Entry Of Immigrants To Colombia Through International Flights As A Determining Factor In Changes In The Consumer Price Index: A Correlational Analysis

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Abstract

The objective of this research work was to determine the existence of a significant association between the arrival of immigrants to Colombia and the Consumer Price Index (CPI). Using data obtained from secondary sources such as the Ministry of Commerce, Industry and Tourism, and the Bank of the Republic of Colombia, immigration figures and CPI values were examined between January 2020 and November 2023. The data found was analyzed using RStudio Team statistical software. Through the Shapiro-Wilk test, it was confirmed that none of the variables studied fit a normal distribution, so the Spearman correlation test was applied to evaluate the correlation between them. The statistical evidence obtained, supported by a P-Value of 1.85×10-15, extremely lower than the significance level of 0.05, confirmed a significant linear association between the entry of immigrants by air to Colombia and the Colombian CPI, with a correlation coefficient of 0.89, which indicated a strong positive correlation between both variables. These findings allow us to affirm that changes in the arrival of immigrants are associated with variations in the CPI, without implying direct causality of one variable on the other, since multiple factors can play a significant role in this dynamic, and therefore it is emphasized in the need for additional research to better understand the causes of the increase or decrease in the CPI in Colombia and how immigration from international flights may be contributing to this phenomenon.

Key words: *migration, economic indicator, immigrants, consumer price index, correlation.*

Introduction

Migration is a global phenomenon that has shaped and continues to shape social, economic and cultural dynamics around the world (Malmberg, 2021). Focusing on the case of the Republic of Colombia, immigration [1]has not been an exception but an integral part of history and national identity (Shaw and Ramaciotti, 2023; León-Santiesteban et al., 2023). Since ancient times, Colombia has witnessed internal and external migratory movements that have contributed to the diversity and wealth of the country (Selee and Bolter, 2022). However, in recent decades,

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international migration has become particularly important due to changing global dynamics, regional conflicts and new economic opportunities (Camargo et al., 2020).

Two of the main characteristics of the migrant population in Colombia are diversity and complexity (Macedo et al., 2020). Being a country that has traditionally experienced internal migration, especially migration from rural areas to urban centers, it is striking that international migration has recently been increasing (Few et al., 2021; Tribín-Uribe, 2020). The generated migratory flows include both Colombians returning from abroad and foreigners who have chosen Colombia as a migratory destination for economic, social or political reasons (Muñoz-Mora et al., 2022; Penaloza-Pacheco, 2022). The reasons for this include relative political stability compared to other countries in the region, continued economic growth and employment opportunities in sectors such as tourism, technology and industry.

On the other hand, one of the least studied aspects of migration in Colombia is the arrival of migrants by air, this is because the focus is mainly on land and river migration, these being historically the channels with the greatest migratory flow in the Colombian territory (Celis and Ortiz, 2021; Delgado-Prieto, 2023). However, in recent years, the arrival of people from other countries to Colombia through international flights has also begun to play an important role in the country's migration dynamics (Bonilla-Aldana et al., 2022). This type of migration has unique characteristics, such as transnational mobility facilitated by air transport and a diverse migration profile, from tourists and businesspeople to refugees and temporary workers (Lebow et al., 2021).

In addition, the Consumer Price Index (CPI) is becoming a core indicator that goes beyond simple economic measurement (Yussuff et al., 2020). This index, which represents the change in the average value of a representative basket of goods and services consumed by households, has a significant impact at an economic and social level (Graf, 2020). This not only directly affects people's purchasing power, but also gives an idea of the country's economic stability (Vasyechko, 2023). CPI changes affect various areas of daily life, from food and housing prices to public policy formulation and citizens' financial planning (Angelache, 2021).

In this context, the following troubling questions arise: Is there a relationship between the flow of migrants via international flights to Colombia and the consumer price index? Can international migration flows influence observed fluctuations in a country's CPI? This question is not only of academic interest but also of practical interest. Studying this possible link requires careful and rigorous analysis that examines the complex interactions between international migration and TBI behavior in Colombia (Daly, 2021; Lebow, 2022). To address this issue in depth, it is important to use statistical methods that can not only identify this relationship, but also understand its strength and direction (Zhao et al., 2021). In this context, the current study aims to clarify these relationships and provide a clearer picture of the country's migration and economic dynamics (Durán et al., 2021).

