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Evolution And Forecast Of Basic Food Basket Prices In Fortaleza From January 1994 To May 2023

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Abstract: *This study sought to analyze the projection of the price of the basic food basket in Fortaleza between January 1994 and May 2023, in addition to verifying the hypothesis of the influence of rainfall on the predicted value of the basic food basket. Monthly rainfall data were obtained from the Ceará Foundation for Meteorology and Hydric Resources (FUNCEME). The series of prices and minimum wages were obtained from the Inter-Union Department of Statistics and Socioeconomic Studies (DIEESE). The values were indexed by the INPC of IBGE and converted into USD of May 2023. The average values, coefficients of variation and geometric growth rates of the annual minimum wage, the average annual price of basic food and rainfall were estimated. An integrated autoregressive moving average ARIMA model (2.1.1) was fitted to capture the trajectory and forecast the prices of the basic food basket. We tested whether the residuals generated in the model were influenced by the rainfall during the period. The results showed that the model fit is adequate to forecast the price of the basic food basket in Fortaleza. They also showed that the growth of the annual minimum wage adjustments, in general, maintained the purchasing power of this variable. The research showed that the prices of the basic food basket evolved at a lower rate than the evolution of the minimum wage in the period analyzed*
Key Word*: Cost of food; rainfall instability; Seasonality; Poverty.*

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I. Introduction

According to the Continuous National Household Sample Survey (Pnad) of the Brazilian Institute of Geography and Statistics (IBGE)[1] 2022, 34.766 million people, i.e. 35.63% of the population received up to 1 minimum wage (R$ 1,212 in 2022), and 30.798 million people, about 31.56% of the total, earned from 1 to 2 minimum wages; and 32.81% received above 2 minimum wages. Also according to IBGE[1], the Northeast region had the lowest nominal household income per capita of R$ 1,023, emphasizing however, that the situation at the regional level is more difficult than at the national level. Thus, the participation of the value of the basic food basket in the income of the population is a determining factor of the quality of life. Given that the higher this participation, the worse the quality of life of families.

However, it is necessary to consider the climatic instabilities that affect the prices of the items of the basic basket that are mostly food. Much of the Northeast region and practically all of Ceará are inserted in the semi-arid region. This climatic regime that has as a rule the rainfall instability, both from a spatial and temporal point of view and the rains are concentrated, in general, in the first three to four months of the year, with high temperatures, and with preponderantly low relative humidity of the air that hinder agricultural practices, unstable climatic regime in rainfall both spatially and temporally [2,3,4,5].

Andrade et al (2011)[6] analyzed the price behavior of basic food basket items in the cities of Itabuna and Salvador, Bahia. The results showed that, in the first half of the year, the effect of seasonality is greater than in the second half. It also inferred that climatic instabilities imply intervention in the series analyzed.

On this issue Silva, Pires and Ferraz (2015)[7] explain that there are numerous factors that result in product price fluctuations in the markets, such as: climate, commodity prices, product seasonality, economic crises, among others.

Silva et al (2019)[8], used computational modeling techniques applied in the analysis and forecasting of time series of the cost of the basic food basket in the city of Ilhéus, a municipality located in the South of Bahia.

For that work, the author used the Autoregressive, Integrated and Moving Average (ARIMA) model to predict the likely prices of the basic food basket, and concluded that it was a wise choice.

In this context, the projection for the measurement of the Price of the Basic Basket is a strategic planning tool for consumers and society, in addition to serving as a parameter to raise public policies with a view to guaranteeing the minimum essential ration (REM) for the most vulnerable populations. Thus, this research seeks to answer the following questions: a) How did the value of the basic food basket develop in the period from January 1994 to May 2023 in Fortaleza, capital of the state of Ceará? b) Was the value of the basic food basket influenced by rainfall during this period?

To answer these questions, the research has the following specific objectives: a - to evaluate the annual evolution of the price of the basic food basket and the minimum wage in Fortaleza; b - to assess the evolution of the relative participation of the value of the basic food basket on the minimum wage in Fortaleza; c - to evaluate the trajectory of the monthly prices of the basic food basket in the city of Fortaleza between January 1994 and May 2023; d - to adjust a forecasting model for these prices; e - to assess whether the monthly rainfall during this period had an impact on these prices.

In this context, the study intends to provide a contribution to society, since it makes it possible to identify the price trends of the basic food basket, as well as the influence that precipitation exerts on the composition of the products entitled basic food basket. Thus, this research contributes important information to the various sectors of the economy, markets and government.

