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BRAZILIAN BEEF AND CHICKEN MEAT TRADE BALANCE PERFORMANCE BETWEEN 2000 AND 2015

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ABSTRACT
This work verified the influence of internal and external income, exchange rate and commercial opening on the behavior of beef and chicken trade balances for Brazil in the period 2000-2015. Due to the existence of a cointegration vector in the beef and chicken trade balance models, the vector error correction model was used. Results indicated that the exchange rate, degree of commercial opening and external income contributed positively to the balances of the two sectors. It was also observed, concerning substitutability ratio between the products, the chicken meat as inferior good and bovine meat as normal good.

Keywords: Meat; Trade balance; Macroeconomic variables.

DESEMPENHO DA BALANÇA COMERCIAL BRASILEIRA DA CARNE BOVINA E DE FRANGO ENTRE 2000 E 2015

RESUMO
Este trabalho verificou a influência da renda interna e externa, taxa de câmbio e abertura comercial sobre o comportamento dos saldos comerciais de carne bovina e de frango para o Brasil no período 2000-2015. Devido à existência de um vetor de cointegração nos modelos de balança comercial de carne bovina e de frango, utilizou-se o modelo de correção de erro vetorial. Os resultados indicaram que a taxa de câmbio, o grau de abertura comercial e a renda externa contribuíram positivamente para os saldos dos dois setores. Também foi observado, quanto à relação de substituibilidade entre os produtos, a carne de frango como bem inferior e a carne bovina como bem normal.

Palavras-chave: Carne; Balança comercial; Variáveis macroeconômicas.

JEL: F0; F1; O13.

1 INTRODUCTION

The agribusiness historically stands out as a supporter of surplus in the Brazilian trade balance (KICH; CORONEL; VIEIRA, 2012). In 2015, the trade balance of agribusiness was US$ 75.151 billion, contributing to a surplus of US$ 19.685 billion in the total balance of Brazil (AGROSTAT, 2016). In addition, according to Figueiredo, Ferreira de Lima and Santos (2012), the products of this sector are too

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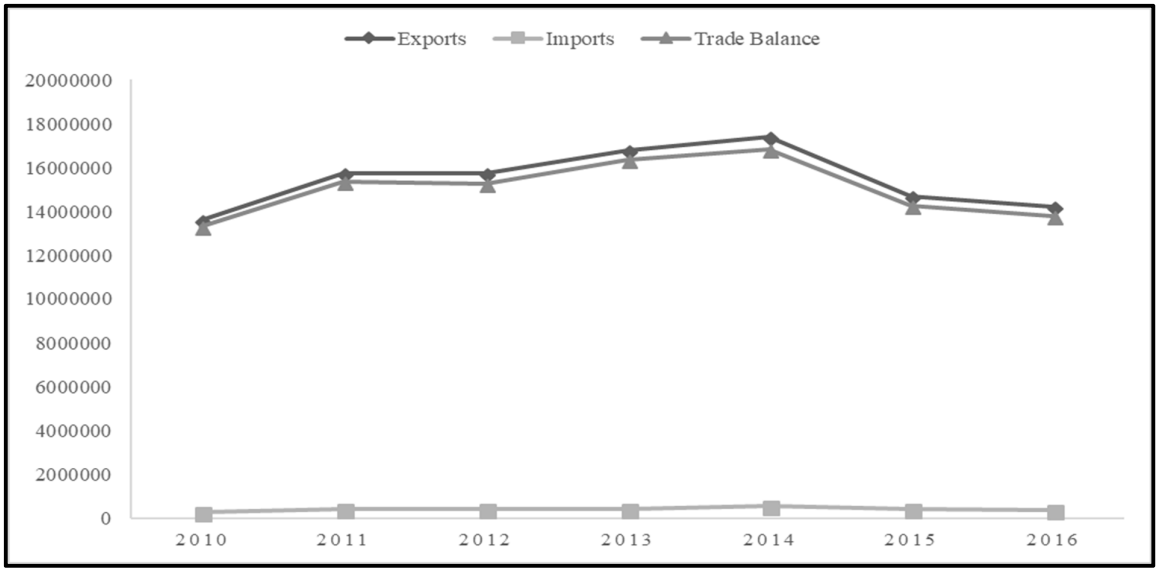
important for Brazil due to the capacity to generate income (equivalent to one third of GDP) and for its importance in the export agenda.