A detailed correlation analysis is performed to fully understand these potential relationships. This statistical analysis allows investigators to quantify the degree of association between the arrival of immigrants in Colombia via international flights and changes in the consumer price index (Makowski et al., 2020). Strict correlation methods are necessary to determine whether there is a significant relationship between two variables and to estimate the direction and strength of this relationship (Ramirez et al., 2023). This analytical approach has helped this research to gain a better insight into how international migration affects CPI trends in Colombia, which in turn leads to a better understanding of the economic and social dynamics of the country.

Materials and Methods

The purpose of this study is to investigate the possible relationship between the variables "Future of Colombian Immigrants" and "Consumer Price Index (CPI)". Data were collected from additional sources, including the website of the Colombian Ministry of Industry, Trade and Tourism and Banco de la República (Colombia). The first variable represents national and foreign immigrants entering Colombia via international flights from January 2020 to November 2023. The second variable, the CPI, indicates the fluctuation in the average cost of a basket of goods and services that represent spending of households, compared to a base period (Banco de la República, 2024). Data analysis was performed using statistical software such as Excel and RStudio Team (2020).

Firstly, the normality of each of the two variables was tested by applying the Shapiro-Wilk test, this was chosen because the total data was less than 50. The Shapiro-Wilk test distinguished itself as a pioneer in identifying deviations from the normal distribution, whether due to skewness, kurtosis, or both. Its preference is based on its solid power properties, surpassing various alternative tests in this aspect (Carmona and Carrión, 2015). According to Shapiro and Wilk (1965) themselves, their test statistic is defined as follows:

$$W = \frac{(\sum_{i=1}^{n} a_i x_i)2}{[\sum_{i=1}^{n} (x_i - \underline{x})2]}$$

Subsequently, a Spearman correlation analysis was carried out, given that the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)" did not exhibit a normal distribution. This test, as Mendivelso & Rodríguez (2022) point out, is used to evaluate the degree of relationship between two sets of paired observations, with the condition of meeting the following assumptions:

- Numerical variables of free distribution or ordinal data.

- Observations x_i, y_i have been obtained in pairs.

- Monotonic trend in dispersion analysis.

Its formula is presented below:

$$rs = 1 - \frac{(6R)}{(n \times (n^2 - 1))}$$

Finally, hypothesis tests were formulated to determine whether the observed correlation was statistically significant.

Results

Below, the data for the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)" are summarized during the years 2020 to 2023. These variables are essential to understand the relationship between migration and consumer prices in the country. This table provides a detailed overview of the number of immigrants entering Colombia in each period and the corresponding CPI values, allowing a comparative analysis by year.

Table 1

Data from the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)" from the years 2020 to 2023.

No	Period	Immigrants	IPC	No	Period	Immigrants	IPC
1	Jan 2020	584631	3.62	25	Jan 2022	521890	6.94
2	Feb 2020	536398	3.72	26	Feb 2022	416624	8.01
3	Mar 2020	289383	3.86	27	Mar 2022	487136	8.53
4	Apr 2020	0	3.51	28	Apr 2022	557201	9.23
5	May 2020	0	2.85	29	May 2022	628092	9.07
6	Jun 2020	151	2.19	30	Jun 2022	657664	9.67
7	Jul 2020	0	1.97	31	Jul 2022	772452	10.21
8	Aug 2020	173	1.88	32	Aug 2022	699917	10.84
9	Sep 2020	9986	1.97	33	Sep 2022	641899	11.44
10	Oct 2020	85546	1.75	34	Oct 2022	709770	12.22
11	Nov 2020	125780	1.49	35	Nov 2022	703364	12.53
12	Dec 2020	239827	1.61	36	Dec 2022	794200	13.12
13	Jan 2021	184991	1.60	37	Jan 2023	768167	13.25
14	Feb 2021	126587	1.56	38	Feb 2023	631871	13.28
15	Mar 2021	170266	1.51	39	Mar 2023	673829	13.34
16	Apr 2021	182461	1.95	40	Apr 2023	697842	12.82
17	May 2021	221080	3.30	41	May 2023	729548	12.36
18	Jun 2021	297150	3.63	42	Jun 2023	780247	12.13
19	Jul 2021	394947	3.97	43	Jul 2023	939864	11.78
20	Aug 2021	366528	4.44	44	Aug 2023	853663	11.43
21	Sep 2021	337934	4.51	45	Sep 2023	764930	10.99
22	Oct 2021	410441	4.58	46	Oct 2023	808010	10.48
23	Nov 2021	470356	5.26	47	Nov 2023	843754	10.15
24	Dec 2021	594443	5.62				

Note. This table was compiled by the authors (2024) and shows CPI values for 47 periods from January 2020 to November 2023, together with immigration data. The data on the CPI value was obtained from the official website of the Ministry of Trade, Industry and Tourism of the Republic of Colombia (MINCIT, 2023).

