

Analysis of FDI: impacts on total factor productivity in Madagascar.

Autor: TAKIDY Manamihaja Obin¹

Email : Obinmanamihaja@yahoo.fr

Co-Autor : Luc Narda Randrianahasina², Joseph Fanor², Freddie Mahazoasy³

Institutions to which the autors belong :

¹ *University of Antananarivo, EAD2 Sciences Economiques*

² *University of Antananarivo, EDA : Rouages des Sociétés et Développement (ROSODEV)*

³ *University of Antsiranana, Departement of Laws, Economics, Management and Political Sciences*

e-mail: f_mahazoasy@yahoo.com

Abstract

This article is aiming at bringing its contribution to current debates on Madagascar's strategy for enhancing its industrial productivity. Indeed, generally speaking, productivity, meaning getting more production while using a minimum input quantity in terms of raw materials, energy and time, is one of the best ways in making industry reconcile with environmental integrity. Its main objective is to closely look at the impacts of FDI on the national economy's total factor productivity (TFP) during the time spanning from 1988 to 2020. The chosen methodology consists in estimating, first, the TFP using a relationship stemming from the Cobb-Douglas model, and, then, the long-term equilibrium relation with the VECM method. The result shows that from 1988 to 2020, inward FDI in Madagascar acts negatively on total factor productivity, with a negative coefficient minus 0.4804. On the other hand, any increase in TFP is accompanied by an improvement in human capital in Madagascar, justified by the positive coefficient 2.4067. The high capital intensity in the extractive industries related FDI contributes only very weakly to productivity growth.

Keywords : TFP, FDI industries, Human capital, VECM method

1.Introduction

Foreign direct investment (FDI) is at the center of the industrialization strategies of developing countries. During the Madagascar's emergence forum— held at the International Conference Center (CCI), in Ivato, in October 2022, participants tend to prioritize a national development strategy based on heavy industry, especially mining,. However, Akira Suehiro (2008) shows that, based on the experiences of emerging countries, industrialization process needs to start with light industry. This strategy is known as the “catch-up industrialization”.

Being aware of the importance of FDI in terms of economic growth, Madagascar has spared no effort since 2000. The weight of FDI related to extractive sector has increased since 2007. In 2009, its FDI stock represented the equivalent of 74% of the whole, valued at 4,605 billions Ariary (BCM/INSTAT, 2009). This is thanks to the contribution of FDI generated by both QMM and Dynatec mining projects. However, the extractive industries have been duly impacted by the Covid19 crisis. The tax contribution was estimated as 4.62% of total revenue in 2018, which amounted 92.18 billion Ariary, compared to 1.07% in 2020 (EITI Madagascar, 2022). On the other hand, the manufacturing industry generally occupies between 40 to 70% of total FDI employment (INSTAT, 2020).

Analyzes of industrial dynamics have long followed two (02) distinct voices (Malerba, 2006). Its two (02) types of analysis, according to Jean-L. Gaffard (2006), on the one hand focused on the entries and exits of firms, with market incentives for innovation, and on the other side, the emphasis on the specificity of technologies and learning conditions. At the theoretical and empirical level, the effects of FDI on growth are manifested, either directly through the flow of capital that they generate, or indirectly through productivity in different sectors, following the transfer of knowledge and technology (Jamal Bouoiyour et Al, 2001).

This article contributes to enrich the current debates on the development of innovative industrial policies for Madagascar. Its objective is to examine the impacts of FDI on the total factor productivity of the national economy from a long term equilibrium relationship term by the VECM method. A descriptive analysis made it possible to study the evolution of labor productivity of FDI as a function of main production factors (FDI capital stock and employment), then an analysis of the link between the labor productivity of FDI and total factor productivity. The decomposition of Mc Millan and Rodrick (2011) facilitates the understanding of sources of labor productivity growth from FDI. It is worth it to underline the fact that TFP analyses is critical for building strategy for long term growth in developing countries which, in contrast with the case of industrialized ones, are still heavily struggling in optimizing the quality of economic environment, whether it is global or sectoral. This is, indeed, particularly true for building green growth strategy.