Among the agribusiness sectors, the meat sector had high commercial importance for the Brazilian economy, representing up to November 2016, the third largest agribusiness export sector, generating around US$ 11.879 billion. The major part of these exports come from beef and chicken sectors (AGROSTAT, 2016). Figure 1 shows the evolution of exports, imports and the trade balance of the meat sector in Brazil between 2010 and 2016 (AGROSTAT, 2016).

Figure 1 - Exports, Imports and Balance of the meat sector. Brazil 2010-2016 at 1000 US$



Source: Agrostat (2016).

In the year 2016, the Brazilian trade balance in the meat sector corresponded to 13.8 billion dollars. However, a decrease in the trade balance between 2014 and 2016 is evident, as result of a relatively appreciated exchange rate compared to the previous decade and economic problems in importing countries.

Despite the conjunctural change, production in Brazil is expected to continue to expand quickly in the next 10 years. Furthermore, the price to producers must also grow at high rates for beef and at lower rates for the chicken market. This factor can be explained by the large increase in the latter's offer in the coming years. Thus, the sector will continue to be important for the national economy and for the supply of protein in the external market (OECD-FAO, 2015).

In 2015, 30.6 million cattle were slaughtered in the country. Eight states account for about 76% of slaughter: Mato Grosso (14.8%), Mato Grosso do Sul (11.1%), Goiás (10%), São Paulo (10%), Minas Gerais (9.3%), Pará (8.6%), Rondônia (6.2%) and Rio Grande do Sul (6%) (INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA, 2016). In relation to chicken, a product of outstanding productivity in the country, production increased from 5.98 million tons in 2000 to 12.69 million tons in 2014, an annual growth rate of 5.14% (ASSOCIAÇÃO BRASILEIRA DE PROTEÍNA ANIMAL, 2016).

Considering the current importance of these sectors for the agribusiness export sector, this study intends to investigate and understand the main determinants for the performance of beef and chicken trade balances in Brazil between 2000 and 2015.

The work consists in this introduction and three other sections. The second one presents the theoretical and empirical background on which this study is based, as well as the econometric analysis utilized. The third section presents the results of the empirical models through the time series data. Finally, last section shows the final considerations and proposals for future studies.

2 THEORETICAL FRAMEWORK EMPIRICAL MODEL AND METHODOLOGY

2.1 Theoretical Framework

The key variable in this study, the trade balance, is given by the relationship between exports (X) and imports (M) for a given period. This relationship considers real adjustment variables of the economy, such as the exchange rate, the capacity of imports from external markets, the level of domestic activity, tariff barriers, among others (SCHWANTES, FREITAS and ZANCHI, 2010).

Conventionally, trade balance (TB) is modeled as a function of domestic income (Y), foreign income (Y^*) and price competitiveness index, generally the real exchange rate (E) and/or the terms of trade (TT), specified as follows (ALMEIDA; BACHA, 1998; YUEN-LING; WAI-MUN; GEOI-MEI, 2008):

$$TB = X(Y^*, E) - M(Y, E) = TB(Y, Y^*, E) \quad (1)$$

The domestic income directly affects the expenses with imports, generating worsening in the trade balance. Foreign income affects the external demand for exports. Therefore, keeping everything more constant, growth in world economic activity improves the domestic trade balance. Regarding the exchange rate, the rise in E has a positive relation with net exports, since it favors the increase of the exports in local country, due to the change of relative prices in favor of this (ALMEIDA; BACHA, 1998; YUEN-LING; WAI-MUN; GEOI-MEI, 2008).