The table 1 shows the fluctuations in the number of immigrants and the change in the CPI during this period. This data set is important for understanding how immigrant flows can be related to changes in consumer prices in a country over time, which can have important economic and social consequences. After understanding this information, the normality test is based on the following assumptions:

H_0: The variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)" fit a normal distribution.

H_1: The variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)" do not fit a normal distribution.

Figure 1 Results of the Shapiro-Wilk normality test, performed in RStudio.

```
> shapiro.test(DatosInmigracion$Inmigrantes)

        Shapiro-Wilk normality test

data:  DatosInmigracion$Inmigrantes
W = 0.93659, p-value = 0.03598

> shapiro.test(DatosInmigracion$IPC)

        Shapiro-Wilk normality test

data:  DatosInmigracion$IPC
W = 0.89459, p-value = 0.002838
```

Figure 1 shows the results of the normality test applied to the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)". For both variables, the obtained P-Value was lower than the significance level of 0.05, therefore, it is concluded that there is sufficient evidence to affirm that the data do not fit a normal distribution. From this, the decision was made to use the Spearman correlation coefficient.

Once the correlation analysis began, the following hypotheses were formulated:

H_0: There is no linear association between the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)".

H_1: There is a linear association between the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)".

As can be seen in Figure 2, the hypothesis test yielded a P-Value of 1.85×10^{-15}. Given that the P Value obtained is less than the significance level of $\alpha = 0.05$, the null hypothesis is rejected in favor of the alternative, that is, that there is sufficient statistical evidence to conclude that there is a linear association between the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)".

Subsequently, once the linear association between the variables studied was corroborated, the Spearman correlation coefficient was calculated to measure the direction and level of linear association between the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)".
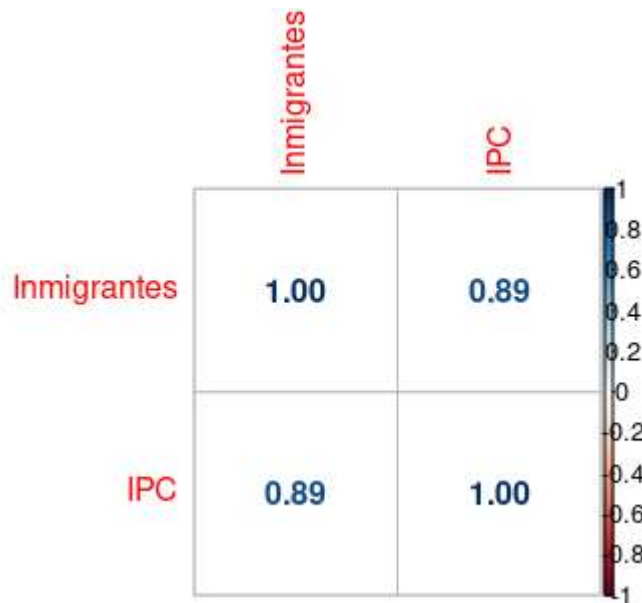
Figure 2 Results of the Spearman correlation test performed in RStudio.

```
        Spearman's rank correlation rho

data:  DatosInmigracion$Inmigrantes and DatosInmigracion$IPC
S = 2237.8, p-value = 1.85e-15
alternative hypothesis: true rho is not equal to 0
sample estimates:
      rho
0.8706161
```

As can be seen in Figure 3, for the variables "Entry of immigrants to Colombia" and "Consumer Price Index (CPI)", a correlation coefficient of 0.89 was obtained. The sign of this value indicates a positive direction. The linear association between the variables and its value between 0.7 and 0.9 shows the existence of a strong correlation between the variables (Amat, 2016). All this is duly represented in figure 3.

Figure 3 Spearman correlation between the variables "Entry of immigrants to Colombia" and the "Consumer Price Index (CPI)"

Conclusions

The statistical evidence obtained in the development of the correlation analysis allows us to conclude that there is a significant positive association between the entry of immigrants by air into Colombian territory and the Consumer Price Index (CPI) with a calculated correlation coefficient value of 0.89. This means that, from a statistical point of view, there is sufficient evidence to affirm that the increase or decrease in the flow of immigrants by air to Colombian territory is associated with an increase or decrease in Colombia's CPI, respectively. The above is supported by the P Value obtained in the correlation analysis between both variables, which has been 1.85×10^{-15}, almost 0, and therefore much lower than the significance level used of 0.05, which provides reliable proof that the observed linear association is statistically significant and is not a product of chance.

