Revista Conhecimento Contábil
DOI:
ISSN: 2447 - 2921

EFEITOS ASSIMÉTRICOS DA VARIAÇÃO CAMBIAL SOBRE OS PREÇOS DO MELÃO AMARELO NO BRASIL

ASYMMETRIC EFFECTS OF EXCHANGE RATE VARIATION ON YELLOW MELON PRICES IN BRAZIL

Fábio Lúcio Rodrigues
prof.fabiolucio@gmail.com
Ildérica Lopes da Silva
ilderica_lopes@hotmail.com
Eliane de Souza Lemos
lianelemos@outlook.com
Joana D'arc Rebouças Mendonça
joannamendoncah@gmail.com
Antônio Flávio de Souza Duarte
flavioduarte.contador2@gmail.com

Abstract

How does exchange rate variation influence the price formation of yellow melons in Brazil? This study aims to analyze the dynamic relationship and the exchange rate pass-through to fruit prices at the producer and wholesale levels. To this end, weekly data from 2023 to 2025 are employed, and a Vector Autoregressive model is estimated, complemented by Variance Decomposition and Impulse-Response Functions. The results evidence an incomplete and asymmetric exchange rate pass-through. Exchange rate variability explains a maximum of 2.20% of producer price fluctuations within a six-week horizon. Furthermore, producers absorb the initial shock negatively (margin squeeze), whereas wholesalers, due to their greater market power, dissipate and even reverse the shock in the medium term. Given this vulnerability, it is recommended to structure public policies focused on democratizing exchange rate hedging instruments and fostering agricultural cooperatives, aiming to mitigate asymmetries and strengthen the bargaining power of fruit growers.

Keywords: Agricultural Markets. Agricultural Prices. Yellow Melon. Exchange Rate Variation.

Resumo

Como a variação da taxa de câmbio influencia a formação de preços do melão amarelo no Brasil? Este estudo tem por objetivo analisar a relação dinâmica e o repasse cambial aos preços da fruta nos níveis de produtor e atacado. Para tanto, empregam-se dados semanais de 2023 a 2025 e estima-se um modelo de Vetores Autorregressivos, complementado pela Decomposição da Variância e Função Impulso-Resposta. Os resultados evidenciam um repasse cambial incompleto e assimétrico. A variabilidade do câmbio explica, no máximo, 2,20% das oscilações dos preços ao produtor em seis semanas. Ademais, produtores absorvem o choque inicial negativamente (esmagamento de margens), enquanto atacadistas, devido ao maior poder de mercado, dissipam e até revertem o choque no médio prazo. Diante dessa vulnerabilidade, recomenda-se a estruturação de políticas públicas focadas na democratização de instrumentos de *hedge* cambial e no fomento a cooperativas agrícolas, visando mitigar assimetrias e fortalecer o poder de barganha dos fruticultores.

Palavras-chave: Mercados Agrícolas. Preços Agrícolas. Melão Amarelo. Variação Cambial.

1 Introduction

The recent dynamics of the global food market reveal a structural shift in consumer preferences, driving demand for fresh and unprocessed products due to growing concerns about food safety and nutritional benefits. Against this backdrop of expanding international demand, Brazilian agribusiness—particularly the fruit-growing sector—has consolidated its position as a strategic contributor to the country's trade balance. Brazil is currently the world's third-largest fruit producer (Vidal, 2024), with exports exceeding 1.07 million metric tons in 2024 and generating approximately US$1.3 billion in foreign exchange earnings. The Netherlands, the United Kingdom, and the United States were the main destination markets (ABRAFRUTAS, 2024).

Within Brazil's fruit export portfolio, melon (*Cucumis melo*) has become the second most important fruit in terms of export volume and value, surpassed only by mango. This prominent position stems from the strategic convergence of the country's natural comparative advantages and the adoption of technology-intensive production systems. Commercial melon cultivation has found highly favorable conditions in Brazil's semiarid region, where abundant sunlight and low relative humidity, combined with substantial investments in irrigation infrastructure and advanced management techniques, have provided the soil, climate, and structural conditions required to increase productivity and comply with stringent international phytosanitary standards (Cunha, 2025; Viana *et al*., 2006).

As a result of this productive specialization, supply is highly geographically concentrated, with the Northeast region accounting for approximately 98% of the national harvest. The state of Rio Grande do Norte, in particular, stands out as the country's leading production and export hub, benefiting from its proximity to strategic ports and the consolidation of efficient irrigated districts (IBGE, 2024). The strength of this agricultural cluster extends beyond macroeconomic indicators, as it plays a vital role in stabilizing the regional economy by generating substantial direct employment and income in historically vulnerable areas. This reinforces the strategic importance of this commodity to the economic development of the semiarid region (Sousa & Miranda, 2018).

The growth trajectory of melon production is confirmed by production and trade indicators. The value of national melon production increased from R$867.9 million in 2022 to R$1.38 billion in 2024, when the harvested area reached 31,287 hectares and total production amounted to 816,939 metric tons (IBGE, 2024). In the foreign market, export volume increased from 228,100 metric tons in 2023 to 243,300 metric tons in 2024. However, foreign exchange revenue declined slightly from US$189.1 million to US$185.2 million over the same period (ABRAFRUTAS, 2024), indicating a decrease in the average international price per metric ton and highlighting the sector's profitability vulnerability to relative price shocks. This apparent contradiction between the increase in physical export volume and the simultaneous decline in gross revenue reveals the limitations of purely descriptive and aggregate approaches. It therefore calls for a detailed empirical investigation into how macroeconomic shocks are transmitted at the microeconomic level across the different links in the supply chain.

Despite the sector's productive strength and the consolidation of technological innovations in the irrigated districts of the semiarid region, recent volatility in melon prices demonstrates that the commercial performance of export-oriented fruit production remains structurally sensitive to macroeconomic and exogenous factors. The agricultural economics literature shows that profitability in this sector is not determined solely by on-farm efficiency. Changes in the global food supply, shifts in international trade policies, and extreme weather events constitute sources of systemic risk. These factors disrupt supply chains and cause considerable fluctuations in agricultural commodity prices, affecting revenue predictability and the determination of the final price paid to producers (Assunção *et al*., 2021; Campos & Bacha,

2012).

Among these exogenous macroeconomic factors, exchange rate volatility emerges as a key determinant of the competitiveness of Brazilian fruit in international markets. Exchange rate exposure has an ambiguous effect on the supply chain. While depreciation of the Brazilian real may improve the competitiveness of Brazilian melons against foreign competitors in European and North American markets, it simultaneously increases production costs because of the sector's heavy dependence on dollar-denominated inputs, such as fertilizers and crop protection products. Specifically, in the export hub of Rio Grande do Norte, empirical studies indicate that exchange rate instability, compounded by logistics infrastructure bottlenecks, represents the sector's most significant contemporary challenge to maintaining profit margins and sustaining export growth (Andrade *et al*., 2025; Silva, Freitas, & Mattos, 2016).