Thus, the study was divided into an introduction and four more sections. The second showed a brief review of the literature on the basic food basket and the semi-arid region. The third section describes the methodology used. In the fourth the results of the research and, therefore, the conclusions and final considerations.

II. Material And Methods

Data were extracted from the Monthly Basic Food Basket Survey conducted monthly by DIEESE[9] and prices corrected to May 2023 values using the National Consumer Price Index (INPC). Information related to rainfall was collected from the Ceará Foundation for Meteorology and Water Resources [10].

Methodology to achieve objectives "a" and "b".

In order to assess annual changes in the prices of basic food baskets, the annual averages of these prices are estimated on the basis of the values observed each month. The annual ratios between the average prices of basic food baskets and the minimum wage, also indexed by the INPC, are then calculated. These ratios will provide estimates of how much the value of the basic food basket represented annually in income.

Next, we estimate the instantaneous geometric growth rates of the annual prices of the basic food basket, the minimum wage, as well as the ratio between the price of the basic food basket and the minimum wage. To do these procedures we use the trend equation presented below:

$$Y_t = e^{(\beta + \rho T + \epsilon t)}$$

In this equation, Y_t can be either the annual price of the basic food basket in year t, or the minimum wage in year t; or the ratio between the price of the basic food basket and the minimum wage. The constant "e" is the base of the natural logarithm; the value of the log-linear coefficient β is the constant of the model and its magnitudes are the values of Y_t when T=0. The angular coefficient ρ, multiplied by 100, is the instantaneous geometric growth rate (GGR) of Yt. The variable T (T = 0, 1, ..., 30) is time. The random term ϵt is the white noise of the model. If these assumptions are true, the trend equations associated with Y_t can be estimated by the ordinary least squares method [11].

Methodology to achieve objectives "c" and "d"

Objectives "c" and "d" are to evaluate the trajectory of monthly prices of the basic food basket in the city of Fortaleza between January 1994 and May 2023; and to adjust a forecast model for these prices. To achieve these objectives, the following theoretical framework is designed.A time series is a group of observations ordered in time (not necessarily equally spaced), and exhibiting serial dependence (i.e. independence between time instants) [11].

In time series analysis, some concepts are essential and necessary for the elaboration of forecasting models, as is the objective of this study. In this conception, it is worth emphasizing that a random or stochastic process is a set of random variables ordered in time [12]. Furthermore, it is added that a stochastic process is stationary when its mean and variance are constant over time and when the value of the covariance between the variables does not depend on the time at which the covariance is calculated.

Consider the time series represented by the random variable Yt. Its predicted value (Y_P) will differ from its observed value Yt due to random factors (ξ_t) that occur along its trajectory. This information can be summarized by Equation 1 In this research the values of Y_P are estimated using the Autoregressive Integrated Moving Average (ARIMA) model developed by Box and Jenkins (1976)[13].

$$Y_t - Y_P = \xi_t \quad (1)$$

To proceed with the procedure of estimating the forecasting model, the central objective of the research, it is important to observe some criteria. First: the series of the random variable (Y_t) must be stationary, or at least susceptible to stationarity, and the random error term (ξ_t), can take positive and negative values. In addition, it is required that the random term has constant variance and is not autoregressive in time [13,12, 11].

A series is considered stationary when it progresses in time randomly around a mean, variance and auto-correlation structure do not change over time, i.e. they are constant.

According to Gujarati and Porter (2011)[12], the unit root test is able to detect stationarity in the series. The starting point for analysis is the unit root process (stochastic):

$$Y_t = \rho Y_{t-1} + \xi_t \quad (2)$$

Where Yt is the time series analyzed, and Yt-1 is the lagged value in one period, and, ξt the error term. Knowing that ρ varies from -1 to 1. When ρ = 1 it means that the stochastic process is non-stationary or a random walk. By subtracting Y_(t-1) from both sides, the following is obtained:

$$Y_t - Y_{t-1} = \rho Y_{t-1} - Y_{t-1} + \xi_t$$

$$Y_t - Y_{t-1} = (\rho - 1) Y_{t-1} + \xi_t \quad (3)$$

$$\Delta Y_{it} = \rho Y_{it-1} + z'_{it} Y + \xi_{it}$$

Where, ΔY_{it} is the first difference of the prices; Y_{it-1} is the lagged price, when i=1,2,...,N for each individual and t=1,2,...,T periods, 〖Z'〗 _it is the deterministic component, which could be zero, one, the fixed effect ξ_{it}, or the time trend fixed effect (t). In simple series models, the hypothesis H0 is tested: ρ = 0. This hypothesis, if accepted, suggests that there is a unit root, or the time series is non-stationary and therefore consists of a random walk. The alternative hypothesis H1: ρ < A|1|. If this hypothesis is accepted and therefore hypothesis H0 is rejected, it tests that the time series is stationary.