2.Methodology

To empirically analyze the impact of FDI on total factor productivity (TFP), the starting point is to estimate total factor productivity. To do this, we use growth accounting method, proposed by Solow (1957), in which growth of an economy can be broken down into growth of several factors used in the production process. To this end, we consider the following production function:

$$Y_t = F(A_t, K_t, L_t) = A_t \cdot K_t^\alpha \cdot L_t^\beta \tag{A.1}$$

where A_t represents neutral technical progress in the Hicks sense, with $\alpha + \beta = 1$. A_t is also known as the total factor productivity (TFP). The terms K_t and L_t correspond, respectively, to capital stock and number of workers.

By differentiating the logarithm of the production function (A.1) with respect to time, we obtain:

$$\frac{\dot{Y}_t}{Y_t} = \frac{\dot{A}_t}{A_t} + \frac{\partial Y_t}{\partial K_t} \frac{K_t}{Y_t} \frac{\dot{K}_t}{K_t} + \frac{\partial Y_t}{\partial L_t} \frac{L_t}{Y_t} \frac{\dot{L}_t}{L_t} \quad (\text{A.2})$$

By inserting α , β , equation (A.2) can be written:

$$\frac{\dot{A}_t}{A_t} = \frac{\dot{Y}_t}{Y_t} - \alpha \cdot \frac{\dot{K}_t}{K_t} - \beta \cdot \frac{\dot{L}_t}{L_t} \quad (\text{A.3})$$

where the notation \dot{x}_t , for the variable $x = A, Y, K$, and L , means the derivative of the variable considered with respect to time t .

By denoting g_x the growth rate of the variable x , with $x = A, Y, K, L$, we can rewrite expression (A.3) as follows:

$$g_A = g_Y - \alpha \cdot g_K - \beta \cdot g_L$$

where $\alpha \cdot g_K$ and $\beta \cdot g_L$ represent respectively the contributions of the growth of capital and labor factors to the growth of national GDP; the term g_A corresponds to the fraction of GDP growth that is not attributed to the accumulation of production factors, namely capital and labor. g_A is therefore the total factor productivity growth.

The mathematical modeling of the Cobb-Douglas production function (A.1) allows total factor productivity to be expressed as a geometric average of the apparent products of labor (Y/L) and capital (Y/K) weighted respectively by α and β , remembering that $\alpha + \beta = 1$:

$$A_t = \left(\frac{Y_t}{K_t}\right)^\alpha \left(\frac{Y_t}{L_t}\right)^\beta$$

A simple relationship between labor productivity and total factor productivity can be written as:

$$\frac{Y_t}{L_t} = A_t \cdot \left(\frac{K_t}{L_t}\right)^\alpha \quad \text{Or} \quad \ln\left(\frac{Y_t}{L_t}\right) = \alpha \cdot \ln\left(\frac{K_t}{L_t}\right) + \ln A_t,$$

This mathematical relationship explains that the evolution of labor productivity is a function of capital deepening (capital stock per capita), efficiency gains and technical progress.

In addition, it is possible to analyze the sectoral dynamics of Madagascar's FDI, based on the method of decomposition of apparent labor productivity. Mc. Millan and Rodrick (2011) break it down as follows:

$$\Delta w = \sum_{i=1}^n \Delta w_i * \theta_{i,t_0} + \sum_{i=1}^n \Delta \theta_i * w_{i,t_1};$$

With Δw_i and $\Delta \theta_i$ being, respectively, the variation in the value added per worker and the variation in the share of employment in sector i between periods t_0 and t_1 , w_{i,t_1} the value added per worker in

the sector i at t_1 and θ_{i,t_0} the share in sector i in total employment at t_0 . The first term of the decomposition represents the intra-sectoral evolution, underlying the growth of total factor productivity, while the second makes it possible to capture the effects on productivity, linked to an intersectoral reallocation of labor artwork. Intersectoral dynamics remain the main driver of productivity and sustainable growth.