From a theoretical perspective, the transmission of these macroeconomic fluctuations to the local economy is formalized through the concept of exchange rate pass-through (ERPT). Established in the literature by Taylor (2000) and widely applied to open economies by Campa and Goldberg (2005), ERPT measures the sensitivity and elasticity of domestic prices in response to exchange rate shocks. In the context of export-oriented agricultural markets, Oliveira (2025) emphasizes that the exchange rate acts as a "double-edged sword." On the one hand, currency depreciation—that is, appreciation of the US dollar against the Brazilian real—increases unit revenue in domestic currency and enhances the attractiveness and competitiveness of the commodity in international markets. On the other hand, the same depreciation substantially increases production costs because the technology packages essential to irrigated fruit production, particularly fertilizers and chemical crop protection products, are predominantly imported and priced in international markets.

The complexity of this phenomenon, however, lies in the fact that the magnitude and speed at which these cost and revenue shocks are passed on to final prices are neither instantaneous nor perfectly elastic. The specialized literature on agricultural price transmission shows that market imperfections, bargaining power, and institutional inertia frequently result in delayed and asymmetric pass-through (Meyer & Von Cramon-Taubadel, 2004). Souza *et al*. (2017) corroborate this dynamic by examining pricing mechanisms specifically within Brazilian melon exports. Their empirical findings demonstrate that exchange rate fluctuations and international price shocks affect marketing margins asymmetrically across the supply chain. This finding suggests that melon prices both at the farm gate and in the wholesale segment absorb exchange rate shocks with different degrees of rigidity and temporal inertia, thus requiring an analytical approach capable of capturing the dynamic trajectory of these interactions.

It is precisely within this analytical gap that the theoretical and empirical limitations of the existing literature and, consequently, the central scientific contribution of this study—are situated. Although the studies conducted by Mayorga *et al*. (2007) and Souza *et al*. (2017) have advanced the understanding of melon marketing, traditional models frequently rely on low-frequency data, such as monthly observations, or treat the product as an aggregate and homogeneous category.

This study advances the literature by introducing two original contributions: (i) the use of high-frequency weekly data, a critical temporal dimension for capturing marketing cycles and the rapid distribution of a perishable product; and (ii) the simultaneous disaggregation of prices by supply chain segment—producer and wholesale and by melon size categories—Types 5 and 8, which strictly meet export standards, versus Types 11 and 12, which are primarily intended for the competing domestic market. This stratification makes it possible to empirically identify the microeconomic frictions, contractual asymmetries, and bargaining power structures that heterogeneously shape macroeconomic pass-through. It therefore provides a new interpretive framework for public policies and private hedging strategies in the sector.

Given the fruit sector's exposure to macroeconomic uncertainty, it is essential to

understand how exchange rate fluctuations are transmitted to fruit prices and the time lags involved in this process. Accordingly, this study aims to analyze the dynamic relationship between the exchange rate and yellow melon prices in Brazil, focusing on the pass-through of exchange rate fluctuations to farm-gate and wholesale prices. To this end, the study employs vector autoregression (VAR) modeling, complemented by impulse response functions and forecast error variance decomposition. These methods are appropriate for capturing the endogeneity and temporal inertia inherent in financial and agricultural price series.

In addition to this introduction, the article is organized into four sections. Section 2 reviews the literature on agricultural price transmission and exchange rate volatility. Section 3 describes the dataset and the econometric procedures employed. Section 4 presents and discusses the empirical results of the unit root tests and the VAR model. Finally, Section 5 provides the concluding remarks and discusses the policy implications of the study.

2 Exchange rate dynamics and price formation: theoretical and empirical evidence

2.1 Exchange Rate Volatility and Trade Flows in the Agricultural Sector

From the perspective of open-economy macroeconomics, the exchange rate serves as the primary transmission mechanism between domestic prices and international markets, thereby determining countries' relative competitiveness (Ibrahim *et al*., 2024). According to the structuralist perspective established by Bresser-Pereira (2012), maintaining a competitive exchange rate is a *sine qua non* condition for economic development because it connects productive sectors endowed with technological and managerial capabilities to foreign demand. Furthermore, the exchange rate level signals the expected profitability of investments in export-oriented sectors, directly influencing domestic saving and capital accumulation capacity.

Historically, the transition to a floating exchange rate system following the collapse of the Bretton Woods agreements in 1973 introduced a structural component of uncertainty into international transactions (Ibrahim *et al*., 2024). The classical theory of international trade under uncertainty, originally modeled by Hooper and Kohlhagen (1978), posits that exchange rate volatility generates unanticipated transaction and adjustment costs. Consequently, when faced with stochastic exchange rate fluctuations, risk-averse economic agents tend to incorporate this uncertainty into their pricing decisions, resulting in a contraction in trade volumes and reduced exposure to foreign markets (Silva, Freitas, & Mattos, 2016).

Conversely, recent empirical literature demonstrates that the effects of exchange rate volatility are not exclusively restrictive. Ibrahim *et al*. (2024) argue that exchange rate fluctuations may induce strategic behavior by encouraging exporters to maximize short-term profit margins through opportunistic adjustments. In scenarios in which economic agents exhibit greater risk tolerance or have access to hedging mechanisms, volatility creates windows of opportunity for the dynamic adjustment of prices and volumes. Evidence also points to asymmetric effects, whereby positive and negative exchange rate shocks affect export and import elasticities with different magnitudes, reflecting each sector's market power and cost structure.

When this macroeconomic debate is extended to agricultural commodity trade, the pioneering work of Schuh (1974) established that exchange rate fluctuations are often more decisive for agribusiness profitability than sector-specific policies themselves. By examining food trade flows among Indonesia, the United States, and China, Ibrahim *et al*. (2024) corroborate this premise by demonstrating that exchange rate sensitivity is heightened for agricultural and food products because of their perishability and the greater rigidity of international demand. This asymmetric price response requires careful analysis and makes it essential to understand pass-through mechanisms to support risk mitigation policies and

measures aimed at promoting agricultural exports during periods of global instability.

Against this theoretical background, a substantial gap remains in the Brazilian literature regarding the mechanisms through which exchange rate fluctuations are transmitted to specific irrigated fruit crops, such as melons. Because melon production is concentrated in Brazil's northeastern semiarid region, operates under a technology-intensive production system, and is predominantly directed toward foreign markets, its marketing margins are intrinsically linked to exchange rate dynamics. This specificity reinforces the need for empirical models capable of quantitatively capturing how macroeconomic shocks are passed through along the supply chain, from rural producers to wholesale markets.

