

**An econometric study of the railway transport profitability
The "Algiers-Oran" line****BOURDACHE Chahrazed**Sustainable Development Laboratory in Highland and Desert Regions
El-Bayadh University Centre (Algeria), c.bourdache@cu-elbayadh.dz**Received:** 18/09/2023**Accepted:** 27/12/2023**Published:** 30/12/2023**Abstract:**

This study aimed to measure the profitability of railway transport for the "Algiers-Oran" line by relying on monthly data for the period (2005-2019), whereby five models were built to test the relationship between profitability and each of the real disposable income, several passengers, price Passenger transportation ticket by train, airline passenger ticket prices, as according to the results of each model we modified the other models, by deleting some variables or reducing the number of observations.

We concluded that the number of passengers is the variable that primarily explains the profitability of rail transport for the Algiers-Oran line. This company is also a public institution concerned with serving citizens by establishing a good network of electrified lines and reducing the cost of transportation compared to other means of transportation.

Keywords: profitability, rail transport, ordinary least squares.**JEL Classification:** C13, L91, L92.

1. Introduction:

Returns are one of the most important technologies used and one of the fundamental indicators of the enterprise, enabling it to give a holistic view of the various aspects of its activity, thus facilitating its control in the sector in which it is active, thereby ensuring that it maintains its position in the market. After Algeria entered into the market economy system, reality has become more urgent than ever for all institutions to study their feasibility and to renew their structures of activity in such a way as to improve their profitability on the one hand and to ensure and enhance their survival in the free competition market on the other.

Considering that the transport sector is among the sectors sensitive to this economic orientation, and as it has a strong relationship with all industries in various areas, it has, like other sectors, identified structural adjustments that have been reflected in the lifting of the State's monopoly and the laying of the foundations for competition.

Given the importance of funds employed and the external impacts on economic activity and the environment, new railways play a strategic role in economic development. Improving productivity has become one of the Foundation's objectives to increase its performance, first with a strategy and then with effectiveness in managing and remaining in the service of citizens.

1.1 Problematic search:

Proceeding from the above, the problem to be considered can be formulated as follows:

What are the determinants of the profitability of a railway transport company?

1. 2 research questions:

- How is the measurement and analysis of profitability in the organization?
- Is the railway transport company achieving profitability?

1. 3 research hypotheses:

- Since the railway transport company is a public enterprise, it aims not so much to achieve high profitability but to serve citizens.
- The measurement and analysis of profitability varies from one institution to another depending on the institution's activity, as there are several indicators of measuring profitability depending on that difference.

2. Basic concepts of Profitability:

The term "yield" is one of the most commonly used terms in financial and accounting analysis, where researchers disagree in defining a precise concept depending on the economic systems.

2.1 Definition of Profitability:

Profitability is a concept called economic and financial situations, which take into account material and human means, where it is expressed by the quotient of dividing the result by the means ¹. **P.Paucher** considered the relationship between results and capital needed to obtain results².

Bernard Colasse defined it as an enterprise's ability to achieve monetary abundance in the sense of profit abundance; that is to say, return is viewed by the enterprise from the angles of the result obtained and the effort made³.

It also considers the social feasibility, namely, the extent to which the institution can achieve social objectives to provide jobs, raise the standard of living, and achieve social welfare.⁴

2.2 Profitability types:

For the feedback of several types, different views differ, among which are the following:

- **Financial Profitability:**

Expresses the extent to which the enterprise can employ capital to ensure the renewal of means of production and the expansion of its investments, thereby generating profits. That is to say, it reflects the enterprise's ability to create new funds. Essential items for measuring this yield are profit and cash flow attributable to its production source (sales, investments, private funds).⁵

- **Economic Profitability:**

Expresses the performance of the project's economic assets, defined as the relationship between the economic outcome and the total assets used to obtain them, It also expresses the efficient use of the resources available from the project or enterprise during a given period regardless of the funding method and hence rationality is an indicator that explains the proportion of results achieved as a result of the use of appropriate means of doing so, Economic viability reflects an enterprise's ability to generate a profit using its own economic assets⁶.

- **Social Profitability:**

Social life within the institution is one of the catalysts that lead to the increase and development of production, and social productivity aims at achieving the following aims⁷:

-Improving social conditions.

-Addressing the social challenge by improving their social conditions so that the worker focuses on improving production.

-Take greater care of working conditions by providing the necessary conditions to prevent work accidents.

The objective of this type of productivity is, therefore, to create motivations and motivations for workers, to produce and to raise people's standard of living, and in general, to provide employment positions for the largest number of workers on the one hand and to improve their social status on the other.

- **Commercial profitability:**

This type of profitability can be called profitability of activity or net margin ratio and is based on the enterprise's commercial submission, relying on the off-tax business number, measuring the profit earned by the enterprise for each dinar of sales, and is commonly used to compare the enterprise with competitors of the same productive sector⁸.

