

## Analytical Limitations of the Forsyth and Kay Model as Applied to Algeria

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**ABSTRACT :** This paper discusses the pre- and post-oil economy, and the emergency of the oil and gas sector, using a modified Forsyth and Kay model. The point raised in this paper is to show the analytical limitations of this model as applied to Algeria, rather than going into seeing whether the development of the oil and gas sector in Algeria would result in capital becoming available for manufacturing industry, so allowing 'industrialization', or whether it would cause 'de-agriculturalization' as has been suggested for the case of Nigeria.

### INTRODUCTION

The discovery of oil and gas in Britain, Holland and Norway led to several substantial discussions on the effects of the development of the resource sector on the structure of developed economies. Since these effects may be rather different from those on underdeveloped economies, or oil economies such as Algeria, the aim of this paper is, first, to review briefly the theoretical analysis of the 'Dutch Disease'; second, to present a modified Forsyth and Kay model (1980); third, to discuss the limitations of this model, and finally, areas for future study are noted.

### The Theory of the Dutch Disease

The underlying theory of the 'Dutch Disease' model of de-industrialization is mainly concerned with the effects of the boom sector on the structure of the economy through the resource movement effect and the spending effect. The boom sector has been defined by Gorden (1984) as follows:

"There has been a once-for-all exogenous technical improvement in [the resource sector], represented by a favourable shift in the production function, this improvement being confined to the country concerned. (2) There has been a windfall of new resources (i.e. increase in supply of the specific sector). (3) ... [the resource sector] produces only for exports, with no sales at home, and these

has been an exogenous rise in the price of its product on the world market relative to the price of imports. (p. 360)

The resource movement effect can be defined as a movement of the means of production between the economic sectors. The development of any sector in the economy requires the use of the means of production, i.e. labour, land and capital. Assuming that the economy is in a state of full employment, and overseas labour and capital are not available, then the boom in the new sector would attract part of the means of production of other sectors.

The spending effect, as defined by Gorden (1984, p. 361), is the extra income in the boom sector which is spent either directly by factor owners, or indirectly through being collected in taxes and then spent by the government.

Using the same core model as Gorden & Neary (1982), we divide the economy into two tradeable sectors, i.e. Resource and Manufacturing and a non-tradeable Service sector.

To show the effect of the boom, two assumptions were made. These are:

- (1) The only mobile factor between the three sectors is labour.
- (2) Wages are measured in terms of manufacturing goods.

### Spending Effect

The boom, which may be due to technological progress, an increase in prices, or a new discovery, leads to extra spending on the service sector, which raises the price of its output, and draws labour of manufacturing into services.

### Resource Movement Effect

The boom in the resource sector raises the marginal product of labour and thus draws labour of the manufacturing and service sectors.

The movement of labour out of the manufacturing and service sectors into the boom sector can be categorized into two parts. First, the decrease of the labour force in the

manufacturing sector would result in a decline in its output, and this would give rise to what is known as ‘**direct de-industrialization**’. Second, as illustrated by Gorden (1984), the movement of labour out of the service sector into the boom sector creates excess demand for the service sector additional to that created by the spending effect. That is, the price of the service sector output rises. This brings about an additional movement of labour out of the manufacturing sector into services, reinforcing the de-industrialization resulting from the spending effect.

The resource movement effect tends to decrease the service sector output, whereas the spending effect tends to increase it. If these are combined, then one might expect that if the resource movement effect is stronger than the spending effect, the output of the service sector will be less than the initial output. However, if the spending effect is stronger than the resource movement effect, the output of the service sector will be more than the initial output. As discussed by Gorden &

Neary (1982): “When the two effects are combined we see that both contribute to a real appreciation” .

For further details on the problem of resource-boom induced de-industrialization, Forsyth & Kay (1980), Bond & Knobl (1982), Gorden & Neary (1982), Enders & Herberg (1983), Long (1983) and Gorden (1984).

The problem of resource-boom induced de-agriculturalization can be explained as follows. If the marginal product of labour in the resource sector is high compared to that of the agriculture sector, one might anticipate a movement of labour out of the latter sector into the former. This will reduce the output capacity in the agriculture sector, and would give rise to what is known as “**de-agriculturalization**”. A prime candidate for de-agriculturalization is Nigeria (Guirnaz, 1985).