2.2 The Economics of Melon Production: Regional Specialization and Competitiveness

Brazil's integration into global trade flows, which intensified following the trade liberalization process of the 1990s, consolidated agribusiness as the primary driver of trade surpluses and long-term economic growth (Barbosa, 2006). The pressing need to adapt to foreign market requirements stimulated the sector's rapid technological modernization, enabling the country to transform its natural comparative advantages into dynamic competitive advantages, with substantial effects on foreign exchange earnings, employment, and income generation (Silva, 2017).

Within this process of productive specialization, fruit production stands out as one of the agricultural sectors with the broadest socioeconomic reach. Brazil benefits from extensive soil and climate diversity and abundant water resources, which, when combined with technology, establish the country as one of the world's leading fruit suppliers. According to Buainain and Batalha (2007), fruit production—particularly irrigated fruit production—is among the agribusiness activities with the strongest employment multiplier effect and the greatest capacity to foster rural development.

In this context, the Northeast region has assumed a leading role at the national level by hosting the country's most efficient irrigated agricultural hubs, which account for the largest share of Brazilian fruit exports (Souza *et al*., 2017). The high levels of sunlight characteristic of the semiarid region, the availability of water for irrigation, the local workforce, and the relatively low incidence of pests create a distinctive environment for fruit cultivation. Moreover, from an international logistics perspective, the Northeast's strategic geographical location reduces transit time to European and U.S. ports, providing its exports with an invaluable logistical advantage.

Within this production ecosystem, melon has taken the lead commercially, consolidating its position as Brazil's second most exported fruit. The commodity's supply structure is characterized by an exceptionally high degree of spatial concentration. As shown in Table 1, national production is overwhelmingly concentrated in the Northeast region and driven by the state of Rio Grande do Norte, whose output of more than 600,000 metric tons alone accounted for over 74% of Brazil's total melon production in 2024.

Table 1: Leading Melon-Producing States in Brazil (2024)

Federative Unit	Production (metric tons)	Share (%)
Rio Grande do Norte	604,566	74.00%
Bahia	85,341	10.45%
Ceará	65,887	8.06%
Pernambuco	53,722	6.58%
Piauí	30,999	3.79%
Rio Grande do Sul	10,944	1.34%

Federative Unit	Production (metric tons)	Share (%)
Alagoas	4,695	0.57%
Paraná	2,613	0.32%
Mato Grosso	1,208	0.15%
Roraima	1,055	0.13%
Selected Total	**816,939**	**95.39%**

Source: Prepared by the authors based on data from IBGE (2024).
Note: The selected states account for approximately 95% of national production, highlighting the overwhelming predominance of Brazil's Northeast region.

Despite the undeniable macroeconomic importance of melon exports to Brazil's agricultural trade balance, the academic literature reveals a considerable analytical imbalance. The current body of knowledge is dominated by agronomic studies focusing on irrigation efficiency, cultivation technologies, and phytosanitary management (Barros *et al*., 2019; Freitas *et al*., 2014; Pereira *et al*., 2021; Sousa & Miranda, 2018). In the economic literature, scholarly research has largely been restricted to assessments of structural competitiveness and international market share, as exemplified by the analyses conducted by Assunção *et al*. (2021), Carvalho and Cunha Filho (2007), and Silva Filho, Ribeiro, and Santos (2023), which confirm the dominant position of melons produced in Brazil's Northeast region in foreign markets.

However, Brazilian empirical research has made limited progress in quantitatively investigating the susceptibility of this supply chain to macroeconomic volatility. A substantial gap remains regarding how systemic fluctuations—particularly changes in the exchange rate—influence domestic price formation and producers' actual profitability. This scarcity of empirical models focusing on melon price transmission mechanisms provides the central justification for investigating exchange rate pass-through across the production and wholesale segments of the supply chain.

3 Methodology

To analyze the dynamic relationship between exchange rate fluctuations and yellow melon price formation in Brazil, this study adopts a quantitative approach based on the application of time-series econometric techniques. The study period extends from January 2023 to September 2025. This sample period was selected to capture distinct recent phases of the Brazilian macroeconomic environment, encompassing periods of both relative stability and sharp exchange rate volatility. This variation strengthens the analysis of exchange rate pass-through to the fruit production sector.

The data were collected at a weekly frequency. This high-frequency periodicity is particularly appropriate for the melon market, in which harvesting, export distribution, and domestic marketing dynamics exhibit rapid fluctuations and very short-term persistence in response to supply and demand shocks.

The time series employed in the study include weekly prices for yellow melons—Types 5 and 8—at the producer and wholesale levels, as well as the nominal exchange rate (R$/US$). Yellow melon was specifically selected because it is the leading variety in Brazil's melon export portfolio. Price data were obtained from the Center for Advanced Studies on Applied Economics (Centro de Estudos Avançados em Economia Aplicada—CEPEA) and are expressed in Brazilian reais per 13-kg box, the standard unit used in commercial transactions. The nominal exchange rate series corresponds to the weekly average ask rate of the Brazilian real against the U.S. dollar and was obtained from the Time Series Management System (Sistema Gerenciador de Séries Temporais—SGS) maintained by the Central Bank of Brazil (Banco Central do Brasil—BCB). Table 1 describes the variables included in the model.

Table 1: Description of the Model Variables

Variable	Frequency	Description
Producer Price (Types 5 and 8)	Weekly	Represents the farm-gate price received by producers for export-standard sizes, indicating the sector's primary profitability.
Wholesale Price (Types 5 and 8)	Weekly	Reflects the logistics pass-through and pricing dynamics of the same export-standard sizes in major distribution centers.
Producer Price (Types 11 and 12)	Weekly	Captures producer profitability for alternative sizes, which generally have greater penetration in the domestic market, thereby allowing market asymmetries to be tested.
Wholesale Price (Types 11 and 12)	Weekly	Measures the commercial behavior of alternative sizes in distribution centers, highlighting wholesalers' bargaining power in the domestic market.
Exchange Rate	Weekly	Exogenous macroeconomic variable that influences the costs of technological inputs—such as imported fertilizers and crop protection products—and revenue denominated in local currency.

Source: Prepared by the authors.

The first methodological step consists of determining the order of integration of the time series by testing for stationarity. Estimating models with nonstationary series may produce spurious regressions and invalidate statistical inferences (Tsay, 2010). To identify the presence of unit roots, the Augmented Dickey–Fuller (ADF) test was applied, complemented by the Phillips–Perron (PP) test.

The ADF test is based on the null hypothesis that the series contains a unit root. The Phillips–Perron test was employed as a confirmatory procedure because it applies a nonparametric correction to the conventional Dickey–Fuller test statistics. According to Bueno (2008), the PP test is robust to autocorrelation and heteroskedasticity in the residuals, eliminating the need to specify a high-order autoregressive structure to correct for serial correlation.

