Determinants of the Long-Run Growth Rate of Libya

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Abstract

This article estimates Total Factor Productivity (TFP) for Libya and analyses its key determinants. According to the Solow (1956) growth model, long-run growth rate equals TFP. Estimated β-coefficients show that trade openness, foreign direct investment and development of financial sector increase TFP.

1. Introduction

This article analyses some key determinants of the long-run growth rate of Libya. Our framework uses theoretical insights from the Solow (1956) growth model and the growth accounting framework in Solow (1957). Our empirical methodology is based on the extensions to these works by Mankiw*et al*. (1992) and Senhadji (2000). Empirical results for Libya are estimated for the period 1970 to 2010. In Section II a production function for Libya is estimated. Using the estimated factor elasticities, a growth-accounting exercise is conducted next to estimate Total Factor Productivity (TFP). The structure of this article is as follows. First we present the literature review. In section 2, it is shown the data used in the estimation. Then the model and the estimation technique are developed in the next section for both Total Factor Productivity (TFP) and its determinants. The empirical results are presented and explained in section 3, and the final section will be policy implications and conclusion.

2. The Production Function and TFP

The neo-classical growth model is also known as the exogenous growth model or Solow growth model. In Solow's model, there are two factors of production: capital and labour. Technology is exogenous and represented by a production function:

$$Y = f(K, L)$$

The literature on the major determinants of economic growth, based on the general framework of cross-country regressions is also quite huge. As mentioned, the theoretical foundations of this approach can be traced to the neo-classical Solow-Swan-Ramsey model of growth as extended to incorporate government policies, human capital, fertility decisions and the diffusion of technology. According to the model, economies converge to the steady state where the growth rates of the economies are determined only by *TFP* growth.

The Solow residual, i.e. *TFP*, represents the effect in GDP of factors other than physical capital and labour. According to the growth literature, we can identify the following groups of factors influencing TFP in the long run:

- geography (location, climate, natural resources)
- human capital (education, training, health)
- institutions (governance, democracy, freedom)
- Culture (language, religion, history)
- Population growth

Growth accounting is an empirical methodology that allows for the breakdown of observed growth of *GDP* into components associated with changes in factor inputs and in production technologies. The basis of growth accounting were presented in Solow (1957), Kendrick (1961), Denison(1962), and Jorgenson and Griliches (1967).

As we mentioned in previous section our aim to estimate the determinants of the long-run growth rate in Libya, our framework uses theoretical based on either the Solow(1957) exogenous growth model or the empirical methodology is based on the extensions to these works by Mankiw*et al* (1992) and Sndhadj (2000). Also, the production function is used to explain the determinants of growth through channel of macroeconomic variables which affect economic growth.

The neo-classical model states that, at any point in time, the total output of economy depends on the quality and quantity of physical capital employed, the quantity of labour employed and the average level of skills of labour force. However, once the economy reaches the full equilibrium level, additional growth in the stock of capital per worker will only take place if productivity increases, either through enhanced capital stock or through improvements in the quality of the labour force. As is common in the growth accounting literature, it is useful to first focus on three major factor categories: physical capital and human capital, labour, and the output. This relationship between *GDP* and the three major factor categories in given period *t* is typically summarized by a Cobb-Douglas relationship.

Theory and evidence suggest that several factors can contribute to *TFP* growth. Economics and policies and institutions play a key role in increasing *TFP*, as highlighted in the endogenous growth literature. Research and Development (R&D) can be important determinants of *TFP* growth (Romer, 1997). Foreign and direct investment can contribute to *TFP* through indirect technology (Coe, Helpman and Hoffmaister, 1997). Trade openness can contribute to *TFP* by allowing an economy greater access to imports of equipment and machinery, as well as some domestic firms can be subjected to get more competition (Grossman and Helpman, 1991).

There are many ways of measuring *TFP*, but the measure is used in this study essentially output, physical capital, labour and human capital as part of labour, and following empirical methodology is conducted by Senhadji (2000).

Senhadji(2000) uses the extended Solow model and growth accounting framework of Solow (1957) to conduct a growth accounting exercise for a sample of 88 developed and developing countries. He estimated *TFP* as the Solow residual for al 88 countries and examines the determinants of *TFP*.