**The Forsyth & Kay Model**

A simplified model of the type first discussed by Forsyth & Kay (1980) is a type of updating process, using the social accounting relationship (Table 1):

$$X = X_1 + X_2 + X_3$$

Where  $X$  = national income;  $X_1$  = value added =  $x_{1p} + x_{2p} + x_{3p}$ ;  $X_2$  = net effects of trade =  $(x_{1e} - x_{1m}) + (x_{2e} - x_{2m})$ ;  $X_3$  = consumption =  $x_{1c} + x_{2c} + x_{3c}$ . The subscripts 1, 2 and 3 refer, respectively, to the resource sector, manufacturing and services, while e, m, p and c represent, respectively, exports, imports, value-added and consumption.

**Table 1. The pre-boom economy**

	Production	Trade	Consumption
<b>1. Resource sector</b>	$x_{1p}$	$x_{1e} - x_{1m}$	$x_{1c}$
<b>2. Manufacturing</b>	$x_{2p}$	$x_{2e} - x_{2m}$	$x_{2c}$
<b>3. Services</b>	$x_{3p}$	-	$x_{3c}$
<b>Total</b>	$X_1$	$X_2$	$X_3$

The main assumptions of the Forsyth & Kay model are:

- (1) Consumption is to increase in line with national income.
- (2) The overall balance on external trade is maintained.

To work out the postulated state of the post-economy (Table 2), Forsyth & Kay used the following steps:

- (1) Because of a ‘resource boom’  $x_{1p}$  increases by  $\Delta x_{1p}$ , i.e.:

$$\text{post-boom resource value-added} = x_{1p} + \Delta x_{1p}$$

- (2) An additional  $\Delta x_{1p}$  of income in the resource sector raises the total output,  $X_1$ , by  $\Delta x_{1p}$  i.e.:

$$\text{post-boom total output} = X_1 + \Delta x_{1p}$$

- (3) From assumption (1), consumption in all sectors is to increase in line with national income, so consumption is multiplied by  $1 + \Delta x_{1p} / X_1$ , i.e.:

$$\text{post-boom resource consumption} = x_{1c}(1 + \Delta x_{1p} / X_1)$$

$$\text{post-boom manufacturing consumption} = x_{2c}(1 + \Delta x_{1p} / X_1)$$

$$\text{post-boom services consumption} = x_{3c}(1 + \Delta x_{1p} / X_1)$$

$$\text{post-boom total consumption} = X_{31} + \Delta x_{1p}$$

- (4) Since services consumption equal its production then:

$$\text{Post-boom production} = x_{3p}(1 + \Delta x_{1p} / X_1)$$

- (5) Subtracting resource sector value-added from its consumption we get the net effect of trade as:

$$(x_{1p} + \Delta x_{1p}) - [x_{1c}(1 + \Delta x_{1p} / X_1)]$$

- (6) In order to keep the overall balance on external trade, i.e.  $X_2$ , manufacturing imports,  $x_{2m}$ , and exports,  $x_{2e}$ , should, respectively, increase and decrease by an equal percentage, i.e.:

Manufacturing imports become:

$$x_{2m} \left\{ 1 + (x_{1p} + \Delta x_{1p}) - [x_{1p}(1 + \Delta x_{1p} / X_1)] - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) \right\}$$

Manufacturing exports become:

$$x_{2e} \left\{ 1 - (x_{1p} + \Delta x_{1p}) - [x_{1p}(1 + \Delta x_{1p} / X_1)] - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) \right\}$$

Where  $\left\{ (x_{1p} + \Delta x_{1p}) - [x_{1p}(1 + \Delta x_{1p} / X_1)] - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) \right\}$  equals the sum of deterioration in the non-oil balance of trade. We recall  $x_{2e} + x_{2m}$  indicates the sum of manufacturing exports and imports in the pre-boom economy.