If the original series is not stationary, the search for stationarization will be done through differencing procedures of the random variable Yt with respect to previous periods. As many differentiations (integrations) will be made as necessary to transform Yt into a stationary series. In general, no more than three differences are needed to achieve the stationarization of a variable that was initially non-stationary[12].

Once the random variable is originally stationary or, if not, has been stationary, one can apply the Autoregressive integrated model and moving average to make its predictions in time.

Brief Overview of the ARIMA Model as it Applies to this Study

This model aims to capture the behavior of a random variable that has distributed values in the form of time series. This model is suitable for series time series that are stationary, or variables whose means, variances and auto-covariances are constant over time [11,10].

Once the unit root test and graphical analysis have been carried out and it has been proven that the series is not stationary, its stationarity must therefore be provided by differentiating the time series. It is likely that with up to three differentiations it is possible to transform a series that has been shown to be non-stationary into stationary. Thus in time series it is important that the selected variables are stationary or at least possible to be stationary, an essential characteristic for the consistency of the hypothesis that the future will be explained by past events, from the regression of these time series. When used to estimate forecasts, it must be assumed that their characteristics are constant over the period, and especially over future periods [12,11].

Consider that the time series Y_t can be represented as follows:

$$Y_t = \mu + \Sigma\psi k.\ \xi_{t-k} = \mu + \psi(B).\ \xi_t \quad (4)$$

Where the linear filter ψ is defined by

$$\psi(B) = \theta(B) / \phi(B) \quad (5)$$

The terms in equation (5) are defined by the following polynomials:

θ(B) = 1 – θ1B- θ2B2 - .... - θqBq e ϕ(B) = 1 – ϕ1B – ϕ2B2 - ... -ϕpBp

Defining: Ỹt = Yt - μ, it will be possible to obtain the following transformation:

$$\phi(B)\tilde{Y}_t = \theta(B)\ \xi_t \quad (6)$$

In equation (6), ξ_t is a generally Gaussian "white noise". To do so, it must meet the following conditions: i) $E(\xi_t) = 0$; ii) $E(\xi_t^{\,2}) = \sigma^2 < \infty$; e iii) $E(\xi_t, \xi_t + k) = 0$, para k = ±1, ±2, ...[13].

According to Box; Jenkins (1976)[13] equation (6) is called ARMA(p,q) and can be rewritten as follows:

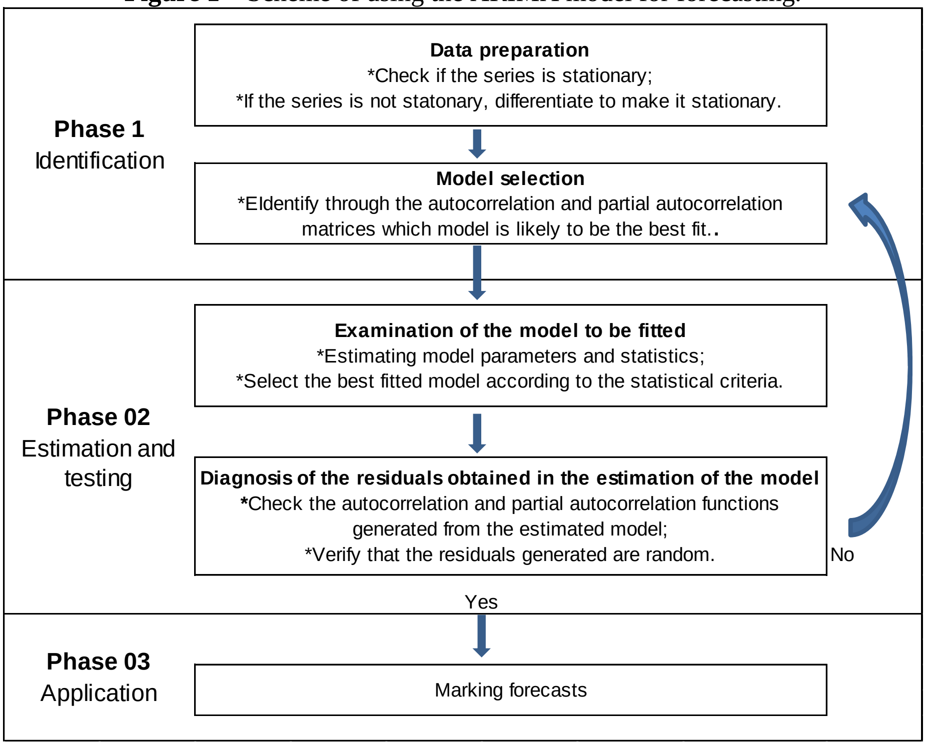
$\tilde{Y}_t=\theta(B)\phi\text{-}1.(B) \quad \xi_t$
(7)