These variables have been widely used in several empirical applications that seek to study extensively the relationship between macroeconomic variables and a country's trade balance, such as Ferreira (1993), da Silva (2000), Yuen-Ling, Wai-Mun e Geoi-Mei (2008), Waliullah, Rehmatullah e Wakeel (2010), Khan e Hossain (2012), Irhan, Alacahan e Korap (2011), e Shawa e Shen (2013).

Trade surpluses tend to reflect positively on the economy, being an indicator for a sound and developing economy, as more resources are entering the country via exports than out, through import payments (KICH; CORONEL; VIEIRA, 2012). Positive balances are essential as they help to balance national accounts and meet the needs of foreign currencies (FERREIRA, 1993; NASCIMENTO; NASCIMENTO; CARDOZO, 2008).

In this sense, the importance of the agribusiness sector is highlighted, given that this is the sector that has historically contributed most to the formation of surplus balances in the Brazilian trade balance (NASCIMENTO; NASCIMENTO; CARDOZO, 2008). Because it is an essential sector for the national economy, it is fundamental to analyze the macroeconomic variables that influence the trade balance for products or for its aggregate. There are several studies for the Brazilian economy in this scope, such as Almeida e Bacha (1998), Schwantes, Freitas e Zanchi (2010) e Kich, Coronel e Vieira (2012).

Almeida and Bacha (1998) studied the short and long-run effects of the variables, real effective exchange rate, terms of trade, domestic income and external income in relation to the trade balance of agricultural and agroindustry products in Brazil between 1961 and 1995. The results indicated that in the short term the variables that stood out were domestic income, foreign income, terms of trade and exchange rate. In the long run, the main determinant was the exchange rate.

Schwantes, Freitas and Zanchi (2010), Kich, Coronel and Vieira (2012) examined the behavior of the agribusiness trade balance, also using as determinants the internal growth of the economy, external consumption, real effective exchange rate and terms of trade. The first authors concluded that the exchange rate is the major determinant in the competitiveness of the Brazilian agribusiness and agroindustry sector. In relation to the second study, the results indicated that shocks in the exchange rate negatively influence the trade balance in a period of 10 months. In addition, the variance decomposition showed that the errors estimated in the twelfth month for the agribusiness balance are mostly explained by itself, and did not have a relevant participation of the other variables.

Therefore, it has been observed in the scientific literature that several macroeconomic variables, such as internal and external income, exchange rate, liberalization of the economy, terms of trade, money supply, among others, are used to investigate the behavior of trade balances in countries and understand how these variables affect the total trade balance or of a certain sector, such as agriculture.

2.2 Empirical Model

The objective of this study is to evaluate the effects of real exchange rate (E), level of domestic income (GDP), world imports, as a proxy for foreign income, (WI), and degree of commercial opening (DCO) on the Brazilian trade balance of beef (TBB) and trade balance of chicken (TBD), in the period 2000 to 2015. The functions for the respective products have the following specifications:

$$TBB = TBB(GPD, WI, E, DCO) \quad (2)$$

$$TBD = TBD(GPD, WI, E, DCO) \quad (3)$$

The following is a description of how these variables were operationalized, noting that all series are monthly and comprise the period from January 2000 to December 2015. In addition, the natural logarithm of all variables was taken.

a) Trade balance of beef (TBB): includes exports and imports of carcasses and half-carcasses of bovine animals, fresh or chilled, boned meat of bovine animals, frozen, edible offal or bovine animals, fresh or chilled and other edible bovine offal,

frozen. These data were obtained through the MDIC[4] (2016), available in the ALICEWEB[5] system.

b) Trade balance of chicken (TBD): includes exports and imports of roosters/hens' meat, not cut into pieces, fresh/chilled, chunks and offal, edible rooster/hens, frozen. This data is from MDIC (2016) available in the ALICEWEB system.

c) Real exchange rate (E): index of the real effective exchange rate with the base date being June 1994 = 100. These were obtained in the Time Series Manager System of the Central Bank.

d) Domestic activity level (GPD): Brazil's GDP expressed in US$ million. These data are from the Economic Department of Central Bank, available at IPEADATA (2016).

