Effects of Oil on the Libyan Balance of Payments

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INTRODUCTION

In addition to its direct gains the investment in the oil industry might result in two kinds of indirect contribution to growth of national income. One is the Linkage effects and the other involves the creation of factors of production, which implies that in the process of its operation the new industry might contribute certain types of factors to the domestic economy, particularly foreign exchange, investment resources (especially if large payments to government occur), and in the training of skilled labour and management. This article deals with the contribution of the oil industry to the Libyan balance of payments.

In the analysis of the balance of payments impact of the Libyan oil the amounts of foreign exchange that the oil sector brings into the country is one of the important vehicles through which this sector can impart the potential for growth to other sectors in the economy.

The Contribution of the Oil Sector to the Balance of Payments

The balance of payments impact of the Libyan oil industry could be reached by two alternative methods. The first is to sum export proceeds and foreign capital inflows and to substract all foreign capital outflows, i.e., imports of goods and services, net factor income paid abroad and increases in overseas cash balances, from this sum. The second is to sum payments to government in form of income taxes, royalties and miscellaneous fees and all other payments made by the operating companies or their contractors to local factors of production. The latter consist mainly of wages and salaries including that part of the salaries of expatriate personnel which is disbursed in local currency and payments for local goods and services and to subtract from this sum the proceeds from local sales.

From the accounting point of view both methods lead to the same result. The figures included in Table 1 and Table 2 show the break down of the oil sector's total foreign exchange contribution to the Libyan economy.

The oil production in Libya began only late in 1961. In the years before 1961 and since oil exploration started in 1955 the contribution of the oil industry was mostly limited to the local expenditures. Table 1 covers the period from 1958 to 1965 which represents the exploration and the beginning of production and exports of oil. Table 2 covers the period from 1969 to 1973 which indicates the present dominant role of the oil sector in the Libyan economy. The figures in Table 1 are given in dollars at the par value of Libyan dinar[1] 1 = \$2.80 and the

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[1] September 1, 1971, the Libyan dinar replaced the Libyan pound as the national currency. The par value in terms of gold remained unchanged at LDI = 2.48828 grams of fine gold.

sionality causes a considerable increase in D, the statistic $\overset{*}{Z}$ seems a better choice in reducing probability of misclassification.

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with

$$A_1 = \tfrac{1}{2}D^{-2}\theta\{4\theta^3(D^2+2) + 4D\theta^2(D^2+2) + \theta[D^4 + 2D^2(3p+3q+5) + 8p] + 2D^3(p+q+1)\}, \quad (2.8)$$

as the coefficient of 1/4N in $\Sigma_{i=1}^3 \overset{*}{L}_i(-\theta N/(N+1); D)$. The term B_1 is composed as

$$B_1 = B_{11} + B_{12} + B_{13}, \quad (2.9)$$

these being coefficients of $1/8N^2$ in $\Sigma_{i=1}^3 \overset{*}{L}_i(-\theta N/(N+1); D), \frac{1}{2}[\Sigma_{i=1}^3 \overset{*}{L}_i(-\theta N/(N+1); D]^2$ and $\Sigma_{i\le j=1}^3 \overset{*}{Q}_{ij}(-\theta N/(N+1); D)$ respectively. Note that the terms $\overset{*}{L}_i$ and $\overset{*}{Q}_{ij}$ are defined in the paper (7). The coefficients in (2.9) are obtained as

$$B_{11} = -D^{-2}\theta^2[4\theta^2(3D^2+8) + 8D\theta(D^2+3) + D^4 + 2D^2(3p+3q+7) + 16p], \quad (2.10)$$

$$B_{12} = \tfrac{1}{4}A_1^2, \quad (2.11)$$

$$\begin{aligned} B_{13} = \tfrac{1}{6}D^{-4}\theta\{&8\theta^5(7D^4 + 24D^2 + 12) + 24\theta^4D(3D^4 + 10D^2 + 4) \\ &+ \theta^3[30D^6 + 3D^4(29p + 29q + 95) + 24D^2(10p + 7q + 17) + 48p] \\ &+ 4\theta^2D^3[D^4 + 3D^2(5p + 5q + 11) + 6(6p + 5q + 9)] \\ &+ 3\theta D^2[D^4(3p + 3q + 5) + 2D^2(6p^2 + 6q^2 + 12pq + 19p + 19q + 15) \\ &+ 8(3p^2 + 4pq + 4p)] + 6D^5(p + q + 1)^2\}. \end{aligned} \quad (2.12)$$