2.3 The importance of Profitability study:

The importance of studying the institution's profitability is manifested in the extent of its contribution to determining the level of performance of this institution, depending on the party interested in this study, such as the state, the managers of the institution or its shareholders. From the macroeconomic point of view, the state is primarily concerned with creating wealth through enterprises. This wealth is measured by the added value that enters into the composition of the gross domestic product, which is what the enterprise provides to

the national economy. The surplus of raw exploitation also reflects the industrial and commercial performance of the enterprise, a level of result that expresses the extent to which the enterprise adapts to its surroundings and market conditions, and from it measures the enterprise's economic performance. As for the managers, they are interested in the organization's raw cash flow and the ability to self-finance, that is, the surplus cash that guarantees shareholders a return. The organization has internal funding available for capital recovery in parallel with its development. While shareholders are primarily interested in maximizing their wealth, the maximization of this wealth is measured by net profit and the accumulation of potential value surpluses, and shareholders receive a portion of the profits, which is called Return on share capital⁹.

The high remuneration policy allows the organization to attract the most qualified and best-trained human resources, which is considered an investment for the organization that may enhance its chances of continuing and achieving satisfactory levels of profitability.¹⁰.

2.4 profitability objectives:

The objectives of profitability are to achieve the following ¹¹:

- Measuring the efficiency and rationalization of the use of resources in order to maximize their returns, taking into account the opportunity cost.
- Plays an essential role in ensuring the operation and development of the enterprise by developing the available resources.
- Achieving the minimum of them is an irreplaceable condition for supporting and maintaining the financial balance of the enterprise.
- Allocate funds for the best uses.
- Ensuring the satisfaction of the minimum needs of all productive forces in the enterprise.

3. Factors affecting profitability:

Several factors affect profitability, including the following:

▪ About human resources:

The human factor plays a big role in the effectiveness and efficiency of the enterprise. It is considered one of the key factors affecting its profitability, but raising and improving the efficiency of the performance of these resources requires the enterprise to ensure their proper management, management, and development in order to ensure positive profitability, on the one hand, and on the other hand, the human element can be a key factor of low profitability in the event that the enterprise does not adopt a clear policy, on the basis of which the good management of human resources is carried out, and in the event that the problems suffered by workers are not eliminated, which contributes significantly to the low profitability of the enterprise.

Among the most important problems that workers suffer from within the enterprise are: the problem of wages, high work accidents, lack of incentives, little or no development and training of workers, lack of interest in the development of workers ' knowledge, lack of qualification and instability in the number of workers...Etc. ¹².

▪ The competition:

We say that an enterprise is competitive if it can constantly survive in a market characterized by competition and development, with the need to achieve a profit rate at least equal to the one required for the continuity of the enterprise in its activity. Thus, it can be

said that competition is one of the most important factors affecting the profitability of an enterprise and, therefore, its survival and continuation in the market. An organization's analytical treatment of competition issues pushes it to constantly search for the best ways to improve its profitability and productivity. This allows it to apply competitive selling prices without compromising the profit margin it earns and also enables it to know the extent of its ability to withstand its competitors. The failure of the enterprise to study the competition will negatively affect its position in the market and hence its profitability.

▪ **About taxes:**

The tax is defined as a monetary duty that is ultimately borne by taxpayers free of charge. It is the financial instrument that the state resorts to achieve its goals. It plays a distinctive role in affecting the enterprise's profitability, as high tax rates burden the enterprise, depriving it of part of its resources that it can direct to expand its production capacity or renew it, and also negatively affect the profitability of the institution¹³.

▪ **Funding:**

The organization must take care of the financing process because it is one of the main concerns of the organization, where the materials with which the organization finances itself must be of high quality because their low quality usually leads to the appearance of waste and important waste, in addition to frequent stops of machines, which results in a marked decrease in profitability and a rise in production costs¹⁴.

4. Rail transport in Algeria:

Rail transport in Algeria has experienced a new dynamic within the framework of strengthening and modernizing the train shed of the national railway transport company, The public authorities have allocated significant financial resources in order to modernize and intensify the railway network and strengthen passenger transportation, focusing on the modernization, expansion, duplication, and electrification of the exploited network, with the introduction of a modern and automated communications system.

4.1 definition of transport:

Transportation is defined as the transfer of individuals from one place to another, it is defined as the means of movement of travelers and goods from one location to another, it is also an activity or a means of moving and moving people and/or property from one place to another to create a spatial benefit, it transfers goods and individuals from a place where the utility is low to a place of high utility, so the price rises. It is a system aimed at managing the transfer and transfer of materials to create the temporal and spatial benefit of various products. Algerian law defines the transport service in the text of Article 16 of law 17/88 of May 10, 1988, as any activity that is transported by a natural or legal person, persons, or goods from one place to another on board a vehicle of any kind. Railways are one of the most important means of public transport that countries rely heavily on in achieving their economic, social, political and military goals, both in terms of transporting people or goods, and the importance of rail transport comes through its great ability to transport heavy loads and long distances at high speeds, and the speed of some trains has exceeded 300 km / h, and the passage of Railways in a particular area is one of the main reasons for the development of that area and the creation of large free gatherings, and therefore the possibility of direct impact on the distribution of the population, and this can be observed in

many industrial European cities that have grown and prospered due to The presence of Railways in it, and thus rail transport is considered a factor of industrial localization, as its importance is highlighted at the production and distribution stages by increasing the opportunities for transporting raw materials, labor and intermediate goods, as well as transferring production to storage and consumption areas¹⁵.