e) World Imports (WI): the value of imports from the rest of world was used as proxy for the level of external income. Amounts are expressed in US$ billion, available from the International Financial Statistics (FMI/IFS) of the International Monetary Fund.

f) Degree of commercial opening (DCO): The calculation being based on the series of exports and imports of meat in question, in addition to GDP, expressed as:

$$DCO_i = \frac{X_i + M_i}{Y} \quad (4)$$

2.3 Methodology and Econometric Procedures

The first econometric procedure performed in the studied time series (TBB, TBC, E, WI, GDP, DCO) was to check the stationarity, that is, if the series does not present trends or seasonality (DF, ADF and KPSS tests). Then, the existence of cointegration between the variables of the equation system was also tested.

[4] Ministry of Industry, Foreign Trade and Services.
[5] Foreign Trade Information Analysis System.

2.3.1 DICKEY-FULLEY TEST

According to Greene (2007), a series is considered stationary when its averages, variances, and self-covariance are constant over time. That said, the existence of unit root in time series implies that their averages or variances, or both, vary over time.

It becomes necessary for there to be the execution of a test for the stationary check in the series. According to Greene (2007), one test commonly performed is the Dickey-Fuller (DF), which presents as a null hypothesis, the existence of unit root, expressed by:

$$\Delta Y_t = \delta Y_{t-1} + u_t \quad (5)$$

Thus, it is estimated that the (5) regression of the null hypothesis of $\delta = 0$. The test DF admits that the error term is uncorrelated, and for the cases where u_t is correlated, the test used is the Augmented Dickey-Fuller (ADF). This test consists on grouping lagged dependent variable ΔY_t, estimating the following regression (GREENE, 2007):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (6)$$

Wherein ε_t is the error term of pure white noise and $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}), \Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$, and so on. In Margarido and Junior (2006), by adding enough lag, the residuals no longer present autocorrelation, obtaining unbiased estimates of δ. To determine the correct number of lag, we use the criterion of Akaike (AIC) and Schwarz (SBC).

2.3.2 KPSS TEST

The KPSS test studies stationarity considering a model with trend, random walk and error, as shown below (KWIATKOWSK et al., 1992):

$$Y_t = \xi t - \mathrm{r}_t + \varepsilon_t \quad (7)$$

Where Y_t represents the studied variable, ε_t a stationary error, ξ a constant that represents t and r_t a random walk ($r_t = r_{t-1} + u_t$), with normal distribution, zero mean and variance σ^2 (KWIATKOWS et al., 1992).

The partial sum of the residues can be defined as (KWIATKOWSK et al., 1992):

$$S_t = \sum_{i=1}^{t} e_t, \quad t = 1,2,3,\ldots,N \tag{8}$$

so that the LM test statistic is represented by:

$$LM = \sum_{t=1}^{N} \frac{S_t^2}{N^2 \hat{\sigma}_\varepsilon^2}, \tag{9}$$

where $\hat{\sigma}_\varepsilon^2$ is the long-term estimate os Y_t. This statistic is used to test the stationarity hypothesis of the series (if $\hat{\sigma}_\varepsilon^2 = 0$ the model has no unit root) (KWIATKOWSK et al., 1992).

2.3.3 COINTEGRATION TEST

According to Alves and Bacchi (2004), the concept of cointegration is economically related to the existence of equilibrium relations in the long-term between two or more variables, therefore, the time series that are not stationary and integrated of the same order can move together in time, and their difference will be stationary.

The methodology used to identify the existence of cointegration among the variables was the Johansen test. Johansen (1988) developed an identification method based on the rank (r) of the matrix (ϕ), as shown below:

$$\Delta Y_t = \delta + \Gamma_1 \Delta X_{t-1} + \cdots + \Gamma_{p-1} \Delta X_{t-p-1} + \phi Y_{t-1} + \varepsilon_{x,t} \tag{10}$$

