it is very important to notice that an early-life shock will influence child development outcomes later. There are many previous studies showed that childhood health indicators are risk factors for the presence of chronic diseases. For example, (Currie and Vogl, 2013) have found that early childhood malnutrition and shocks adversely affect child development outcomes. In other word, early childhood shocks are critical for child development outcomes, for example, impact on child educational attainment, cognitive and non-cognitive skills, mid-childhood and adult health, labor productivity. Currie and Vogl find in their study that anthropometric markers such as birth weight and child height are shown to have significant effects on later outcomes, specifically, schooling, employment, earnings, family formation, and health. Almond, Edlund, and Zhang (2010) is another paper looks at the long-term impacts of exposure used, in this paper; the authors use multiple datasets from the census and find dramatic effects on children subjected to the famine in utero. China famine is considered in their paper as exogenous environmental stress. In their study, find that childhood exposure to famine impacts martial outcomes. They found dramatic effects on children, for example, affected men (women) were nine percent (six percent) more likely to be illiterate and six percent (three percent) less likely to work. The finding of larger effects for men than for women is striking and not uncommon in the fetal effects. Finally, (Currie et al., 2014) Investigating the effect of environmental pollution on child development. They create a simple from a three-period model by dividing life into three distinct stages: early childhood, late childhood, and adulthood. The study finds that there is a significant adverse effect on the health of children, both concurrently and in later life. More specially, the study finds that toxic exposure during pregnancy does not only have a short-term effect at that moment but really an effect that lasts the entire lifetime. Besides, they find that it is among infants, where previous research has demonstrated that they are especially sensitive to changes in environmental conditions.

III. **Data source**

In order to analyze the impact of conflict on the effectiveness of health indicators, this study uses cross-sectional data obtained from the Household Socio-Economic Survey of Iraq 2006-2007 conducted in Iraq, which took place in 2006-2007[1]. IHSES is a nationally representative sample of the Iraqi population with the interview, which asked the households and individuals' demographics in questionnaire form. The data were collected using paper questionnaires with concurrent data entry in the field using Computer Assisted Field Entry (CAFE). The target age groups for demographic variables in this datasets vary by the topic.

The purpose of doing (IHSES) survey is to assess household roster, composition, and demographics; consumption and receipts of rations; housing; health; education; job search, past and current employment; wages, earnings, and income. Moreover, the survey also monitors the indicators on loans and assistance; activities; consumption of food and non-food items; time use all across Iraq. The 2006-2007 IHSES survey was performed with face-to-face interview technique; the original sample consists of more than 25,000 households. The survey covers the entire country, and the target population comprises all persons who are residing within the border of Iraq.

The second source of our data is *Iraqi Body Count* (IBC). This data are extracted from the IBC database. We obtained this data after we signed *a Non-Disclosure Agreement (NDA)* with Iraq Body Count founder. This organization recording civilian deaths and giving incident details sorted chronologically. Victims are recorded in a database table on a daily basis or whenever the incident happened (see table 2.1). Where each cell-included victim is assigned to the

[1] There is another survey called Iraq - Household Socio-Economic Survey 2012, Second Round (IRQ_2012_IHSES). In this study, we only used the Iraq-Household Socio-Economic Survey 2006-2007 in order to capture the difference in the outcome for children's whose affected by the 2003 war. Considering 2012 survey might lead to biased results because as the kids grow their diets will change and have a vaccine or not that might have no affect them.

incident, in which he/she died. Also in the IBC dataset, is basic demographic information about them such as their age, gender, occupation in order to consider the specified victim that meet their definitions for civilians. In fact, the amount of demographic information for the civilian deaths provided is not sufficient to do statistical analysis.

To include demographic details about these victims in analyses, we would need to combine the incident and victim datasets, and account for the fact that the latter is only a subset of the overall data. In this paper, we are ignoring the demographic variables for now. For example, age, occupation, marital status, etc. Instead, we focused on the number of civilian deaths by taking the maximum number and derived the level of intensity of violence across provinces from these two datasets; we construct our analysis to investigate the impact of conflict on health variables that we have described later under model specification.

IV. Identification and Empirical Strategies

A. Identification

The identification strategy in this paper comes by exploiting differences in the timing and geographical intensity of the conflict. Ideally, we want to compare the health outcomes for the people who were exposed to the war versus people who were not exposed to the war. This comparison would generate sound estimates of the Average Treatment Effect (ATE). Generally, comparing outcomes of kids exposed to war (born after 2003) to the outcomes of kids who were not exposed to the war (born before 2003). Without appropriately controlling for the individual characteristics and other characteristics that might correlate with the decision of taking the child or not for the purpose of obtaining the appropriate vaccine that is necessary for her/his age stage. To avoid this problem in our estimation, we have controlled for the individual's characteristics.

For example, receiving any ration with a ration card, the number of languages that the kids might learn, and if there are any outstanding loans or debts on the households. By this approach, the children's outcome (vaccination) should be changed to the change of the education level of kids and the economic well-being of the household. Therefore, we have controlled for unobserved individual characteristics at the lower level. Moreover, the decision of taking the number of vaccinations also is correlated with some unobservable variables we could not capture in the first baseline regressions (Table 2.4). For example, house ownership is positively correlated with distanced to health fecality/ residence and negatively associated with the decision to take the vaccination. For example, being a renter for the house means there is a big possibility that they choose a house or apartment would be located in the outskirts of residential areas and avoids city centers because of the price effect, so, it is literally far away from health centers. On the contrary, when one might be the owner of the house, this means that he or she has a connections or some kind of roots in the residential area with taking into account that being rational, so the choice of the house ideally should be near the community services (schools, health centers, recreation centers, etc.). In addition, we have controlled dwelling characteristics and city characteristics. Finally, our primary focus is on kids born before the war in 2003 and after the war (i.e., before and after the treatment) in provinces affected by different levels of violence. Therefore, our treatment variable was the "war" in 2003. For the treated and pseudo group, we have chosen the high – intensity of violence province as the treatment group, and low-intensity of violence province as a control group. We have determined the low and high-intensity provinces of violence based on the Iraqi Body Count (IBC) data set (Table 2.1 is listed in the appendix one) (see figures 2.1,2.2,2.3, and 2.4 in appendix three)

B. Empirical Model:

The purpose of this section is to identify the effect of the treatment war that happened in 2003 is used as a time effect. This war had an impact on an unlimited number of the type of health indicators, for example, immunization, diseases, malnutrition, and any other health variable. We considered immunization indicators as response variables and created a cohort that should be observed pre and post-treatment. We have created a pseudo group because we do have data that observed the same group before and after the war, which time-variant, as well as all the variables used in the time-invariant (before-and-after). Therefore, the date of birth and the place are what matters in this paper.

In this paper, we used multiple models as preliminarily models, and we are going to discuss them at the end of our discussion. Some of the variables are continuous variables, and others are not. So OLS and Linear Probability Model are used accordingly. The Difference in Difference model introduced to address the interaction effects. However, my primary focused is on the Difference In Difference Model (DID), for that we assumed this model captures the treatment effect of the exposure to the war

$$Y_i = \alpha + \beta T_t + \gamma t_t + \delta T_i . t_t + \varepsilon_i \qquad (1)$$

Where Y_i is the outcome of interest, α is the constant term, T dummy to indicate if the kid is born after the war (treatment group), t_t dummy indicate if the kid resides in a treated province (high, medium, and low violence provinces) (see table 2.7). Finally, the coefficient of interest, the Difference-in-Difference estimator (DID) which is δ: true effect of treatment interaction of dummies T (kid born after the war) and t (born in treated provinces). ε_i is the random error

On the other hand, the model in equation (1) has many econometrics problems. For example, casual effect and omitted variable; one can say that the level of education has an impact on the kid's health, living in rural vs. urban areas also has an effect on the level of the health. Moreover, city characteristics, households' characteristics, economic conditions. All these which can be considered controls when we created the time and group treated. Therefore, we formulate new models after taking into account the controls discussed in the identification strategy above. The new model is:

$$Y_i = \alpha + \beta T_t + \gamma t_t + \delta T_i . t_t + \beta \eta_i + \beta \zeta_i + \varepsilon_i \qquad (2)$$

Where η_i **:** vector of the individuals, location and household characteristics, ζ_i **:** is a vector of pre-war household characteristics

In equation (2) we have addressed many econometrics estimation problems. For example, the causal effect omitted variable problems, so we controlled for individuals, households, city, and dwelling characteristics. For example, high negative relationships with the dates of birth-year and positive relationship distance to the health facility/ Residents. In terms an explanations for dependent variables. In this paper, we considered some of the important indicators of health, which is (vaccinations). Vaccination is considered one of the conditions to meet health requirements. More importantly, is that the vaccination includes the provision of essential health services through community health people. (De Janvry, A., & Sadoulet, E. (2016)).

Providing a vaccination is considered as an adequate supply of health services in developing countries, which remains a critical issue in improving health outcomes. There are multiple reasons of why the vaccinations are impotent for the kids. For example, a study by the World Health Organization (WHO) indicated that the vaccination greatly reduces disease, disability, death, and inequity worldwide (Andre and el al. 2008). Another study focuses on the public health by showing that what they call it the full impact of increasing routine immunization further and implementing new vaccines against pneumonia and diarrhea agents in the poorest countries could prevent more than two million additional childhood deaths each year. They derived their results based on U.S. health birth data. (Schuchat, 2011). Therefore, we have chosen six dependent variable treated with different models. The first dependent variable is ***TB vaccination*** as indicated by one of the critical variables to determine the health services in any particular region as mentioned in chapter 17 of De Janvry, A., & Sadoulet, E. (2016). So the interviewer asked and checked with the head of the household by asking this question "If the child has a vaccination card, (otherwise ask the mother): has the child received the following vaccines? (Tuberculosis (B.C.G.))" (COSIT survey, 2006-2007).

Second, ***Polio vaccination***; same as before the interviewer asked the household this question" If the child has a vaccination card, record the following (otherwise ask the mother): has the child received the following vaccines? (***Polio***). Third, ***Suffer illness***, in this case, the interviewer ask not only the mother or the head of the households. Instead, he/she asked every single person this question by putting all household members who suffer from a disability about the causes of this disability and write down the applicable answer code. If there is more than one cause, he writes down the most important three.

The question is “Do you suffer from a chronic disease?” Fourth, ***Measles vaccination*** with same kind of questions as before as following” If the child has a vaccination card, record the following (otherwise ask the mother): has the child received the following vaccines? (***Measles***).

On the other hand, we have chosen different independent variables for our primary regression models. For example, we have chosen ***Polio vaccination, a number of doses*** and ***Dpt vaccination, a number of doses***.[1] The gov. of Iraq and the World Bank whom the founders of the survey gave instructions[2] for the interviewer in order to check for this question “If the child has a vaccination card, record the following (otherwise ask the mother): has the child received the following vaccines? (*Number of dosages/injections taken against Polio*)” and the instructions were:“ On the same token, this question been asked ***for Dpt vaccination, number of doses*** “so the literal question, if the child has a vaccination card, record the following (otherwise ask the mother): has the child received the following vaccines? (***Nb doses child got of Triple Vaccine/ DPT Diphtheria, Whooping Cough, Tetanus***). All those vaccinations are essential for kids around the world. For more information about the for vaccination schedule for infants and children in Iraq, see tables 2.2 and 2.3 in appendix 2.

VI. Discussion and Results

[1] More discussion about those two variables is stated in the footnote of table 2.3.

[2] The instructions to the interview stated: Information for children aged less than 5 years are to be copied from the immunization cards. If there is no immunization card, ask the mother and write down the answer either YES or NO about their vaccination against the corresponding disease.

As shown in tables 2.4 and 2.5 we added a restriction in our estimation by classified the provinces of Iraq to the three regions (high-intensity violence provinces, medium-intensity violence provinces, and low-intensity violence provinces[1]) (see graphs1,2, 4). The high-intensity violence provinces include (Nainwa, Al Anbar, Baghdad, Diyala, Saladin). The medium-intensity violence provinces include (Babylon, Basra, Karbala, Kirkuk, Maysan, Najaf, Wasit). The low-intensity violence provinces include (Muthanna, Qadisiyyah, Dhi Qar, Nineveh, Dohuk, Erbil, Sulaymaniyah). We have classified the provinces violence based on data of *Iraq Body Count (IBC)* (table 2.1).

We have created an interaction term for treatment (place*time of birth). For the dependent variables, we have used the same variables mentioned above. For the explanatory variables, we simply added an interaction term. So, we create a dummy for treated group equal to the 1 if a kid born in treated provinces and zero otherwise. We also created another dummy for the time period, equal to the one if kids born after 2003 and zero otherwise. Finally, we generated interaction for the two which represent as *DID* estimate of the treatment effect. The question has been asked here how the war affects kids health? If there is an effect, is that effect distributed on the whole sample? Is there any difference between the treated groups (provinces)[2]?

Therefore, our principal analysis contains two primary tables (2.4, 2.5). These two tables show the DID estimations for different dependent variables. By looking to table 2.4, we can see that we ran DID for two continuous variables, so polio vaccination "the number of doses," and Dpt vaccination, "the number of doses" were considered as dependent variables. Also, we have chosen

[1] We excluded the low-intensity violence in our estimation to avoid collinearity problem.

[2] We can elaborate on how the using of DID model can answer many of the questions in this context. More appro-bate work is needed to explain interesting questions especially those questions regarding the Iraq war.

two intensity levels, high and medium intensity violence. We applied the OLS model in both tables. By looking at table 2.4. In this linear model, most of the parameters are significant at 1% and 5%. For the born after 2003 variable, all the coefficients are significant at a 1% confidence level, distance to service/ pharmacy is also is significant at a 1% confidence level under Dpt vaccination and 5% confidence level under polio vaccination. The most crucial variable which the place of birth for kids born in high-intensity provinces. It's ultimately significant for high-intensity violence provinces but not significant for medium intensity provinces. Besides, In this table, we can see how the significance of coefficients changes by moving from one group to another and how the group with high-violence intensity gets the most significant coefficient in this estimation. The DID coefficients presented in the fourth –fifth rows are important. First, the interpretation of this DID coefficient for the high sample is that, if the kids are born in high-intensity violence provinces, the expected mean change of outcome (Polio vaccination) will be affected as long as the kids are born after 2003 (war treatment). The interpretation for the high-intensity violence provinces we can claim that expected mean change of outcome (Dpt vaccination) will be affected as long as the kids born after 2003 (war treatment) and in the treated provinces. DID coefficients represent the mean difference of outcome between the treatment and control groups after the intervention which (2003 war). The DID coefficients are significant under Dpt vaccination regardless of the violence levels of different provinces. More importantly, the DID coefficients have a significant impact for both variables with different violence provinces, which is expected. The size of the household coefficients are significant at 1%, and 5% confidence level Suffer illness coefficient has a negative effect on the outcome variables. Whether or not the child has an immunization card has a positive impact on the Polio vaccination and Dpt vaccination outcomes. R-square values are low[1]. The reason might be for small value for R-squared related to using one data set not a combination of many. One can say that small R-squared does reflect the variation caused by explanatory variables used in the model, but the model itself is suitable for prediction.

Also interestingly enough that we can see that place of birth and born after 2003 variables are significant regardless the classification of violence among provinces. There is one interpretation for this scenario, which is that there is an impact on health service on kids are born in Iraq in all provinces after 2003. More clearly, regardless of the kids' birth location, there is an impact on his/her health services since he/she was born after the war in 2003. However, the interaction terms are significant for medium intensity violence provinces but not for high intensity violence provinces, Finally, The health services are deficient in all provinces of Iraq, but it became worse after the war 2003, and that is manifested in high and medium province DID coefficients (table 2.4) but not in the medim intensity of violence provinces.