4.2 Definition of a railway transport company (*S.N.T.F):

The national railway transport company is a public company of an industrial and commercial nature with a capital of 20.7 billion Algerian dinars, which emerged after the restructuring campaign of the institutions in 1976 from the national railway company *S.N.C.F.A was established in 1963 after independence when it was separated from the French parent company. The national railway transport company is a company under the guardianship of the Ministry of Transport, specializing in the transportation of passengers, goods, and cargo, and within the framework of its mission for public services, the National Railway Company consists of ¹⁶:

- The headquarters of the institution, including the General Directorate and the central directorates, are represented by the Directorate of human resources, base facilities, property protection, equipment and Traction, Railway security, automated information, finance and Accounting, Audit, Finance, and customers.
- Four regional directorates: Algiers, Annaba, Constantine, and Oran. Railway maintenance workshops are also available for these regional directorates.

4.3 the reality of the rail transport sector network in Algeria:

The railway network in Algeria is estimated at 4,200 km, as it witnessed the electrification of some sections to put high-speed trains. The national railway transport company has prepared an extensive program that includes the rehabilitation and renovation of train carriages and the acquisition of new traction gear in order to strengthen its hangar and improve its services, the railway network is operated by the national railway transport company (SNTF), and this network is equipped with about 410 stations, including ¹⁷:

- 480 km of electrified Railways.
- 560 km of double track.
- 3404 km of monorail.

4.4 company activities and organization:

The national railway transport company includes several activities and has a decentralized system, according to the following¹⁸:

▪ The company's activities:

The company's activities include the following:

- Transportation of passengers and cargo.
- Management of railway lines.
- Managing the company's various properties (such as real estate and equipment).

▪ Organization:

The company is a decentralized organization consisting as follows:

*S.N.T.F: National Railway Transport Company.

* S.N.C.F.A: National Society of Algerian Railways.

- The institution's headquarters, including the General Directorate and the central directorates.
- Four regional railway directorates.
- Four main workshops for railway maintenance.
- Social and cultural delegations would be transferred to social partners and trade unions after the election of committees.

5. The econometric study of the profitability of the railway transport company during the period (2005-2019) for the line (Algeria-Oran):

In this part, we conduct a standard study of the relationship between profitability, real disposable income, the number of passengers, the price of a train passenger ticket, and airline passenger ticket prices, based on monthly data, for the period (2005-2019), according to the following model:

$$REN_t = \beta_0 + \beta_1 * REV_t + \beta_2 * VOY_t + \beta_3 * PT_t + \beta_4 * PCON_t + \varepsilon_t$$

Where:

REN_t : The profitability of the railway transport company for the line (Algeria – Oran)

REV_t : Real disposable income

VOY_t : Number of passengers of the railway transport company of the line (Algeria – Oran)

PT_t : The following is the price of the train ticket for the Algiers – Oran line

$PCON_t$: Air Algérie Passenger ticket prices (competitive price).

5.1 The first model* :

After estimating the model by the least squares method (MCO), using the Informational ProgramEviews10, we get the following estimation results:

$$REN_t = -2,32E+10 + 449280,5 * VOY_t + 31546653 * PT_t + 4224005 * PCON_t - 1,11E+09 * REV_t$$

$T_{STAT} \quad (-7.44) \quad (25.927) \quad (6.19) \quad (3.34) \quad (-1,908)$

$$\begin{array}{lll} \overline{R}^2 = 0,932785 & D-W = 1.238135 & n = 180 \\ SCR = 4.56E+21 & F_{STAT} = 622.0209 & k = 4 \end{array}$$

The initial reading of the model indicates the existence of a self-correlation of errors, on this basis, we resort to the Cochran-ORCUTT method, which is a method that enables us to

* For more details, see Appendix No. 1.

address the self-correlation of errors of the first degree, where we propose to estimate the estimated values of the error limit as follows: $\rho = \frac{\sum e_t e_{t-1}}{\sum e_t}$

After removing this problem, the estimation results are as follows:

$$\begin{aligned} \text{RE}\hat{N}_t = & -2,44\text{E}+10 + 462231,2 \cdot \text{VOY}_t + 32947392 \cdot \text{PT}_t + 3643679 \cdot \text{PCON}_t \\ & - 8,65\text{E}+08 \cdot \text{REV}_t + 0,39 \cdot \text{AR}(1) \end{aligned}$$

$T_{\text{STAT}} \quad (-5,27) \quad (25,07) \quad (4,55) \quad (1,96)$
 $(-1,01) \quad (5,52)$

$$\begin{aligned} \bar{R}^2 &= 0,943962 & D-W &= 1,905447 & n &= 180 \\ \text{SCR} &= 3,88\text{E}+21 & F_{\text{STAT}} &= 582,8436 & k &= 4 \end{aligned}$$

▪ The economic interpretation of the results of the estimate:

Through the above results, we note that when it rises by one unit, the profitability rises by 462231,2 monetary units, and this is consistent with the economic theory, but if we move to the PT_t parameter under the constancy of the rest of The explained external variables, the profitability rises by: 32947392 monetary units, which also corresponds to the economic theory, and for the PCON_t parameter, its rise by one unit led to a rise in profitability by 3643679 monetary units, which contradicts the theory finally, we see that the decrease in REV_t by one unit led to a decrease in profitability by 8,65 E+08, which also contradicts the economic theory, which says that there is a direct relationship between them, moreover, is an overestimated value.