Now $\exp\left[-\dfrac{\theta D}{2(N+1)} + \dfrac{\theta^2N^2}{2(N+1)^2}\right]$ can be expanded with respect to N^{-1} as

$$(1 + A_2/N + B_2/2N^2 + \ldots)\, e^{\theta^2/2}, \quad (2.13)$$

where

$$A_2 = -\theta D/2 - \theta^2, \quad (2.14)$$

$$B_2 = \theta^4 + \theta^3D + \theta^2(D^2/4 + 3) + \theta D. \quad (2.15)$$

Using (2.6), (2.7) and (2.13) we have

$$\begin{aligned} \phi_1(\theta) &= (1 + A_1/4N + B_1/8N^2 + \ldots)(1 + A_2/N + B_2/2N^2 + \ldots)e^{\theta^2/2} \\ &= [1 + (A_1 + 4A_2)/4N + (B_1 + 4B_2 + 2A_1A_2)/8N^2 + \ldots]e^{\theta^2/2} \\ &= \left[1 + \frac{1}{4N}a_1(\theta) + \frac{1}{8N^2}a_2(\theta) + \ldots\right]e^{\theta^2/2}, \end{aligned} \quad (2.16)$$

$a_1(\theta)$ and $a_2(\theta)$ are found to be as in (2.2) and (2.3). The use of Cramer's method (2, p. 225) of inverting a characteristic function of the above form completes the proof.

Since by interchanging $\bar{x}_1^*$ and $\bar{x}_2^*$ in (1.1) we obtain $-\overset{*}{Z}$, the following result is easily derived from above theorem.

Theorem 2

$$F(z|\pi_2) = 1 - [1 + a_1(d)/4N + a_2(d)/8N^2 + O_3]\Phi(-z). \quad (2.17)$$

Corollary: The probability of misclassifying an observation into π_2 when it comes in fact from π_1 is given by

$$\{1 - [1 + a_1(d)/4N + a_2(d)/8N^2 + O_3]\Phi(z)\}_{z=D/2}. \quad (2.18)$$

The other probability of misclassification has the same expression.

The above corollary follows from Theorem 1 and the procedure proposed in classifying an observation into its relevant population in the first section of this paper.

Remarks: Taking q = 0 in (2.1) the distribution of Z statistic is obtained as in (8).

Table 1 of (8) shows that the probability of misclassification decreases as the dimensionality p decreases or the Mahalanobis distance D^2 increases, when Z is used as a discriminant function. The terms $a_1(d)$ and $a_2(d)$ when compared with similar terms in (8) indicate a general increase in dimensionality. But as in using $\overset{*}{Z}$, D increases, it follows that the superiority of $\overset{*}{Z}$ over Z depends mainly on q and D. In situations where the introduction of a covariate of small dimenbeing the Mahalanobis distance between π_1 and π_2. Asymptotically, $(2D)^{-1}(\overset{*}{Z} + D^2)$ is a standardized normal variate. We shall obtain its distribution when $N_1 = N_2 = N$.

Theorem 1: If $D > 0$, an asymptotic expansion of the distribution of $(2D)^{-1}(\overset{*}{Z} + D^2)$ when $\binom{x}{y}$ comes from π_1 is given by

$$F(z|\pi_1) = (1 + a_1(d)/4N + a_2(d)/8N^2 + O_3)\,\Phi(z) \tag{2.1}$$

where $d = d/dz$, $\Phi(z)$ is the cdf of $N(0, 1)$, O_3 is the third order term with respect to N^{-1} and

$$a_1(d) = \tfrac{1}{2}D^{-2}\Big[4(D^2 + 2)d^4 + 4D(D^2 + 2)d^3 + \big[D^4 + 2D^2(3p + 3q + 1) + 8p\big]d^2 + 2D^3(p + q - 1)d\Big], \tag{2.2}$$