Once the variables' order of integration and stationarity properties had been established, vector autoregression (VAR) modeling was employed to capture simultaneous and lagged interrelationships over time. The VAR framework does not require an arbitrary distinction between endogenous and exogenous variables because all variables are treated symmetrically. Initially, a simple bivariate system illustrates this dynamic, in which each variable depends on its own lags and those of the other variable, as expressed in Equations (1) and (2):

$$y_t = b_{10} - a_{12}z_t + b_{11}y_{t-1} + b_{12}z_{t-1} + \varepsilon_{yt} \quad (1)$$

$$z_t = b_{20} - a_{21}y_t + b_{21}y_{t-1} + b_{22}z_{t-1} + \varepsilon_{zt} \quad (2)$$

In this conceptual representation, the variables are assumed to interact contemporaneously through the coefficients and , which capture the immediate effect of a shock to one variable on the other within the same time period, \(t\). Extending this principle to the multivariate setting of the present study, comprising \(n\) endogenous variables, the structural form of a VAR model of order \(p\) can be mathematically defined by Equation (3) (Bueno, 2008; Enders, 2015):

$$AX_t = \beta_0 + \sum_{i=1}^{p} \beta_i X_{t-i} + \varepsilon_t \quad (3)$$

where is the \(n \times 1\) vector of endogenous variables in this study, the exchange rate, producer price, and wholesale price; denotes the vector of intercepts; represents the coefficient matrices associated with the lagged variables; \(A\) is the contemporaneous

relationships matrix, which parameterizes the immediate effects among the variables in the system; and is the vector of stochastic innovations, or structural shocks, assumed to be independently and identically distributed white noise.

Because simultaneity prevents the structural shocks from being estimated directly, the model is multiplied by the inverse of matrix, resulting in the reduced-form specification presented in Equation (4), which can be estimated equation by equation using ordinary least squares (OLS):

$$X_t = \phi_0 + \sum_{i=1}^{p} \phi_i X_{t-i} + e_t \quad (4)$$

This mathematical transformation from the structural form to the reduced form eliminates contemporaneous simultaneity bias from the vector of disturbance terms by converting the unobservable structural shocks, into linearly combined residuals, which can be statistically estimated. The optimal lag length (\(p\)) will be selected using the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC), with the aim of identifying the most parsimonious model whose residuals exhibit no serial correlation.

Finally, the analytical interpretation of the VAR model extends beyond the estimation of individual coefficients and relies on two instruments that make market dynamics empirically intuitive: forecast error variance decomposition and the impulse response function (IRF).

According to Mayorga *et al*. (2007), variance decomposition provides a diagnostic measure of "relative importance." In practical terms, when interpreting the results, this tool will provide a percentage-based answer to the following question: of the total instability or variance—observed in melon prices, what proportion is specifically explained by exchange rate fluctuations, and what proportion results from inertia within the melon market itself? This indicator therefore reveals the degree of external dependence in domestic price formation over the forecast horizon.

Complementarily, while variance decomposition quantifies the relative contribution of each shock, the impulse response function describes the temporal path of exchange rate pass-through. The IRF graphically simulates the behavior of the system's variables following an unanticipated macroeconomic shock equivalent to one standard deviation in the error term, ___. In the analysis of the results, the IRF curves will provide a visual representation of market dynamics by indicating the specific week in which melon prices—at either the producer or wholesale level—begin to respond to a sharp change in the U.S. dollar exchange rate, the maximum magnitude of this pass-through, and, fundamentally, the number of weeks required for the supply chain to absorb the shock and return to its long-run equilibrium.

4 Presentation and discussion of results

The empirical analysis of exchange rate transmission mechanisms begins by determining the order of integration of the variables of interest. This step is necessary because, as Enders (2015) cautions, estimating autoregressive models using series that are nonstationary in levels may produce spurious parameter estimates and invalidate statistical inference. Table 2 reports the statistics from the ADF and Phillips–Perron unit root tests applied to the exchange rate and yellow melon price series—size categories 5/8 and 11/12—in both levels and first differences.

Table 2: Unit Root Test Results for the Series in Levels and First Differences

Test	Time Series	Level Statistic	Level *p*-value	First-Difference Statistic	First-Difference *p*-value
Augmented Dickey–	Exchange Rate	−1.4836	0.7914	−4.1769	< 0.01

Test	Time Series	Level Statistic	Level *p*-value	First-Difference Statistic	First-Difference *p*-value
Fuller (ADF)	Yellow Melon, Types 5 and 8—Producer	−3.4580	0.0488	−4.5480	< 0.01
	Yellow Melon, Types 5 and 8—Wholesale	−3.9272	0.0148	−4.2344	< 0.01
	Yellow Melon, Types 11 and 12—Producer	−3.5060	0.0444	−4.4042	< 0.01
	Yellow Melon, Types 11 and 12—Wholesale	−3.9544	0.0135	−4.0918	< 0.01
	Exchange Rate	−6.5427	0.7388	−107.4313	< 0.01
Phillips–Perron (PP)	Yellow Melon, Types 5 and 8—Producer	−16.2226	0.1814	−107.1611	< 0.01
	Yellow Melon, Types 5 and 8—Wholesale	−16.5461	0.1628	−97.5156	< 0.01
	Yellow Melon, Types 11 and 12—Producer	−16.2867	0.1777	−122.3145	< 0.01
	Yellow Melon, Types 11 and 12—Wholesale	−18.1415	0.0922	−93.2388	< 0.01

Source: Prepared by the authors based on the estimation results.

The results show that the null hypothesis of a unit root in the nominal exchange rate series cannot be rejected in levels by either test, with the series becoming stationary only after first differencing. This result characterizes the exchange rate series as a first-order integrated process, \(I(1)\), and is consistent with the broad empirical consensus in international macroeconomics. Seminal authors such as Meese and Rogoff (1983), as well as studies applied to Brazilian foreign trade (Silva, Freitas, & Mattos, 2016), demonstrate that floating exchange rates tend to follow a random walk, a behavior associated with the rapid incorporation of new financial information and systemic uncertainty.

Regarding melon prices, the tests provide divergent evidence. While the ADF test indicates marginal stationarity in levels, the PP test fails to reject the null hypothesis of a unit root in the original series for all market segments and melon size categories. Bueno (2008) and Enders (2015) demonstrate that the PP test is analytically more robust than the ADF test, particularly because it nonparametrically corrects for heteroskedasticity and serial correlation, both of which are common in high-frequency weekly series.

Furthermore, the PP test's empirical indication that melon prices behave as \(I(1)\) series is fully consistent with agricultural economics theory. As argued by Margarido (2004) and corroborated by Mayorga *et al*. (2007) in their specific analysis of the Brazilian melon market, agricultural commodity price series exhibit strong structural persistence. This behavior reflects slow intertemporal adjustments across harvests, rigidity in wholesale contracts, and delayed responses to supply shocks, thereby explaining the nonstationarity of the series in levels. After first differencing, all price series reported in Table 2 became unequivocally stationary at the 1% significance level.