- (6) We calculate projected manufacturing consumption by subtracting the net effects of trade (Table 2) i.e.:

Post-boom manufacturing production

$$= x_{2c}(1 + \Delta x_{1p} / X_1) - \left\{ x_{2m}(1 + x_{1p} + \Delta x_{1p}) - [x_{1c}(1 + \Delta x_{1p})] - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) \right\} +$$

$$x_{2e} \left\{ 1 - [(x_{1p} + \Delta x_{1p}) - x_{1c}(1 + \Delta x_{1p} / X_1)] - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) \right\}$$

**Table 2. Post-boom economy**

Production	Trade	Production
$x_{1p} + \Delta x_{1p}$	$x_{1p} + \Delta x_{1p} - [x_{1c}(1 + \Delta x_{1p} / X_1)]$	$x_{1c}(1 + \Delta x_{1p} / X_1)$
$x_{2c}(1 + \Delta x_{1p} / X_1) - x_{2m} \{ 1 + (x_{1p} + \Delta x_{1p}) - [x_{1c}(1 + \Delta x_{1p} / X_1)] - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) \} + x_{2e} \{ 1 - (x_{1p} + \Delta x_{1p}) - [x_{1c}(1 + \Delta x_{1p} / X_1)] - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) \}$	$x_{2m} [ 1 + (x_{1p} + \Delta x_{1p}) - x_{1c}(1 + \Delta x_{1p} / X_1) - (x_{1e} - x_{1m}) / (x_{2e} + x_{2m}) ] + x_{2e} \{ 1 - (x_{1p} + \Delta x_{1p}) - [x_{1c}(1 + \Delta x_{1p} / X_1)] \}$	$x_{2c}(1 + \Delta x_{1p} / X_1)$
$x_{3p}(1 + \Delta x_{1p} / X_1) x$	-----	$x_{3c}(1 + \Delta x_{1p} / X_1)$
$X_1 + \Delta x_{1p}$	$X_2$	$X_2 + \Delta x_{1p}$

### **Analytical Limitations**

There are four major analytical limitations to this technique as applied to the case of Algeria:

(1): Booms in the resource sector raise the demand for all goods. The resource sector and manufacturing sector products are 'tradeables', i.e. they are governed by world prices, so their prices stay fixed, but 'non-tradeables' (services) can have their prices forced up. This will draw factors from other sectors (especially labour and investment from manufacturing); thus manufacturing will be doubly squeezed. However, for the case of Algeria the above argument is not always true, because neither manufacturing nor agriculture were so developed as to be affected by the development of the resource sector, in terms of the movement of resources out of these sectors. Nevertheless, some authors believe that the development of the resource sector resulted in 'de-agriculturalization' (Giurnaz, 1985). This is because the government failed to initiate agricultural development in the rural areas, or to create industries which could act as a stabilizing force within the more underdeveloped regions.

(2): Revaluation of the domestic currency makes imports cheaper, and so raises the real purchasing power of domestic consumers even further than the oil boom itself. This argument can be true if, first, oil revenues constitute a small proportion of the national income, and second, if there exist money markets which allow exchange rate fluctuations. However, for the case of Algeria, the exchange rate is fixed, and the money markets are not yet mature.

(3): Forsyth & Kay model ignored intermediate demand for services, i.e. services for the manufacturing sector, which is very important in Algeria. As manufacturing output declines, so will services on the demand side. Therefore, the Forsyth & Kay model is purely a supply side model.

(4): The Forsyth & Kay model takes a comparative static approach, i.e. it compares two equilibria. A proper understanding needs a full dynamic model.

The effect of the development of the oil and gas sector on the Algerian economy: Industrialization or De-agriculturalization?, using Forsyth & Kay model was discussed in a separate papers (Matallah & Proops, 1990, 1992, 1994), where 1968 input-output tables was chosen to represent the Algerian pre-oil economy, while the 1974 input-output table was taken as the peak production year. The analysis showed that the Forsyth & Kay model is less applicable to Algeria than to the UK. In Algeria at the time of the nationalization of the oil and gas industry, neither capital nor skilled labour were locally available, therefore neither manufacturing nor agriculture were so developed as to be affected in the sense of the movement of resources out of these sectors. What is described as a problem for Britain, as 'de-industrialization', and for Nigeria as 'de-agriculturalization', does not seem in the 1980s to be a major problem for Algeria.

### **Areas for Future Study**

The present paper has illuminated some interesting aspects of the Forsyth & Kay model as applied to the case of Algeria (i.e. the limitations of this model). Still other issues obviously require further study. Further work could examine the following:

(1): With a new input-output table the above model can be repeated and updated.

(2): The Forsyth & Kay model takes a comparative static approach, i.e. compares two equilibria. A proper understanding needs a fully dynamic model.

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