Generally, the model does not agree with economic theory; let's now turn to its study from a statistical point of view.

▪ Statistical interpretation of the estimation results:

From the results obtained, we find that: ($t_{\text{cal}}=5,27 > t_{\text{tab}}=2$) for parameter β_0 , ($t_{\text{cal}}=25,07 > t_{\text{tab}}=2$) for parameter β_1 , and ($t_{\text{cal}}=4,55 > t_{\text{tab}}=2$) while for parameter β_2 , which indicates the significance of each parameter, while ($t_{\text{cal}}=1,96 < t_{\text{tab}}=2$) for parameter β_3 , and ($t_{\text{cal}}=1,01 < t_{\text{tab}}=2$) for the parameter β_4 , which indicates that they are not significant. Let's turn to the significance of the parameters of the model as a whole. Only the Fisher statistic with a degree of freedom (4,176) equal to ($F_{\text{cal}}=582,8436 > F_{\text{tab}}=2,41$) indicates that the combined parameters explain the profitability, the percentage of interpretation of the model by the coefficient of determination ($\bar{R}^2 = 0,942343$) is 94,23% explained by: (VOY_t , PT_t , PCON_t , REV_t), 5,77% is due to other variables not included in the model.

Based on the economic and statistical interpretation of the model, it appears to us that the model is unacceptable.

5.2 The second model* :

The results of the assessment during the period (2008-2019):

After estimating the model by the least squares method, we get the following estimation results, and this is after omitting the years marked by the stability of the profitability in the period (01:2008 -12:2019).

$$\begin{aligned} \text{REN}_t = & -3,10\text{E}+10 + 546921,3 \cdot \text{VOY}_t + 51017770 \cdot \text{PT}_t - 5644334 \cdot \text{PCON}_t \\ & + 2,59\text{E}+09 \cdot \text{REV}_t \\ T_{\text{STAT}} \quad & (-10,11) \quad (31,27) \quad (8,88) \quad (-2,87) \\ & (3,02) \end{aligned}$$

$$\begin{aligned} \overline{R}^2 = & 0,958766 \quad D-W = 1.458039 \quad n = 144 \\ \text{SCR} = & 2,44\text{E}+21 \quad F_{\text{STAT}} = 832,2521 \quad k = 4 \end{aligned}$$

The initial reading of the model indicates a subjective correlation of errors, to eliminate this problem we resort to the Cochran-ORCUTT method, so the results are as follows:

$$\begin{aligned} \text{REN}_t = & -3,10\text{E}+10 + 545839,9 \cdot \text{VOY}_t + 5739853 \cdot \text{PT}_t - 5461134 \cdot \text{PCON}_t \\ & + 2,53\text{E}+09 \cdot \text{REV}_t + 0,27 \cdot \text{AR}(1) \\ T_{\text{STAT}} \quad & (-7,90) \quad (30,03) \quad (7,04) \quad (-2,27) \\ & (2,37) \quad (3,25) \end{aligned}$$

$$\begin{aligned} \overline{R}^2 = & 0,9614425 \quad D-W = 1.911840 \quad n = 144 \\ \text{SCR} = & 2,26\text{E}+21 \quad F_{\text{STAT}} = 713,8129 \quad k = 4 \end{aligned}$$

▪ The economic interpretation of the results of the estimate:

From the above results, we note that when VOY_t rises by one unit, the profitability rises by: 9,395854 monetary units, which is consistent with the economic theory, but if we move to the parameter PT_t under the constancy of the rest of The explained external variables, the profitability rises by: 50739853 monetary units, which is also consistent with the economic theory, and for the parameter PCON_t , its decrease by one unit led to a decrease in profitability by: 5461134 monetary units, which is consistent with the economic theory, which says that there is an inverse relationship between them, and finally we see that an increase in REV_t by one unit led to an increase in profitability by: 09 E+2.53, which is also in line with the economic theory, which says that there is a direct relationship between them. So the model corresponds to the economic theory; now, let's move on to studying it statistically.

▪ Statistical interpretation of the estimation results:

Based on the results obtained, we find that: $(t_{\text{cal}}=7,90 > t_{\text{tab}}=2)$ for parameter β_0 , and $(t_{\text{cal}}=30,03 > t_{\text{tab}}=2)$ for parameter β_1 , also $(t_{\text{cal}}=7,04 > t_{\text{tab}}=2)$ for parameter β_2 , as well as $(t_{\text{cal}}=2,27 > t_{\text{tab}}=2)$ for parameter β_3 , the same we find that $(t_{\text{cal}}=2,37 > t_{\text{tab}}=2)$ for the parameter

* For more details, see Appendix No. 2.

