



Munich Personal RePEc Archive

# **An Analytical Theory of Labor Supply in Africa**

Van, Germinal

George Washington University

7 June 2020

Online at <https://mpra.ub.uni-muenchen.de/100951/>  
MPRA Paper No. 100951, posted 19 Jun 2020 02:51 UTC

# **An Analytical Theory of Labor Supply in Africa**

By

Germinal G. Van

[germinalvan27@gwmail.gwu.edu](mailto:germinalvan27@gwmail.gwu.edu)

The George Washington University  
2121 I Street, NW  
Washington, D.C. 20052  
(202)730.5913

# **An Analytical Theory of Labor Supply in Africa**

## **Abstract:**

The functioning of labor supply in Africa is substantially different from the one in developed countries. Most African economies remain heavily agricultural, which means that their economy is primarily based on the exportation and importation of commodities. However, an economy based on natural resources and the use of commodities generate a stagnated labor supply in the long run. Labor supply, however, expand more consistently in an economy that is based on human resources. This paper has two purposes. The first objective is to theoretically demonstrate how relying on natural resources as the primary basis of economic development could hamper the expansion of labor supply in an economy which is in the midst of structural transformation. The second objective is to substantiate that human resources as the primary basis of economic development, enable the expansion of labor supply whether it is in an open or a close economy.

**Keywords:** Labor Supply, Economic Growth, Economic Development, Mathematical Economics, Development Economics, Macroeconomics

## **Introduction**

In this twenty-first century, it is clear that, except for North Korea, and perhaps few other countries, most countries do have an open economy including the People's Republic of China. It suggests that most countries do engage in free-trade and other exchange mechanisms. As the majority of countries trade with each other, it is limpid that the world is now a globalized economy where everything intermingles with one another. Our analysis is not to focus on the development of current economic systems in the sense of whether they are opened or closed economies. That is not the goal. A great majority of African economies are open economies. The purpose is to theoretically evaluate the development of labor supply in African economies within two different economic structures.

The first economic set in which we aim to assess the development of labor supply, is an economic system based on commodities and natural resources. In this kind of economic structure, the system is primarily based on the agricultural commodities and natural resources. In this such structure, labor supply has the propensity to stagnate steadier because the factors of production which stimulate and contribute to economic growth in such system are exogenous rather than endogenous. However, in the second economic set, which is an economic system whereby its structure is based upon human resources, labor supply expands steadier because the factors which enable its expansion as well as that of economic growth, are endogenous.

Our aim, in this analysis, is to theoretically demonstrate that labor supply in most African economies could be significantly improved and expanded sustainably if their economic structure relies on endogenous factors such as human capital rather than exogenous factors such as commodities. In this paper, we will use a set of equations to introduce and substantiate our theory.

## **I. Labor Supply in a commodity-based economy**

The African continent is a vast land extremely rich in commodities and endowed in natural resources. Indeed, Africa has many natural resources in many parts of the continent. For example, the Sahara Desert, although it is a desert, it is endowed with precious minerals and subsoil assets such as oil, uranium, bauxite, manganese, iron...etc., which are exploited and utilized for the purpose of manufacturing cars, planes, boats, and nuclear weapons. The Nile, the Zaire, the Niger, and the Zambezi Rivers; the Victoria, Tanganyika, and Chad Lakes, are all-natural resources which have provided great use for commercial purpose and generated economic value. In short, African economies possess an abundance of natural resources to create growth. Yet, African economies are struggling to grown on a long-term basis. The fundamental reason for which African economies based on commodities are struggling to expand is because the supply of labor in these economies stagnates over time.

In economies that primarily rely on the utilization of commodities and natural resources, labor supply is not based upon the number of individuals who participate within the economy, but it is grounded upon the price of commodities. Wages are determined by the price of commodities and skills do not play a relevant role in how labor supply could be expanded. Logically, in such economy, agricultural activities are the primary and main form of economic activities which create value.