As emphasized by Silva and Coronel (2012), the determination of the quantity of cointegrated vectors depends on the rank (r) of the matrix ϕ. When the regression presents cointegration, the most appropriate to do is the estimation of a Vector Error Correction Model (VECM). According to Leroy and Santos (2008), the VECM allows us to study the dynamics of both short and long-term relationships between the

variables, as specified from the following system:

$$\Delta x_t = \Gamma_1 \Delta x_{t-1} + \cdots + \Gamma_{p-1} \Delta x_{t-p+1} + \Pi x_{t-1} + A_0 + \Psi D_t + \varepsilon_t \quad (11)$$

$$\Gamma_i = -(I - A_1 - \cdots - A_i),\ i = (1, \ldots, p-1) \quad (12)$$

$$\Pi = (I - A_1 - \cdots - A_P) \quad (13)$$

Where x_{t-i} c corresponds to a vector $(n\,x\,1)$ of stochastic variables; Δ is operator of differences; D_t is a vector of deterministic variables; $\varepsilon_t \sim N(0, \Sigma)$; A_i is a matrix of parameters $(n\,x\,n)$, and I is an identity matrix$(n\,x\,n)$. Johansen (1988) proposes the decomposition of the matrix Π into:

$$\Pi = \alpha\beta' \quad (14)$$

In which the rank of the matrix Π defines the number of cointegration vectors, α represents the speed of adjustment or the short-term adjustment coefficient, and β' is a matrix of long-term cointegration coefficients (JOHANSEN, 1988). It should be noted that the summary of the Johansen cointegration test indicated that the cointegration equation for the beef model should be null of intercept and tendency. The model for chicken indicated that the equation should include a constant term.

Two other results that are relevant are the analysis of the impulse response function and the variance decomposition. The first, observes the answers obtained when shocks occur on the variables, making it possible to investigate how a shock on a certain variable affects in a long-term the others (ENDERS, 1995). In addition, by analyzing the variance decomposition, it is possible to verify the relative importance of each system variable in relation to the other variables (PFAFF, 2008).

3 RESULTS FROM EMPIRICAL MODELS

In this section, we discuss the tests and empirical models results. Initially, it is necessary to verify the stationarity of the series, by means of the ADF, GLS and KPSS tests (Tables 1, and 2, respectively). In both tests the number of lags used was determined by the Modified Akaike Information Criterion (MAIC). In addition, the tests included constant and trend.

Table 1 - ADF test for the series (level) used in the model

Beef				Chicken Meat			
Variable	Trend	P	Statistic	Variable	Trend	P	Statistic
lnTBB	No	6	-1,95	lnTBC	No	4	-2,18
	Yes	2	2.96		Yes	1	-3.01
LnE	No	1	-1.65	LnE	No	1	-1.65
	Yes	1	-1.75		Yes	1	-1.75
lnWI	No	6	-1,46	lnWI	No	6	-1,46
	Yes	6	-1.77		Yes	6	-1.77
lnGDP	No	0	-1.16	lnGDP	No	0	-1.16
	Yes	0	-0.49		Yes	0	-0.49
lnDCO	No	6	-0.15	lnDCO	No	5	-0.01
	Yes	0	-4.58*		Yes	5	-3.3***

Notes: * Significant at 1% of significance, *** Significant at 10% of significance. H0: Presence of unit root; H1: Absence of unit root.
Source: the author, from the data on labor in the research.

The test ADF indicates that all variables, except for the degree of commercial opening of beef and the degree of commercial opening of chicken meat, have unit root. Already in the test DF-GLS, the exchange rate and the degree of commercial opening of beef are stationary at a significance level of 10%. Only lnDCO of beef did not present unit root in both tests.

Table 2 - DF-GLS tests for series (level) used in the model

Beef				Chicken Meat			
Variable	Trend	P	Statistic	Variable	Trend	P	Statistic
LnTBB	No	4	0.50	lnTBC	No	4	0.36
	Yes	4	-1.35		Yes	1	-2.5
lnE	No	1	-1.67***	lnE	No	1	-1.67***
	Yes	1	-1.69		Yes	1	-1.69
LnWI	No	6	0.11	lnWI	No	6	0.11
	Yes	6	-1.89		Yes	6	-1.89
lnGDP	No	0	0.18	lnGDP	No	0	0.18
	Yes	0	-0.91		Yes	0	-0.91
lnDCO	No	4	0.75	lnDCO	No	5	1.21
	Yes	0	-2.89***		Yes	5	-1.36

Notes: *** Significant at 10% of significance. H0: Presence of unit root; H1: Absence of unit root.
Source: the author, from the data on labor in the research.