β_4 , this means that all parameters are significant ($\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$) 'along with this, we moved on to the significance of the model as a whole, only the Fisher statistic with a degree of freedom (4,140) equal to ($F_{cal}=713,8129 > F_{tab}=2,43$) indicates that the combined parameters are significant. As for the percentage of interpretation of the model through the determination coefficient ($\bar{R}^2 = 0,9614425$), 96.14% is explained by: ($VOY_t, PT_t, PCON_t$, and REV_t); the remaining 3.86% is due to other variables not included in the model.

Based on the available data, the model's economic and statistical interpretation appears acceptable.

5.3 The third model *:

$$REN_t = \beta_0 + \beta_1 * REV_t + \beta_2 * VOY_t + \beta_3 * PT_t + \varepsilon_t$$

The results of the model estimation during the period [2005 - 2019], after deleting the variable Air Algérie passenger ticket prices (competitor price), as well as deleting 11 months from [01: 2005 2008:10 to 2009:09 2019:12] for the presence of duplicate statistics.

$$\begin{array}{cccc} REN_{\hat{t}} = & -2477969611 & -5887,3935 * VOY_t & +3362993,18 * PT_t + 21060468,5 * REV_t \\ T_{STAT} & (-7,1785) & (-3,5589) & (13,11032) \quad (3,3060) \end{array}$$

$$\begin{array}{ccc} \bar{R}^2 = 0,6011 & D-W = 0,31879 & n = 168 \\ SCR = 3,88 & F_{STAT} = 84,90114 & k = 3 \end{array}$$

The initial reading of the model indicates that there is a subjective correlation of errors on this basis; we eliminate this problem, so the estimation results are as follows:

$$\begin{array}{cccc} REN_{\hat{t}} = & -3,36E+09 & +5237,424 * VOY_t & +2572859 * PT_t + 4,15E+08 * REV_t \\ T_{STAT} & (5,1656) & (12,33390) & (4,597637) \quad (6,932503) \end{array}$$

$$\begin{array}{ccc} \bar{R}^2 = 0,9766 & D-W = 2,02336 & n = 168 \\ SCR = 226E+08 & F_{STAT} = 1743,451 & k = 3 \end{array}$$

▪ The economic interpretation of the estimation results:

From the above results, we note that when the constant decreases by one unit, the yield decreases by: 3,36 E+09 monetary units, which is somewhat an overestimated value. While when VOY_t increases by one unit, the yield increases by: 12,33390, and this is consistent with economic theory, which is an acceptable value that is not exaggerated. If we turn to the variable REV_t , we note that the higher income of families by one unit, followed by an

* For more details, see Appendix No. 3.

increase in profitability by: 6,932503 monetary units, which is reasonable and not exaggerated and also corresponds to the economic theory, as for the last variable, represented by PT_t , and under the constancy of the rest of the external variables, when it rises by one unit, the profitability increases by: 4,597637 monetary units, which is not exaggerated and corresponds to the economic theory.

Generally, we say that the model from an economic point of view corresponds to economic theory; let's now turn to a study from a statistical point of view.

▪ Statistical interpretation of the estimation results:

We start first with the significance of each parameter separately, and we find that ($t_{cal}=5,1656 > t_{tab}=2$) in relation to the parameter β_0 , which means the significance of the parameter, and in relation to parameter β_1 , we find that ($t_{cal}=12,33390 > t_{tab}=2$) is also interpreted, and the parameter in question β_2 is significant where ($t_{cal}=4,597637 > t_{tab}=2$), and the same with respect to the last parameter where we find that ($t_{cal}=6,932503 > t_{tab}=2$) which indicates its significance if we turn to the significance of the parameters of the model as a whole, only the Fisher statistic with a degree of freedom (3,165) which is equal to 1743,451 indicates that the combined parameters ($\beta_0, \beta_1, \beta_2, \beta_3$) explain the profitability, and the percentage of interpretation of the model by the corrected determination coefficient is: ($\bar{R}^2=0,9766$) so, 97,66% of the profitability is explained by: (VOY_t, PT_t, REV_t) and 2.4 are due to other variables that are not included in the model.

Finally, based on the economic and statistical interpretation of the model, it is acceptable.

5.4 The fourth model *:

$$\log REN_t = \beta_0 + \beta_1 * \log REV_t + \beta_2 * \log VOY_t + \beta_3 * \log PT_t + \varepsilon_t$$

From the above, we say that the modified model gave us acceptable results, as they can be improved by adding the logarithm to the model in order to obtain less variation. The results of the assessment were as follows:

$$\begin{array}{ccccccc} \hat{REN}_t & = & 0,427383 & + & 1,197275 * \log VOY_t & + & 0,919676 * \log PT_t & + & 0,484976 * \log REV_t \\ T_{STAT} & & (0,5046) & & (55,12609) & & (9,181140) & & (2,259501) \end{array}$$

$$\bar{R}^2 = 0,991051 \quad D-W = 1,8920 \quad n = 168$$

$$SCR = 0,731855 \quad F_{STAT} = 3267,778 \quad k = 3$$

The initial reading of the model indicates that there is no subjective correlation of errors, and it improved as ($\bar{R}^2$) it became equal to: 0,991051, but we note that the constant parameter is not significant ($t_{cal}=0,5046 < t_{tab}=2$), that is, the constant limit does not explain the profitability, so we can delete it.