Within an economy that relies on commodities to increase its output and to enhance its development, the major agents who participate in the activities of the economic system are farmers and manufacturers. Evidently, to become a farmer or a manufacturer, one needs not to be necessarily skilled in order to produce. In the rural areas of Africa, the economic activities are mainly dominated by agriculture and the utilization of commodities. In these areas, farmers are usually individuals who do not have a high level of education since they started plowing the land from an early age on. They generally do not need to follow a rigorous educational training in order to become a farmer. The value they bring to agriculture or to the manufacturing of commodities is consequently not based on the knowledge of agriculture or manufacturing but on their physical ability to perform the job. It is important, moreover, to fathom that in an economic system based on the use of commodities and natural resources, wages are based upon the price of commodities and the price of commodities are generally determined by either the government if it is the public sector, or the fluctuations of the market if it is the private sector. African farmers and manufacturers earn their wages based on the output of commodities produced.

Labor supply in a commodity-based economy is grounded upon three major axioms: profit, the price of commodities, and the wage of the workers who produce these commodities. The price of commodities is determined by two factors, which are the commodity produced per unit, and the of commodity sold per unit. The summation of these two factors, in addition with the profit made of the commodity sold on aggregate, determines the wage of the worker who produce these commodities. Moreover, wages are determined by two factors as well, which are the effective labor

input per worker times the capital per unit of efficiency labor. Let us translate this process mathematically as the following equation:

$$L = \pi + [\sum P (p_i \times x_i) \times \sum w (\lambda \times \kappa)] \quad (1)$$

where (L) represents the total labor supply of the economy; ( $\pi$ ) represents the profit made on the total commodities sold per unit; ( $\sum P$ ) represents the total price of commodities; ( $p_i$ ) represents the commodity produced per unit; ( $x_i$ ) represents the commodity sold per unit; ( $\sum w$ ) represents total wage per worker; ( $\lambda$ ) represents the effective labor input per worker, and ( $\kappa$ ) represents capital unit of efficiency labor.

It is important to understand that, in a commodity-based economy based, labor supply expands only when the price of commodities increases. It suggests that an elasticity in the quantity of commodities supplied for by sellers, is necessary. That being said, the price elasticity of supply increases the demand for consumption for these commodities, and the increase in the demand for consumption subsequently increases wages because there are more commodities that are being produced. Let us illustrate this concept with the following model:

Labor Supply in an African commodity-based economy in the short-run

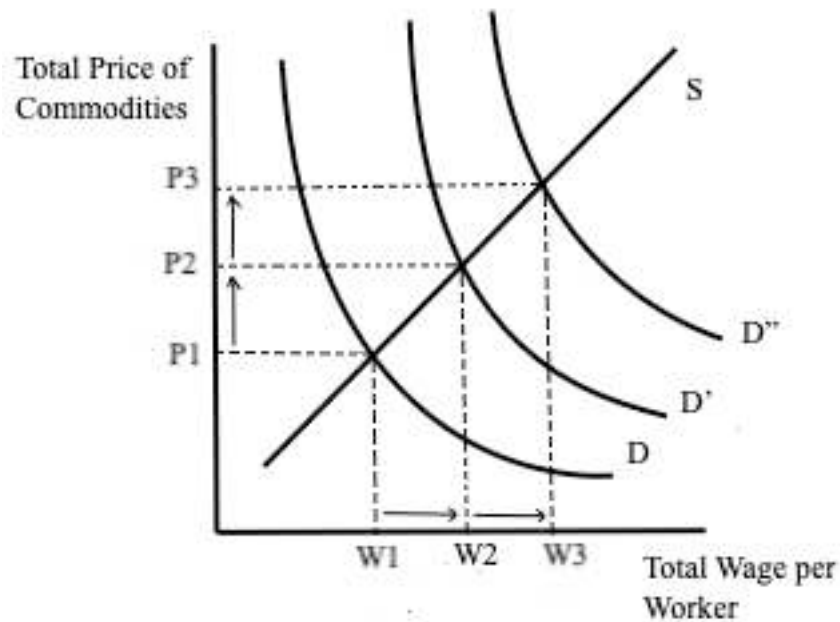


Figure 1

In the diagram, we clearly see that wages increase insofar as prices surge.  $P_1, P_2, P_3, W_1, W_2,$  and  $W_3$  accordingly represent the change of price and wages within the timeframe of three years. The change in the percentage of quantity and price indicates three essential elements. The first element indicates the availability of resources necessary for production, the second element reveals the mobility of factor and the third element specifies the time responsiveness. For the first element, we see that the availability of resources to produce these commodities is abundant. The more resources there are, the more it could be supplied on the market at an affordable price for consumption. For the second element, which is the mobility of factor, we can observe from the diagram that the factors of production are easily available and if a producer producing one good can switch their resources and put it towards the creation of a product in demand, then it can be said that the price elasticity of supply is then relatively elastic.<sup>1</sup> The third element, and probably the most preponderant of all, is time responsiveness. The more time a producer has to respond to price changes the more elastic the supply.<sup>2</sup> Normally, supply is more elastic in the long-run than in the short-run for producers of goods, since it is generally assumed that in the long-run all factors can be utilized to increase supply, whereas in the short-run only labor can be increased, even then changes may be prohibitively costly.<sup>3</sup>

However, the reason why labor supply stagnates in the long-run within a commodity-based economy is because the price of commodities falls as they become scarce. Consequently, the elasticity of supply shifts into an elasticity of demand as the following diagram shows:

Labor Supply in an African commodity-based economy in the long-run

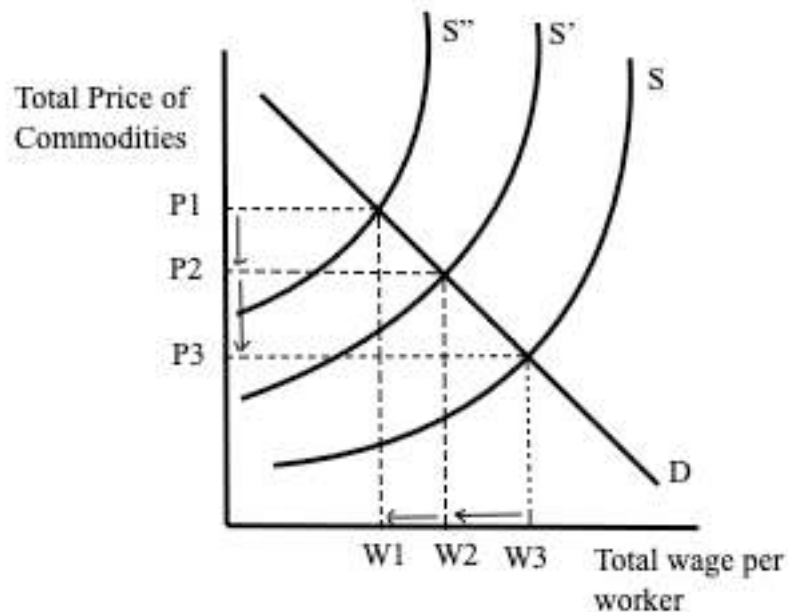


Figure 2

<sup>1</sup> Case, K; Fair, R. *Principles of Economics* (5<sup>th</sup> edition), (1999).

<sup>2</sup> Ibid.

<sup>3</sup> Adams, Walter, *The Structure of the Indian Industry* (8<sup>th</sup>. Edition). (1990). MacMillan Publishing Company. ISBN 0-02-300771-0.

As we observe the second diagram, we see that wages decrease as prices decrease. If prices decrease, it signifies that there are no more profits made upon the commodities sold. There could be many reasons for which the price of commodities could fall. One reason could be the fact that when African countries deal or negotiate with developed countries on the price of commodities that need to be sold, the bargaining power is not adequate. Developed countries have a higher bargaining power than African countries, therefore they can impose a price set on commodities that African governments must have to agree to otherwise no transaction could be proceeded.