$$\begin{aligned} a_2(d) = D^{-4}\Big[&(D^2 + 2)^2d^8 + 2D(D^2 + 2)^2d^7 + \tfrac{1}{6}\big[9D^6 + 2D^4(9p + 9q + 46) \\ &+ 12D^2(5p + 3q + 19) + 48(p + 2)\big]d^6 \\ &+ \tfrac{1}{2}D\big[D^6 + 2D^4(4p + 4q + 13) + 8D^2(3p + 2q + 10) + 16(p + 2)\big]d^5 \\ &+ \tfrac{1}{16}\{D^8 + 4D^6(7p + 7q + 17) + 4D^4\big[9(p + q)^2 + 76p + 72q + 135\big] \\ &+ 32D^2(3p^2 + 3pq + 21p + 14q + 18) + 64p(p + 2)\}d^4 \\ &+ \tfrac{1}{12}D^3\{D^4(3p + 3q + 5) + 18D^2\big[(p + q)^2 + 6p + 6q + 9\big] \\ &+ 24(p^2 + pq + 11p + 10q + 6)\}d^3 + \tfrac{1}{4}D^2\{D^4(p + q)^2 \\ &+ 4p + 4q + 7\big] + 4D^2\big]6(p + q)^2 + 13p + 13q + 13\big] + 16p(3p + 4q)\}d^2 \\ &+ D^5\big[(p + q)^2 + 2p + 2q + 5\big]d\Big]. \end{aligned} \tag{2.3}$$

Proof: Memon and Okamoto (7) use the Fourier transform to obtain the distribution of $D^{-1}(\overset{*}{W} - \tfrac{1}{2}D^2)$; the limiting distribution of $\overset{*}{W}$ is $N(\tfrac{1}{2}D^2, D^2)$ as $\binom{x}{y} \in \pi_1$. Following the same approach the characteristic function of $(2D)^{-1}(\overset{*}{Z} + D^2)$ is

$$\phi_1(\theta) = \underline{E}\big[E\{\exp[-\theta(2D)^{-1}(\overset{*}{Z} + D^2)]|\pi_1\}\big], \tag{2.4}$$

where $\theta = -it$ and $\underline{E}$ indicates expectation w.r.t. joint distribution of $(\bar{x}_1, \bar{x}_2, \bar{y}_1, \bar{y}_2, S)$. With $N_1 = N_2 = N$ as

$$\begin{aligned} \overset{*}{Z} &= \frac{N}{N + 1}\big[(\overset{*}{x} - \bar{x}_1^*)'\,\underline{S}^{-1}(\overset{*}{x} - \bar{x}_1^*) - (\overset{*}{x} - \bar{x}_2^*)'\,\underline{S}^{-1}(\overset{*}{x} - \bar{x}_2^*)\big] \\ &= \frac{N}{N + 1}\big[2\overset{*}{x}'\underline{S}^{-1}(\bar{x}_2^* - \bar{x}_1^*)' - (\bar{x}_1^* + \bar{x}_2^*)'\,\underline{S}^{-1}(\bar{x}_2^* - \bar{x}_1^*)\big] \\ &= \frac{-2N}{N + 1}\overset{*}{W}, \end{aligned} \tag{2.5}$$

(2.4) can be written as

$$\underline{E}\left[E\left\{\exp\left[\left(\frac{N\theta}{N + 1}\right)\left(\frac{\overset{*}{W} - D^2/2}{D}\right) - \frac{\theta D}{N + 1}\right]\middle|\pi_1\right\}\right] = e^{-\theta D/2(N+1)}\,\phi(-\theta N/(N + 1)) \tag{2.6}$$

where ϕ is the same function as 4.1 of the paper (7). So, $\phi(-\theta N/N + 1)$ can be derived from there by changing θ to $-\theta N/N + 1$ in the expression for the asymptotic expansion of $\phi(\theta)$. We find that on simplifying,

$$\phi(-\theta N/(N + 1)) = (1 + A_1/4N + B_1/8N^2 + \dots)\,e^{\theta^2N^2/2(N+1)^2} \tag{2.7}$$