One can compare the DID table (2.4) to DID binary regression in the table (2.5), where we can see that the binary regression results. For example, most of the DID coefficients are not significant in the first and second columns, while in the DID coefficients in table 2.4 consistently significant at 1% and 5% confidence level. The binary model is not consistent with the hypothesis of this study.

VII. Endogeneity threat

The endogeneity threat is an issue in most empirical work in applied economics. In previous models, we have presented the relationship between health indicators as an outcome and some of

[1] For the R-square values, I think it is unworthy of being interpreted. Small R-squared values present small effect, but that cannot be true in some cases. Typically in our case, there is not much variability explained by R -squared values for binary dependent variable

the variables (explanatory variables). One of the most important variables is kids who are born after the time of the start of treatment (the year of 2003) in high-intensity violence (specific provinces). Based on these two variables, we have created an interaction variable, then ran a DID estimator. The endogeneity threat might be involved with violence variables. Parents who are living in lands of terror might post their plan to have a baby in the coming years so that they will reticence their usage of health service. Therefore, violence is a function of some other variables; in other words, the relationship between violence and error term is not equal to zero. Along with literature, the most effective way to solve the endogeneity problem is finding instrumental variables. It is extremely difficult to find such variable due to spillover effects between variables inside the sample. However, we have used some of the variables that we think that they have an impact on violence and not affect health indicators. The first one is having a job. Since the health services are free in Iraq, especially the primary health service for kids. Having a job or not does make a difference in the decision of participation in violence. According to the paper by Berman et al. (2011), having a job meaning, there are monthly payments to the parents. Parents having jobs more likely against violence because escalating the level of violence in their area will result in stop receiving payments from central government. The second variable is born here, if the parent born in the area, obviously that would like to reduce the violence instead of escalating it. Most of the rebels or the key makers of violence are coming in from outside of the city itself. The third one is house ownership. Being an owner of the property has an opposite impact on the level of violence. The fourth variable is the relationship to the head of the household. If the owner of the household has a tight relationship with rest if members, which overall reduce the level of violence.

All these variables assumed to be exogenous to the violence and not affecting the level of health services provided to kids. In order to implement the above discussion variables, Heckman Selection Model is used. The first equation represents some original one with the endogeneity problem and the second one with some of the exogenous variables that have been defined at the beginning of our discussion. Most of the variables have the expected signs. The magnitude of all variables still same as introduced in tables (2.6).

Moreover, our model might experience another issue which is omitted variables. The issue in this following discussion is a continuation of the previous one, but in this following discussion, we suspect some other variables might have an impact on our outcome variables they are not observed in our estimation. One of the ways to address this problem is using Generalised Linear Models, which a procedure which is performed in SAS for fitting different kind of models, for example, models include classical linear models with normal errors, *logistic* and probit models for binary data, and log-linear and Poisson regression models for count data. We have used selected equation in the Generalised linear model, in this equation, we have to use some of the variables that exogenous to indigenize variable and have zero impact on the estimated equation. We used some variables as before all the results are presented in table (2.7). Also, we might think that the design of our treatment is not well set up, so that we recalculate our table which the number if civilians who were killed (presented in table 3.1) only for the year 2003-2007, not 2003-2016 based on the results, we got almost same results that we have from the previous discussion.

Therefore, from table (2.7), there is a negative impact on Tb vaccination by the violence level among different provinces. From table (2.8), the size of the houshold and suffer illness are significant under differnt sample regression.

Also, we did report the ordered probit estimation for the different dependent variables (Polio vaccination, Suffer/disabalty illness, and Measles vaccination..etc) in the tables (2.7). We find that has immunization card coefficients have a positive impact on kids for having vaccinations, but there is no impact of distance to pharmacy and public hospital except for TB vaccination. Als, we ran a Poisson model (table 2.8) for the different dependent variables and we considered the same explanatory variables, as we mentioned in the first model. the dependent variables are Polio vaccination, Dpt number of doses, and suffer/ disability illness. We find that most of the coefficients are not significant, with a note that Polio vaccination, is distributed at 18 doses and Dpt vaccination is distributed at 8 doses based on the survey that we used in our analysis(see tables 2.3)

The results are given in Table 2.4. As we discussed in the above points, we can state that the DID model is preferred because the rest of the models might be assocated with causal and omitted variables problems. Moreover, DID model coefficients are significant for most of the independent variables. For example, sex, distance to service: public hospital, place of birth, area, and distance to service: pharmacy which coefficients are significant at 1% significance level. However, from the tables above, we can see that there is no consistency in the estimated coefficient for the two models ordered logit and probit models. Coefficients reported in table 2.6 give much more reliable results than the table 2.7. However, some of the coefficients in the ordered logit regression table are not significant. Finally, we find that the DID model is statistically significant for high-intensity violence provinces, and it is not equivalent to the baseline regression. Therefore, the DID is better than another model since we figured that these interaction terms are adding significant value to the above estimations. However, it is not consistent throughout our estimations.

VII. Conclusion

For the longest time in its history, Iraq has been in the war which has adversely impacted on the nation well-being ranging from the economic, social, and political. Different regions are affected differently, and the south and central regions of Iraq are the most affected by violence. Before the war, the health industry in Iraq was considered as the best in the Middle East. However, the health system in the country has deteriorated due to prolonged exposure to war. The study aims to estimate the impact of conflict, which has been created after the 2003 war on the health indicators. We have investigated the impact of the conflict on six outcome variables (Tb vaccination, Polio vaccination, Suffer illness, Measles vaccination, Polio vaccination-a number of doses, and Dpt vaccination-a number of doses) respectively. Because of the war, linear regression is applied to the first four outcomes, and linear probability models are used for the last two outcomes. Difference In Difference (DID) estimation is applied for the primary four outcomes variables after classified the provinces of Iraq into three regions (high, medium, and low) based on the level of violence. The results show that estimate baseline regressions for the above first outcome is not consistent across four tables. After controlled for some individuals, household, city, and dwelling characteristics, we have got robust coefficients, and more of the coefficients become significant. On the other hand, we have applied DID estimation, and we have found that there is a significant change in the mean of outcomes after the war and base on the level of violence for each group. The health services are weak in all provinces of Iraq, but it became worse after the war in 2003, and that is clearly manifested in high and medium province DID coefficients but not in the low intensity of violence provinces.

Overall, the war has a tremendous negative impact on human lives in Iraq. For example, there have been increased mortality rates, increased physical, emotional and psychological problems among the population, decreased number of health professionals and inadequate health resources such as food and medicine among other adverse effects which have deteriorated the health system in Iraq. More work is needed to investigate these problems.

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Appendices

Appendix one: Tables

Table 2.1: Civilian Deaths from Violence Distributed by Iraqi provinces (2003-2017)

	Governorate	*2003*	*2004*	*2005*	*2006*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*Total*	
1	*Al Anbar*	2591	11153	10058	18300	18745	6765	6036	5419	6525	7075	11245	39009	31002	14111	1251	*189,285.00*	*12%*
2	*Babylon*	604	3490	10168	13816	14696	4531	3791	2834	3878	3596	6594	9674	6053	5059	33	*88,817.00*	*6%*
3	*Baghdad*	7288	15671	35460	105275	127168	29520	13921	10813	9708	13096	40815	46486	37277	30176	2419	*525,093.00*	*33%*
4	*Basra*	1539	1439	2265	8129	8513	3400	670	486	419	471	1296	1005	1208	440	70	*31,350.00*	*2%*
5	*Dhi Qar*	511	419	160	635	656	780	96	3	26	267	305	300	236	208	3	*4,605.00*	*0%*
6	*Al-Qādisiyyah*	278	128	152	1675	2536	275	271	82	266	298	388	146	6	9	NA	*6,510.00*	*0%*
7	*Diyala*	1355	5137	11537	43462	45546	19635	6761	5183	6149	8352	15975	21027	15059	12415	1186	*218,779.00*	*14%*
8	*Dohuk*	NA	40	46	3	NA	43	NA	NA	79	76	73	3	3	49	NA	*415.00*	*0%*
9	*Erbil*	329	19	298	12	162	243	195	110	192	67	12	95	227	590	NA	*2,551.00*	*0%*
10	*Karbala*	1064	1137	570	3318	2172	697	759	720	560	414	655	636	NA	521	NA	*13,223.00*	*1%*
11	*Kirkuk*	1287	2452	3682	9376	8612	3185	2985	1234	2120	3974	4547	5789	5303	11053	1816	*67,415.00*	*4%*
12	*Maysan*	377	636	309	1264	841	351	111	16	125	48	230	112	263	369	NA	*5,052.00*	*0%*
13	*Muthanna*	337	187	107	537	514	6	70	3	3	3	325	311	116	205	40	*2,764.00*	*0%*
14	*Najaf*	672	2403	384	872	765	70	49	453	199	125	173	256	6	76	172	*6,675.00*	*0%*
15	*Nineveh*	1482	9690	12731	16956	27767	18410	10807	7900	8307	10427	15959	18695	26736	39645	8416	*233,928.00*	*15%*
16	*Saladin*	1896	6777	14046	14627	18555	10396	2682	3070	4743	7442	18751	30749	15229	8116	934	*158,013.00*	*10%*
17	*Sulaymaniyah*	99	NA	172	209	404	157	171	15	272	416	296	117	188	83	3	*2,602.00*	*0%*
18	*Wasit*	336	938	1773	11425	8320	2474	450	442	366	744	1652	549	185	6	NA	*29,660.00*	*2%*
																		1.00

Table 2.2: Summary Statistics for Whole Sample data

Variable	Obs	Mean	Std. Dev.	Min	Max
Individual variables					
Household size	10,135	7.571978	3.814958	2	45
Sex	10,135	1.369117	0.48259	1	2
Age	10,135	22.73577	14.92803	0	91
Date of birth, day	10,070	11.48908	9.869535	1	31
Date of birth, month	10,135	6.023779	3.218374	1	12
Date of birth, year	10,135	1983.574	14.87926	1915	2007
Relationship to the head	10,135	2.345437	1.459594	1	8
Born here	10,135	1.082881	0.275716	1	2
1st language/language code *	10,764	1	0	1	1
Household variables					
Number of persons employed	6,885	2.264198	1.058187	1	4
Frequency of payment†	6,884	2.850523	1.441039	1	6
Outstanding loans or debts	10,135	1.513567	0.499841	1	2
Source of loan/credit, 1st	4,930	2.842191	2.336703	1	12
Purpose to borrow, 1st	4,936	3.387763	3.009132	1	10
Marital status	7,231	1.23012	0.636497	1	5
Receive any ration with ration card‡	10,135	1.000296	0.017203	1	2
In ration card/children	10,103	0.39325	0.603282	0	3
Years living in housing unit	10,131	19.16385	12.63159	0	74

* The interviewer ask the respondent; what language can you deal with, and what is your level of proficiency in that language? (Mother Tongue, Level of reading)

† Every household member employed in a wage job is asked about the mechanism or frequency of payment of the wages. Indicate code 1 if he receives wages on a daily basis, 2 if on a weekly basis, etc.

‡ Ration card is required by the gov. or Iraq in order to receive subsided food (floor, sugar, oil, etc). The interviewer ask the respondent; Here every household is asked if it receives ration under a ration card. Mark 1 if YES it receives and 2 if it does not receive ration.

City Variables					
Distance to service: public hospital	10,135	2.835619	1.248253	1	7
Distance to service: private hospital	10,135	4.029798	1.469075	1	7
Distance to service: primary health center	10,135	5.449433	1.230726	1	7
Distance to service: pharmacy	10,135	6.037296	1.253765	1	7
Distance health facility/residence (km)	10,135	5.254668	11.94333	0	300
Dwelling variables					
Households in dwelling	10,135	1.418155	0.876072	1	6
Type of housing unit	10,135	1.163789	0.519609	1	5
Wall material	10,135	2.124618	1.562702	1	8
Household area, built up	10,100	134.5451	83.73205	11	610
Bedrooms............ Exclusive[*]	10,135	1.928762	1.126347	0	8
Kitchen............. exclusive[†]	10,135	0.759941	0.43447	0	2

[*] The interviewer ask the respondent; How many rooms do you have for bedroom (Specific to the household)?
† How many rooms do you have for kitchen (Specific to the household)?

Bath & toilet room... Exclusive	10,135	0.096793	0.305861	0	3
Kitchen............. shared[*]	10,130	0.165844	0.373812	0	3
Sanitation	10,135	2.334583	1.11321	1	5
Housing ownership	10,135	1.322546	0.749883	1	5
Dwelling old[†]	10,135	4.444894	1.430412	1	7
Health Variables					
Has immunization card[‡]	10,135	1.02151	0.145083	1	2
Tb vaccination	10,135	1.002072	0.045475	1	2
Polio vaccination	10,135	1	0	1	1
Polio vaccination, number of doses	10,135	4.050814	2.253757	0	16
Dpt vaccination	10,135	1	0	1	1
Dpt vaccination, number of doses	10,135	2.778885	1.176772	0	9
Measles vaccination	10,135	1.162802	0.369203	1	2
Hepatitis b vaccination	10,135	1.057622	0.233039	1	2
Dummy for Sex (1 male, 0 female)	10,135	0.630883	0.48259	0	1

* How many rooms do you have for kitchen (Jointly with other households)?
† Ask each household about the housing unit it resides in regardless of the type of ownership: How many years have passed since this unit was built?
‡ Dummy variable has been created (0,1)

Dummy for Place of birth/ area (1 urban,0 rural)	10,135	0.666897	0.471346	0	1
Dummy for Born here (0 Yes, 1 No)	10,135	0.917119	0.275716	0	1

Table 2.3. Variables Description Based on Survey

Variable	*Description*
Individual variables	
Qadha (District)	The number of districts
Governorate (Province)	The number of provinces
Sex	=1 if Male, =0 if female
Age	
Date of birth, day	=1 first day of the month, 31 last day of the month
Date of birth, month	=1 Jan- =12 Dec
Date of birth, year	
Relationship to the head	=1 head, 2 spouse, =3 son, daughter, =4 son/ daughter in law, 5Granson/granddaughter ,=6father, mother, =7brother, sister, =8 other relative, and =9 unrelated to household
Born here	=1 yes , =0 no
*1st language/language code**	=1 Arabic, =2 Kurdish,=3 Turmani, =4 Assyrian,=5 Al – chaldeania,=6 English, =7 French,=8 Persian,=9 Other languages.
Household variables	
Household size	The number of the people who live in the house
Number of persons employed	=1 less than 5 employees, =2 5-10 employees,=3 11-50 employees,=4 more than 50 employees
Frequency of payment†	What is the unit on which wages are set in this job?, =1 daily, =2 weekly, =3 bi-monthly, =4 monthly, =5 by piece, =6 other
Outstanding loans or debts	*=1 yes, =0 no*
Source of loan/credit, 1st	=1 Relatives in Iraq; =2 Relatives abroad; =3 Friends,eighbours; =4 Moneylender;=5 Trader ;=6 Landlord; =7 Employer;=8 Governerat bank/governerat firm;=9 Local bank;=10 Ngo;=11 Other;=12 Never get loan.
Purpose to borrow, 1st	the main purpose of borrowing money, =1 Household consumption needs, =2 Emergencies cases, =3 Social cases(wedding,funel), =4 Maintenance of dwelling, =5 Purchase of land, =6 Building home, =7 Purchase home, =8 Purchase of consumer durables, =9 Payback existing debts, =10 other
Marital status	=1 married, =2 Never married, =3 divorced, =4separeted, =5 widowed
Receive any ration with ration card‡	=1 yes, =0 no

* The interviewer ask the respondent; what language can you deal with, and what is your level of proficiency in that language? (Mother Tongue, Level of reading)

† Every household member employed in a wage job is asked about the mechanism or frequency of payment of the wages. Indicate code 1 if he receives wages on a daily basis, 2 if on a weekly basis, etc.