The commodities sold are sold at a price below the price that is supposed to match the level of output. Therefore, the profit that was meant to be generated from the sale cannot be used as a salary to pay the workers who produce the commodities. The logical result is that wages stagnate, and their stagnation leads to the stagnation of labor supply. Individuals seeking employment do so because they expect their wage to increase over time. If wages stagnate, workers will start quitting their job because the ratio between ( $\lambda$ ) and ( $\kappa$ ) is not proportional.

## II. Labor Supply in a non-commodity-based economy

Labor supply in a non-commodity-based economy, evidently, operates very differently from labor supply in a commodity-based economy. In a non-commodity-based economy, the supply of labor is based upon human capital. Human capital is the skills, knowledge, and experience possessed by an individual or population, viewed in terms of their value or cost to an organization or country.<sup>4</sup> In short, human capital is the sum of the intangible resources within the human mind that creates economic value. As labor supply in a non-commodity-based economy is based upon human capital, the wage of the worker is therefore based on his skills rather than the commodity sold. Let us clarify that a non-commodity-based economy does not mean that there are no commodities sold, it principally means that the amount of commodities sold, does not affect the wage of the worker regardless of its price since the worker's wage is not based on the price of the commodity but on his skills.

There two ways for an individual to acquire the skills needed in order to increase his competitiveness on the labor market. The first way, and the most fundamental one, is through formal education, and the second way is through on-the-job training. Either way, the worker acquires primarily a theoretical set of skills through an educational training whether it is in a conventional academic institution or through vocational training also known as apprenticeship. Unlike conventional academic education, vocational training is more specialized for a very specific profession. For example, an individual who seeks to become a barber, a cosmetology instructor, a plumber, an electrician, or a hotel manager; needs to be trained in a special school that strictly focuses on that kind of endeavor in order to create economic value. Without a specific skillset, the prospective worker cannot be competitive on the labor market.

The particularity about human capital is that it is intangible, which means that it never becomes scarce as knowledge and skills are infinite since they are embodied within the human mind. Knowledge and skills can be used limitlessly because they can be reproduced indefinitely.

---

<sup>4</sup> Godin, Claudia, "Human Capital" Department of Economics Harvard University and National Bureau of Economic Research. (2014). Article.



We shall note that in a non-commodity-based economy, the service sector is essentially more prevalent than the manufacturing and agricultural sector because services do not require the manufacturing nor the selling of commodities but only the use of special skills to provide a quality service to the consumer. Therefore, in such economic system, the supply of labor expands instead of stagnating.

Nonetheless, in a commodity-based economy, the agricultural and the manufacturing sectors are the sectors in which most of the economic activities take place. The majority of African economies are mainly based on their agricultural and manufacturing sectors although these economies have an important human capital. The fundamental problem is that the human capital of African countries that have a commodity-based economy, is not educated enough in the sense that it does not have a high literacy rate. That being said, a society that has a low literacy rate is doomed to have a slow and short industrialization and economic growth.

As it was aforementioned, the supply of labor in a non-commodity-based economy expands sustainably than in a commodity-based economy. In such economic system, wages are not based on the price of commodities but on the skills of the labor force. Logically, wages increase as the skills of the worker increase over a given period of time. That being said, labor supply in a non-commodity-based economy is based upon three major axioms. The first axiom is output, the second axiom is wages, and the third axiom is human capital. The output axiom is the aggregate production of the labor force. The wage axiom encompasses three variables which are the capital per worker, the capital per unit of efficiency labor, and output of efficiency labor. The human capital axiom encapsulates two variables which are the gross investment in human capital and human capital per worker. These axioms will give us the general following equation:

$$L = Y [(\sum W (\kappa \times ki \times \lambda)) \times (\sum H (I^H + h))] \quad (2)$$

where (L) represents the supply of labor; (Y) represents output, ( $\sum W$ ) represents the summation of the wage axiom; ( $\kappa$ ) represents the capital per unit of efficient labor; ( $ki$ ) represents the capital per worker; ( $\lambda$ ) represents output per unit of efficient labor; ( $\sum H$ ) represents the summation of the human capital axiom; ( $I^H$ ) represents the gross investment in human capital; and (h) represents the human capital per worker. Let us emphasize that the equation ascertained above is not exhaustive. In fact, a second linear equation is mandatory in order to determine the essential variables that constitute the axiom of human capital.