These findings have important social and economic implications for Colombia. The high positive association, already indicated previously, corroborates that the number of immigrants

who arrive in the country on international flights significantly influences the CPI of the Republic of Colombia, which explains that, when the number of immigrants arriving in the country grows, the value of the indicator also increases.

On the other hand, it is important to always keep in mind that the correlation between variables does not imply a causal relationship. Although there is a strong correlation between the two variables, the analysis is not decisive to affirm that the increase in immigrants arriving in the country on international flights is the direct cause of the growth of the CPI in Colombia, due to other social and economic factors. and politicians, among others, could play an important role in this relationship. It can be stated, however, that changes in one of the two variables usually occur at the same time as changes in the other.

It is essential, therefore, to carry out more in-depth research to better understand the causes of the increase or decrease in the CPI in Colombia and how immigration from international flights may be contributing to this phenomenon. A more detailed analysis would allow us to identify possible causal relationships and design more effective policies to address the effects of migration on the Colombian economy and society.

References

Amat, J. (2016). Correlación lineal y Regresión lineal simple. Available under a Attribution 4.0 International (CC BY 4.0) at: https://n9.cl/9h5km

Anghelache, C., Anghel, M. G., & Iacob, Ș. V. (2021). The evolution of consumer prices-the main brake on economic growth. Theoretical & Applied Economics, 28(4). URL: https://n9.cl/uljmk

Banco de la República de Colombia (2024). Índice de precios al consumidor (IPC). Consulted on January 6, 2024 on the Official Page of the Bank of the Republic (Colombia), available through: https://n9.cl/xkpai

Bonilla-Aldana, D. K., Thormann, M., Lopardo, G., & Rodriguez-Morales, A. J. (2022). Monkeypox virus–Would it arrive in Latin America?. Revista Panamericana de Enfermedades Infecciosas, e1-e1. DOI: https://n9.cl/0eqzy

Camargo, G., Sampayo, A. M., Peña Galindo, A., Escobedo, F. J., Carriazo, F., & Feged-Rivadeneira, A. (2020). Exploring the dynamics of migration, armed conflict, urbanization, and anthropogenic change in Colombia. Plos one, 15(11), e0242266. DOI: https://doi.org/10.1371/journal.pone.0242266

Carmona Arce, M. and Carrión Rosales, H. (2015). Potencia de la prueba estadística de normalidad Jarque-Bera frente a las pruebas de Anderson-Darling, Jarque-Bera Robusta, Chi-Cuadrada, Chen-Shapiro y Shapiro-Wilk [Thesis, Universidad Autónoma del Estado de México]. Available: https://core.ac.uk/download/pdf/159384191.pdf

Celis, D. O., & Ortiz, L. M. M. (2021). Foreigners vs. Migrants: Colombia's Aporophobia in Border Control. McGill GLSA Research Series, 1(1), 1-27. DOI: https://doi.org/10.26443/glsars.v1i1.148

César Daly, J. (2021). Effects of Venezuelan migration on Colombian price level. Documento CEDE, (8). DOI: http://dx.doi.org/10.2139/ssrn.3801095

Delgado-Prieto, L. (2023). Immigration and Worker Responses Across Firms: Evidence from Administrative Records in Colombia. Working Paper, Universidad Carlos III de Madrid. URL: https://ludelgad.github.io/files/JMP_Delgado.pdf

Durán, J. R., Guilliany, J. G., & Bilbao, O. R. (2021). Migración como promotora del emprendimiento. Aproximaciones teóricas. SUMMA. Revista disciplinaria en ciencias económicas y sociales, 3(2), 1-22. DOI: https://doi.org/10.47666/summa.3.2.25

Few, R., Ramírez, V., Armijos, M. T., Hernández, L. A. Z., & Marsh, H. (2021). Moving with risk: Forced displacement and vulnerability to hazards in Colombia. World Development, 144, 105482. DOI: https://doi.org/10.1016/j.worlddev.2021.105482

Graf, B. (2020). Consumer Price Index Manual, 2020: Concepts and Methods. In Consumer Price Index Manual, 2020. International Monetary Fund. DOI: https://doi.org/10.5089/9781484354841.069

Lebow, J., Moreno Medina, J., & Coral, H. (2021). Immigration and trust: The case of Venezuelans in Colombia. Available at SSRN 3660641. DOI: http://dx.doi.org/10.2139/ssrn.3660641