Given these data properties and prioritizing the statistical reliability provided by the Phillips–Perron test, the series were conservatively transformed in accordance with rigorous methodological procedures. Consequently, the VAR models were estimated using the variables in first differences, representing weekly changes in exchange rates and prices. This procedure ensures the joint stationarity of the system, a *sine qua non* condition for model stability and valid inference in the subsequent variance decomposition and impulse response analyses.

After stationarity had been verified and the statistical adequacy of the first-differenced series established, the next step consisted of determining the lag order (\(p\)) of the VAR

models. According to Lütkepohl (2006), selecting the appropriate number of lags is a critical step in multivariate modeling. Underestimating the lag order may generate serial correlation in the residuals and bias the results, whereas overestimating it consumes degrees of freedom and increases the variance of the estimates.

To address this structural trade-off, the analysis relied on the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC). The AIC imposes a smaller penalty for the inclusion of additional parameters and therefore tends to select models with longer lag structures, whereas the SBC applies a stricter logarithmic penalty based on sample size, thereby favoring parsimony (Enders, 2015). Convergence between the two criteria guided the selection of the optimal bivariate system for each market segment and melon size category, as reported in Table 3.

The temporal structure selected by the information criteria reveals an inherent feature of the melon supply chain. The finding that the optimal lag length ranges from one to three weekly periods indicates a highly fluid market with very short-term persistence. This empirical result is fully consistent with the findings of Souza *et al*. (2017) and Assunção *et al*. (2021), who argue that, because of the perishability of fresh fruit and its rapid distribution to ports and major distribution centers, macroeconomic and cost shocks are transmitted quickly across the different links in the supply chain.

Table 3: Information Criterion Results for Selecting the VAR Model Lag Order

Bivariate System (VAR)	Optimal Lag Order (\(p\))
Δ Exchange Rate ↔ Δ Producer Price (Melon Types 5 and 8)	2 weeks
Δ Exchange Rate ↔ Δ Wholesale Price (Melon Types 5 and 8)	1 week
Δ Exchange Rate ↔ Δ Producer Price (Melon Types 11 and 12)	2 weeks
Δ Exchange Rate ↔ Δ Wholesale Price (Melon Types 11 and 12)	3 weeks

Source: Prepared by the authors based on the estimation results.

Additional heterogeneity is observed in the speed of adjustment within the wholesale segment. While export-standard sizes—Types 5 and 8—require only a one-week lag to absorb shocks within the system, the alternative sizes—Types 11 and 12—exhibit longer market memory, extending over three weeks. This temporal divergence corroborates the findings of Meyer and Von Cramon-Taubadel (2004) regarding asymmetric price transmission. It suggests that products intended for different markets—strictly export-oriented versus domestic or alternative markets—incorporate exchange rate fluctuations at different speeds because of differences in contracting arrangements and inventory turnover.

Once the optimal lag lengths had been identified, the VAR models were estimated for each specific relationship. However, given the analytical scope of the study and in accordance with the methodology established by Sims (1980), the individual coefficients of the reduced-form models are not reported. In highly parameterized simultaneous systems, the isolated assessment of autoregressive coefficients has limited interpretive value. Accordingly, the exchange rate pass-through analysis is conducted using forecast error variance decomposition and impulse response functions, which allow for a direct and dynamic economic interpretation while accounting for the endogenous relationships among the variables.

The dynamic analysis of the VAR model then proceeded with forecast error variance decomposition. This instrument quantifies the relative contribution of the exchange rate to future fluctuations in melon prices. The analysis was conducted over a six-week forecast horizon, considered analytically appropriate given the very short-term persistence of one to three weeks previously identified by the lag-selection criteria. This horizon also reflects the rapid perishability and high inventory turnover characteristic of the fruit sector.

Table 4 summarizes the estimated percentage of melon price variance explained specifically by unanticipated exchange rate shocks. The pattern reported in Table 4 shows that prices do not respond contemporaneously—in Week 1—to exchange rate fluctuations, indicating initial rigidity typically associated with fixed-price contracts. Beginning in the second week, the effect increases asymptotically and stabilizes at relatively low levels by the end of the forecast horizon. For the export category—Types 5 and 8—the exchange rate explains, at the peak of its influence in Week 6, only 2.20% of producer price variability and a negligible 0.42% of wholesale price variability. A similar pattern is observed for Types 11 and 12, for which the maximum contributions are 1.95% and 1.08%, respectively.

Table 4: Variance Decomposition of Melon Prices Explained by Exchange Rate Shocks over a Six-Week Horizon

Week	Producer—Types 5 and 8 (%)	Wholesale—Types 5 and 8 (%)	Producer—Types 11 and 12 (%)	Wholesale—Types 11 and 12 (%)
1	0.00	0.00	0.00	0.00
2	0.19	0.34	0.32	0.12
3	1.87	0.41	1.75	0.12
4	2.09	0.42	1.84	1.02
5	2.18	0.42	1.94	1.08
6	2.20	0.42	1.95	1.08

Source: Prepared by the authors based on the estimation results.

This empirical finding represents a classic case of incomplete and low-magnitude exchange rate pass-through in the Brazilian fruit and vegetable sector. It supports the theoretical framework established by Taylor (2000) and Campa and Goldberg (2005), who argue that the transmission of external shocks to domestic prices is systematically attenuated by microeconomic imperfections and frictions. In the specific context of agricultural economics, this limited exchange rate influence is directly consistent with the evidence presented by Bacha (2012) and Assunção *et al*. (2021). According to these authors, because melon production serves a substantial domestic consumer market that competes with exports, melon price formation is predominantly endogenous and driven by fundamental determinants of local supply, such as weather shocks, harvest seasonality, and logistics bottlenecks, which outweigh external exchange rate disturbances.

From an analytical perspective, the modest statistical contribution of the exchange rate indicates that the melon supply chain is strongly anchored in real domestic supply factors, leaving it partially insulated from purely macroeconomic shocks in the short term. Conceptually, as proposed by Campa and Goldberg (2005), the low magnitude of pass-through suggests that agents involved in the international fresh fruit trade tend to absorb foreign exchange fluctuations within their immediate marketing margins. This pricing strategy is intended to preserve market share in highly competitive destination markets, thereby cushioning foreign currency volatility before it reaches domestic retail outlets and distribution centers.

Another important finding from Table 4 concerns the asymmetric absorption of exchange rate shocks across the different segments of the supply chain. Farm-gate prices are unequivocally more sensitive than wholesale prices under both melon specifications. This asymmetric behavior strongly corroborates the findings of Souza *et al*. (2017) and Barros *et al*. (2019), who investigated price transmission mechanisms in agribusiness in Brazil's Northeast region.