‡ Ration card is required by the gov. or Iraq in order to receive subsided food (floor, sugar, oil, etc). The interviewer ask the respondent; Here every household is asked if it receives ration under a ration card. Mark 1 if YES it receives and 2 if it does not receive ration.

In ration card/children	How many household members are recorded in the ration card/cards for this household (children under 1 year of age), 0-10 children
Years living in a housing unit	How long have you been staying in this housing unit?
City Variables	
Distance to service: elementary school	=1 0-100 meters,=2 101-300 meters,=3 301-500 meters , =4 501-1000 meters, =5 1-5 km , =6 5-10 km ,=7 more than 10 km
Distance to service: intermediate or secondary school	=1 0-100 meters,=2 101-300 meters,=3 301-500 meters , =4 501-1000 meters, =5 1-5 km , =6 5-10 km ,=7 more than 10 km
Distance to service: public hospital	=1 0-100 meters,=2 101-300 meters,=3 301-500 meters , =4 501-1000 meters, =5 1-5 km , =6 5-10 km ,=7 more than 10 km
Distance to service: private hospital	=1 0-100 meters,=2 101-300 meters,=3 301-500 meters , =4 501-1000 meters, =5 1-5 km , =6 5-10 km ,=7 more than 10 km
Distance to service: primary health center	=1 0-100 meters,=2 101-300 meters,=3 301-500 meters , =4 501-1000 meters, =5 1-5 km , =6 5-10 km ,=7 more than 10 km
Distance to service: pharmacy	=1 0-100 meters,=2 101-300 meters,=3 301-500 meters , =4 501-1000 meters, =5 1-5 km , =6 5-10 km ,=7 more than 10 km
Distance health facility/residence (km)	The distance between this medical services location and the residence?
Dwelling variables	
Households in dwelling	How many households are there in this dwelling? From 1-7, *=0 otherwise*
Type of housing unit	= 1 house, =2 apartment , =3 clay house, =4 reed house, =5 other, *=0 otherwise*
Wall material	=1 brick, =2 stone, =3 cement blocks, =4 thermostone, =5 prefab boards, =6 clay, =7 reed, =8 other, *=0 otherwise*
Household area, built up	The total area of the residential unit and the residential grounds that is being occupied by the household? (Total Built Area, m2)

Bedrooms............ Exclusive[*]	
Kitchen............. exclusive[†]	
Bath & toilet room... Exclusive	
Kitchen............. shared[‡]	
Sanitation	Main sewage disposal system, =1 public network, =2 septic tank, =3 covered drain, =4 open drain,=5 other, *=0 otherwise*
Housing ownership	*=1 owned,=2 privet sector, =3 public sector, =4 government , =5 other, =0 otherwise*
Dwelling old[§]	= 1 less than one year, = 2 1 year to less than 5 years, =3 5 years to less than 10 years, =4 10 years to less than 20 years, = 5 20 years to less than 30 years, =6 30 years to less than 50 years, =7 50 years or more
<u>Health Variables</u>	
Has immunization card	*=1 yes, =0 No*
Tb vaccination	*=1 Yes, =0 No*
Polio vaccination	*=1 yes, =0 No*
Polio vaccination, number of doses	*0-18 based on the number of doses*
Dpt vaccination	*=1 yes, =0 no*
Dpt vaccination, number of doses	*0-8 based on the number of doses*
Measles vaccination	*=1 yes , =0 No*

[*] The interviewer ask the respondent; How many rooms do you have for bedroom (Specific to the household)?
† How many rooms do you have for kitchen (Specific to the household)?
‡ How many rooms do you have for kitchen (Jointly with other households)?
§ Ask each household about the housing unit it resides in regardless of the type of ownership: How many years have passed since this unit was built?

Hepatitis b vaccination	*=1 yes , =0 No*
Suffer illness	*=1 yes, =0 no*

Note: this the full description of all the variables used in our estimation. If there are any specific details needed for any variable, please refer to the STATA files

Table 2.4: DID estimation of Polio and Dpt vaccinations by violence level for different regions

VARIABLES	(1) *Polio vaccination, number of doses*[1]	(2) *Dpt vaccination, number of doses*[2]
High-intensity violence[3]	0.346***	0.398***
	(0.024)	(0.023)
Medium-intensity violence [4]	0.040	0.075*
	(0.044)	(0.044)
Born after 2003	0.143***	0.144***
	(0.012)	(0.012)
DID (high-intensity violence x born after 2003)	-0.142	-0.345**
	(0.162)	(0.159)
DID(medium -intensity violence x born after 2003)	-1.285***	-1.022**
	(0.455)	(0.447)
Gender(female)	-0.124***	-0.098***
	(0.010)	(0.010)
Place of birth, Rural area	0.057***	0.004
	(0.012)	(0.011)
Size of the household	-0.003***	0.002**
	(0.001)	(0.001)
Distance to service: pharmacy	-0.008**	0.042***
	(0.003)	(0.003)
Distance to service: public hospital	0.012***	-0.008*
	(0.004)	(0.004)
Has immunization card	0.060***	0.169***
	(0.019)	(0.018)
Suffer illness	-0.007	-0.148***
	(0.018)	(0.018)
Constant	1.226***	1.056***
	(0.040)	(0.039)
Observations	10,763	10,763

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

[1] Polio vaccines are vaccines used to prevent poliomyelitis. One of the Recommended Vaccines by Disease, CDC recommends that children get four doses of polio vaccine. They should get one dose at each of the following ages: 2 months,4 months,6 through 18 months,4 through 6 years. Polio, or poliomyelitis, is a crippling and potentially deadly disease. It is caused by the poliovirus. The virus spreads from person to person and can invade an infected person's brain and spinal cord, causing paralysis (can't move parts of the body) source: U.S. Department of Health & Human Services, Centers for Disease Control and Prevention https://www.cdc.gov/vaccines/vpd/polio/index.html .

[2] DPT refers to a class of combination vaccines against three infectious diseases in humans: diphtheria, pertussis, and tetanus

[3] High-intensity violence provinces: Nainwa, Al Anbar, Baghdad, Diyala, Saladin.

[4] Medium-intensity violence provinces: Babylon, Basra, Karbala, Kirkuk, Maysan, Najaf, Wasit.

* We have excluded the low-intensity violence provinces to avoid collinearity in the estimations.

Table 2.5: DID estimation of binary dependent by violence level for different regions

VARIABLES	(1) *TBvaccination1*	(2) *Suffer from Chronic disease*	(3) **Measles vaccination**
High-intensity violence	-0.014***	-0.021***	-0.055***
	(0.004)	(0.007)	(0.018)
Medium-intensity violence	-0.001	-0.010	-0.061*
	(0.008)	(0.013)	(0.033)
Born after 2003	-0.005**	0.033***	-0.036***
	(0.002)	(0.003)	(0.009)
DID (high-intensity violence x born after 2003)	0.006	0.047	0.047
	(0.030)	(0.046)	(0.120)
DID(medium -intensity violence x born after 2003)	0.005	-0.015	0.940***
	(0.083)	(0.130)	(0.338)
Gender(female)	-0.009***	-0.025***	-0.031***
	(0.002)	(0.003)	(0.007)
Place of birth, Rural area	-0.015***	-0.009***	-0.040***
	(0.002)	(0.003)	(0.009)
Size of the household	0.001***	-0.005***	-0.003***
	(0.000)	(0.000)	(0.001)
Distance to service: pharmacy	0.004***	0.011***	0.012***
	(0.001)	(0.001)	(0.002)
Distance to service: public hospital	-0.001*	0.005***	-0.032***
	(0.001)	(0.001)	(0.003)
Has immunization card	0.003	0.034***	-0.013
	(0.003)	(0.005)	(0.014)
Suffer illness	0.003	0.268***	0.062***
	(0.003)	(0.005)	(0.013)
Constant	0.993***	1.435***	1.191***
	(0.007)	(0.011)	(0.029)
Observations	10,764	10,763	10,764

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 2.6: Robustness check: Heckman selection model

VARIABLES	(1) ***TB vaccination (outcome)***	(2) ***Selection***
High-intensity violence	-0.002	
	(0.018)	
Medium-intensity violence	-0.007	
	(0.051)	
Gender(female)	0.003	0.282***
	(0.003)	(0.031)
Place of birth, Rural area	-0.008**	-0.191***
	(0.004)	(0.041)
Size of the household	-0.000	-0.006*
	(0.000)	(0.003)
Distance to service: pharmacy	0.002	-0.097***
	(0.001)	(0.011)
Distance to service: public hospital	0.001	-0.106***
	(0.001)	(0.014)
Has immunization card	0.005	0.041
	(0.005)	(0.061)
Suffer illness	0.007	0.187***
	(0.005)	(0.059)
Constant	0.982***	-0.344**
	(0.014)	(0.134)
Observations	10,764	10,764
athrho		-0.016
		(0.120)
lnsigma		-2.980***
		(0.016)
roh		-.0155364
		(.1201612)
Sigma		.0507745
		(.0008219)
Lamda		-.0007889
		(-.0007889)
Log pseudo-likelihood	-1776.67	
Wald test of(rho = 0):chi2(1)	Prob > chi2 = 0.9156	

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 2.7: Ordered Logit Model for Different Dependent Variables

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Log of Dpt vaccination, number of doses	Log of Polio vaccination	TB vaccination	Polio vaccination (Binary)	Suffer/ disability illness	Measles vaccination
Gender(female)	0.1140	0.1697	0.0308	-0.3465	-0.3776***	-0.2273
	(0.1853)	(0.1772)	(0.5153)	(0.4687)	(0.0821)	(0.2805)
Size of the household	-0.0285	-0.0242	0.0817	0.0606	0.0975***	0.0424
	(0.0246)	(0.0246)	(0.0584)	(0.0561)	(0.0131)	(0.0371)
Suffer illness	0.0569	0.8136	-2.0566*	-2.2218**	-0.7019***	-0.5721
	(0.4828)	(0.4971)	(1.2365)	(1.0847)	(0.0770)	(0.5032)
Distance to service: pharmacy	-0.0879	0.1945	1.1258*	0.6011	-0.0331	-0.2832
	(0.2102)	(0.2027)	(0.5993)	(0.5427)	(0.0831)	(0.3169)
Distance to service: public hospital	0.1620	-0.1616	-1.2757*	-0.4680	0.1171	0.3789
	(0.2293)	(0.2160)	(0.7405)	(0.5989)	(0.0929)	(0.3451)
Has immunization card [1]	-0.0983	0.3531	11.2982***	10.7580***	0.1271	8.2385***
	(0.4846)	(0.4345)	(0.8655)	(0.7855)	(0.7238)	(0.4138)
Place of birth, Rural area [2]	-0.3900	-0.2129	0.4361	0.7829	0.6753***	0.1956
	(0.2556)	(0.2352)	(0.6045)	(0.6050)	(0.0771)	(0.3505)
Controls[3]:						
Individual Characteristics	✓	✓	✓	✓	✓	✓
Household Characteristics	✓	✓	✓	✓	✓	✓
City Characteristics	✓	✓	✓	✓	✓	✓
Dwelling	✓	✓	✓	✓	✓	✓
Constant	-0.5622	-3.5108***	4.9712*	4.8679*	-4.1779***	7.4547***
	(1.0393)	(1.0358)	(2.9341)	(2.7791)	(0.5162)	(1.6225)
Observations	10,763	10,763	17,113	17,113	17,113	17,113

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

[1] STATA by default considered has immunization card: yes as reference variable for this dummy variable

[2] STATA be default considered Place of birth, area (urban) as reference variable for this dummy variable.

[3] For the ***individual characteristics*** we have controlled for receive any ration with ration card, first language, outstanding loans or debts. For ***household characteristics***, we have controlled for housing ownership, type of housing unit, for ***city characteristics*** we have controlled for distance to service: elementary school. For ***dwelling characteristics,*** we have controlled for dwelling old, bedrooms............. exclusive, bath & toilet room... exclusive, and sanitation.

Table 2.8: Ordered Probit Model for Different Dependent Variables

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	Log of Dpt vaccination, number of doses	Log of Polio vaccination	TB vaccination	Polio vaccination (Binary)	Suffer/ disability illness	Measles vaccination
Gender(female)	0.0705	0.0938	-0.0309	-0.1960	-0.1951***	-0.0888
	(0.1067)	(0.1018)	(0.1774)	(0.1640)	(0.0385)	(0.1212)
Size of the household	-0.0158	-0.0167	0.0338	0.0185	0.0416***	0.0181
	(0.0146)	(0.0140)	(0.0210)	(0.0203)	(0.0058)	(0.0158)
Suffer illness	-0.0394	0.4266	-0.6631	-1.0168**	-0.3473***	-0.2834
	(0.2851)	(0.2672)	(0.4341)	(0.4555)	(0.0370)	(0.2336)
Distance to service: pharmacy	-0.0774	0.0916	0.3549*	0.1075	-0.0204	-0.0999
	(0.1212)	(0.1146)	(0.2100)	(0.1872)	(0.0395)	(0.1378)
Distance to service: public hospital	0.1337	-0.1025	-0.4127	-0.0915	0.0580	0.1295
	(0.1288)	(0.1233)	(0.2749)	(0.2129)	(0.0431)	(0.1511)
Has immunization card	-0.0638	0.1763	4.8240***	4.8013***	0.0209	3.7513***
	(0.2810)	(0.2251)	(0.2749)	(0.2867)	(0.3085)	(0.1759)
Place of birth, Rural area	-0.1400	-0.0787	0.0704	0.2227	0.3279***	0.1275
	(0.1470)	(0.1360)	(0.2039)	(0.2110)	(0.0370)	(0.1532)
Controls:						
Individual Characteristics	✓	✓	✓	✓	✓	✓
Household Characteristics	✓	✓	✓	✓	✓	✓
City Characteristics	✓	✓	✓	✓	✓	✓
Dwelling	✓	✓	✓	✓	✓	✓
Constant	-0.1452	-1.9237***	2.5694**	2.7523**	-2.2918***	3.3836***
	(0.6079)	(0.5744)	(1.2292)	(1.2600)	(0.2429)	(0.6857)
Observations	10,763	10,763	17,113	17,113	17,113	17,113

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 2.9: Poisson Regression for Different Dependent Variables

VARIABLES	(1)	(2)	(3)
	Log of Dpt vaccination, number of doses	Log of Polio vaccination	Suffer/ disability illness
Gender(female)	0.0193	0.0312	-0.0070
	(0.1019)	(0.0877)	(0.0117)
Size of the household	-0.0062	-0.0059	0.0017
	(0.0140)	(0.0119)	(0.0016)
Suffer illness	-0.0219	0.1314	-0.0195
	(0.2761)	(0.2180)	(0.0133)
Distance to service: pharmacy	-0.0172	0.0369	-0.0004
	(0.1147)	(0.0987)	(0.0126)
Distance to service: public hospital	0.0429	-0.0399	0.0024
	(0.1208)	(0.1065)	(0.0134)
Has immunization card	-0.0438	0.0915	0.0010
	(0.2761)	(0.2006)	(0.0748)
Place of birth, Rural area	-0.0565	-0.0074	0.0183
	(0.1394)	(0.1164)	(0.0129)
Controls:			
Individual Characteristics	✓	✓	✓
Household Characteristics	✓	✓	✓
City Characteristics	✓	✓	✓
Dwelling	✓	✓	✓
Constant	-0.4372	0.2455	0.6866***
	(0.5750)	(0.4821)	(0.0733)
Observations	10,763	10,763	17,113