In this study we use time series technique to estimate first *TFP*, and then we will focus on a few key of determinants of *TFP* in Libya. In particular, these determinants are the ratios to Gross Domestic Product (*GDP*) of the following:

Foreign direct investment (*FDIRAT)* Traditionally, *FDI* is viewed as being a key channel for the transfer of advanced technology and superior organizational forms from industrialised to developing countries. Furthermore, *FDI* is believed to generate positive externalities in the form of knowledge to the domestic economy through, for instance, linkages with local suppliers and clients (s- called backward and forward linkages), learning from nearby foreign firms and employee training programmes plays an important role in driving growth through increase in productivity levels. In addition, *FDI* brings technology and creates employment which is also help to adopt new methods of production and enhances productivity by bringing competition in the economy. Moreover, it brings improvements in the quality of labour and capital inputs in the host economy. Keller and Yeaple (2003), studying plants in the U.S. (1987-1996), find a strong link between FDI and growth. Approximately 14 per cent of productivity growth over this period can be attributed to FDI indirect.

Trade openness (*TRAT*) is proxy with the ratio of imports plus exports to *GDP* (it will affect the growth positively from the benefits of international knowledge. Also it is believed that more open economies can grow more rapidly through greater access to advanced technologies that contribute to *TFP*),

Government expenditure (*GRAT*), we use government expenditure as a share of *GDP* to observe its effect on *TFP*. A rain (1989) argues that government can both foster and hinder the process of economic growth depending upon the nature of its activities.

Time trend (T), we used time trend to capture the effects of other trended but ignored variables which may have positive or negative effects. Hasan (2002) studies Indian manufacturing firms between 1976/1977 and 1986/1987. He investigates how productivity was affected by various embodied and disembodied technology inputs. In terms of former, he generally establishes a significantly positive effect of imported new capital goods on both productivity and new domestic capital goods (the real effect of the two is about the same)

Inflation rate *(INF)* is used to capture the stability of economy, which is hypothesized as necessary for *TFP* growth. In addition, inflation adds to economic growth by generating employment or merely increasing the working hours of employed labour in a sense that the positive relationship of inflation and *TFP* can be expected. Akinlo(2005) studied the macroeconomic factors and total factor productivity growth in Sub-Saharan countries. Inflation was one of the indicators for macroeconomic stability of total factor, and he found negative relationship between inflation and *TFP*.

Oil revenue (*OILR*), we use oil revenue as Libya exporting country, oil prices is another major exogenous shock that affect TFP. In the previous section showed that the fluctuations of oil price affect economic growth. So we will include **Dummy variables**

(*DUM81 or DUM73*)[1]is to capture the effects of reforms, since oil shock took place after the oil embargo of 1973 followed by the second oil shock in 1981. Other selected variables are assumed to affect TFP with a lag.

Senhadji (2000) is the earliest to use the framework of estimating an augmented production function using time series data and including human capital. His specification of the augmented production function can be expressed as:

$$Y_t = A_t K_t^{\ a} (H_t \times L_t)^{(1-\alpha)} \qquad (1)$$

Where *Y*= output, *A*= stock of knowledge, and it is index for the level of total factor productivity at time t, *K*=stock of capital, *L*= employment, *H*= a human capital formation through education and health services, *a and (1-a)* are parameters that measure the respective elasticity of capital and labour inputs at time *t*. Also *H* is a measure for human capital; hence the product of (*LH*) represents skill-adjusted employment (Senhadji, 2000).
In our exercise we use the education expenditure as indicator of human capital. Investment in education promotes more skilled and specialized labour input. Since more skilled workers are better able to adjust in a dynamic, knowledge-based economy, this will result in enhanced productivity performance. Sharp(1998) has argued that with stable macroeconomic environment, increased public support for training, higher education, research and development enhances overall productivity of the economy.

Take the logs of variables in equation (1), the value of regional *TFP* can be obtained as:

$$\ln Y_t = \alpha \ln K_t + (1-\alpha)\ln A_t + (1-\alpha)\ln(L_t H_t) + \varepsilon_t \qquad (2)$$

The decomposition of real *GDP* to its different sources requires getting estimates for the coefficients characterizing the production function, (α) and $(1-\alpha)$. The first step to get such estimates is to log linear equation (2) to become:

$$\ln Y_t = \alpha(\ln K_t - \ln L_t H_t) + \ln L_t H_t + \varepsilon_t \qquad (3)$$

Therefore the production function in its first difference is:

$$\ln Y_t = \ln A_t + \alpha \ln K_t + (1-\alpha)(\ln L_t + \ln H_t) \qquad (4)$$

3. The estimation of Total Factor productivity (TFP)

A crucial step in the estimation of *TFP* is the determination of the relative share of physical capital to production, that is the *A* parameter in the Cobb-Douglas function. Using all the data and Equations are mentioned above, the estimated value of *A* is 0.71, which the t-ratio in brackets is (24.5), and highly significant. By using this value, *TFP* is estimated as follows:

$$TFP = \ln Y - 0.71\ln K - (1-0.71)(\ln H + \ln K) \qquad (5)$$

The average TFP before 1990 was approximately -0.21 per cent and this has increased to near 0 during 1990 to 2009.