After calculating total factor productivity (TFP), the next step is to estimate the impact of FDI on TFP. The methodology adopted in this work is based on the application of the cointegration test and the estimation of the VECM (Vector Error Correction Model) where the dependent variable is the TFP and the explanatory variables are those mentioned below. The data comes mainly from the World Bank database over a period of time spanning from 1988 to 2020.

$$\text{LOGTFP}_t = c + \alpha_1 \text{LOGIDE} + \alpha_2 \text{LOGKH} + \alpha_3 \text{LOGPPublic}$$

With :

- LOGPTF being the logarithm of total factor productivity which represents the variable to be explained. TFP is useful for the analysis of competitiveness, it measures technical progress in the use of the combination of capital and labor factors.
- LOGIDE being the logarithm of foreign direct investment as a percentage of GDP. FDI is considered one of the channels of transmission of technology and know-how from foreign firms to local companies and can therefore influence TFP.
- LOGKH being the logarithm of human capital stock is measured by the primary school completion rate. It is accepted that the higher the level of education, the more growth is positively affected. Thus, technological progress is often closely linked to education, especially in the case of higher education.
- and LOGPPUBLIC, the logarithm of government final consumption expenditure as a percentage of GDP as a measure of the size of the public sector.

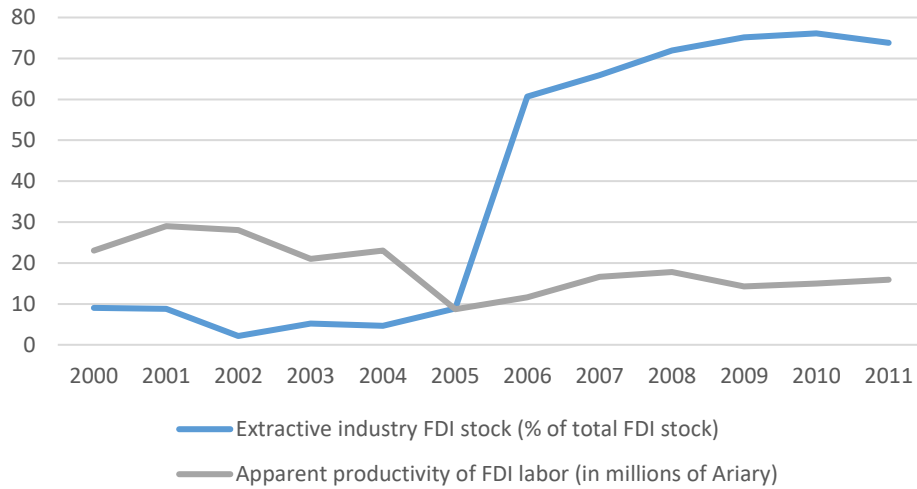
3. Results

Structural evolution and labor productivity of the FDI sector

The stock of FDI in Madagascar was entirely dominated by the industrial branches of “extractive” and “manufacturing” activities. These occupy on average 75.12% between 2006 and 2011. Indeed, the FDI flow of 493.2 billion Ariary, mainly the current account contribution of 292.6 billion Ariary, led to an increase in the growth rate of FDI stock of 112.95% in 2006 compared to 2005.

It appears from Figure 1 below that this high capital intensity in the extractive industries since 2006 has not been accompanied by a satisfactory improvement of the growth of labor productivity. Thus, FDI labor productivity only weakly reacts to the shock of capital accumulation in the extractive industry.

Figure 1 : Evolution of Apparent productivity of FDI labor and Extractive industry FDI stock