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Appendix Two:

Table 2.1.1: Variables Abbreviations Definitions

Variables names	Definitions
qhada	Qadha' name "district name"
gover	Governorate
hhsize	Household size
sex	Sex
age1	Age
dobday	Date of birth, day
dobmonth	Date of birth, month
dobyear	Date of birth, year
relationship	Relationship
bornhear	Born here
placeofbithgov	Place of birth, governorate
placeofbitharea	Place of birth, area
maritakstatus	Marital status
receiveration~d	Receive any ration with ration card
inrationcartc~d	In ration card/children
hhindwelling	Households in dwelling
yearsofliving~t	Years living in housing unit
typeofhunit	Type of housing unit
typeofhousing~t	Wall material
hhareabuiltup	Household area, built up
bedrooms	Bedrooms............. Exclusive
kitchenexc	Kitchen.............. exclusive
bathandtoil	Bath & toilet room... Exclusive
shared	Kitchen.............. shared
sanitation	Sanitation
hhownership	Housing ownership
dwellingold	Dwelling old
disttoelemsch~l	Distance to service: elementary School
disttosecschool	Distance to service: intermediate or secondary school
disttopubhost~l	Distance to service: public hospital
disttophospital	Distance to service: private hospital
disttophealth~r	Distance to service: primary health center
disttopharm	Distance to service: pharmacy
firlang	1st language/language code
firlangR	1st language/reading level
firlangW	1st language/writing level
seclang	2nd language/language code

seclangR	2nd language/reading level
thirlang	3rd language/language code
thirlangR	3rd language/reading level
everattendsch	Ever attended school
yearsofschool~g	Years of schooling
suffdisaboril~s	Suffer disability/illness
yearsofdisable	Years is disabled
suffillness	Suffer illness
yearsofchroni~l	Years is chronically ill
typeofhelpreci	Type of help received
medicalcarere~d	Medical care received
disthealthfac~y	Distance health facility/residence (KM)
resdidnotrece~C	Reason did not receive medical care
birthachild	Birth a child
evervaccination	Ever vaccinated
hasimmuncars	Has immunization card
TBvaccination	Tb vaccination
poliovaccinat~n	Polio vaccination
poliovaccinat~s	Polio vaccination, number of doses
Dptvaccination	Dpt vaccination
Dptnofdoses	Dpt vaccination, number of doses
mwaslesvaccin~n	Measles vaccination
hepatitisBvac~n	Hepatitis b vaccination
Nofpemployed	Number of persons employed
freqofpayment	Frequency of payment
outsloansorde~s	Outstanding loans or debts
sourofloan	Source of loan/credit, 1st
purposeofborrow	Purpose to borrow, 1st

Table 2.2.2: Vaccination Schedule for Infants and Children

Age	Type of vaccine
0-1 Week	OPV0 dose, HepB1, BCG
2 Months	OPV1 , PENTA1,ROTA1
4 Months	OPV2 , TETRA1,ROTA2
6 Months	OPV3 , PENTA2,ROTA3
9 Months	Measles + VIT A
15 Months	MMR (Measles, Mumps, Rubella)
18 Months	TETRA2, OPV First Booster dose + VIT A
4-6 Years	DPT, OPV Second Booster dose + MMR2

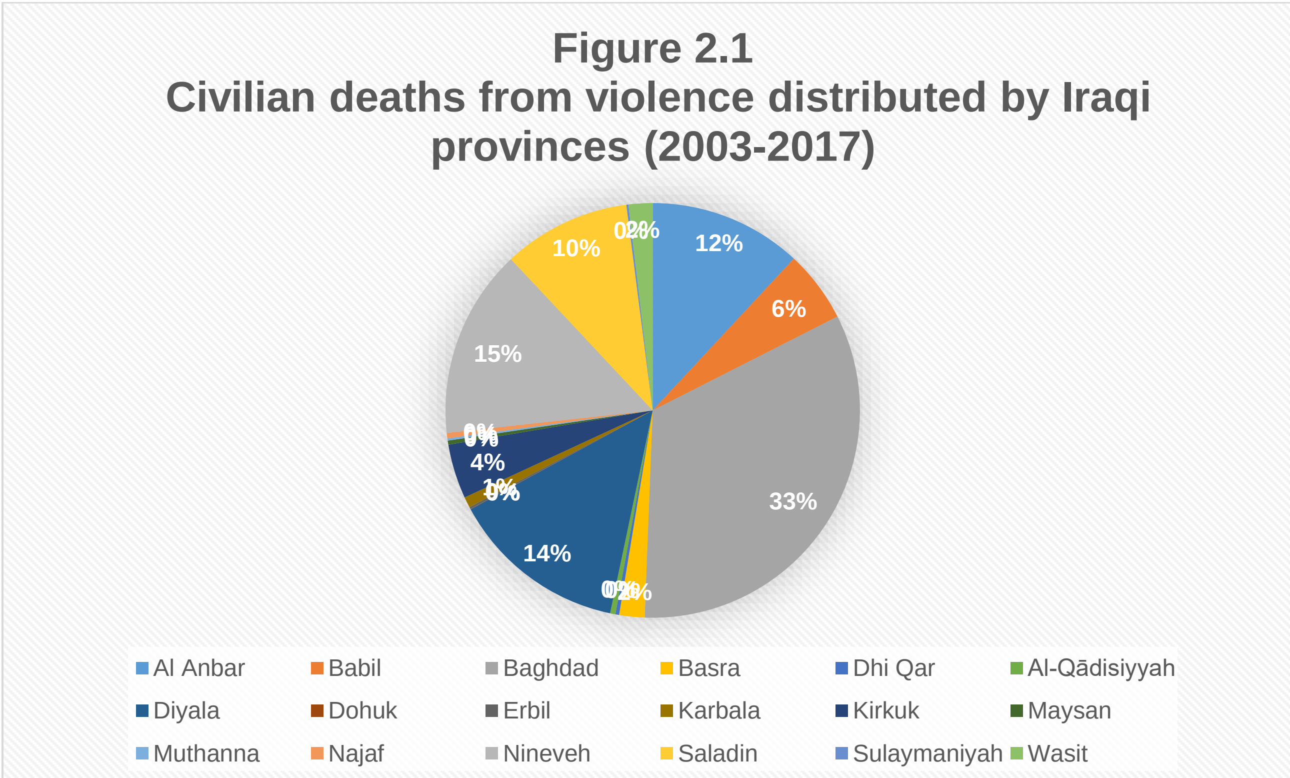
This table represents the vaccination schedule based on the 2012 plan.
OPV: Oral Polio Vaccine
Hep: Hepatitis B
BCG: Bacillus Calmette-Guerin, which is a vaccine, is a vaccine primarily used against tuberculosis.
PENTA: Diphtheria, Tetanus, Pertussis +Hepatitis B + Haemophilus influenza type B DTP + IPV.
ROTA: rotavirus vaccine.
Tetra: Tetravalent Vaccine: DPT (Diphtheria, Tetanus, and Pertussis) + Haemophillus influenza type B.
DPT: Diphtheria, Tetanus, Pertussis

Table 2.2.3: National Immunization Schedule for Infants and Children 2015

Age	Type of vaccine
0-1 Week	HepB1 , BCG + OPV0dose
2 Months	HEXA 1,ROTA1 ,PREV13-1+OPV1
4 Months	HEXA2,ROTA2,PREV13-2 + OPV2
6 Months	HEXA3,ROTA3,PREV13-3 + OPV3
9 Months	Measles + VIT A
15 Months	MMR(Measles , Mumps , Rubella)
18 Months	PENTA (DTP+IPV+Hib) OPV + VIT A
4-6 Years	TETRA (DTaP +IVP) + OPV + MMR

HEXA HEXAVALENT Vaccine: (Diphtheria, Tetanus, Pertussis +Hepatitis B +Haemophillus influenza type B) + injectable Polio Vaccine.

Appendix Three



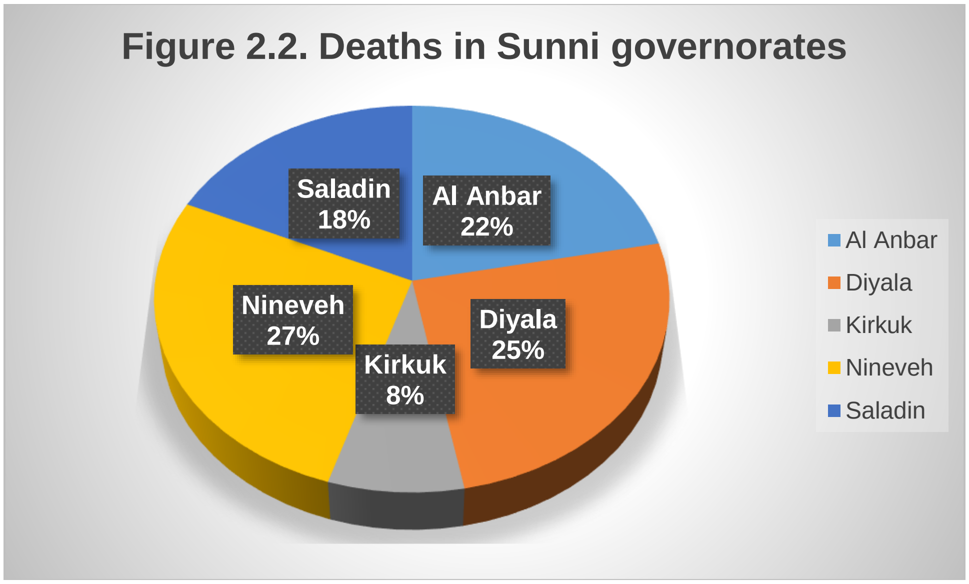


Figure 2.2. Deaths in Sunni governorates
Saladin
18%
Al Anbar
22%
Nineveh
27%
Diyala
25%
Kirkuk
8%
Al Anbar
Diyala
Kirkuk
Nineveh
Saladin

Figure 2.3. Deaths in Shia governorates

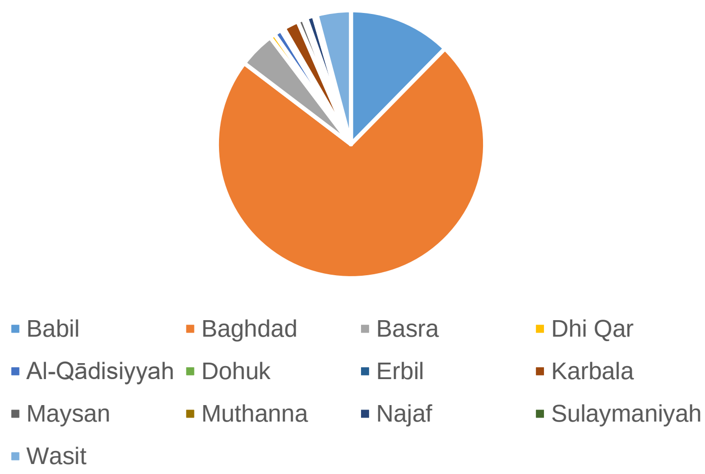


Figure 2.4: Distribution of Casualties across provinces

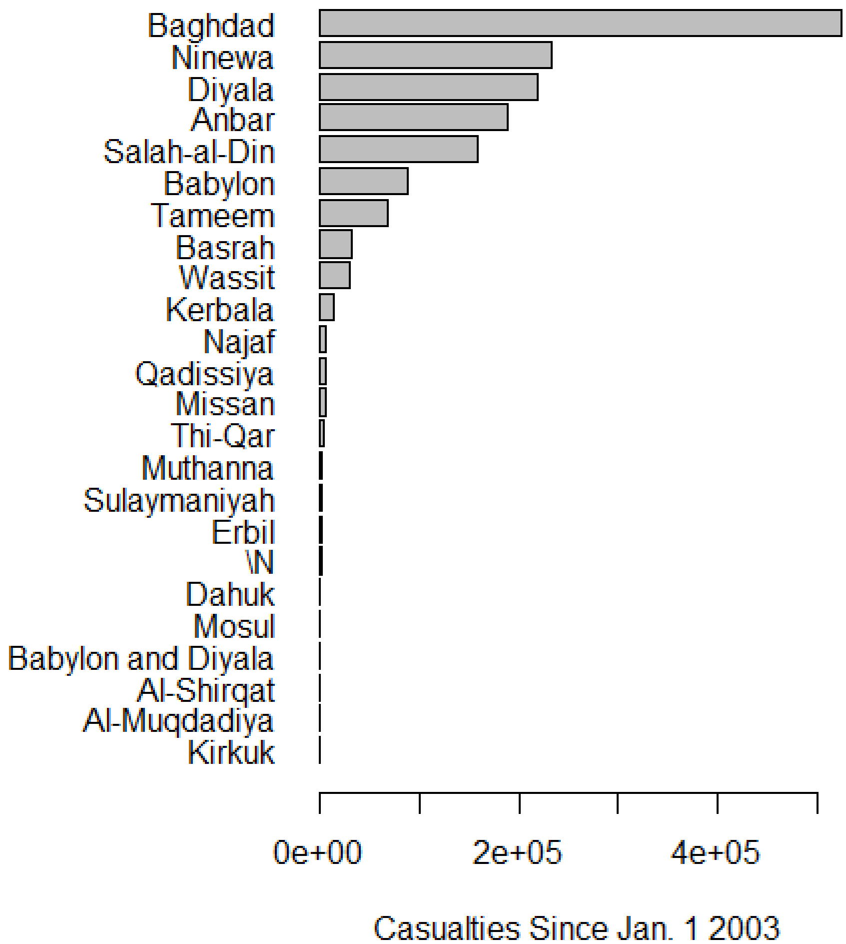
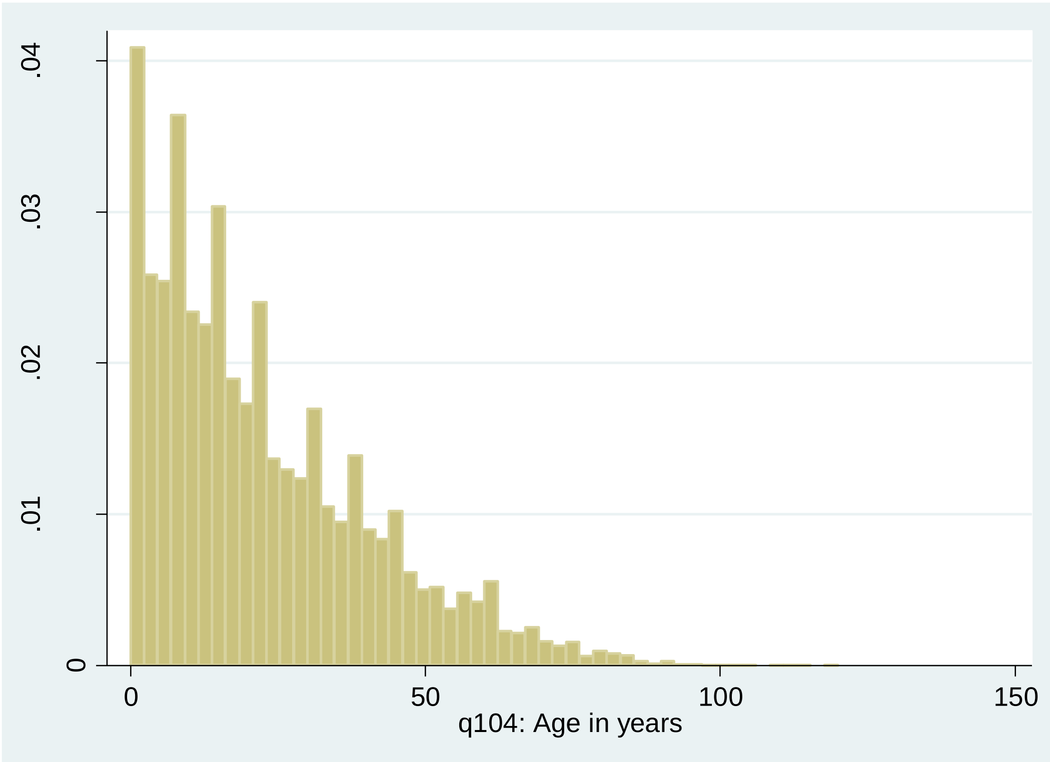


Figure 2.5: Distribution of age in years across provinces



Third chapter: Estimation of Production Function with multiple Inputs in the Iraq Economy

Abstract

Oil is one of the strategic resources of Iraq. Unfortunately, after looking carefully at the literature, there is no paper that estimates the interaction effect between capital, labor, and energy for the Iraqi economy. This study estimates that production factor demand elasticities with a particular focus on the oil sector in Iraq. Results take into account variation in the prices of input demand of the production function, using the Cobb-Douglas model, an interaction production function and the translog production function. We prefer the first model because it is the only one that provides significant coefficients. Tests indicate that there is no autocorrelation issue in these models. Moreover, The Cobb-Douglas model provides more significant output elasticities. The interpretation suggests that each one percent increase in capital and energy inputs will result in a large effect on GDP. Energy input in Iraq is underpaid compared to other input factors, making the markets uncompetitive.