* For more details, see Appendix No. 4.

5.5 The fifth model *:

$$\log REN_t = \beta_1 * \log REV_t + \beta_2 * \log VOY_t + \beta_3 * \log PT_{t_2} + \varepsilon_t$$

After removing the constant β_0 , the estimation results became as follows:

$$\log \hat{REN}_t = 1,197235 * \log VOY_t + 0,872731 * \log PT_t + 0,3924536 * \log REV_t$$

$T_{STAT} \quad (55,50748) \quad (21,76869) \quad (3,436596)$

$$\overline{R}^2 = 0,99111$$

$$D-W = 1,899754$$

$$n = 167$$

$$SCR = 0,733361$$

$$F_{STAT} = 1549,23$$

$$k = 3$$

▪ **The economic interpretation of the estimation results:**

Through the results, we note that when the number of passengers increases by one unit, the profitability of rail transport responds by: 1,197235, which is not exaggerated and agrees with the economic theory, but if we turn to real disposable income, we find that the change in the value of the profitability of the change in income is equal to 0,3924536, which is not exaggerated and at the same time matches the economic theory, which indicates the (S.N.T.F) it makes a positive change in the profitability, so changing it by one unit leads to a profitability response of 0.872731, this is the agreement Economic theory, which says that there is a direct relationship between prices and profitability, and it seems that this value is not exaggerated.

In general, we say that the model from an economic point of view agrees with the economic theory, which says that all the variables included in the model have a direct relationship with profitability; now, let's move on to a study from a statistical point of view.

▪ **Statistical interpretation of the estimation results:**

We start first with the significance of each parameter separately. We find that ($t_{cal}=55,50748 > t_{tab}=2$) with respect to the number of passengers, and ($t_{cal}=21,76869 > t_{tab}=2$) with respect to the ticket price parameter, the same is the real disposable income ($t_{cal}=3,4365961 > t_{tab}=2$), this means that all independent variables separately explain the model, i.e. ($\beta_1 \neq 0, \beta_2 \neq 0, \beta_3 \neq 0$) , here we accept all alternative hypotheses and reject the hypotheses of nothingness, but the DW statistic, which is approximately equal to 2, indicates the absence of self-correlation of errors. Let's turn to the significance of the model as a whole. Only the Fisher statistic with a degree of freedom (3,164), equal to 1549,23, indicates that the parameters collectively explain the profitability. As for the percentage of interpretation of the model through the corrected determination coefficient ($\overline{R}^2 = 0,99111$), 99,111% of the profitability is explained by the variables PT_t , REV_t , and VOY_t . In comparison, 0,889% is due to other variables that are not included in the model.

In the latter, it becomes clear to us through the economic and statistical interpretation of the estimation results that the model is acceptable.

* For more details, see Appendix No. 5.

6 Analysis of results:

After estimating the models, we came to the following results:

- Rejection of the first model [2005:01 - 2019:12] in which we included all the variables, and this is what became clear through the economic and statistical study of the model⁴
- For the second model [2008:01 - 2019: 12], after omitting the period marked by instability, we accepted the model economically and statistically.
- Acceptance of the third form [2005:01 2008:10 – 09: 2009 2019:12] after deleting 11 months, i.e. [2008:10- 2009:09] and remove the competition variable for being immaterial.
- The fourth and last models are considered one of the best economic and statistical models by improving the model for a third using the logarithm and deleting the constant.

In the end, we come to the conclusion that the number of passengers is a variable explained primarily by the convenience of rail transport. Still, since the railway transport company is a public institution, it does not aim to achieve profitability as much as it cares about serving citizens by creating a decent network of electrified lines and reducing the cost of transportation compared to other modes of transport.

7 Conclusion:

The continuation of an enterprise depends on its profitability, and no matter how many types, methods, and areas of application, it seeks the same goal, pouring into a single framework, which is the effective and optimal use of available resources and means, moving towards a better future.

Railways have brought about a revolution, as it has given people the ability to gain time and the possibility of reaching anywhere and reducing distances, and Algeria, like other countries, is in dire need of the transport sector of all types, especially rail transport, because of its advantages that have made it one of the most suitable modes of transport with quality and efficiency in all aspects, rail transport in Algeria has passed through several stages since its establishment, and it has always been and remains a monopoly by the state, and the railway network in Algeria is estimated at 4,200 km, as it has witnessed the electrification of many sections to put trains it has a high speed, including the link between Algeria and Oran, which is known for a high turnout by citizens.