Types of Box and Jenkins Models: 1 - Autoregressive (AR) models: these are those where $\theta(B) = 1$ and are said to be AR(p). These models are so called because Y_t, at time t, is a function of the values of this variable at times prior to t; 2 -Moving average (MA) models: these will be those in which $\phi(B) =1$ and are said to be MA(q); 3 - Auto regressive moving average (ARMA) models, will be those that have an (AR)part with an MA part, and will have the notation ARMA(p,q); 4 -Auto-Regressive Integrated Moving Average (ARIMA) models, will be those called integrated ARMA model or ARIMA is an extension of the ARMA model class to include the "d" ARIMA differentiation (p.d.q).

It is evident that in the case of the need to differentiate a time series "d" times to make it stationary and apply the ARMA (p.q) model to it, it is stated that the original time series is ARIMA (p.d.q). Therefore, the integrated autoregressive moving average time series, where "p" denotes the numbers of autoregressive terms, "d" the number of times the series must be differenced before becoming stationary and "q" the number of moving average terms [13,12,15].

To build the ARIMA model that best suits the study, it is necessary to follow the steps of the Box-Jenkins methodology shown in figure 1. There are three phases: the first is the identification, in which through the analysis of the data the most appropriate ARIMA model is selected. In the second, the parameters of the model are estimated with statistical robustness gauged. In the third, the fitted model is used to make forecasts. Figure 1 shows the steps for applying the ARIMA(p.d.q) model.

Figure 1 – Scheme of using the ARIMA model for forecasting.



Fonte: Based on Gujarati and Porter (2011).

In the data preparation stage, a transformation was made consisting of constructing an equivalent stationary series through the successive differences procedure and the verification of stationarity through the ADF (Augmented Dickey-Fuller) unit root test. The autocorrelation function (ACF) and the partial autocorrelation function (PACF) of the series are then calculated, in addition to the graphical analysis that allowed the ARIMA model (p, d, q) to be selected.

After the identification stage, the model parameters were estimated. The parameter d refers to the number of times the difference between the elements of the series was taken until it became stationary. In the present study it was only necessary to take the first difference to make the series stationary, i.e. $d = 1$. The calculation of the autoregressive parameters p and moving average q involves the analysis of the FAC and FACP functions respectively. The FAC function presented two significant peaks indicating $p = 2$, while the FACP function presented one peak indicating $q = 1$. However, the ARIMA(2, 1, 1) model was obtained as a result.

Still in phase 2 of estimation and testing, after defining the appropriate values, the analysis of the residuals (ξ), which must be white noise, is carried out. For this purpose, the Ljung-Box (LB) statistic is used, which must be non-significant at a significance level of at least 10%. Next, the mean absolute percentage error (MAPE) is analyzed, which considers the relative error of each forecast, in order to compare the values predicted by the model with the observed values of the series, characterizing the forecasting capacity of the adopted model.

In addition to the aforementioned parameters, it is considered that the fit of the model will be better with few regressors used. The coefficient of determination (R^2) is examined, which assesses the percentage of variation of the analyzed variable that is explained by the structured model; Pearson's correlation coefficient, capable of verifying the proximity between the observed values and the values predicted by the model; Akaike's information criterion (AIC) and the Bayesian integrated criterion (BIC), the second will be used in the research. These are criteria that penalize the likelihood, so that a more parsimonious model is selected, and these conceptions are based on the concepts of information and entropy, which are of fundamental importance for their complete understanding [13,11]. Once all these steps have been completed, the forecasting model is used and explored.

Relationship between the forecast model and rainfall in Ceará (objective "e").

The research presented admits that the values of the basic food basket were influenced by the exogenous variable: rainfall (C_t). Thus, the value of the basic food basket (Y_t) in Fortaleza between January 1994 and May 2023 can be exposed as shown in Equation (8), now explained in the way it was estimated in this study:

$$Y_t = \lambda_0 + \lambda_1 C_t + \xi_t \quad (8)$$

In Equation (8) the coefficient λ_0 represents the linear parameter; λ_1 is the angular coefficient which, being statistically different from zero, measures the sensitivity of the basket forecast term (Y_t) to oscillations in monthly rainfall (C_t). The random term ξ_t, by hypothesis, is also endogenously "white noise" in Equation (8). If this hypothesis is true, the coefficients λ0 and λ1 can be estimated by the ordinary least squares method (OLS) [11].