Keywords: *prices, capital, labor, energy, government Policy*

JEL Codes: Q4, Q43, Q48, Q47

I. Introduction

Iraq is one of the few oil exporting countries in the world. The economy is mainly dependent on oil, and the same sector takes up much of the budgetary allocation to finance oil production, leaving little for capital expenditure. Given the influence of oil on every area of the economy, it is vital to examine how energy interacts with labor and capital. According to a 2012 report by the International Energy Agency, Iraq is the third-largest oil exporter in the world (Birol et al.2012). The report expounded on possible strategies for navigating the Iraq oil industry amidst numerous political, economic, and social challenges. Evidence shows that economies of less developed nations with abundant mineral and oil deposits often collapse due to the concentration on oil production and negligence of other crucial aspects of governance including democracy (Birdsall and Subramanian, 2004). Iraq faces a potential resource curse that will ruin the nation if the oil industry is managed poorly. 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 3.1)

The oil reserves in Iraq are considered the world's 5th largest proven oil reserves, with about 140 billion barrels as showing in figure 3.1. Such a 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 devotes a large proportion of the 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).

Following the 2003 political leadership change in Iraq (post-Saddam Hussein era), the country resolved to adopt structural changes based on market mechanisms (Jabir, 2002). Figure 3.2 shows how the oil production is fluctuating overtime between (1980-1988) Iraq- Iran war, 1990-1991 Iraq- Kuwait war, and a dramatic drop in 2003 the us-Iraq war. There is a large drop in oil production during the war.(figure 3.2)

The proposed system involved reformation of government spending imbalances that favored the oil sector and rendered other areas of the economy, such as tourism and agriculture, unproductive. The previous uneven and non-scientific budgeting procedures used by the previous government saw the large proportion of the national budget allocated to recurrent expenditure. Massive corruption characterized the Saddam Hussein regime, and the enormous and growing national debt was a glaring manifestation (Jabir, 2002). Amid the proposed reformation of the Iraqi economy was the impediment of external debts. The international community raised concerns over the massive debts, while the reforms relied heavily on external financing.

The appropriate substitution of capital, labor, and energy is one way to evaluate a robust economy. Given that oil production is essential to Iraq, the government invests capital, labor, and energy in the oil sector. For example, Stresing (2008) uses time series data for countries like Germany, Japan, and the USA and linearly combined the time series of capital, labor, and energy in a cointegration algorithm of their oil refining business (Stresing, 2008).

The purpose of this study is to investigate the interaction effects between capital, labor, and energy, taking into account the effect of varying input prices on the Iraqi economy.

The integration of labor and capital in Iraq is vital for the growth of the economy. While the interaction of capital, labor, and energy is critical, the policymakers in Iraq can determine how capital and labor can substitute for energy without damaging the economy.

For instance, one finding of ((Kemfert and Welsch, (2000)) is that Germany substitutes energy for capital and labor after they used a dynamic multisector model that first assessed the effects of substitution. Similarly, the economy of Iraq must have a strategic path that takes into account dependence on the resources available in the country and the state of the political, economic, and social environment. Given that Iraq has faced social challenges, the country has fluctuated labor force as a factor of production. Figures 3.3 and 3.4 show how the two variables (gross domestic product and energy consumption are trending over time

Therefore, labor is a weak substitute, while energy is the most reliable substitute. For the USA, labor a firm substitution while energy and capital are weak substitutes in ((Copeland and Thompson, (2016)).

II. Literature Review

In this section, we are going to give a brief introduction to a literature review in order to provide an overview of some significant literature published on the topic. The problem of the Iraqi economy is that it depends on the oil sector and its financial resources. More clearly, the issue of the Iraqi economy is the total dependence of the government on the oil sector, that provides revenues of about 95% of the total general budget. Most of the literature discusses the effect of oil price fluctuation on the macroeconomic variables.

Empirical studies have shown that decreases in prices of oil slow the pace of growth in countries that produce and export the product. Increases in oil prices in the world markets benefit the oil-producing nations by increasing their revenues and development. The extent of the effects of fluctuations in prices of oil on the gross domestic product depends on the level of reliance of the economy on the oil sector. Those countries that rely on oil revenues suffer serious economic if the oil price falls. Unfortunately, although Iraq has enormous reserves of oil (figure 1), there is little literature review on this sector. A study carried out by Sulaiman D.M (2010) to determine the effect of the fluctuations in oil prices on export revenues of Pakistan established a positive correlation. The research employed the Johnsean co-integration method for and 1975-2008 yearly data to develop the long-term relationship between the variables under study. The study revealed relationships between fluctuations in oil prices and Pakistan export revenues, labor, and gross domestic product growth rate.

Capital, labor, and energy are autonomous factors of production at any point in time. Business people can shift them as indicated by their choices on the capital stock's amount and quality and the level of capital input. Varieties of labor and energy at consistent amount nature of capital are related to changes in the level of capital usage, changes in mechanization or technology, and change the relative productivity of the labor and energy inputs. Raw materials are latent components in the production process and do not effectively contribute to value added (Kummel et al. 2002). The model does not recognize land as a factor of production as long as its finite nature remains a non-factor to growth. Creativity or innovation is ignored in the short run.

Iraq spends most of its government finances on oil production, a practice that could put the economy under threat in the future. Therefore, econometrics dictate that a country should find interdependent factors of production for substitution (Berndt and Wood, 1979). Capital and energy can substitute for each other. Iraq leverages the availability of oil to seek financing from foreign investors. In fact, in the period between 1978 – 1988, Iraq undertook import substitution in the manufacturing production of consumer goods (Zaidan, 1998). Iraq had been importing capital and manufacturing goods, but policymakers developed strategies to produce commodities such as agricultural products locally. However, today the substitutions and integration of capital, energy, and labor are dependent on legislation regarding oil and agreements on revenue sharing between Iraq and the US (Blanchard, 2009). The policies are a basis for the long-term growth through collaboration with the US. Part of the reason for stalling the implementation of legislative policies is financial and administrative corruption in the economy (Mohammed et al. 2015). The revenue collected from oil exports in Iraq are the financial resources for production in other areas, thus the imbalance of capital-energy substitution. However, officials are corrupt and usually decline the implementation of agreed-upon legislative policies, hurting the economy (Jabir, 2002).

The present study submits that interactions and substitution of labor, capital, and energy will keep changing as the Iraq economy grows. Pindyck (1979) wrote that as industrial demand for oil increases, income for oil producing nations increases, and capital and energy might no longer be complimentary while labor and energy can become substitutes. For example, oil was a significant factor in the US-Iraq war. Iraq experienced challenges in production at the time, and the integration of labor, energy, and capital was complicated. Such alterations in the economy due to external factors reflect in the financial markets which quantify the level of economic regression (Leigh and Wolfers, 2003). After the end of the war, Iraq stabilized although the nation is still behind in economic development. In the future, the interaction between labor, capital, and energy will depend on global issues such as the campaigns to use renewable energy (Abed et al., 2014). Prospects show that the Iraq economy will progress, primarily because of turning to multiple energy sources such as solar, wind, and electricity for production (Saeed et al., 2016). Such energy sustainability is a foundation for very long-term economic growth. For instance, research shows that Iraq receives 3,000 hours of solar radiance annually in Baghdad alone. The government harnessed the energy and build street lights from photo variant cells. Empirical studies show that solar energy is sustainable for production in specific sectors of the economy (Kazem and Chaichan, 2012).

III. Model Specification

Some of the previous studies used capital, labor, energy, and creativity in the KLEC model, which represents the interaction between these factors altogether. Also, the KLEC model recognizes capital, labor, and energy as the drivers of economic growth (Shen and Whalley, 2017) (Kummel et al. 2002). Capital includes all equipment that transforms energy and their protective structures or components. Output or growth can be changed by different combinations of factors. Producers (in this case, the Iraqi economic planners) decide on the quantities of labor, capital, and energy within the available technology to obtain desired outcomes.

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 Hessian matrix in the following equation:[1]

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

[1] The model specification of this paper is based on handout for AGEC 8060 course taught by Henry W. Kinnucan, Auburn University, Fall, 2016.

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 $L = \sum_{i=1}^{3} p_i x_i + \lambda\big(y - f(x_1, x_2, x_3)\big)$.

The Hessian corresponding to this minimization problem is the matrix in (1). Its inverse provides the slopes of the factor demands. The slopes are converted to (Hicksian) price elasticities according to $\eta_{ij}^* = \frac{\partial x_i}{\partial p_j}\frac{p_j}{x_i}$.

Preceding reversing the Hessian, the $f_i, f_{ii}, and f_{ij}$ are replaced with their reciprocals expressed in terms of production elasticities $\alpha_i = \frac{\partial y}{\partial x_i}\frac{x_j}{y}$. The replacement, expressed in general form, are:

(2a) $f_i = \frac{\alpha_i y}{x_i}$

(2b) $f_{ii} = \frac{\left(\frac{\partial \alpha_i}{\partial x_i} x_i + \alpha_i(\alpha_i - 1)\right) y}{x_i^2}$

(2c) $f_{ij} = \frac{\left(\frac{\partial \alpha_i}{\partial x_j} x_j + \alpha_i \alpha_j\right) y}{x_i x_j} = f_{ji}$

The reason for this clarification is to demonstrate that when the variables in (1) are expressed as proportionate (rather than absolute) changes, the Hessian takes a form more convenient for computation. Let $Z^* = \frac{dz}{z}$ be the proportionate change in variable$z$. With this definition, (1) can be expressed as

(3) $$\begin{bmatrix} \alpha_1 - 1 + \emptyset_{11} & \alpha_2 + \emptyset_{12} & \alpha_3 + \emptyset_{13} & 1 \\ \alpha_1 + \emptyset_{21} & \alpha_2 - 1 + \emptyset_{22} & \alpha_3 + \emptyset_{23} & 1 \\ \alpha_1 + \emptyset_{31} & \alpha_2 + \emptyset_{32} & \alpha_3 - 1 + \emptyset_{33} & 1 \\ \alpha_1 & \alpha_2 & \alpha_3 & 0 \end{bmatrix} \begin{bmatrix} X_1^* \\ X_2^* \\ X_3^* \\ \lambda^* \end{bmatrix} = \begin{bmatrix} p_1^* \\ p_2^* \\ p_3^* \\ y^* \end{bmatrix}$$

where

(4) $\emptyset_{ij} = \frac{\partial \alpha_i}{\partial x_j}\frac{x_j}{\alpha_i}$

are parameters that show the sensitivity of the production elasticities to inputs. An advantage of (3) is that matrix inversion provides the price elasticities directly with no need to compute them from slopes as is the case with (1).

Equation (3) is valid irrespective of the form of the production function. If the production function is of the constant elasticity type (e.g., CES, Cobb-Douglas), the $\emptyset_{ij}$vanish and equation (3) reduces to

(5) $$\begin{bmatrix} \alpha_1 - 1 & \alpha_1 & \alpha_{31} & 1 \\ \alpha_1 & \alpha_2 - 1 & \alpha_3 & 1 \\ \alpha_1 & \alpha_2 & \alpha_3 - 1 & 1 \\ \alpha_1 & \alpha_2 & \alpha_3 & 0 \end{bmatrix} \begin{bmatrix} X_1^* \\ X_2^* \\ X_3^* \\ \lambda^* \end{bmatrix} = \begin{bmatrix} p_1^* \\ p_2^* \\ p_3^* \\ y^* \end{bmatrix} \qquad (\emptyset_{ij} = \frac{\partial \alpha_i}{\partial x_j}\frac{x_j}{\alpha_i} \forall i and j)$$

Factor demand elasticities are computed by inserting numerical estimates of the production elasticities into the matrix and then using the matrix inversion tool. In competitive cost-minimizing equilibrium production elasticities equal factor shares. Factor share is expenditure on the input divided by the value of output, i.e.$\frac{p_i x_i}{py}$. In this instance, the price elasticities obtained by inverting the matrices in (3) and (5) satisfy the theoretical restrictions of homogeneity, symmetry, and adding-up (Cournot). There is no need to impose the restrictions, as they are satisfied automatically.

The next step derives (3). We then show that when inputs are paid the value of their marginal products, the price elasticities obtained from the inverted matrix satisfy the general restrictions.

In constrained cost-minimizing equilibrium the following conditions must hold

(6a) $f_i \lambda = p_i i = 1,2,3$

(6b) $f(x_1, x_2, x_3) = y$.

Writing (6) in proportionate change form

(7a) $f_i^* + \lambda^* = p_i^* i = 1,2,3$

(7b) $\alpha_1 x_1^* + \alpha_2 x_2^* + \alpha_3 x_3^* = y^*$

Expanding f_i^*

$$f_i^* \equiv \frac{df_i}{f_i} = \frac{f_{i1}dx_1 + f_{i2}dx_2 + f_{i3}dx_3}{f_i} = \frac{f_{i1}x_1x_1^* + f_{i2}x_2x_2^* + f_{i3}x_3x_3^*}{f_i}$$

(8) $f_i^* = \frac{f_{i1}x_1}{f_i}x_1^* + \frac{f_{i2}x_2}{f_i}x_2^* + \frac{f_{i3}x_3}{f_i}x_3^*$ $\qquad i = 1,2,3.$

Substitute (2) and (4) into (8) to find

(9a) $f_1^* = (\alpha_1 - 1 + \emptyset_{11})x_1^* + (\alpha_2 + \emptyset_{12})x_2^* + (\alpha_3 + \emptyset_{13})x_3^*$

(9b)$f_2^* = (\alpha_1 + \emptyset_{21})x_1^* + (\alpha_2 - 1 + \emptyset_{22})x_2^* + (\alpha_3 + \emptyset_{23})x_3^*$

(9c) $f_3^* = (\alpha_1 + \emptyset_{31})x_1^* + (\alpha_2 + \emptyset_{32})x_2^* + (\alpha_3 - 1 + \emptyset_{33})x_3^*$

Substitute (9) into (7a) and write the resulting equations along with (7b) in matrix form

(10) $$\begin{bmatrix} \alpha_1 - 1 + \emptyset_{11} & \alpha_2 + \emptyset_{12} & \alpha_{31} + \emptyset_{13} & 1 \\ \alpha_1 + \emptyset_{21} & \alpha_2 - 1 + \emptyset_{22} & \alpha_3 + \emptyset_{23} & 1 \\ \alpha_1 + \emptyset_{31} & \alpha_2 + \emptyset_{32} & \alpha_3 - 1 + \emptyset_{33} & 1 \\ \alpha_1 & \alpha_2 & \alpha_3 & 0 \end{bmatrix} \begin{bmatrix} X_1^* \\ X_2^* \\ X_3^* \\ \lambda^* \end{bmatrix} = \begin{bmatrix} p_1^* \\ p_2^* \\ p_3^* \\ y^* \end{bmatrix}$$

General Restrictions:

To be consistent with theory, factor demands elasticities for a competitive firm that minimizes cost subject to a given output level must satisfy the following conditions,

(11a) $\sum_{j=1}^{n} \eta_{ij}^* = 0$ $\qquad i = 1,2,\dots,n$ $\qquad$ (homogeneity)

(11b) $\theta_i \eta_{ij}^* = \theta_j \eta_{ji}^* \qquad \forall i and j, i \neq j$ (symmetry)

(11c) $\sum_{j=1}^{n} \theta_i \eta_{ij}^* = 0 \qquad j = 1,2,\ldots,n$ (Cournot or adding-up)

where the as yet undefined term $\theta_i = \frac{p_i x_i}{py}$ are factor shares, where P is the price of output. Are the factor demand elasticities obtained by inverting (3) consistent with theory? To answer the question, without loss of generality, we restrict attention to the two-factor case where production elasticities are fixed constants. In doing so, we develop analytical expressions for the factor demand equations. These are useful in identifying the particular restrictions that are imposed on the price elasticities when the production elasticities are assumed to be fixed constants.

