

# An Evaluation of the Relevance of the AK Model to Developing Countries Such as Zimbabwe

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## Abstract

AK models, unlike the exogenous models, factor in technology as endogenously determined within the model by economic decisions; hence they are also called endogenous models. This paper serves to outline the AK model as propounded by Frankel (1962) as well as to evaluate its relevance to a developing country. A theoretical approach is used to analyse its relevance. It was noted that, the AK model by Frankel (1962) is relevant to developing countries as it helps to combat the major impediments to economic growth faced in these countries such as low productivity, high unemployment, low levels of investment and dilapidated infrastructure. Capital accumulation will also bring positive externalities through learning by doing effects. The model might nevertheless fail to bring desired results since it does not consider other factors such as political instability and good institutions which equally contribute to economic growth.

**Keywords:** Developing Countries, AK Model, Endogenous Model, Zimbabwe

## 1. Introduction

AK models, unlike the exogenous models, factor in technology as endogenously determined within the model by economic decisions; hence they are also called endogenous models. This paper serves to outline the AK model as propounded by Frankel (1962) as well as to evaluate its relevance to a developing country.

## 2. The AK Model

The AK model by Frankel (1962) states that, thrift; capital accumulation and efficient allocation of resources are the keys to economic growth as opposed to novelty and innovation (Aghion and Howitt, 2006). It assumes that, when people accumulate capital, 'learning by doing' generates technological progress that tends to raise the marginal product of capital, thus offsetting the tendency for the marginal product to diminish when technology is unchanged (Aghion and Howitt, 2010). Similar to the Solow Swan model, the AK model by Frankel (1962) also assumes a) the conditions of perfect competition in the economy, b) factors of production can be substituted one for another and c) full employment. It also assumes a long run growth rate that depends on the savings (Aghion and Howitt, 2010).

The model demonstrated in this paper is adopted from Aghion and Howitt: Erauskin, 2015:p71-79 and it takes into consideration the production function of each firm which is of the form:

$$y_i = \bar{B} k_i^\alpha L_i^{1-\alpha}$$

Where  $k_i$  and  $L_i$  are the individual firm  $i$ 's own employment of capital and labour respectively,  $\bar{B}$  is the aggregate productivity. Aggregate productivity is dependent upon the total amount of capital that has been accumulated by all firms, thus:

$$\bar{B} = B_0 \left[ \sum_{i=1}^N k_i \right]^\theta$$

Where  $\theta > 0$  and reflects the extent of the knowledge externalities generated among firms.

It is assumed, for simplicity that  $L_i = 1$  for all  $i$ .

Let  $K$  denote aggregate capital stock and  $Y$  to denote aggregate output flow we have:

$$K = \sum_{i=1}^N k_i \quad \text{and} \quad Y = \sum_{i=1}^N y_i$$

Due to perfect competition all firms face the same technology and the same factor prices, they will hire factors in the same proportions, such that:

$$k_i = \frac{K}{N} \quad \text{for all } i$$

This in turn implies that in equilibrium

$$\bar{B} = B_0 K^\theta$$

Hence individual firm  $i$ 's outputs are all equal to:

$$y_i = B_0 K^\theta \left(\frac{K}{N}\right)^\alpha$$

Therefore aggregate output is:

$$Y = NB_0 K^\theta \left(\frac{K}{N}\right)^\alpha$$

This can be written as:

$$Y = AK^{\alpha+\theta}$$

Where  $A = B_0 N^{1-\alpha}$

Assuming a constant savings rate, this generates the capital accumulation as in Solow-Swan and Harrod-Domar Model.

$$\Delta K = sAK^{\alpha+\theta} - \delta K$$

Where  $\Delta K$  is the change in capital stock over time,  $\delta$  is the depreciation coefficient of capital and  $s$  is the marginal propensity to save which is assumed to be constant..

The growth rate of capital stock which also translates to the growth of the economy will therefore be given by:

$$g_K = \frac{\Delta K}{K} = sAK^{\alpha+\theta-1} - \delta \dots \dots \dots (1)$$

Three cases can be analysed from the equation (1):

1.  $\alpha + \theta < 1$

In this case, externalities derived from knowledge spillovers will not be strong enough to offset the effect  $1 - \alpha$  of decreasing returns to individuals' capital accumulation, and the long-run growth rate is zero (Aghion and Howitt: Erauskin, 2015:75).

2.  $\alpha + \theta > 1$

In this case, learning externalities are strong that the aggregate economy experiences an ever-increasing growth rate. This is known as the "explosive growth" (Aghion and Howitt: Erauskin, 2015:75).