Table 1 estimates of total factor productivity growth over the 1962 to 2009. *TFP* growth has been calculated as the simple residual between output and factors input such as labour and capital.

[1] A dummy variable taking the value of 1 in the period of oil price satiability, and 0 otherwise is used in the analysis.

It can be seen from table 7.1 that there is clear increase in *TFP* growth from1960s to 1970s, but it decreased during the 1980s and 1990s respectively. That could be due to the decline on investment of physical capital. In 2000s there is increase in *TFP* growth and that is related to the massive public investment in education and health services.

Table 1: the average growth of total factor productivity in Libya from 1962 to 2009

The period	1960s	1970s	1980s	1990s	2000s
Average of TFP	-0.201	0.126	0.005	-2.584	0.176

4. Determinants of Total Factor Productivity

The basic empirical framework employed in this study is based on the determinants of economic growth, more specifically the macroeconomic determinants of *TFP*. We can specify a simple model of *TFP* as follows:

$$TFP_t = a + \beta_1 FDIRAT + \beta_2 TRAT + \beta_3 GRAT + \beta_4 OILRAT + \beta_5 INFRAT + \beta_6 T + \beta_7 DUM_{73} + \mu_t \quad (6).$$

Where

β_1,.....β_6 are parameters of the determinants of *TFP* respectively.

Table 2: Augmented Dickey-Fuller and Phillips-Perron Unit Root Test from 1962 to 2009.

Variables	ADF		PP	
	C	C&T	C	C&T
TFP	-7.601***	-8.464***	-6.552***	-7.076***
FDIRATE	-2.865	-2.859	-2.744	-2.723
Δ*FDIRAT*	-8.747***	-8.965***	-8.965***	-9.821***
OILRATE	2.432	1.181	1.871	0.704
Δ *OILRATE*	-4.235***	-5.308***	-4.907***	-5.385***
TRATE	-12.957***	-2.968	-16.046***	-42.107***
Δ *TRATE*	-3.150**	-3.456**	-2.718	-3.186**
INFRATE	-2.563	-2.549	-4.379***	-4.403***
Δ *INFRATE*	-9.623***	-9.613***	-10.911***	-10.860***
GRATE	2.671	1.595	2.598	1.153
Δ *GRATE*	-7.211***	-7.684***	-7.312***	-7.213***

Note: ***, ** and * implies significant at 1%, 5% and 10% level respectively

5.The Vector Autoregressive (VAR)

To investigate the long-run relationship between each pair of variables under consideration, VAR model will be used to determine the long-run relationship. This model was developed by Sims, Stock, and Watson (1990) and Toda and Phillips (1993). They pointed out that in a system that contains unit roots, standard Wald statistics based on ordinary least-squares (OLS) estimation of level VAR model for testing coefficient restrictions have nonstandard asymptotic distributions and cannot be applied to mixed integration orders. Toda and Yamamoto (1995) proposed a simple procedure requiring the estimation of an "augmented" VAR, even when the variables have different orders. Additionally, VAR is estimated with lag order of (k+d), where (d) is the maximum order of integration of the variables in the system and k is the VAR.

In our study with only 48 observations it is not possible to determine the optimal lag order for Vector Auto-regression with 9 variables even if we use an initial lag order of 2. Therefore, we have used only three crucial ratios namely, *FDIRAT*, *GRAT* and *TRAT* starting with five lags, to determine the order of VAR model. We using information criteria such as: AIC and SBIC to determine the optimal lags. All the selected methods indicated that a first-order VAR is optimal. Equation (6) is estimated through unrestricted VAR model with variables that are stationary and a lag number selected by AIC and SBIC.

Once the VAR model with optimal lags has been selected, we need to estimate long-run coefficients. The coefficients on the forcing variables must be significant to prove the long-run relationship between the variables under investigation. Then the appropriate distributed lag regression model is distributed lag model with only current and past value of the selected explanatory variables (it can be seen from table 3). Table 3 reports the tests of the unrestricted VAR model, and the investigation of the determinants of total factor productivity produced interesting results that are broadly consistent with other previous studies. Using a first-order VAR, the estimated equation is re-estimated after deleting the insignificant variables. These estimates are impressive and all the coefficient have the expected signs and are significant at the conventional levels of 5 or 10 percent except the OILRAT which is insignificant. The *TRAT*, *GRAT* and *FDIRAT* have a positive and significant impact on TFP. Also with trade openness, trade become strongly significant, and that implies trade openness is one of the key determinants of TFP in Libya. On the other hand, inflation rate has a negative and significant effect on TFP. The fact is that high and unstable prices cannot create economic uncertainties and discourage investment in Libya. OILRAT is not significant suggest that it doesn't have any effect on TFP.