Lebow, J. (2022). The labor market effects of Venezuelan migration to Colombia: reconciling conflicting results. IZA Journal of Development and Migration, 13(1). DOI: https://doi.org/10.2478/izajodm-2022-0005

León-Santiesteban, M., Mendez-Prada, M. C., Cardona-Arce, Y. P., & Guerrero-Mosquera, N. (2023). Multicriteria Model for Measuring the Potential of Cultural Identity in the Tourism Development of Sincelejo, Colombia. Sustainability, 15(20), 15082. DOI: https://doi.org/10.3390/su152015082

Macedo, M., Lotero, L., Cardillo, A., Barbosa, H., & Menezes, R. (2020, February). Gender patterns of human mobility in Colombia: Reexamining Ravenstein's laws of migration. In Complex Networks XI: Proceedings of the 11th Conference on Complex Networks CompleNet 2020 (pp. 269-281). Cham: Springer International Publishing. DOI: https://doi.org/10.1007/978-3-030-40943-2_23

Makowski, D., Ben-Shachar, M. S., Patil, I., & Lüdecke, D. (2020). Methods and algorithms for correlation analysis in R. Journal of Open Source Software, 5(51), 2306. DOI: https://doi.org/10.21105/joss.02306

Malmberg, G. (2021). Time and space in international migration. In International migration, immobility and development (pp. 21-48). Routledge. Available: https://n9.cl/bgqzv

Mendivelso, F. (2021). Prueba no paramétrica de correlación de Spearman. Revista Médica Sanitas, 24(1). DOI: https://doi.org/10.26852/01234250.578

Ministerio de Comercio, Industria y Turismo de la República de Colombia (MINCIT) (2023). Informe mensual de turismo, Noviembre 2023. Consulted on January 6, 2024 on the Official Page of the Ministry of Commerce, Industry and Tourism of the Republic of Colombia, available through: https://n9.cl/uhp1xm

Muñoz-Mora, J. C., Aparicio, S., Martinez-Moya, D., & Urbano, D. (2022). From immigrants to local entrepreneurs: Understanding the effects of migration on entrepreneurship in a highly informal country. International Journal of Entrepreneurial Behavior & Research, 28(9), 78-103. URL: https://n9.cl/fj0ac

Penaloza-Pacheco, L. (2022). Living with the neighbors: the effect of Venezuelan forced migration on the labor market in Colombia. Journal for Labour Market Research, 56(1), 1-32. DOI: https://doi.org/10.1186/s12651-022-00318-3

Ramirez, J., García, J., Navarro, E., & Niebles, W. (2023). Analysis of the Predictors of Unemployment of Venezuelan Migrants in the city of Barranquilla through a Logistic Regression Model. Migration Letters, 20(S3), 104-111. DOI: https://doi.org/10.59670/ml.v20iS3.3762

RStudio Team (2020). RStudio: Integrated Development for R. RStudio. PBC, Boston, MA. URL: http://www.rstudio.com/

Selee, A., & Bolter, J. (2022). Colombia's open-door policy: An innovative approach to displacement?. International Migration, 60(1), 113-131. DOI: https://doi.org/10.1111/imig.12839

Shaw, J., & Ramaciotti, J. P. (2023). The transient foreigner': Restrictions on citizenship acquisition in Chile and Colombia for those said to be 'passing through'. International and Comparative Law Quarterly. DOI: https://doi.org/10.1017/S0020589323000477

Tribín-Uribe, A. M. (2020). Immigration and Violent Crime: Evidence from the Colombia-Venezuela Border. Borradores de Economía; No. 1121. DOI: https://doi.org/10.32468/be.1121

Vasyechko, O. (2023). Current challenges related to the consumer price index (CPI) in Ukraine. Statistics in Transition. New Series, 24(1), 105-130. URL: https://www.ceeol.com/search/article-detail?id=1134616

Yusuff, A. Q., Ajayi, S. O., Akanbi, O. A., & Amusa, S. O. (2020). Econometric Analysis of Consumer Price Index on Some Major Economic Indicators. International Journal of Applied Science and Mathematical Theory, 6(3), 19-25. DOI: https://n9.cl/7jy3x

Zhao, J., Li, Z., Gao, Q., Zhao, H., Chen, S., Huang, L., ... & Wang, T. (2021). A review of statistical methods for dietary pattern analysis. Nutrition journal, 20(1), 1-18. DOI: https://doi.org/10.1186/s12937-021-00692-7