From the above, we have come to several conclusions, among which:

- Algeria's efforts to establish and electrify a sizable network of railway lines led to an increase in passengers.
- Lack of technical and expert elements in the field of operation and maintenance of Motor Equipment and lines due to poor configuration.
- The lack of training of qualified personnel to work in the railway field, the limited number of training institutes, and the lack of specialized research centers.
- The absence of a sense of responsibility among many station officials and the lack of people with experience and qualifications.
- Not to use modern technologies and means of communication, especially since the nature of rail transport requires the development and modernization of these means.
- The number of passengers is a variable explained primarily by the resource and friendliness of rail transport for the Algiers - Oran line.

From the results obtained by us, we propose the following recommendations:

- Rehabilitation of old tracks and equipping them with modern systems leads to more control over the operation of trains and monitoring them before, during, and after their running.
- Development of the railway transport system by paying attention to training and human resources in parallel with the financial and technical resources.
- The authorities should study the various positive effects in cooperation with experts and specialists in the rail transport sector in order to develop a strategy for this sector to maximize its profitability.

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9 Appendices:

Appendix N° 1: (2005:01- 2019:12)

$$REN_t = \beta_0 + \beta_1 * REV_t + \beta_2 * VOY_t + \beta_3 * PT_t + \beta_4 * PCON_t + \varepsilon_t$$

Before modification:

Dependent Variable: REN
Method: Least Squares
Date: 09/01/22 Time: 08:47
Sample: 2005:01 2019:12
Included observations: 180

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.32E+10	3.11E+09	-7.443263	0.0000
REV	-1.11E+09	5.83E+08	-1.908962	0.0579
VOY	449280.5	17328.06	25.92792	0.0000
PT	31546653	5094220.	6.192637	0.0000
PCON	4224005.	1264185.	3.341287	0.0010
R-squared	0.934287	Mean dependent var	2.04E+10	
Adjusted R-squared	0.932785	S.D. dependent var	1.97E+10	
S.E. of regression	5.11E+09	Akaike info criterion	47.57239	
Sum squared resid	4.56E+21	Schwarz criterion	47.66109	
Log likelihood	-4276.516	F-statistic	622.0209	
Durbin-Watson stat	1.238135	Prob(F-statistic)	0.000000	

After modification:

Dependent Variable: REN
Method: Least Squares
Date: 09/01/22 Time: 08:50
Sample(adjusted): 2005:01 2019:12
Included observations: 179 after adjusting endpoints
Convergence achieved after 18 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.44E+10	4.63E+09	-5.274902	0.0000
REV	-8.65E+08	8.51E+08	-1.015486	0.3113
VOY	462231.2	18435.38	25.07306	0.0000
PT	32947392	7229075.	4.557622	0.0000
PCON	3643679.	1853855.	1.965460	0.0510
AR(1)	0.390943	0.070766	5.524420	0.0000
R-squared	0.943962	Mean dependent var	2.05E+10	
Adjusted R-squared	0.942343	S.D. dependent var	1.97E+10	
S.E. of regression	4.74E+09	Akaike info criterion	47.42749	
Sum squared resid	3.88E+21	Schwarz criterion	47.53433	
Log likelihood	-4238.760	F-statistic	582.8436	
Durbin-Watson stat	1.905447	Prob(F-statistic)	0.000000	
Inverted AR Roots	.39			

Appendix N° 2: (2008:01 - 2019:12)

$$REN_t = \beta_0 + \beta_1 * REV_t + \beta_2 * VOY_t + \beta_3 * PT_t + \beta_4 * PCON_t + \varepsilon_t$$

Before modification:

Dependent Variable: REN
Method: Least Squares
Date: 09/01/22 Time: 08:57
Sample: 2008:01 2019:12
Included observations: 144

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.10E+10	3.07E+09	-10.11776	0.0000
REV	2.59E+09	8.53E+08	3.029069	0.0029
VOY	546921.3	17486.96	31.27595	0.0000
PT	51017770	5740187.	8.887823	0.0000
PCON	-5644334.	1963197.	-2.875073	0.0047
R-squared	0.959919	Mean dependent var	2.38E+10	
Adjusted R-squared	0.958766	S.D. dependent var	2.06E+10	
S.E. of regression	4.19E+09	Akaike info criterion	47.18325	
Sum squared resid	2.44E+21	Schwarz criterion	47.28636	
Log likelihood	-3392.194	F-statistic	832.2521	
Durbin-Watson stat	1.458039	Prob(F-statistic)	0.000000	

After modification:

Dependent Variable: REN
Method: Least Squares
Date: 09/01/22 Time: 09:04
Sample: 2008:01 2019:12
Included observations: 143
Convergence achieved after 16 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.10E+10	3.93E+09	-7.902635	0.0000
REV	2.53E+09	1.06E+09	2.376821	0.0188
VOY	545839.9	18175.06	30.03236	0.0000
PT	50739853	7200484.	7.046728	0.0000
PCON	-5461134.	2401586.	-2.273970	0.0245
AR(1)	0.267515	0.082286	3.251046	0.0014
R-squared	0.962774	Mean dependent var	2.38E+10	
Adjusted R-squared	0.961425	S.D. dependent var	2.06E+10	
S.E. of regression	4.05E+09	Akaike info criterion	47.12325	
Sum squared resid	2.26E+21	Schwarz criterion	47.24700	
Log likelihood	-3386.874	F-statistic	713.8129	
Durbin-Watson stat	1.911840	Prob(F-statistic)	0.000000	
Inverted AR Roots	.27			