When there are only two-factors, equation (3) reduces to

(12) $$\begin{bmatrix} (\alpha_1 - 1) & \alpha_1 & 1 \\ \alpha_1 & (\alpha_2 - 1) & 1 \\ \alpha_1 & \alpha_2 & 1 \end{bmatrix} \begin{bmatrix} X_1^* \\ X_2^* \\ \lambda^* \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} p_1^* \\ p_2^* \\ y^* \end{bmatrix}$$

Applying Cramer's rule to (12) yields the input demand equations

(13a) $X_1^* = -\frac{\alpha_2}{\alpha_1+\alpha_2} p_1^* + \frac{\alpha_2}{\alpha_1+\alpha_2} p_2^* + \frac{1}{\alpha_1+\alpha_2} y^*$

(13b) $X_2^* = -\frac{\alpha_1}{\alpha_1+\alpha_2} p_1^* + \frac{\alpha_1}{\alpha_1+\alpha_2} p_2^* + \frac{1}{\alpha_1+\alpha_2} y^*$

That the price elasticities in (13) satisfy homogeneity can be seen upon inspection.

To determine whether symmetry and Cournot are satisfied we need expressions for the θ_i . For this purpose, note that in competitive cost-minimizing equilibrium $\lambda = MC = MR = p$ Replacing λ in equation (6a) with output price yields

(14) $f_i = \frac{p_i}{p}$ $(i = 1,2)$.

According to equation (2a) $f_i = \frac{\alpha_i y}{x_i}$. Hence,

$$(15)\ \frac{\alpha_i y}{x_i} = \frac{p_i}{p} \Rightarrow \alpha_i = \frac{p_i x_i}{py} \equiv \theta_i \qquad (i = 1,2).$$

When factors are paid the value of their marginal products the output elasticities equal their respective revenue (or cost) shares. In long-run competitive equilibrium revenue equals cost, so revenue shares are cost shares, hereafter referred to as factor shares.

Proceeding with the tests, symmetry implies

$$(16) \qquad \theta_1\eta_{12}^* = \theta_2\eta_{21}^* \Rightarrow \alpha_1\left(\frac{\alpha_2}{\alpha_1+\alpha_2}\right) = \alpha_2\left(\frac{\alpha_1}{\alpha_1+\alpha_2}\right),$$

which clearly holds. Cournot implies

$$(17a) \qquad \theta_1\eta_{11}^* = \theta_2\eta_{21}^* = 0 \Rightarrow \alpha_1\left(\frac{-\alpha_2}{\alpha_1+\alpha_2}\right) = \alpha_2\left(\frac{\alpha_1}{\alpha_1+\alpha_2}\right) = 0$$

$$(17b) \qquad \theta_1\eta_{12}^* = \theta_2\eta_{22}^* = 0 \Rightarrow \alpha_1\left(\frac{\alpha_2}{\alpha_1+\alpha_2}\right) = \alpha_2\left(\frac{-\alpha_1}{\alpha_1+\alpha_2}\right) = 0,$$

which clearly holds as well. Price elasticities obtained by inverting the matrix in (5) satisfy the general restrictions.

IV. Application

For an application of the foregoing framework, consider the translog production function

$$(18) \qquad \ln y = b_0 + b_1 \ln x_1 + b_2 \ln x_2 + b_3 \ln x_3 + b_{12} \ln x_1 \ln x_2 + b_{13} \ln x_1 \ln x_3 + b_{23} \ln x_2 \ln x_3 + \frac{1}{2} b_{11}(\ln x_1)^2 + \frac{1}{2} b_{22}(\ln x_2)^2 + \frac{1}{2} b_{33}(\ln x_3)^2$$

The output elasticities associated with (18) are:

$$(19a) \quad \alpha_1 \equiv \frac{\partial lny}{\partial lnK} = b_1 + b_{11} * lnx_1 + b_{12} * lnx_2 + b_{13} * lnx_3$$

$$(19b) \quad \alpha_2 \equiv \frac{\partial lny}{\partial lnL} = b_2 + b_{12} * lnx_1 + b_{22} * lnx_2 + b_{23} * lnx_3$$

$$(19c) \quad \alpha_3 \equiv \frac{\partial lny}{\partial lnE} = b_3 + b_{13} * lnx_1 + b_{23} * lnx_2 + b_{33} * lnx_3$$

The $\emptyset_{ij}$ parameters associated with (18) are:

$$(20a)\ \emptyset_{11} \equiv \frac{\partial \ln \alpha_1}{\partial \ln x_1} \equiv \frac{\partial \alpha_1}{\partial \ln x_1}\frac{1}{\alpha_1} = \frac{b_{11}}{\alpha_1} \qquad \emptyset_{12} \equiv \frac{\partial \ln \alpha_1}{\partial \ln x_2} = \frac{b_{12}}{\alpha_1} \qquad \emptyset_{13} \equiv \frac{\partial \ln \alpha_1}{\partial \ln x_3}\frac{b_{13}}{\alpha_1}$$

(20b) $\emptyset_{21} \equiv \frac{\partial \ln \alpha_2}{\partial \ln x_1} \equiv \frac{\partial \alpha_2}{\partial \ln x_1}\frac{1}{\alpha_2} = \frac{b_{12}}{\alpha_2}$ $\emptyset_{22} \equiv \frac{\partial \ln \alpha_2}{\partial \ln x_2} = \frac{b_{22}}{\alpha_2}$ $\emptyset_{23} \equiv \frac{\partial \ln \alpha_2}{\partial \ln x_3}\frac{b_{23}}{\alpha_2}$

(20c) $\emptyset_{31} \equiv \frac{\partial \ln \alpha_3}{\partial \ln x_1} \equiv \frac{\partial \alpha_3}{\partial \ln x_1}\frac{1}{\alpha_3} = \frac{b_{13}}{\alpha_3}$ $\emptyset_{32} \equiv \frac{\partial \ln \alpha_3}{\partial \ln x_2} = \frac{b_{23}}{\alpha_3}$ $\emptyset_{33} \equiv \frac{\partial \ln \alpha_3}{\partial \ln x_3}\frac{b_{33}}{\alpha_3}$

where the translog model has been estimated, numerical values for the output elasticities are computed by inserting the appropriate parameter estimates into equation set (19) and evaluating the log expressions at a particular data point. For example, the numerical value for α_1 is computed as

(21) $\hat{\alpha}_1 = \hat{b}_1 + \hat{b}_{11}\ln \bar{x}_1 + \hat{b}_{12}\ln \bar{x}_2 + \hat{b}_{13}\ln \bar{x}_3$

where the overbar $(\,\bar{}\,)$ indicates a particular data point (the sample mean or the mean of the last five years of the sample). Once the $\hat{\alpha}_1$ are computed, they are substituted into equation set (20) along with the appropriate estimates of the b_{ij} parameters to get numerical values for the $\emptyset_{ij}$parameters. The final step is to insert these numerical values into the Hessian matrix

$$(22)\begin{bmatrix} \hat{\alpha}_1 - 1 + \hat{\emptyset}_{11} & \hat{\alpha}_2 + \hat{\emptyset}_{12} & \hat{\alpha}_3 + \hat{\emptyset}_{13} & 1 \\ \hat{\alpha}_1 + \hat{\emptyset}_{21} & \hat{\alpha}_2 - 1 + \hat{\emptyset}_{22} & \hat{\alpha}_3 + \hat{\emptyset}_{23} & 1 \\ \hat{\alpha}_1 + \hat{\emptyset}_{31} & \hat{\alpha}_2 + \hat{\emptyset}_{32} & \hat{\alpha}_3 - 1 + \hat{\emptyset}_{33} & 1 \\ \hat{\alpha}_1 & \hat{\alpha}_2 & \hat{\alpha}_3 & 0 \end{bmatrix}.$$

The first three rows $\hat{H}^{-1}$ provide the coefficients of the output-constant input demand equations

(23) $d\ln x_i = \eta^*_{i1} d\ln p_1 + \eta^*_{i2} d\ln p_2 + \eta^*_{i3} d\ln p_3 + \delta_i d\ln y \quad i = 1,2,3.$

The price elasticities in each equation sum to zero by homogeneity. Homogeneity can be checked by inspection. Cournot can be checked by setting $\theta_i = \hat{\alpha}_i$ and applying the formula

(24) $\sum_{j=1}^{n} \theta_i \eta^*_{ij} = 0 \qquad j = 1,2,3$

Symmetry can be checked by dividing the η^*_{ij} by the θ_i as

$$\begin{bmatrix} \frac{\eta_{11}^*}{\theta_1} & \frac{\eta_{12}^*}{\theta_2} & \frac{\eta_{13}^*}{\theta_3} \\ \frac{\eta_{21}^*}{\theta_1} & \frac{\eta_{22}^*}{\theta_2} & \frac{\eta_{23}^*}{\theta_3} \\ \frac{\eta_{32}^*}{\theta_1} & \frac{\eta_{32}^*}{\theta_2} & \frac{\eta_{33}^*}{\theta_3} \end{bmatrix} = \begin{bmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{bmatrix}$$

where σ_{ij} are Allen-Uzawa partial elasticities of substitution. Symmetry holds when $A = A^T$.

We estimated the three models as in Copeland and Thompson (2016),

Model A: is Cobb-Douglas

$$\Delta\, ln\, y = c_0 + c_1 \Delta\, ln\, K_1 + c_2 \Delta\, ln\, L_2 + b_3 \Delta\, ln\, E_3 + \in_A$$

Model B: Includes interaction terms

$$\Delta\, ln\, y = b_0 + b_1 \Delta\, ln\, K_1 + b_2 \Delta\, ln\, L_2 + b_3 \Delta\, ln\, E_3 + b_{12} \Delta\,(ln\, K_1\, ln\, L_2) + b_{13} \Delta\,(ln\, K_1\, ln\, E_3) + b_{23} \Delta\,(ln\, L_2\, ln\, E_3) + \in_A$$

Model C: Full translog production function

$$\Delta\, ln\, y = a_0 + a_1 \Delta\, ln\, K_1 + a_2 \Delta\, ln\, L_2 + a_3 \Delta\, ln\, E_3 + a_{12} \Delta\,(ln\, K_1\, ln\, L_2) + a_{13} \Delta\,(ln\, K_1\, ln\, E_3) + a_{23} \Delta\,(ln\, L_2\, ln\, E_3) + 1/2\, a_{11} \Delta(lnK_1)^2 + 1/2\, a_{22} \Delta(lnL_2)^2 + 1/2\, a_{33} \Delta(lnE_3)^2 + \in_A$$

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 consumption, all measured in the Iraqi economy.

V. Data Sources

We use two sources to extract the dataset that we need to conduct our estimation. So we extracted the same variables that we need to do the estimation but from different sources. The reason for doing this is because there is certain vagueness surrounding the contents of some of the variables used in the literature and the present study. For example, there is a discussion in the literature about the selection problem of the data used to investigate the interaction effect of capital, labor, and energy. More specifically, what kind of variable represents labor, is it wage or labor force? Which variable represents capital? Is it fixed capital accumulation by different sector? Which GDP should we consider, GDP based on production possibilities, the common GDP or GDP based on expenditures which reflect the economic well-being of people? So data from PWI is used for this purpose.

All this and the other reason of extracted same dataset from different sources is because of the carry out of the robustness check. We consider the second part of the results as a robustness check for the work. Therefore, the first source for collecting the first dataset is the typical source, but it's also including different sources, but these sources are the standard sources to collect such a dataset, also most of the papers that we have mentioned in the literature review section have used these sources. The first source includes as follow; the data cover Iraq from 1970 to 2015. Indices for gross domestic product GDP/breakdown at constant 2005 prices in US Dollars[1], for capital, we used: fixed capital formation and the data source is from the UN National Accounts Main Aggregates Database. Labor data used the total labor force (numbers) data from World Development Indicators (WDI). For energy data, we used Primary Energy Consumption PEC. The series of the Primary Energy Consumption[2] is based on 1000 oil equivalent unite from World energy statistical data; we can see there is a considerable reduction in the consummation of energy starting in 1980-1991. During this period Iraq fought two wars the first one with Iran 1980-1988 and the second one was with Kuwait 1990-1991(figure 3.3).

[1] The data from United National Statistics Division (UNSD) https://unstats.un.org/unsd/snaama/dnlList.asp

[2] Total Petroleum Consumption includes internal consumption, refinery fuel and loss, and bunkering. Also included, where available, is direct combustion of crude oil.

The second source for a dataset is extracted from Penn World table source (PWT), which is well-known data source for many economists, having been used in many published economics papers. For the Gross Domestic Product, we use real GDP at constant 2011 national prices (in millions. 2011US$)[1], for capital we use capital stock at constant 2011 national prices (in millions. 2011US$), for labor we use number of persons engaged (in millions)[2], and for energy input, we use Btu energy input.

VI. **Discussion Results:**

I. As mentioned above, our results are divided into two parts, the first part using data following the standard path that has been used in the literature review, and another part is by using data from Penn World Table source (PWT). Each part has some regression process using different software to do the task. In the first part, estimations for three models Cobb-Douglas (A), Cobb-Douglas with interaction terms (B), and Full translog production function(C) are presented in table 3.2. We regress each model with and without a dummy variable for war years in Iraq. Therefore, we started our estimation by doing a regression analysis for the three models A, B, and C equations, as shown above. Capital and labor estimated coefficients are significant at 1% level except for the coefficient for energy. (table 3.2), so for the first model, "Model A," we have only two parameters that

[1] Real GDP at Constant 2011 National Prices - Reports real gross domestic product (GDP) at constant (2011) national prices. Real GDP in the Penn World Table means GDP converted to international dollars using purchasing power parity (PPP) rates. Source: Penn World Table source (PWT) https://data-planet.libguides.com/Penn-WorldTables

[2] Number of Persons Engaged - Per person engaged is defined in the Penn World Table (PWT) to include all persons aged 15 years and over, who during the reference week performed work, even just for one hour a week, or were not at work but had a job or business from which they were temporarily absent. Source: Penn World Table source (PWT) https://data-planet.libguides.com/PennWorldTables

are significant. The coefficient of capital and labor are significant at 1 %. The interpretation of these two coefficients is that, if the fixed capital formation increases by one percent, the GDP will increase by 4% per year.