These authors demonstrate that wholesalers and exporters have greater capital concentration and substantial bargaining power, enabling them to act as buffers against

macroeconomic fluctuations by strategically adjusting their profit margins to protect retail prices. In contrast, farmers structurally operate as price takers. Because they are directly exposed to shocks in the costs of dollar-denominated inputs—such as fertilizers and crop protection products—and depend on the rapid sale and distribution of a highly perishable product, producers ultimately absorb a larger share of exchange rate volatility, even though the upper limit of this influence remains statistically constrained by local supply and demand conditions.

Complementing the variance decomposition analysis, short-term dynamics were investigated using impulse response functions. While variance decomposition measured the relative contribution of the exchange rate to price variability, the IRF graphically traces the direction, immediate magnitude, and persistence of melon price responses to an unanticipated structural exchange rate shock equivalent to a one-standard-deviation innovation. The simulation horizon was maintained at six weeks, consistent with the rapid pace of trade in this commodity. Figure 1 presents the four response paths for the different size categories and market levels.

The panels in Figure 1 reveal a complex temporal pattern that initially appears counterintuitive. During the first few weeks following the exchange rate shock, melon prices exhibit a predominantly negative response. This initial downward effect is particularly pronounced in the prices received by producers, both for export-oriented sizes—Types 5 and 8—and for those intended for the domestic market—Types 11 and 12.

This empirical result supports the short-term "margin squeeze" hypothesis. As theorized by Oliveira (2025) and empirically tested by Souza *et al*. (2017) in the fruit sector of Brazil's Northeast region, a sudden currency depreciation initially affects producers through the cost channel by increasing the prices of fertilizers, crop protection products, and dollar-denominated technology packages. Because producers have limited market power and frequently operate under fixed-price supply contracts, they are unable to pass these cost shocks on immediately through their selling prices. Consequently, the exchange rate shock initially produces a net negative effect on the actual price received at the farm gate. Although modest in absolute magnitude, this initial decline illustrates how short-term agricultural price rigidity penalizes the primary production segment when it faces macroeconomic cost shocks.

As the response path progresses, the IRF shows that the negative effect dissipates asymptotically and loses statistical significance more rapidly after the third week. This gradual attenuation suggests that contracts begin to be renegotiated and supply adjusts to the new macroeconomic conditions following the initial shock. This rapid shock-absorption pattern is fully consistent with the literature on the marketing of highly perishable products, whose market adjustment cycles occur within narrow weekly windows (Bacha, 2012). This helps explain why exchange rate shocks do not generate large cumulative distortions over time.

Figure 1: Responses of Melon Prices to a Generalized Exchange Rate Shock

Figure 1.1 – Impulse Response Function: Exchange Rate → Yellow Melon, Types 5 and 8—Producer

Revista Conhecimento Contábil
DOI:
ISSN: 2447 - 2921

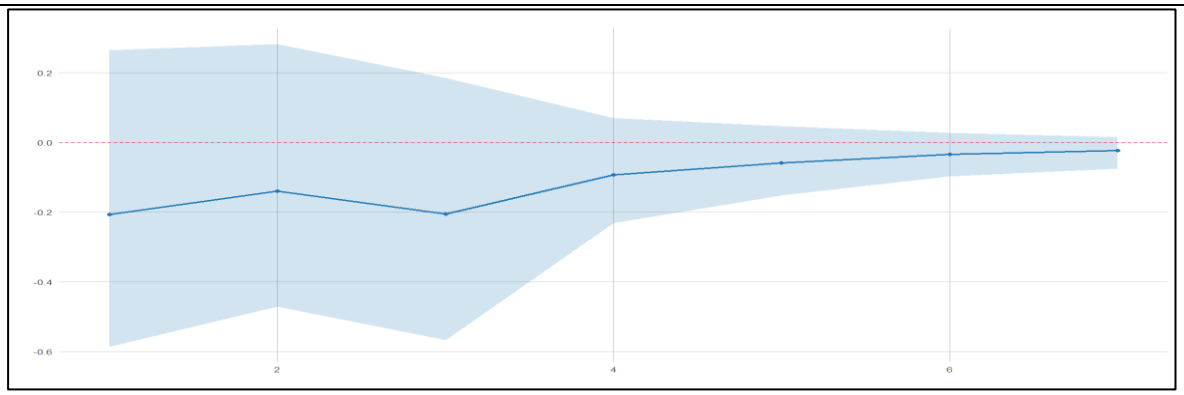


Figure 1.2 – Impulse Response Function: Exchange Rate → Yellow Melon, Types 5 and 8—Wholesale

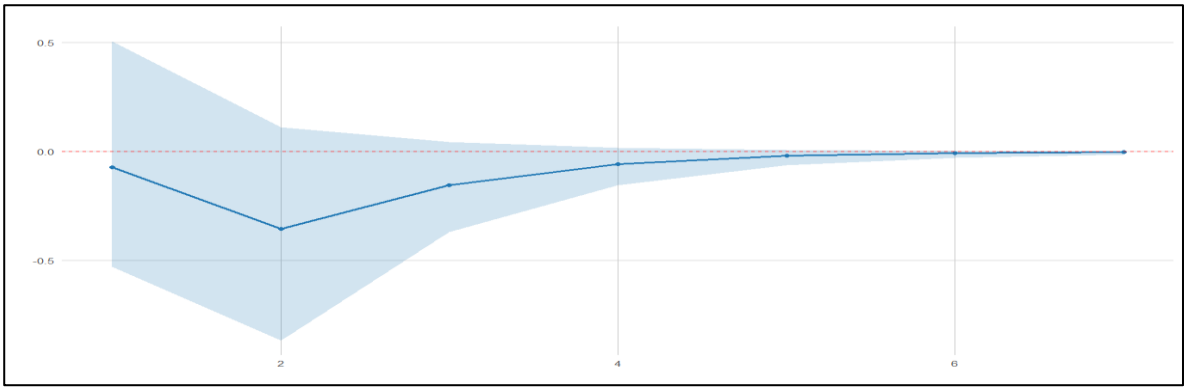


Figure 1.3 – Impulse Response Function: Exchange Rate → Yellow Melon, Types 11 and 12—Producer