III. Result and Discussion

The discussion of the results will be made in the sequence in which the research objectives are presented.

Results found to meet objectives "a" and "b"

The results found to meet objectives "a" and "b" are shown in Table 1. Through the evidence shown in this table, it appears that the annual minimum wage ranged from USD91.30 in 1994 to USD274.43 in 2023 with an average of USD191.42 and a CV=30.50%, "very high" in the definition of Gomes (1985)[16]. The minimum wage grew at a rate of 3.7% per year over the period analyzed.

The average value of the basic food basket in the period studied was USD94.09. Around this average gravitated values ranging from USD71.32 to USD274.43, which provided a CV=19.63 considered average, approaching to be "high" in the scale drawn by Gomes (1985)[16]. The growth rate of the basic food basket of 1.8% per year was much lower than that experienced by the growth of the minimum wage. For this reason, the ratio of the price of the basic food basket to the minimum wage experienced a regression in growth of around 1.9% per year. Indeed, the average value of the ratio was 0.52, with minimum and maximum values of respectively: 0.39 in 2006 and 1.00 in 1994. The CV=26.92 is classified as "high" on the scale constructed by Gomes (1985)[16].

The average rainfall for the period was 406.8 mm with a coefficient of variation of 112%, considered "very high" in Gomes' classification. Therefore, the rainfall had a very high instability that made the prices of the basic food basket also very high in the period.

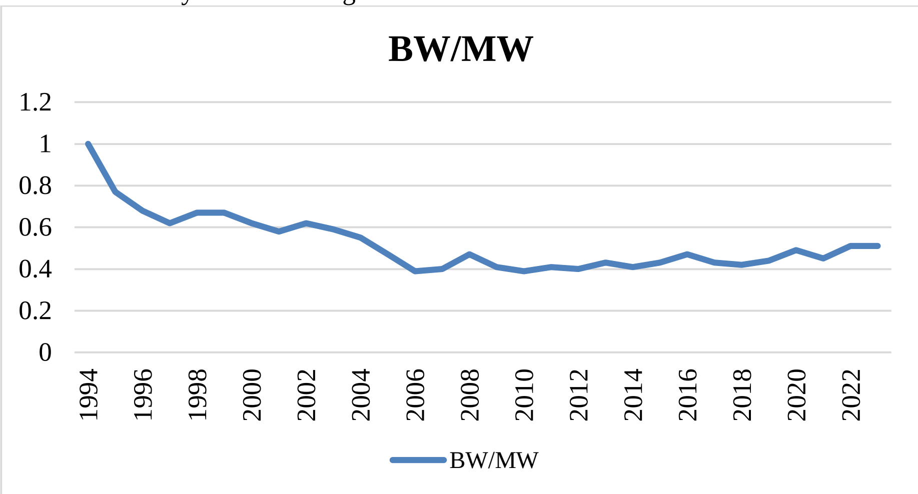
Table 1 - Estimates of the descriptive statistics and annual geometric growth rates (GGR) of the basic food basket (BB), minimum wage (MW) and the ratio (BB/MG) in Fortaleza between 1994 and 2023

	Descriptive Statistics				
Varibles	Minimum	Maximum	Average	SD	CV
BB	71.32	139.72	94.09	18.47	19.63
MW	91.30	274.43	191.2	58.39	30.50
BB/MG	0.39	1.00	0.52	0.14	26.92
	Estimation of GGR				

		Constant		Regr. Coeficient	
Variables	Adj. R^2	Value	Sign.	Value	Sign.
BB	0.640	5.844	0.000	0.018	0.000
MW	0.920	6.244	0.000	0.037	0.000
BB/MG	0.487	-0.400	0.000	-0.019	0.000
Source: Prepared based on data from DIEESE					

Figure 2 illustrates the trajectory of the relationship between annual prices of basic food baskets and minimum wage in Fortaleza between 1994 and 2021.