As we mentioned in the previous section the two dummy variables are included to capture the effects of reforms. The dummy variables are (*DUM73*) and (*DUM81*). When we include *DUM81* to our analysis, the coefficient for *DUM81* implies that there is no effect on TFP. On the other hand, the dum73 implies that reforms in Libya have enhanced TFP.

Table 3: Estimated equation (6) for *TFP* and its determinants for period 1962 to 2009 by using *VAR* method

	TFP	*TRAT*	*OILRAT*	*INF*	*GRAT*	*FDIRAT*
TFP(-1)	1.057*** [6.885]	-0.0026 [-1.109]	0.176 [1.071]	-0.031* [-1.872]	-0.183* [-1.621]	-0.425 [1.320]
TRAT(-1)	6.107** [2.159]	0.601*** [15.231]	0.117 [1.411]	2.460 [1.234]	-2.970* [-1.712]	3.812** [2.107]
OILRAT(-1)	-0.134 [-0.712]	0.0062 [0.158]	0.972*** [9.697]	-3.658* [-1.613]	0.486*** [4.534]	1.182* [1.610]
INF(-1)	-0.013* [-1.873]	-3.380 [-0.274]	-0.018** [-2.490]	0.228 [1.362]	-0.002 [-0.245]	0.005 [0.096]
GRAT(-1)	0.049* [1.722]	-0.036* [-1.729]	-0.024 [-0.130]	2.402 [0.573]	0.171 [0.863]	-0.489 [-0.338]
FDIRAT(-1)	0.034* [1.643]	0.008* [1.623]	0.031* [1.920]	-1.051* [-1.867]	0.043** [2.007]	0.325** [2.058]
C	-0.322** [-2.604]	0.005*** [3.487]	0.277* [1.688]	5.525** [2.366]	0.801 [0.724]	-2.189* [-1.655]
T	-0.007* [-1.854]	-0.003*** [-3.232]	0.005 [1.294]	0.079 [0.839]	0.049 [1.035]	0.083** [2.333]
DUM73	0.063* [1.669]	-0.006 [-0.410]	-0.071 [-0.632]	1.636 [0.645]	0.123 [1.032]	-1.791** [-2.047]
Adj. R-squared	0.705	0.972	0.932	0.103	0.853	0.555
F-statistic	7.095 [0.001]	20.019 [0.0001]	79.931 [0.0000]	1.785 [0.091]	34.426 [0.000]	8.174 [0.001]
AIC	-0.265	-8.849	-0.627	5.610	-0.493	3.482

Note: ***, ** and * implies significant at 1%, 5% and 10% level respectively. The VAR optimal lag structure was determined by AIC and SIC.

Conclusion and Policy implications

This study develops a theoretical model for productivity determinants in developing countries following the advices and recommendations of Senhadji (2000), taking into account two effects of reforms; 1973 and 1981. To do so the key macroeconomic variables in the behavioural equations were tested for stationarity and non-stationarity. To test the stationarity of the Libyan time series data the ADF and PP tests with an intercept term and a linear trend indicates that the traditional unit root test were able to reject null-hypothesis that selected variables have unit root.

The econometric method for estimating the share of physical capital is based on estimating an aggregate production function. Moreover, the estimated value of *A* is 0.71 which is relatively higher than the usual values of 0.4 to 0.5, used in growth accounting exercises .After the long run relationship was established the long run relationship between TFP and macroeconomic variables were estimated by unrestricted VAR approach. In addition, this study looks at *TFP* series in the broad context of the Libyan macro-economy during four distinct phases starting from the 1962 until 2009.

The behaviour and the growth of *TFP* have found to vary from one phase to another. In thisstudy we found some key determinants of *TFP* for Libya. By using one lag of the ratios of *GDP* of trade opened, foreign direct investment and government expenditure have significant positive effects. Economic reforms from1973 have also had a significant positive effect. Inflation rate has negative effects on *TFP*. Although the average rate of growth of per capita output during 2000 to 2009 was 3.3 per cent, the average of TFP was 0.17 percent. Therefore, it is not possible to sustain this growth rate in the long run because it is entirely because of factor accumulation. To increase this growth rate to double the per capita in the future, it is necessary to increase TFP and maintain the contribution of factor accumulation to the growth. Since factor accumulation proves the most important component of output growth, economic policies designed to increase the participation of labour supply which can spur economic growth.

These policies to increase *TFP* can be implemented in the short to medium terms. Therefore policy makers should focus on policies that improve trade openness because this will increase TFP in Libya.

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