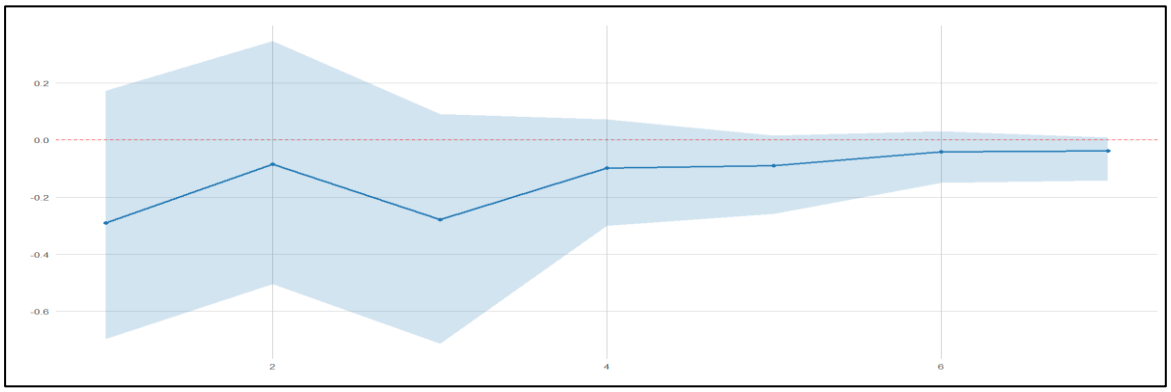
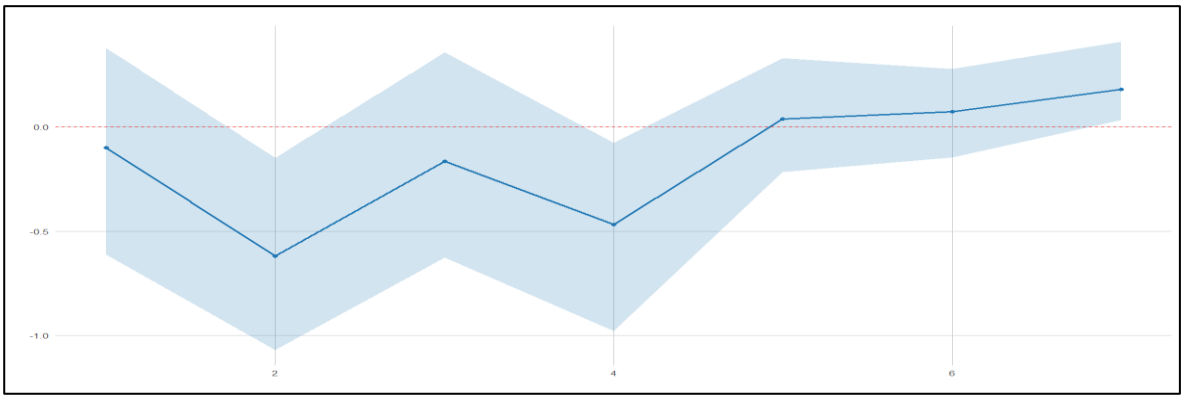


Figure 1.4 – Impulse Response Function: Exchange Rate → Yellow Melon, Types 11 and 12—Wholesale



Source: Prepared by the authors based on the estimation results.

A particularly noteworthy finding emerges for the wholesale price series of yellow

melons in Types 11 and 12 (Figure 1.4). For this specific segment, the IRF projects a reversal of the effect, shifting from negative to positive beginning in the sixth week of the forecast horizon. This result is closely aligned with the findings of Meyer and Von Cramon-Taubadel (2004) regarding asymmetric price transmission and institutional inertia. The reversal indicates that wholesalers, owing to their temporary cold-storage capacity, broader distribution networks, and considerable bargaining power relative to retailers, are able—after a certain lag—not only to pass on cost inflation but also to capture the benefits of a potentially more favorable exchange rate by repricing the product in the domestic market.

In summary, the impulse response results challenge the assumption of homogeneous and linear exchange rate pass-through. The evidence shows that exchange rate fluctuations initially exert strong cost pressure, producing a negative effect that primarily penalizes farmers. However, the resilience of the supply chain and asymmetries in market power allow the shock to be absorbed within a few weeks or, in the wholesale segment, reversed in favor of marketing margins. Thus, the low statistical magnitude identified throughout the study reflects an intricate system of short-term microeconomic offsets, in which institutional adjustments to distribution-channel margins prevent foreign exchange market pressures from generating explosive or highly volatile effects on nominal fruit prices.

5 Concluding remarks

This article investigated the magnitude and temporal path of the pass-through of exchange rate fluctuations to yellow melon prices in Brazil. By applying vector autoregression modeling to high-frequency price series, the study sought to address a gap in the literature by incorporating the marketing dynamics of fruit production in Brazil's Northeast region into the empirical debate on open-economy macroeconomics and price transmission.

The empirical results revealed that, although the exchange rate has historically been perceived by the export sector as a dominant source of risk, its actual effect on domestic melon price formation is structurally limited and characterized by incomplete, low-magnitude pass-through. The variance decomposition showed that exchange rate fluctuations have no immediate contemporaneous effect and, asymptotically, explain no more than 2.20% of producer price variability after six weeks. This finding demonstrates that melon price formation is primarily driven by endogenous sources of persistence, including seasonal harvest fluctuations, localized weather shocks, and supply constraints, which outweigh exogenous exchange rate disturbances.

In addition, the impulse response analysis revealed a pronounced asymmetry in shock absorption across the different segments of the supply chain. An exchange rate shock was found to have an immediate downward effect on farm-gate prices, creating a classic margin-squeeze scenario in which the production segment cannot pass on sudden increases in the prices of dollar-denominated inputs, such as fertilizers and crop protection products. In contrast, the wholesale segment exhibits greater resilience, acting as a market buffer that, because of its stronger bargaining power and greater inventory flexibility, can absorb volatility and, in the case of sizes intended for the domestic market, even reverse the shock in its favor over the medium term.

These findings indicate that the fruit sector's exchange rate vulnerability lies not only in the exchange rate itself but also in the asymmetry of market power that disadvantages the initial link in the supply chain. As a sectoral policy recommendation, government agencies and agricultural development institutions should establish public and private mechanisms that broaden small- and medium-sized fruit growers' access to financial instruments for hedging exchange rate exposure and input costs. Furthermore, policies should encourage the consolidation of producer cooperatives in Brazil's northeastern semiarid region. By aggregating

supply volumes, cooperatives can strengthen farmers' bargaining power relative to large wholesalers and trading companies, mitigate existing asymmetries in price formation, and ensure a fairer distribution of export-generated income during periods of macroeconomic instability.

References

ABRAFRUTAS - ASSOCIAÇÃO BRASILEIRA DOS PRODUTORES E EXPORTADORES DE FRUTAS E DERIVADOS. **Painéis de exportação**: exportação de frutas brasileiras - por fruta e ano. Brasília, DF: Abrafrutas, 2024. Disponível em: https://abrafrutas.org/dados-estatisticos/. Acesso em: 30 set. 2025.

ANDRADE, T. *et al*. Os aspectos quali-quantitativos da exportação do melão norte-riograndense: um estudo de caso da empresa CMR Brasil. **EmpíricaBR-Revista Brasileira de Gestão Negócio e Tecnologia da Informação**, v. 5, n. 1, p. 33-33, 2025.

ASSUNÇÃO, B. F. *et al*. Correlações em séries temporais de preços de manga produzida no Vale do São Francisco. **Research, Society and Development**, v. 10, n. 12, p. e266101220460-e266101220460, 2021.