For energy, when if the energy consumption increases by one percent, the GDP will decrease by almost 10% per year. R^2 values are 0.87, 0.91, 0.92 for model A, model B, and model C respectively. This implies that the change in GDP can be explained 87%, 91%, and 92% of the variation in the change of capital, the size of the labor force, and energy consumption, respectively. The results show that all the estimates of a factor of productions for Iraq for three different nested structures models have almost the same goodness of fit. R^2 round 0.90, the results are similar to the studies mentioned above, which have R^2 round to about 0.90.

The results show that the energy coefficient is not significant at any level. This might support our argument that we stated in the beginning of our paper. Oil-dependent countries such as Iraq experienced little revenue collections, which led to weak economic activity in these nations. Little revenue collections implied increased debt as Iraq turned to borrow to finance the national budget. Such tendencies were coupled with the growing unemployment rate.

Also, we conducted a preliminary unit root test using Augmented Dickey-Fuller test (ADF), and we found that all three models are stationary models. The unit root test was used for all variables for the period (1970-2015) in a more concentrated way in the second part of the estimation. Dummy variables were created to the war years, as explained above. The coefficients and the standard errors for the dummy variables for the three models show the direction of the relationship between the GDP and the regressors. The sign of coefficients for all the models are positive and almost have the same magnitude, which is unexpected. The interpretation of the dummy variable is the change in GDP between the war and non-war years, holding capital, labor, and energy inputs constant is positive, means there is a positive relationship between the size of GDP and the war years when we keep other factors constant.

Lastly, from the first estimation, we prefer model A (Cobb-Douglas model) because it has more reliable coefficients with and without dummy variables.

ii. Before starting to estimate the production elasticities and comparing the results from the two models, we should check our dataset to assure whether it's stationary or not. (Table 3.3). For that, we have conducted a unit root test. A regression of a non-stationary time series on another non-stationary time series maybe causes a superior regression or biased results. From figure 3.5, we can see that the residuals of model A are non-stationary. In order to clarify this, we have done a unit root test for each variable separately. Unit root test is conducted to check whether or not the data is stationary. We performed the primary test using Augmented Dickey-Fuller test. As showing in table 3.3. The null and the alternative hypothesis for the unit root test is as follows:

H_0: the variable has a unit root;

H_a: the variable does not have a unit root

The test was done using three different standard options available which are $\boldsymbol{\tau}$, $\boldsymbol{\tau_c}$, and $\boldsymbol{\tau_{c+t}}$ Indicate the model statistics without either constant or trend, with constant, and with constant and trend, respectively. The number of lags is chosen by the Schwarz Information Criterion (BIC) for the Augmented Dickey-Fuller, wherein 9 is the default.

Regression results based on non-stationary data have a non-sense meaning. Run a unit root test for the variable by itself then taking the first difference and do the test again. If the critical statistical values are greater than table values, this means that the variable is no longer non-stationary. Contrarily, if the values of critical statistics are less, that means that the data is still non-stationary, and we need to take more difference to reduce the non-stationary variations.

For all the variables that I have in my dataset, I found that after taking the first difference for the variable, the data became stationary and we can rely on the results that we got out of these data set as shown in the figures (3.6 and 3.7)

iii. In the second part of the analysis, we estimated the three models with all the variables described in this paper using the first data source. We have repeated the same procedure we used in table 3.2 by estimating each variable separately, then adding inputs interchangeably. We used output GDP at constant 2011 prices, fixed capital formation, the number of people engaged, not labor force, and energy consumption. In this case, we have capital and energy coefficients as significant at 5% and 1% respectively. The R^2 values are very low compared to the previous table (table 3.2). For the first model (table 3.4), the D.W. is 2.087 and the critical DW value at 5% with observations, and the k=3 number of the independent variable, dL=1.201, and dU=1.474. Therefore, we conclude that there is no statistical evidence that the error terms are positively autocorrelated. For the second model (table3.4), the D.W. value is 2.33 and the critical value of D.W. value at 5% with the k=6 number of the independent variable, a number of observations are 45, so d_L = 1.019 and d_U=1.643. Therefore, we conclude that the test is inconclusive; in this case, it is not possible either to reject or fail to reject the null hypothesis. The third model (table 3.4) D.W. values are 2.22. The critical value of D.W. value at 5% with observations and the k=9 number of the independent variable, the number of observations are 45, so d_L =1.768 and d_U=0.927. Therefore, we conclude that the test is inconclusive; in this case, it is not possible either to reject or fail to reject the null hypothesis.

iv. Then we computed the production elasticities associated with each model. After taking the mean of the last five years of the sample, we computed the αi for the three models of estimated parameters as shown below (table 3.5). Since the three models are in the form of logarithmic differential equations, we can have considered that these parameter estimates are elasticities. However, production elasticities formulas used to calculate elasticities in SAS as follows:

Model A:

$$\alpha_1 \equiv \frac{\partial lny}{\partial lnK} = a1$$
$$\alpha_2 \equiv \frac{\partial lny}{\partial lnL} = a2$$
$$\alpha_3 \equiv \frac{\partial lny}{\partial lnE} = a3$$

Model B:

$$\alpha_1 \equiv \frac{\partial lny}{\partial lnK} = a1 + a12 * ln\bar{L} + a13 * ln\bar{E}$$
$$\alpha_2 \equiv \frac{\partial lny}{\partial lnL} = a2 + a12 * ln\bar{K} + a23 * ln\bar{E}$$
$$\alpha_3 \equiv \frac{\partial lny}{\partial lnE} = a3 + a13 * ln\bar{K} + a23 * ln\bar{L}$$

Model C:

$$\alpha_1 \equiv \frac{\partial lny}{\partial lnK} = a1 + a11 * ln\bar{K} + a12 * ln\bar{L} + a13 * ln\bar{E}$$
$$\alpha_2 \equiv \frac{\partial lny}{\partial lnL} = a2 + a12 * ln\bar{K} + a22 * ln\bar{L} + a23 * ln\bar{E}$$
$$\alpha_3 \equiv \frac{\partial lny}{\partial lnE} = a3 + a13 * ln\bar{K} + a23 * ln\bar{L} + a33 * ln\bar{E}$$

By exploring the results from table 3.5, we can see that the elasticity associated with capital is (0.15), labor (-0.82), and energy (1.63). In case of estimation, the Cobb-Douglas model the output elasticities for the logarithmic differential model for all variables should be an equal one, in our case is almost one which a representation of Constant Return To Scale (CRTS). According to the results, only the energy elasticity is significant at 10%. Table 3.5 shows model A provides more significant production elasticities compared to other models (we reported results only for model A), and furthermore, if we assume a significant level at 99%, then model A offers better significant production elasticities. Therefore, without significant estimation perspective, we will prefer model A., but out of significant estimation perspective, we will prefer model A.

v. In order to test whether model B and model C arestatistically equivalent to model A, the following tests have been done in SAS. (table3.6)

Test 1: whether model B is statistically equivalent to model C.

$$H_0 = a_{11} = a_{22} = a_{33} = 0$$

$$H_1 Atleastoneofparametersarenotequaltozero.$$

Test 2: whether model A is statistically equivalent to model C.

$$H_0 = a_{11} = a_{22} = a_{33} = a_{12} = a_{13} = a_{23} = 0$$

$$H_1: Atleastoneofparametersarenotequaltozero.$$

Based on the results from table 3.6, because the p-value is both greater than 0.05, we conclude that we fail to reject the H_0,indicating that both model B and C is statically equivalent to model A.

F-test results from table 3.6 show that model B and A is statically equivalent to model C, although model C includes more explanatory variables. Even in table 3.4 R^2 in model B shows a little larger value than model A, the difference is relatively small, a 6 percent difference in R^2 Does not make much difference in terms of the explanatory power of models. Based on the above discussions, in conclusion, we prefer model A.

In order to test whether production output elasticities equate to equal the *assumed factor share*, the following tests have been done in SAS.

Test 1: $H_0{:}\alpha_1 = 0.30$, $H_1{:}\alpha_1 \neq 0.30$

Test 2: $H_0{:}\alpha_2 = 0.20$, $H_1{:}\alpha_2 \neq 0.20$

Test 3: $H_0{:}\alpha_3 = 0.50$, $H_1{:}\alpha_3 \neq 0.50$

Table 3.7 shows that test 1 and test 3 fail to reject the null hypothesis, while test 2 would reject the null hypothesis, indicating production elasticity of labor and energy is equal to its factor share, but production elasticity of labor is not equal to its factor share.

Having different results will help to compare the relationship between the effect of the factor inputs on the gross domestic product of Iraq. Also, using dummy variables for the war years will provide a clear explanation of how the structural change in the economics of the selected period could affect the relationship between the factor of production and GDP. Optimization of cost minimization yields that output elasticities should be equal to its usual factor cost share, while in our case results are not consistent with 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 as perfectly competitive as we assumed, probably there is monopoly power in those two markets. These results also indicate that this production function is almost experiencing CRTS or homogeneous in (K, L, E), because $\sum_{i=1}^{3} \alpha_i \neq 1$ according to the above tests. This assumption can be imposed in estimates for future analysis. By comparing the results from the two models, each model based on a different dataset, it can be inferred that Model A is the best model in the two estimations. Capital and labor inputs have more power to affect GDP of Iraq (table 3.2). Capital and energy have significant impact compared to labor (table 3.4). For instance, it can be confirmed that by looking at tables (3.2 and 3.41) in which it can be seen that the P-values and standard errors are changing dramatically between the two models. This means that by using the labor force or a number of people engaged affects the outputs. These results provide the reason for the robustness of the results in the two models because they remain the same on a preferential basis one model on the other.

VII. Conclusion

Overreliance on oil as the primary source of revenue in Iraq continues to threaten the economic stability of the nation. Factors of production are the resources that allow us to create finished products and perform services. Economic growth results from better factors of production. The importance of the factors of production not only shows that four of them should be available to start producing goods and services but also that states should keep using them in balance, as opposed to intensive labor and less capital, which create sinefficiencies. The purpose of the study is to investigate the interaction effects between capital, labor, and energy taking into accounts the determining of the effect of global oil prices on the Iraqi economy. According to the results, none of the models gives us any significant estimator's results except the first model. Model A provides more significant production elasticities compared to model B and C. Also, optimization of cost minimization yields that output elasticities should be equal to its usual factor cost share, while in our case results are not consistent to this condition.

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Appendixes

Appendix one: list of tables

Table 3.1 Summary Statistics for GDP, Capital, labor, and Energy for Iraq in U.S $ (1970-2015)

Variable	*N*	*Mean*	*Std Dev*	*Minimum*	*Maximum*
GPD (US Dollars)	46	28,910,726,153	17,162,895,562	8,291,644,375	75,414,070,731
Fixed capital (US Dollars)	46	4,692,005,175	4,648,518,776	202,198,938	19,744,783,406
Labor force	46	4,368,710	2,622,651	1,104,562	9,414,921
Primary energy consumption (tones oil equivalent)	46	20,569,429	12,333,227	3,138,047	42,048,415

Table 3.2 Estimates of Models (A, B, and C)

	Model A		Model B		Model C	
Variables	*Coeff. w/ war dummy*	*Coeff. w/o war dummy*	*Coeff. w/ war dummy*	*Coeff. w/o war dummy*	*Coeff. w/ war dummy*	*Coeff. w/o war dummy*
K	4.615 (1.282)***	5.328 (1.294)***	-1.637 (9.33)	-7.545 (9.200)	9.282 (1.713)	2.419 (1.498)
L	4.323 (1.188)***	4.280 (1.241)**	1.230 (7.438)	1.230 (7.438)	-7.069 (1.826)	-1.693 (1.772)
E	-9.316 (1.598)	-4.624 (1.659)	1.128 (6.166)	1.128 (6.166)	-1.511 (2.053)	-3.662 (2.101)
K, L			1.362 (6.88)	9.564 (7.124)	-7.094 (5.626)	-1.104 (5.232)*
L, E			-6.827 (5.77)	-7.882 (6.138)	-1.159 (7.063)	-5.84 (7.232)
K, E			8.356 (8.86)	5.580 (9.377)	1.234 (1.080)	5.83 (1.105)
K,K					4.316 (2.219)	5.721 (2.104)*
L,L					3.640 (3.353)	5.652 (3.207)
E,E					7.645 (2.991)	1.231 (3.053)
Intercept	4.946 (-0.17)	5.716 (2.873)	1.422 (9.75)	-4.597 (1.007)	1.734 (2.140)	2.504 (2.142)
Dummy	4.392 (2.026)*		6.101 (2.457)*		4.372 (2.622)	
Augmented Dickey–Fuller test (ADF)	-2.8696	-2.7022	-3.5709	-2.986	-3.5446	-3.9342
R^2	0.87	0.86	0.91	0.89	0.921	0.91
N	40	41	37	38	34	35

Table 3.3 Unit Root Results of Log Input Variables [1]

Variable	**Specification**	**Augmented Dickey- Fuller (ADF)**		
		τ	τ_c	τ_{c+t}
Log GDP	***Level***	0.0037	-0.058	-0.206
	Differenced	-1.008	-1.051	-1.053
Augmented Dickey-Fuller test statistic for the level				
Test critical values		**1.34**	**-1.02**	**-2.18**
1% level***		-2.62	-3.58	-4.17
Augmented Dickey-Fuller test statistic (Differenced)				
Test critical values		***-6.77***	***-6.98***	***-6.91***
1% level***		-2.62	-3.58	-4.17
Log K	***Level***	0.00068	-0.018	-0.045
	Differenced	-0.093	-0.166	-1.186
Augmented Dickey-Fuller test statistic for the level				
Test critical values		***1.15***	***-2.01***	***-2.86***
1% level***		-2.62	-3.58	-4.17
Augmented Dickey-Fuller test statistic (Differenced)				
Test critical values		***-1.53***	***-1.999***	***-7.75***
1% level***		-2.62	-3.581	-4.18
Log L	***Level***	0.023	0.016	-0.038
	Differenced	-0.209	-2.703	-2.703
Augmented Dickey-Fuller test statistic for the level				
Test critical values		9.92	2.11	-0.99
1% level***		-2.62	-3.58	-4.17
Augmented Dickey-Fuller test statistic (Differenced)				

[1] The $\boldsymbol{\tau}$, $\boldsymbol{\tau_c}$, and $\boldsymbol{\tau_{c+t}}$ indicate the model statistics without either constant or trend, with constant, and with constant and trend, respectively. The number of lags is chosen by the Schwarz Information Criterion(BIC) for the Augmented Dickey-Fuller is 9. Tests for unit roots have been carried out in Eviews 11.0.