We established that the human capital axiom is based on the two main variables which are ( $I^H$ ) and (h). These two variables are also the primary axioms of the different variables that established the foundation of human capital. As it has been elaborated in the previous paragraphs of this analysis, what determines human capital is the skills and knowledge that an individual possesses in order to create economic value. These skills and knowledge could be acquired either in school or on the job. Let us hypothetically assume that two workers who have been working for the same firm for the past three years and started at the very same time and at the very same position with no prior work experience, will not earn the same wage. The worker with no substantial education (less than a high school degree) will logically earn less than the one with an education (high school degree or higher) because it is assumed that his critical thinking is not

developed enough to solve empirical problems compared with the worker with an education who learned how to think critically by learning the theoretical framework of solving real-problems. Yet both workers will see their skills increasing as well as their wages because they both acquired substantive work experience over time. Nonetheless, the worker with no substantial education will still earn less than the one with an education although he has developed his skills and critical thinking by learning on the job. But the worker with a substantial education has also furthered his skills through the experience he gained on the job in addition of his ability to think critically. In short, education is an important variable within (h). Both workers, regardless of their individual wages, do bring an economic value to the firm by increasing the firm's output. In addition to education being an essential variable within the human capital per worker axiom (h), output per unit of human capital and the human capital per unit of efficiency labor, play an important within the gross investment in human capital axiom ( $I^H$ ). These two variables are the metrics upon which an investment in human capital could be made in order to determine the impact of labor productivity. The two axioms ( $I^H$ ) and (h) could be mathematically written as the following:

$$I^H = \gamma + hi^2 \quad (3)$$

$$h = \ln x^0 (\tau + 0) + \ln x^1 (\tau + 0) \quad (4)$$

For equation (3), ( $I^H$ ) represents the gross investment in human capital; ( $\gamma$ ) represents the output per unit of human capital, and ( $hi^2$ ) represents the human capital per unit of efficiency labor. For equation (4), (h) represents the human capital per worker, ( $\ln x^0$ ) represents the worker with no education and no prior work experience; ( $\ln x^1$ ) represents the worker with a level of education but with no prior work experience. ( $\tau + 0$ ) represents time at the moment they started the job. Therefore, human capital could be expressed as the following equation:

$$H = (\gamma + hi^2) + (\ln x^0 (\tau + 0) + \ln x^1 (\tau + 0)) \quad (5)$$

Now that we have established equations (3) (4) and (5), equation (2) could be considered as the definitive formula of labor supply in a non-commodity-based economy and could be written as the following:

$$L = Y [(\sum W (\kappa \times ki \times \lambda)) \times (\sum H ((\gamma + hi^2) + (\ln x^0 (\tau + 0) + \ln x^1 (\tau + 0))))] \quad (2)$$

As we have determined equation (2), which is the mathematical formulation of labor supply in a non-commodity-based economy, we are now going to illustrate the supply of labor in a form of a mathematical model. We have asserted that in a non-commodity-based economy, wages are based on the skills of the workers. Wages increase as labor productivity increases. Labor productivity is the human capital axiom, which encapsulates the variables of gross investment in human capital ( $I^H$ ), and the human capital per worker (h). In addition to the augmentation of labor productivity,

output also increases wages because the higher is the output, the more profit the firm makes, and that profit could be added as a bonus upon the wage of the worker. Labor supply in a non-commodity-based economy looks like the following diagram:

Labor Supply in a non-commodity-based economy

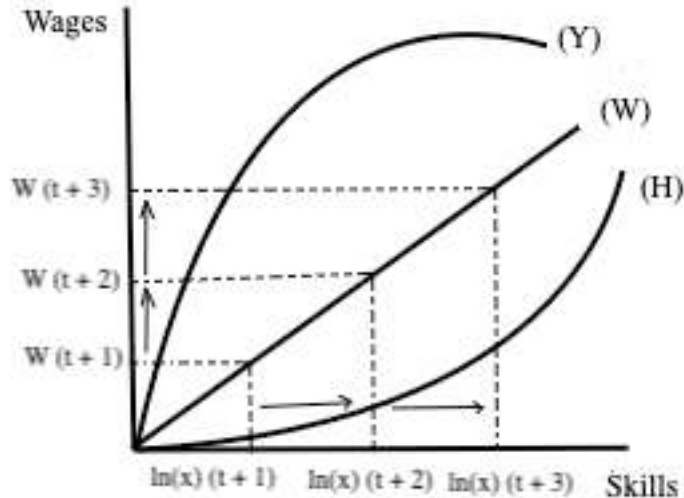


Figure 3

In this diagram, although it is not written,  $W(t+n)$  indicates the wage of the worker at a given time period within of a year as  $(t)$  represents the given time period and  $(n)$  represents the year in which the wage is being compensated to the worker. That being said,  $(W(t+1))$ ,  $(W(t+2))$  and  $(W(t+3))$  indicate the surge of wages within a three-year period. As we observe the diagram, the output, wage, and human capital curves increase concurrently as the skills of the workers progress over time. The more skilled a worker becomes over a given period of time; the more efficient labor productivity becomes. As the efficiency of labor productivity increases, aggregate output increases as well because the resources that are used for increasing production are allocated efficiently.

## Conclusion

Throughout this analysis, we have distinguished the structure and functioning of labor supply in two different economic systems in Africa. As it was aforementioned at the commencement of this analytical work, we have explicated that most African economies are based on their commodities and natural resources rather than their human capital. Although the human capital in many African countries remains young, the literacy rate and the lack of proper education have penalized these economies to rely on its men instead of its commodities.

The fundamental conundrum with a commodity-based economy is that in such system, labor supply is not sustainable because wages are determined by the price of commodities sold. It means that a worker in such system will earn a wage if no commodity is sold. If the quantity of commodity sold is insufficient, the worker's wage may barely make the level of subsistence. The two main sectors that engine most African economies are the agricultural and the manufacturing sectors. The agricultural sector is the sector in which commodities are gross products and the manufacturing sector is the sector that transforms these gross products into finished ones for direct consumption. Commodities become scarce the moment that the demand for its consumption exceeds its propensity to supply. If commodities become scarce, those who worked on the production of commodities cannot earn their wage on a regular basis since the fluctuations of the market will affect the price of the commodity. Consequently, labor supply in such system will eventually stagnate and potentially decline,

Within a non-commodity-based economy, we have analyzed that it does not really matter whether commodities are sold or not because the wage of the worker in that system is based on his skills and efficiency. In that system, education plays a quintessential role in determining the competitiveness of the worker on the labor market and his efficiency in labor productivity. As knowledge and skills are intangible, these resources are used limitlessly. In a non-commodity-based economy, labor supply expands because the workforce is literate and educated enough to apply its critical thinking in producing output. Logically, the service sector is the most dominant sector in such system because individuals use their knowledge, judgement, and skills to provide quality service for consumption. The African countries that rely on such system are far more advanced and far more industrialized than the agricultural ones. In a non-commodity-based economy, labor supply does not exhaust because the resources used in this system are intangible.

## References

1. Case, K; Fair, R. *Principles of Economics* (5<sup>th</sup> edition), (1999).
2. Ibid.
3. Adams, Walter, *The Structure of the Indian Industry* (8<sup>th</sup>. Edition). (1990). MacMillan Publishing Company. ISBN 0-02-300771-0.
4. Godin, Claudia, “Human Capital” Department of Economics Harvard University and National Bureau of Economic Research. (2014). Article.