BARBOSA, G. R. A fruticultura irrigada no Nordeste: estímulo ao desenvolvimento sustentável? *In*: ENCONTRO NACIONAL DE ENGENHARIA DE PRODUÇÃO (ENEGEP), 26., 2006, Fortaleza. **Anais** [...]. Fortaleza, CE: ABEPRO, 2006.

BARROS, V. S. *et al*. Agronomic and environmental performance of melon produced in the brazilian semiarid region. **Revista Caatinga**, v. 32, n. 4, p. 877-888, 2019.

BUAINAIN, A. M.; BATALHA, M. O. **Cadeia produtiva de frutas**. Brasília, DF: IICA/MAPA/SPA, 2007. v. 7, 102 p.

BUENO, R. L. S. **Econometria de séries temporais**. São Paulo: Cengage Learning, 2008.

BRESSER-PEREIRA, L. C. A taxa de câmbio no centro da teoria do desenvolvimento. **Estudos avançados**, v. 26, p. 7-28, 2012.

CAMPA, J. M.; GOLDBERG, L. S. Exchange rate pass-through into import prices. **Review of Economics and Statistics**, v. 87, n. 4, p. 679-690, 2005.

CAMPOS, P. T. C.; BACHA, C. J. C. **Economia e política agrícola no Brasil**. São Paulo: Atlas, 2012.

CARVALHO, R. M.; CUNHA FILHO, M. H. Competitividade da Fruticultura Brasileira no Mercado Internacional. **Revista de Economia e Agronegócio,** v. 5, n. 4, p. 547-565, 2007.

CUNHA, P. A. S.. **Certificação na produção de melão (*Cucumis melo*) no Rio Grande do Norte**: importância, oportunidades e impactos ao mercado internacional. 2025. 44 f. Monografia (Especialização) – Curso de Engenharia Agronômica, Escola Agrícola de Jundiaí, Universidade Federal do Rio Grande do Norte, Macaíba, 2025. Disponível em: https://repositorio.ufrn.br/items/86b0df72-aaef-4f05-9d82-85113ecd403f. Acesso em: 01 out. 2025.

ENDERS, W. **Applied econometric time series.** 4 ed. New York: John, Wiley & Sons, 2015.

FREITAS, L. D. *et al*. Crescimento e produção do meloeiro cultivado sob diferentes níveis de salinidade e nitrogênio. **Revista Brasileira de Engenharia Agrícola e Ambiental**, v. 18, n. suppl, p. 20-26, 2014.

HOOPER, P.; KOHLHAGEN, S. W. The effect of exchange rate uncertainty on the prices and volume of international trade. **Journal of International Economics**, v. 8, n. 4, p. 483-511, 1978.

IBRAHIM, K. H. *et al*. Exchange rate volatility and COVID-19 effects on Indonesia's food products' trade: Symmetric and asymmetric approach. **Heliyon**, v. 10, n. 12, 2024.

IBGE - INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA. **Produção agropecuária**: produção de melão. Rio de Janeiro: IBGE, 2024. Disponível em:

https://www.ibge.gov.br/explica/producao-agropecuaria/melao/br. Acesso em: 25 set. 2025.
LÜTKEPOHL, H. **New introduction to multiple time series analysis**. Berlin: Springer Science & Business Media, 2006.
MARGARIDO, M. A. A. **Econometria de Séries Temporais Aplicada à Agricultura**. São Paulo: Atlas, 2004.
MAYORGA, R. O. *et al*. Análise de transmissão de preços do mercado atacadista de melão do Brasil. **Revista de Economia e Sociologia Rural**, v. 45, n. 3, p. 675-704, 2007.
MEESE, R. A.; ROGOFF, K. Empirical exchange rate models of the seventies: Do they fit out of sample? **Journal of International Economics**, v. 14, n. 1-2, p. 3-24, 1983.
MEYER, J.; VON CRAMON-TAUBADEL, S. Asymmetric price transmission: a survey. **Journal of Agricultural Economics**, v. 55, n. 3, p. 581-611, 2004.
OLIVEIRA, V. A. de. Efeitos da variação cambial na produção agrícola brasileira. **Agrolink**, [S. l.], 2025. Disponível em: https://www.agrolink.com.br/colunistas/coluna/efeitos-da-variacao-cambial-na-producao-agricola-brasileira_498559.html. Acesso em: 17 out. 2025.
PEREIRA, W. B *et al*. Produção e qualidade de melões sob diferentes arranjos do sistema de irrigação e coberturas do solo. **Revista Brasileira de Meteorologia**, v. 36, p. 285-294, 2021.
SCHUH, G. E. The exchange rate and US agriculture. **American Journal of Agricultural Economics**, v. 56, n. 1, p. 1-13, 1974.
SILVA FILHO, L. A.; RIBEIRO, J. R. S.; SANTOS, J. M. Dinâmica e competitividade das exportações de melão no estado do Ceará - 2000-2020. **Revista de Economia Agrícola**, v. 70, p. 1-16, 2023.
SILVA, T. J. J. Desempenho exportador do agronegócio pernambucano: Uma análise entre o período de 2003 a 2013. **A Economia em Revista**, v. 25, n. 2, p. 81-94, 2017.
SILVA, F. A.; FREITAS, C. O.; MATTOS, L. B. Volatilidade da taxa de câmbio e seus efeitos sobre o fluxo de comércio dos países da América do Sul. **Revista de Economia Contemporânea**, v. 20, n. 2, p. 229-249, 2016.
SIMS, C. A. Macroeconomics and reality. **Econometrica: Journal of the Econometric Society**, v. 48, n. 1, p. 1-48, 1980.
SOUSA, E. P.; MIRANDA, S. H. G. Competitividade dos produtores de melão na Área Livre de *Anastrepha grandis* no Nordeste brasileiro. **Revista de Ciências Agrárias**, v. 41, n. 1, 2018.
SOUZA, S. F. *et al*. Mecanismo de transmissão de preços: uma análise sobre as exportações brasileiras de melão. **Economia Aplicada**, v. 21, n. 1, p. 95, 2017.
TAYLOR, J. B. Low inflation, pass-through, and the pricing power of firms. **European Economic Review**, v. 44, n. 7, p. 1389-1408, 2000.
TSAY, R. S. **Analysis of financial time series**. 3. ed. Hoboken: John Wiley & Sons, 2010.
VIANA, S. S. A. *et al.* Competitividade do Ceará no mercado internacional de frutas: o caso do melão. **Revista Ciência Agronômica**, v. 37, n. 1, p. 25–31, 2006.
VIDAL, M. de F. Fruticultura. **Caderno Setorial ETENE**, Fortaleza, ano 9, n. 337, 2024. Disponível em: https://www.bnb.gov.br/revista/cse/article/download/2706/1833/8987. Acesso em: 25 set. 2025.