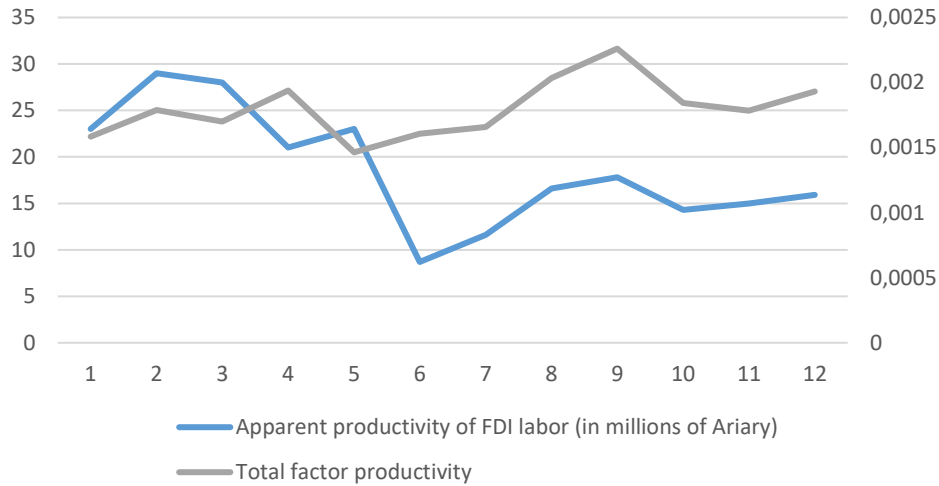
Source: Author on xlstat software, 2023. Based on INSTAT/BCM 2000-2011 data

Apart from this high capital intensity at the level of extractive industries, the activities of FDI manufacturing industries remain the largest provider of employment in the industrial sector. Between 2000 and 2011, the structure of employment by branch of activity shows that “manufacturing activities” industries occupy, on average, 53% of employment at the level of FDI companies (INSTAT/BCM 2000-2011).

Total factor productivity and labor productivity

The contribution of large capital accumulation, from 2005 to 2008, created a positive impact on the growth of total factor productivity of the national economy. The latter experienced a substantial increase of 39.01% in 2007, compared to that of 2004. This coincides with the significant mining investments during this period. Nonetheless, since the 2009 crisis, growth in total factor productivity has generally been negative, signifying deterioration of technical progress of innovation. Figure 2 shows that there is a significant link between the total factor productivity of the national economy and the labor productivity of FDI companies.

Figure 2 : Evolution of Apparent productivity of FDI labor and Total factor productivity



Source: Author, 2023. From BCM/INSTAT 2000-2011 data

Between 2005 and 2008, the average growth in total factor productivity of 11.69% was accompanied by an average increase of 30.22% in the apparent labor productivity of the FDI sector. The analysis of the decomposition of FDI labor productivity growth below partly confirms this connection.

Table 1: Breakdown of labor productivity growth according to Mc. Millan and Rodrick (2011)

| Year | Growth in apparent labor productivity (in billions of Ariary) | Contribution of the component | |
|-----------|---|--|---------------------------------------|
| | | Intra-sectoral (in billions of Ariary) | Intersectoral (in billions of Ariary) |
| 2012/2010 | 0,0741 | 0,36925 | -0,29515 |
| 2006/2004 | 0,7704 | 0,91605 | -0,14565 |

Source: Author, 2023. From BCM/INSTAT 2000-2011 data

The growth in apparent labor productivity of the FDI sector is drawn more from the intra-sectoral component underlying the growth in total factor productivity. During two study periods, the intersectoral component is negative, this suggests the insufficiency of transfer of labor from branches with low productivity growth to branches with high productivity growth. In terms of sectoral performance, the Commerce (including petroleum products trade) and Financial activity branches remain the FDI branches that contribute the most to the growth in apparent labor productivity (see Appendix 1).

Long-term relationship dynamics according to Johansen's method (1984)

Johansen's cointegration test (1984) makes it possible to observe whether there exists, for the case of Madagascar, a long-term relationship between the variables Total factor productivity, inward FDI, Weight of the public sector and Human capital over the course of the period from 1988 to 2020.

Table 2: Test result of the series in primary difference:

| variable | Critical value | Statistical test, 5% threshold | Probability |
|------------|----------------|-----------------------------------|-------------|
| LOGTFP | -2.9639 | -7.4912 | 0.0000 |
| LOGIDE | -2.9511 | -5.0725 | 0.0002 |
| LOGPPUBLIC | -2.9511 | -5.6914 | 0.0000 |
| LOGKH | -3.9414 | -2.9540 | 0.0047 |

Source: author's calculations on Eviews software

The tests carried out on the variables show that the variables are all stationary in primary difference, with the presence of at least a single cointegration relationship. From this result, we move on to the estimation of the long-term equilibrium model. After identifying the number of delays ($p=4$) of the Var(4) model, using the Akaike and Schwach criteria, below is the result of the optimal test.