Test critical values		**-2.29**	**-6.30**	**-6.13**
1% level***		-2.62	-2.62	-4.19
Log E	***Level***	0.016	-0.044	-0.141
	Differenced	-4.515	-4.518	-4.517
Augmented Dickey-Fuller test statistic for the level				
Test critical values		2.08	-1.68	-1.94
1% level***		-2.62	-3.58	-4.17
Augmented Dickey-Fuller test statistic (Differenced)				
Test critical values		**-5.57**	**-5.49**	**-5.41**
1% level***		-2.62	-3.61	-4.21

Table 3.4 Estimates of Models (A, B, and C) using from Penn World Table data [1]

Variables	*Model A*	*Model B*	*Model C*
K	0.140 (0.03)**	1.904 (0.37)	0.104 (0.971)
L	-0.488 (0.33)	4.769 (0.46)	3.697 (0.843)
E	0.587 (0.01)***	-5.593 (0.43)	-7.608 (0.464)
K, L		-0.331 (0.19)	-0.452 (0.137)
K, E		0.197 (0.35)	0.332 (0.221)
L, E		0.135 (0.67)	1.854 (0.149)
K,K			0.062 (0.416)
L,L			-1.651 (0.393)
E,E			-1.610 (0.153)
Intercept	0.025 (0.52)	0.01 (0.80)	0.003 (0.961)
R^2	0.25	0.33	0.22
D.W	2.29	2.33	2.22
N	45	45	45

[1] https://cid.econ.ucdavis.edu/pwt.html

Table 3.5 **Production elasticities of model C,** output elasticities

Model A:			*estimate*	*Approx Std Err*	*t value*	*P value*
	α_1	*Elasticity of K*	0.15	0.170	0.89	0.377
	α_2	*Elasticity of L*	-0.82	2.193	-0.37	0.711
	α_3	*Elasticity of E*	1.63	0.891	1.83	0.076
sum			*0.96*			

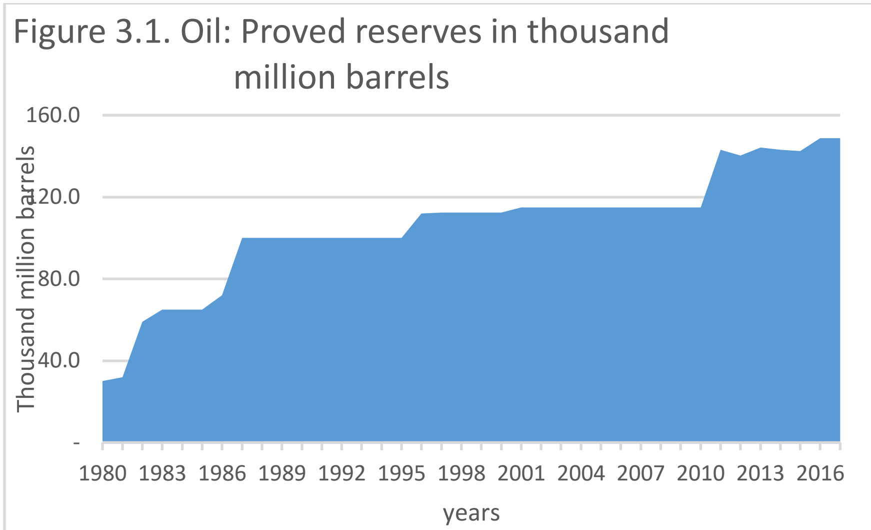
Table 3.6 F-Test Results of Test Whether Model B and Model C are Statistically Equivalent to Model A (Wald test)

	statistic	P value
Test 1	2.08	0.422
Test 2	4.69	0.58

Table 3.7 T-Test Results of Whether Production Elasticities Equation to Factor Shares

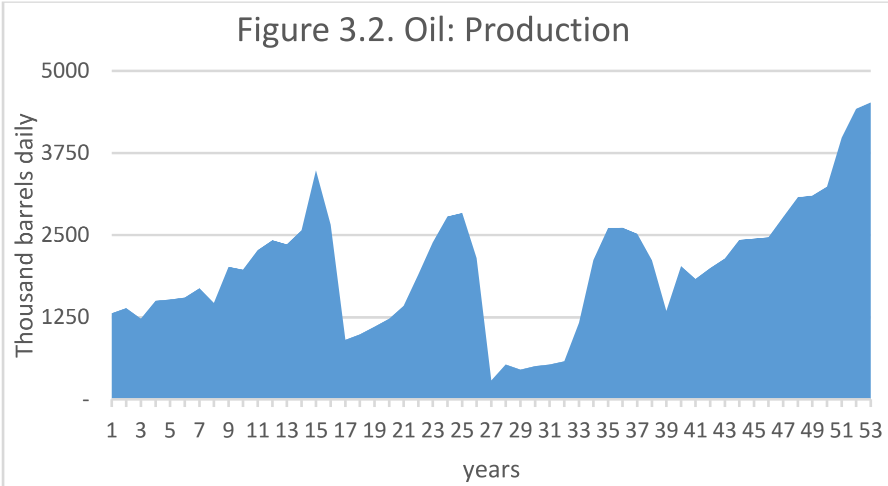
	Statistic	*P value*
Test 1	3.95	0.0468
Test 2	0.32	0.5695
Test 3	3.01	0.083

Appendix two: list of tables



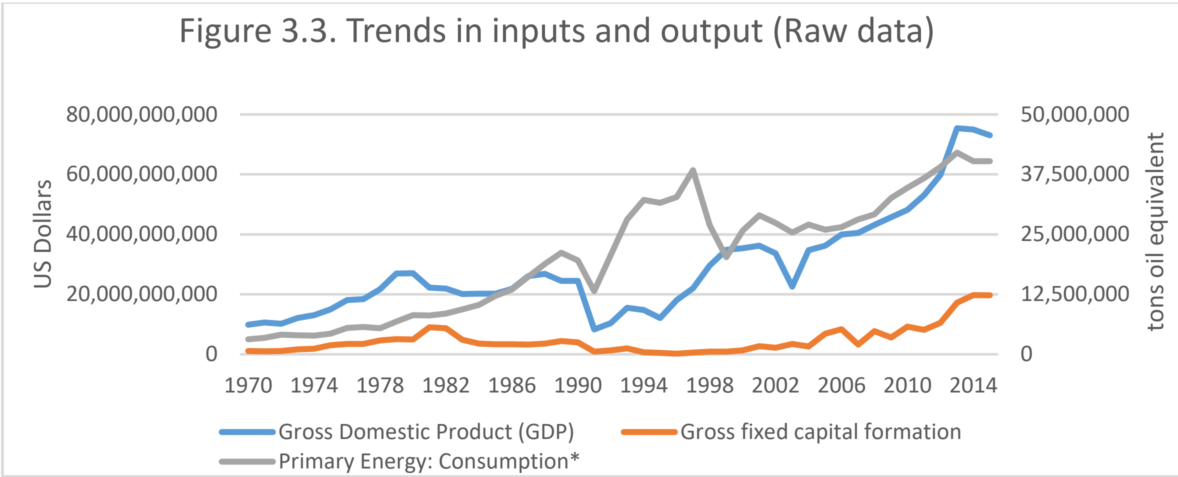
"BP statistical review of world energy 2018." *London, UK* (2018).

https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html

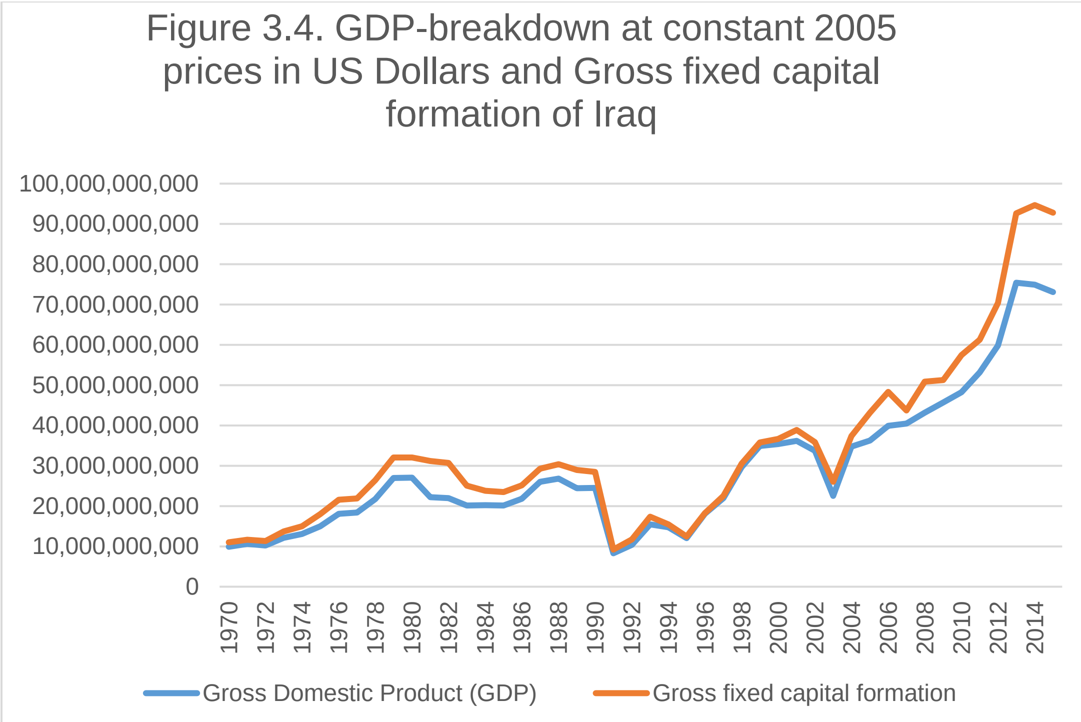


"BP statistical review of world energy 2018." *London, UK* (2018).

* Includes crude oil, shale oil, oil sands and NGLs (natural gas liquids - the liquid content of natural gas where this is recovered separately).

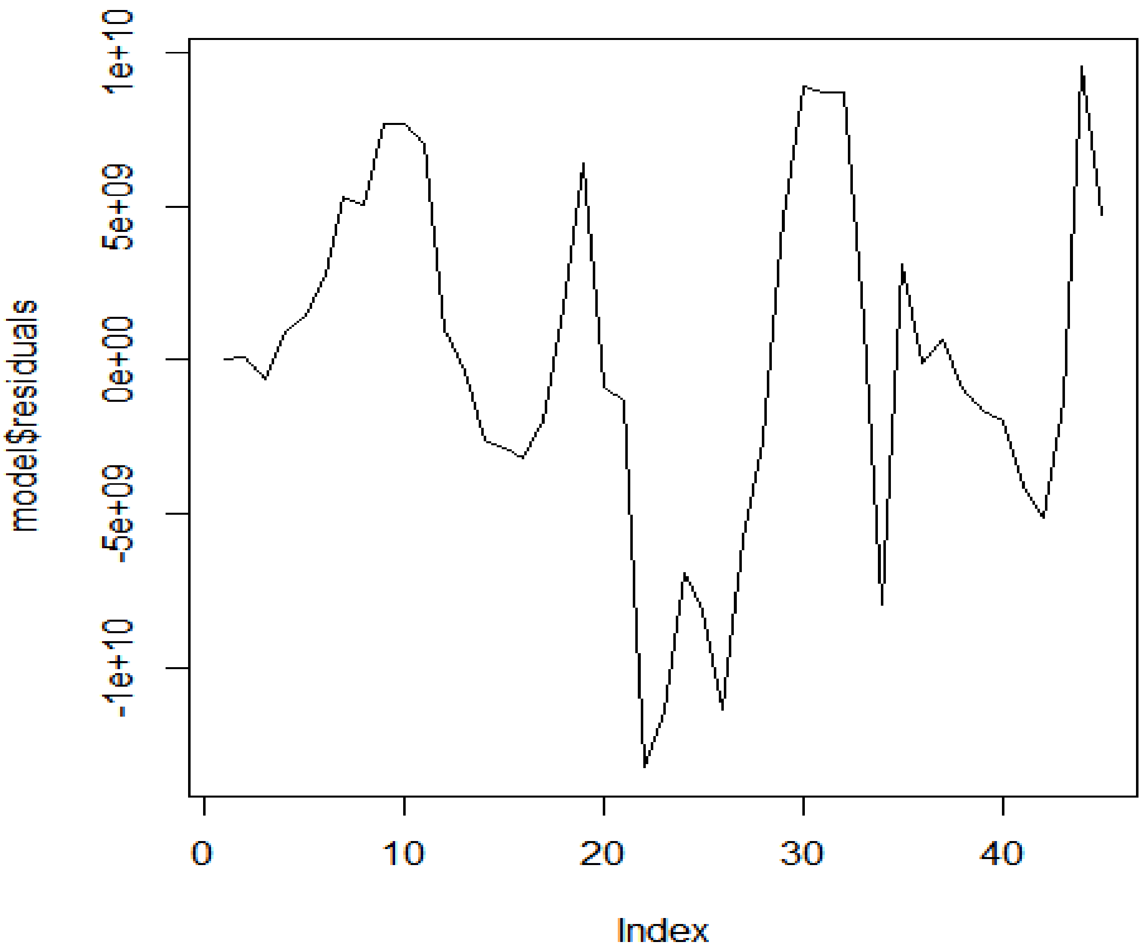


* Note that in this review, primary energy comprises commercially-traded fuels, including modern renewables used to generate electricity.



United Nations. "National Accounts Statistics: Main Aggregates and Detailed Tables." (2017). https://unstats.un.org/unsd/nationalaccount/madt.asp

Figure 3.5 Residuals of the Model A



3.6 Trends of inputs and output

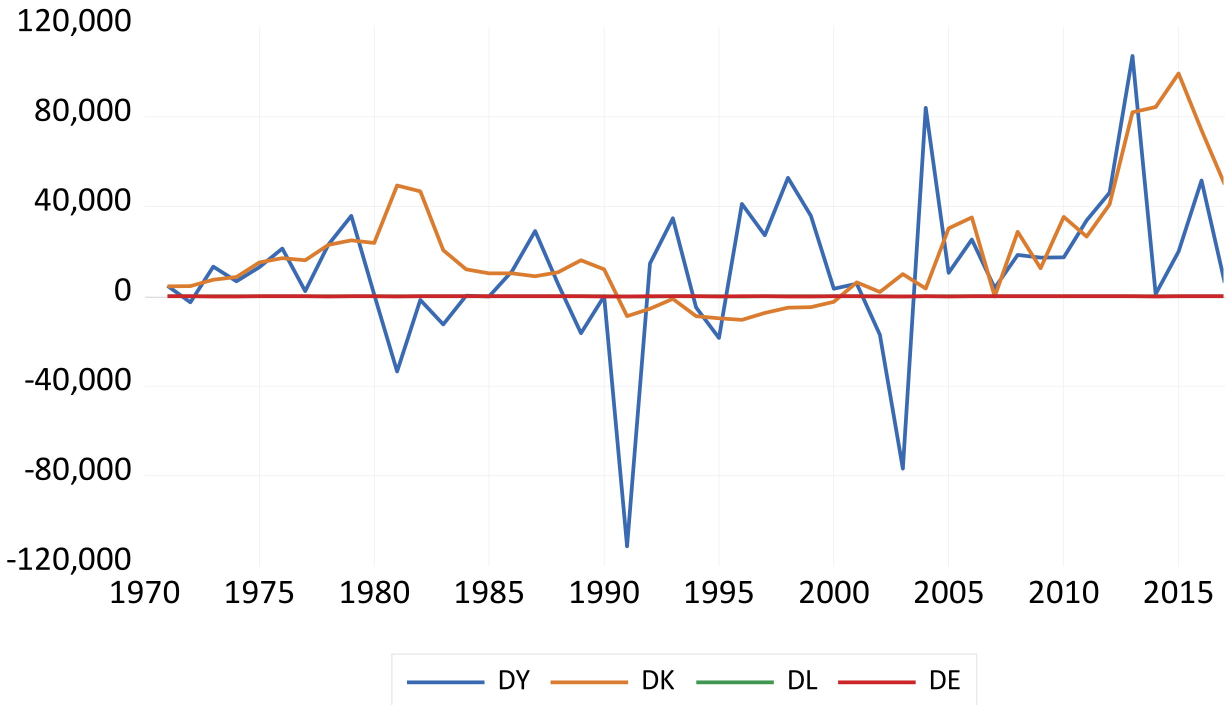


Figure 3.7 Auto covariance of the residuals of Model A