3.  $\alpha + \theta = 1$

In this case, learning externalities exactly compensate decreasing returns to individual capital accumulation, so that the aggregate production function becomes an AK function, shown as:

$$Y = AK$$

Thus the aggregate growth rate becomes:

$$g = \frac{\Delta K}{K} = sA - \delta \dots \dots \dots (2)$$

Equation (2) is identical to the Harrod-Domar growth rate and is obtained as the long-run growth rate in a model with substitutable factors and full market clearing. As capital increases, output increases in proportion, even though there is continual full employment of labour because knowledge automatically increases by just the right amount (Aghion and Howitt: Erauskin, 2015:75).

### 3. Relevance of the Model to Developing Countries

**a. Growth in capital accumulation:** To a greater extent, the model is relevant to a developing country, in that: in most developing countries, there is usually excessive labour force and low levels of capital stock. The AK model advocates for an increase in capital accumulation which would consequently increase the growth of an economy and hence reduce unemployment. Most of the labour in developing countries is being underutilised in the agricultural sector. In order to ameliorate the challenge of low industrialisation, the government should ensure an increase in capital through such undertakings as promoting savings which will then result in investment.

In Zimbabwe, for example, the economy is mainly dependant on the agricultural sector with about 67% of the population directly involved in farming activities in which many people are under employed. Policies that encourage the accumulation of physical capital would be welcome as this would in principle encourage the growth of industries (especially agro-based industries) and increase employment of those previously under

employed and unemployed.

**b. Learning by doing theory:** According to Arrow (1962), learning by doing theory, an increase in a firm's capital stock leads to a parallel increase in its stock of knowledge. An increase in the physical capital stock will simultaneously lead to higher productivity of labour in a developing country such as Zimbabwe. This then results in efficiency in production and allocation of resources within the economy. It is the assertion of the AK model by Frankel (in Aghion and Howitt, 2010) that economic growth depends on efficiency and thrift. Learning by doing also improves technological progress and this would result in the increased marginal product of capital which will counteract diminishing marginal product of capital.

**c. Technological progress:** Developing countries also face excessive balance of payments deficits due to the exportation of unprocessed raw materials at lower prices and importation of relatively expensive imports. Accumulation of capital, coupled with technological progress would lead to industrialisation which would in turn lead to economic growth and improved standards of living. From the model, since

$$g_K = \frac{\Delta K}{K} = sAK^{\alpha+\theta-1} - \delta$$

increase in the technological coefficient  $A$  directly leads to

economic growth holding other things constant.

Technology levels are very low in Zimbabwe, when compared to developed countries. Since technology in this model is assumed to be endogenous, industrial innovations and funding of science education may also be implemented to improve technology. Initiatives such as the STEM Programme which was launched in 2016 are great strides in this regard.

Capital accumulation through foreign direct investment and public private partnerships are fundamental in resolving problems currently bedevilling the Zimbabwean economy. Power shortages, dilapidated infrastructure and low competitiveness of the products are some of the problem causing massive company failures in the economy. An injection of capital will lead to favourable outcomes chief among them being reduced unemployment and sustainable economic growth.

#### 4. Critique of the Model

**a. Low rate of savings:** However, the model may be irrelevant to a developing country in that: the levels of per capita income are very low, when compared to developed countries. The marginal propensity to save is also very low since most people would be consuming all their income. In such a scenario, savings which are necessary for capital accumulation tend to be very low.

In Zimbabwe, the majority of the labour force is found in the informal sector, which is characterised by low levels of income. Most of those who are formerly employed, earn way below the poverty datum line. Saving some funds especially through the banking is seen as a luxury rather than a necessity and some people are actually caught up in a debt circle in endeavour to provide for their families. The model would therefore be less effective due to depressed capacity for capital accumulation.

Besides low incomes, the savings through the formal channels are affected by the public's low levels of confidence in the banking sector as well as high bank charges. Due to policy inconsistencies, with regard to the financial sector and the continued closure of financial institutions, the savings are bound to be very low. The Government has continued to actively participate in the financial sector controlling even the activities of the Central Bank to the discouragement of savings.

**b. Lack of specific prescriptions:** Some scholars argue that the model is too generalised in nature (Cesaratto, 2008). There are no specific prescriptions which are adequately designed to match the conditions that prevail in the economy. For example, it asserts that the knowledge spill overs from the accumulation of capital should just move at the same rate as the marginal diminishing rate of capital. This in practice might prove difficult to measure or predict since the spill over are just unintended benefits from the continued use of capital.

**c. Inadequacy of the variables:** The model also leaves out other important factor to economic growth such as political stability, human rights, good institutions and the protection of property (Cesaratto, 2008). These are pertinent issues in most developing countries and failure to include them in the model for economic growth would have a negative bearing on the intended results.

#### 5. Conclusion

In conclusion, the AK model by Frankel (1962) is relevant to developing countries as it helps to combat the major impediments to economic growth faced in these countries such as low productivity, high unemployment, low levels of investment and dilapidated infrastructure. Capital accumulation will also bring positive externalities through learning by doing effects. The model might nevertheless fail to bring desired results since it does not consider other factors such as political instability and good institutions which equally contribute to economic growth.

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