Appendix N° 3: (2005:01 2008:10 2009:09 2019:12)

$$REN_t = \beta_0 + \beta_1 * REV_t + \beta_2 * VOY_t + \beta_3 * PT_t + \varepsilon_t$$

Before modification:

Dependent Variable: REN
Method: Least Squares
Date: 09/04/22 Time: 09:34
Sample: 2005:01 2008:10 2009:09 2019:12
Included observations: 170

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.38E+09	3.41E+08	-6.988416	0.0000
REV	1.88E+08	62336342	3.016510	0.0030

VOY	-5806.425	1649.956	-3.519139	0.0006
PT	3345149.	256561.9	13.03837	0.0000
R-squared	0.612592	Mean dependent var	-2.41E+08	
Adjusted R-squared	0.605590	S.D. dependent var	7.76E+08	
S.E. of regression	4.87E+08	Akaike info criterion	42.86932	
Sum squared resid	3.94E+19	Schwarz criterion	42.94311	
Log likelihood	-3639.892	F-statistic	87.49622	
Durbin-Watson stat	0.312024	Prob(F-statistic)	0.000000	

After modification:

Dependent Variable: REN

Method: Least Squares

Date: 09/04/22 Time: 09:39

Sample(adjusted): 2005:01 2008:10 2009:09 2019:12

Included observations: 169 after adjusting endpoints

Convergence achieved after 19 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.32E+09	6.11E+08	-5.437238	0.0000
REV	4.15E+08	60228860	6.897934	0.0000
VOY	5104.941	426.3578	11.97337	0.0000
PT	2539739.	552321.8	4.598297	0.0000
AR(1)	0.967374	0.015119	63.98559	0.0000
Adjusted R-squared	0.976229	S.D. dependent var	7.72E+08	
S.E. of regression	1.19E+08	Akaike info criterion	40.05760	
Sum squared resid	2.33E+18	Schwarz criterion	40.15020	
Log likelihood	-3379.867	F-statistic	1725.862	
Durbin-Watson stat	2.096565	Prob(F-statistic)	0.000000	
Inverted AR Roots	.97			

Appendix N° 4: (2005:01 2008:10 2009:09 2019:12)

$$\log \text{REN}_t = \beta_0 + \beta_1 * \log \text{REV}_t + \beta_2 * \log \text{VOY}_t + \beta_3 * \log \text{PT}_t + \varepsilon_t$$

Dependent Variable: LOG(REN)

Method: Least Squares

Date: 09/04/22 Time: 22:28

Sample(adjusted): 2005:01 2008:10 2009:09 2019:12

Included observations: 169 after adjusting endpoints

Convergence achieved after 15 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.427383	0.846930	-0.504626	0.6148
LOG(VOY)	1.197276	0.021719	55.12609	0.0000
LOG(PT)	0.919676	0.100170	9.181140	0.0000
LOG(REV)	0.484976	0.214638	2.259501	0.0258
AR(1)	0.686317	0.070029	9.800444	0.0000
R-squared	0.991354	Mean dependent var	18.98402	
Adjusted R-squared	0.991051	S.D. dependent var	0.846956	
S.E. of regression	0.080124	Akaike info criterion	-2.169386	
Sum squared resid	0.731855	Schwarz criterion	-2.052616	
Log likelihood	134.0785	F-statistic	3267.778	
Durbin-Watson stat	1.892080	Prob(F-statistic)	0.000000	
Inverted AR Roots	.60			

Appendix N° 5: (2005:01 2008:10 2009:09 2019:12)

$$\log \text{REN}_t = \beta_1 * \log \text{REV}_t + \beta_2 * \log \text{VOY}_t + \beta_3 * \log \text{PT}_{t_2} + \varepsilon_t$$

Dependent Variable: LOG(REN)

Method: Least Squares

Date: 09/04/22 Time: 22:34

Sample(adjusted): 2005:01 2008:10 2009:09 2019:12

Included observations: 169 after adjusting endpoints

Convergence achieved after 8 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOG(VOY)	1.197236	0.021569	55.50748	0.0000
LOG(PT)	0.872731	0.040091	21.76869	0.0000
LOG(REV)	0.392454	0.114198	3.436596	0.0008
AR(1)	0.696668	0.068542	10.16404	0.0000
R-squared	0.991336	Mean dependent var		18.98402
Adjusted R-squared	0.991110	S.D. dependent var		0.846956
S.E. of regression	0.079856	Akaike info criterion		-2.184137
Sum squared resid	0.733361	Schwarz criterion		-2.090721
Log likelihood	133.9562	Durbin-Watson stat		1.899754
Inverted AR Roots	.76			