Figure 2: Trajectory of the relationship between the average monthly price of the basic food basket and the monthly minimum wage in Fortaleza between 1994 and 2023

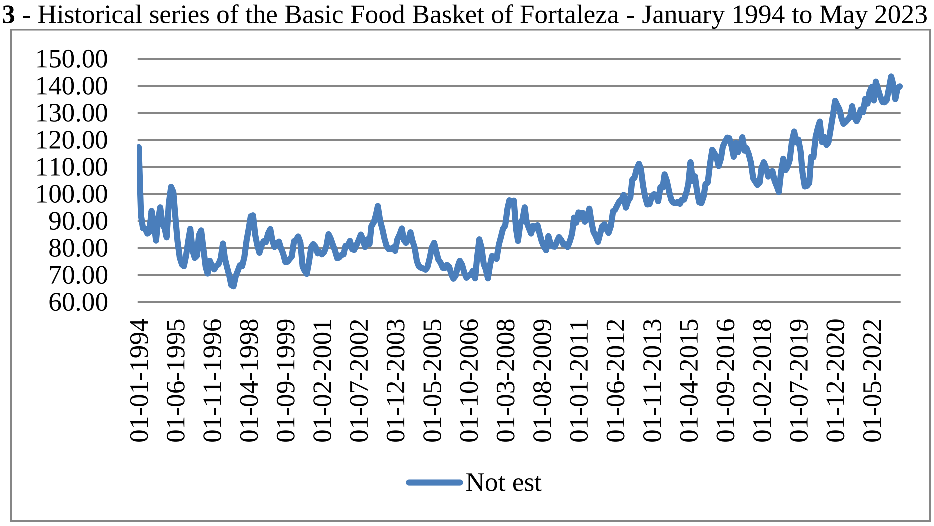


Source: Prepared based on data from DIEESE

Results found to achieve objectives "c" and "d".

The visual analysis of the basic food basket price series shown in Figure 3 suggests that it was not stationary and needed tstationarization procedures to be triggered. This characteristic was confirmed when the unit root test was performed using the Augmented Dickey-Fuller (ADF) test. The series became stationary after making the first difference ($d = Y_t - Y_{t-1}$), as can be seen in figure 4.

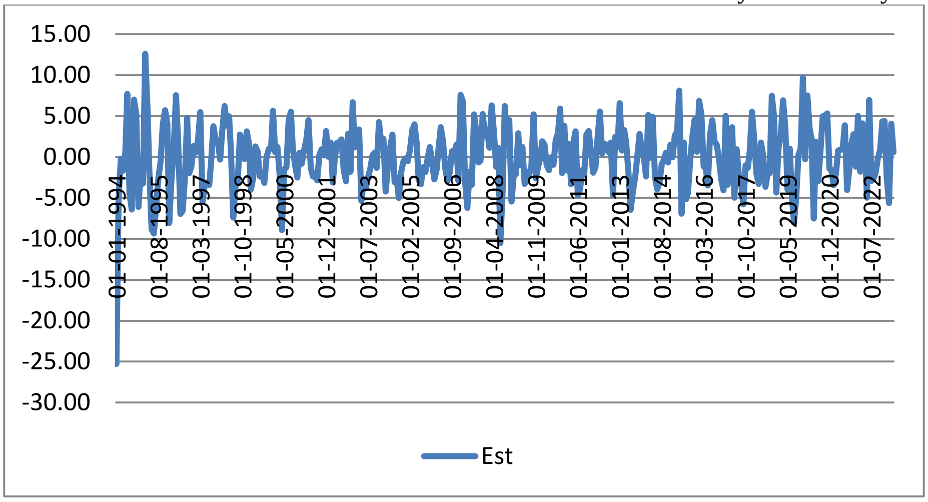
Figure 3 - Historical series of the Basic Food Basket of Fortaleza - January 1994 to May 2023



Source: Prepared based on data from DIEESE

The stationarity of the series occurred at the first difference, as illustrated by Figure 3.

Figure 4 - Fortaleza Basic Food Basket time series with first difference - January 1994 to May 2023



Source: Prepared based on data from DIEESE

After stationarization of the series, the results found in the estimations of the parameters of the forecasting models, as well as the relevant statistics that ensure the robustness and parsimony of the results found are shown in Table 2. Summary of the ARIMA (2,1,1) model.