Table 3: Cointegration equation:

| Cointegrating Eq: | CointEq1 |
|-------------------|--------------------------------------|
| LOGTFP(-1) | 1.000000 |
| LOGIDE(-1) | 0.480489 (0.12932) [3.71559] |
| LOGKH(-1) | -2.406770 (0.49771) [-4.83573] |
| LOGPPUBLIC(-1) | 2.960494 (0.75080) [3.94312] |
| C | 7.625511 (2.33042) [3.27216] |

Source: author's calculations on Eviews software

We note through this model that the total factor productivity of the economy, at the aggregate level, is explained by the net inflows of foreign direct investments, the improvement of human capital and the weight of the public sector. Because, in fact, the model coefficients are all significant at 5%.

4. Discussions

Over the period from 1988 to 2020, the FDI variable is significant, but acts negatively on total factor productivity in the long term. Which could be different in the short term, since the shock suffered thanks to the high capital intensity of industrial FDI from 2003 to 2009 was accompanied by strong growth in total factor productivity. Haddad and Harrison (1993) showed similar results, the presence

of foreign companies in Morocco has negative effects on the production performance of companies at the national level. The economic literature designates this phenomenon as the potential costs of FDI. Loss of markets for local businesses, balance of payments deficit, which weakens the competitiveness of local industries.

However, the impacts do not have the same effect for the different branches of the industrial sector. Analysis of the results of the external sector survey from 2000 to 2011 shows that among FDI companies, the apparent labor productivity of manufacturing industries is among the highest. At the level of the industrial sector, they remain the most competitive branch of activity in terms of labor compared to extractive industries, production of electricity, water and gas, and others. The cointegration relationship shows that human capital has a positive impact on total factor productivity in the long term, for the case of Madagascar. Authors such as Li and Lu (2005) having studied the relationship between FDI and growth, showed the positive interaction of human capital with economic growth. This is confirmed by the theory of endogenous growth, notably through Lucas (1988).

From this result, we can say, first of all, that the importance of FDI in volume does not necessarily mean positive improvement in total factor productivity for the case of Madagascar. Corroborating Figure 2, the result of the long-term balance test shows a positive correlation between improvement in total factor productivity and human capital. The latter, measured by the primary school completion rate, is significant and has a positive effect on total factor productivity. Thus, any improvement in human skills in Madagascar strengthens productivity and economic growth. Added to this, these results suggest that inward FDI accumulation does not automatically trigger TFP growth until it is accompanied with a significant amount of technology and labor training. A practical application of this would be, in one hand, that the country should adopt a policy which promotes technology transfer. In another hand, the Government of Madagascar should use part of revenues generated by the FDI to fund technology research and training efforts.

5. Conclusion

This article examines the impacts of FDI on the total factor productivity of the national economy of Madagascar within the period spanning from 1988 to 2020. FDI statistics available for all branches of activity since 2000, from the survey on the external sector, also allow carrying out a descriptive analysis of the characteristics of FDI.

Descriptive analysis makes it possible to analyze the mathematical link between changes in labor productivity and changes in the main factors of production (capital stock and employment). It reveals that the high capital intensity in FDI following the large accumulation of capital in the extractive industrial branch only contributes very little to the increase in the labor productivity of FDI. Labor productivity growth is more driven by improvements in the total factor productivity of the national economy.

The analysis of the long-term relationship shows that incoming FDI in Madagascar has a negative impact on total factor productivity, with a coefficient -0.4804 . On the other hand, any increase in total factor productivity is accompanied by an improvement in human capital, justified by the positive coefficient of 2.4067 . Improving this result can be achieved through the large accumulation of capital in the manufacturing industry with high labor productivity to strengthen the performance of FDI on total factor productivity.

It emerges from this study that it is not the volume of investment in the capital stock which counts, in first place, to support growth of economic productivity, thus reducing carbon footprint in Madagascar.

The best strategy could involve supporting labor-intensive industries, strengthening human capital, and improving determinants of total factor productivity.

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