Table 2 - Models fitted for the forecasts of the Basic Food Basket of Fortleza Fortaleza between January 1994 and May 2023

Edjusted Model	Statistics
AR lag 1	0,995*
AR lag 2	-0,341*
MA lag 1	0,799*
R-squared	0,962
Ljung Box	$57{,}200^{NS}$
MAPE	2,942
BIC	5,790
R Pearson	0,997

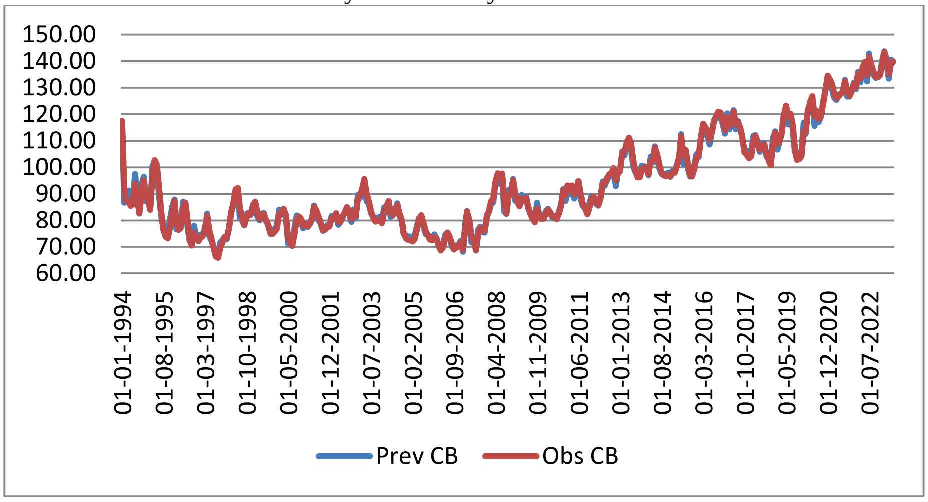
Source: Prepared based on data from DIEESE

The results listed in Table 2 show that the adjustments, besides being parsimonious, presented robust results from a statistical point of view, which are important requirements to use the model to forecast the price of the basic food basket in Fortaleza. It is also observed that, according to the Ljung Box test, the residuals resulting from the adjustment were random (white noise), meeting what the literature predicts, as can be seen from the statistics generated by the Ljung-Box test that proved to be non-significant.

The MAPE (Mean absolute potential error), widely used for the evaluation of forecasting methods and which indicates the average size of the error through a percentage that is the difference between the observed value and the predicted value, regardless of whether it is positive or negative provided value of 2.942, low magnitudes. The coefficient of determination (R2 = 0.962), the BIC statistic = 5.79, as well as the estimate of the Pearson correlation coefficient between the observed values of the series and those predicted by the model of the order of 0.997, complement the information that the adjusted model is suitable to be used for forecasting (Table 2).

The trajectories of the observed values and the values predicted by the fitted model for the basic food basket are presented visually in Figure 3. As presented in Table 2 and now in terms of figure 5, the adjustments found and which generated the predicted values showed great adherence.

Figure 5 - Trajectories of the observed and predicted series in the model for the basic food basket of Fortaleza January 1994 to May 2023



Source: Prepared based on data from DIEESE

The relationship between the values of the basic food basket in Fortaleza and rainfall

Finally, it was tested whether the very unstable path of food basket prices between January 1994 and May 1993 had been influenced by the also very unstable rainfall observed in the period. The results showed a regression coefficient of 0.128, statistically different from zero at a significance level of 0.036. This result confirms one of the assumpions of this research.

Indeed, between 1994 and 2022 (the rainfall records for 2023 only cover the period from January to May this year) the average rainfall in Fortaleza was 761 millimetres.

In the period analyzed in the research, there were some years of rainfall difficulties, which were more severe. This happened mainly between 2012/2017, when the longest period of rainfall retraction in the Northeast was observed since rainfall records from 1901. In those years, the average rainfall in Fortaleza was 533.37 millimeters.

The estimated average value of the food basket for the entire period analyzed was, as shown, USD94.09. In the years prior to 2012, the average value of the basic food basket was USD81.54. Between 2012 and 2017, the average price of the basic food basket jumped to USD104.42, and remained on the rise until the end of the period, when it reached a value of USD139.72. This caused the geometric growth rate of food basket prices estimated for Fortaleza in the period to assume the magnitude of 1.8% per year.

IV. Conclusion

The general conclusion of the research is that the minimum wage had an increasing evolution over the period analyzed. As it is a variable that is not determined by the market, although its definition by the executive branch takes into account the ongoing inflationary process in defining its magnitude. In this case, it was observed that throughout the trajectory the minimum wage adjustments, in general, maintained its purchasing power. The high instability of the trajectory of this variable, captured in a CV=30.5%, suggests that the instabilities that have occurred in the economy over the years have been somewhat offset by the adjustment policies implemented by governments.

The price of the basic food basket over the years, on the contrary, is defined by market fluctuations. Most of the items that make up the basic food basket of Fortaleza residents are imported from outside the state and, in order to reach homes, encounter many obstacles, such as problems in the areas of production, transportation, logistics, among other difficulties. The products that are part of the basic food basket of the residents of this city that are not imported (food, mainly) suffer from the frequent rainfall instabilities of the Northeast where the capital of Ceará is located.

The research showed that variations in rainfall in Fortaleza had a positive influence on the prices of the basic food basket, as supposed. This fact became more pronounced between the years 2012 and 2017 when there was a long period of rainfall restrictions in the Northeast, in Ceará and in Fortaleza. This boosted the prices of the basic food basket in that period, and the survey found that prices continued to expand, perhaps reflecting expectations on the part of the agents who produced and sold the products of basic basket.

Notwithstanding the oscillations in the prices of the basic basket in Fortaleza over the period analyzed, it was observed that the growth of the minimum wage of around 3.7% per year caused the evolution of the relationship between the prices of the basic food basket and the minimum wage to experience an average annual deceleration of 1.7%.

The model fitted in the survey managed to capture, with statistical rigor evidenced in the magnitude of the estimates obtained, the entire trajectory of the series of prices of the basket, which was one of the main objectives of the research. In addition, it showed that the residuals generated, which are endogenously random, are exogenously influenced by the monthly rainfall observed in the period. This makes the model suitable for forecasting.

References

[1]. IBGE, Instituto Brasileiro De Geografia E Estatística. Brasilia, DF. Available At: Http://Www.Ibge.Org.Br/Estatistica/Indicadores/Precos/Inpc_Ipca.
[2]. Lemos, J. D. J. S. (2020). Vulnerabilidades Induzidas No Semiárido.
[3]. Melo, R. F. De, Simoes, W. L., Pereira, L. A., Brito, L. D. L., Ferreira, E. P., De BARROS, L. C., & Ribeiro, P. D. A. (2019). Água Para O Fortalecimento Dos Sistemas Agrícolas Dependentes De Chuva. In: Melo, R.F., Voltolini, T.F. Agricultura Familiar Dependente De Chuva No Semiárido. EMBRAPA Semiárido. P.188 – 228.
[4]. Mohammed, R., & Scholz, M. (2019). Climate Change And Water Resources In Arid Regions: Uncertainty Of The Baseline Time Period. Theoretical And Applied Climatology, 137(1-2), 1365-1376.
[5]. Salviano, J. I. D. A., Praxedes, A. L. F., & Lemos, J. D. J. S. (2020). Sinergias Entre As Instabilidades Pluviométricas E A Produção De Lavouras De Sequeiro No Semiárido Cearense.
[6]. Andrade, S. F., De Moura Pires, M., & Ferraz, M. I. F. (2011). Segurança Alimentar: Uma Análise Do Comportamento Dos Preços Dos Itens Da Cesta Básica. Revista Desenbahia Nº, 31.
[7]. Silva, M. D. V., De Moura Pires, M., & Ferraz, M. I. F. (2015). Análise Da Interdependência Entre Os Preços Da Cesta Básica Das Capitais Do Nordeste. Reflexões Econômicas, 1(1), 219-247.
[8]. Silva, D. R. Da, Dominguez, D. S., Ambrosio, P. E., & Iglesias, S. M. (2019). Método Híbrido De Redes Neurais E Modelo ARIMA Na Previsão Do Custo Da Cesta Básica Na Cidade De Ilhéus. Revista Mundi Engenharia, Tecnologia E Gestão (ISSN: 2525-4782), 4(3).
[9]. DIEESE, Departamento Intersindical De Estatística E Estudos Socioeconômicos. (2016). Cesta Básica Nacional Metodologia.
[10]. FUNCEME, Fundação Cearense De Meteorologia. (2023). Plataforma De Coleta De Dados.
[11]. Wooldridge, J. M. (2015). Introductory Econometrics: A Modern Approach. Cengage Learning.
[12]. Gujarati, D. N., & Porter, D. C. (2011). Econometria Básica-5. Amgh Editora.
[13]. Box, G. E., Jenkins, G. M., Reinsel, G. C., & Ljung, G. M. (2015). Time Series Analysis: Forecasting And Control. John Wiley & Sons.
[14]. Cochrane, J. H. (1997). Time Series For Macroeconomics And Finance.
[15]. Greene, W. H. (2012). Econometric Analysis. 71. Ed. New York: Stern School Of Business, New York University.
[16]. Gomes, F. P. (1985). Curso De Estatística Experimental.