The KPSS test was also used to evaluate whether or not the series had a unit root. Its null hypothesis (H0) is that the series is stationary, that is, inverse to the ADF test. Thus, as a rule of decision, it is check if the value of statistic test is higher or

lower than the critical values, if this is higher, reject the null hypothesis of stationarity. Table 3 shows the results of the KPSS stationarity test, the number of lags was was selected by the New West specification. The test was also performed with constant and constant trend

Table 3 - KPSS test for the series (level) used in the model

Beef				Chicken Meat			
Variable	Trend	P	Statistic	Variable	Trend	P	Statistic
lnTBB	No	11	1,47*	lnTBC	No	11	1,56*
	Yes	10	0,40		Yes	10	0,39*
lnE	No	11	0,82*	lnE	No	11	0,82*
	Yes	10	0,23*		Yes	10	0,23*
lnWI	No	11	1,54*	lnWI	No	11	1,54*
	Yes	10	0,30*		Yes	10	0,30*
lnGDP	No	11	1,54*	lnGDP	No	11	1,54*
	Yes	10	0,26*		Yes	10	0,26*
lnDCO	No	11	1,65*	lnDCO	No	11	1,66*
	Yes	9	0,21**		Yes	9	0,23*

Notes: * Significant at 1% of significance, *** Significant at 10% of significance. H0: Absence of unit root; H1: Presence of unit root.
Source: the author, from the data on labor in the research.

According to the results, with the exception of variables lnDCO of beef and chicken meat, which presents unit root at 5% of significance, all variables are non-stationary at 1% significance. Thus, the results found by previous tests are confirmed.

One can thus start from the Johansen test, which tests the existence of cointegration among the model variables. The cointegrations tests (Tables 4 and 5) have taken into account the discrepancy criterion proposed by SBIC, indicating that a one lag should be used.

Through the trace statistic (Tables 4 and 5) it is stated that there is a one cointegration vector for both models. In this case, the variables present common behavior in the long term, producing stationary residues. In the short term, deviations from this equilibrium trajectory occur, and the error correction mechanism returns to the long-term equilibrium between the variables. In order to analyze the relations between these variables we tried to estimate a Vector Error Correction Model. (VECM).

Table 4 - Johansen cointegration tests – Beef

Null Hypothesis	Alternative Hypothesis	Trace	Critical Value
r=0	r>0	71.1702	59.46
r≤1	r>1	28.1685*	39.89
r≤2	r>2	9.3885	24.31
r≤3	r>3	2.2167	12.53
r≤4	r>4	0.7739	3.84

Note: * Significant at the 0.05 probability level.
Source: the author, from the data on labor in the research.

Table 5 - Johansen cointegration tests - Chicken meat

Null Hypothesis	Alternative Hypothesis	Trace	Critical Value
r=0	r>0	87.2376	68.52
r≤1	r>1	46.8005*	47.21
r≤2	r>2	19.5655	29.68
r≤3	r>3	4.1482	15.41
r≤4	r>4	0.7498	3.76

Note: * Significant at the 0.05 probability level.
Source: the author, from the data on labor in the research.

The results of the long-term estimates and the short-term error correction mechanism of the VEC model, for the trade balance of beef and chicken meat, are presented in Tables 5 and 6. They have already been inverted due to the normalization of the cointegration vectors, in this case, the normalization was performed using as endogenous variables beef trade balance in the first model and chicken meat trade balance in the second model.

Due to the fact that the variables are in ln, we interpret the results as elasticities of transmission. From the estimates of the long-term coefficients β (Table 6) it is stated thatit can be seen that the transmission rate of the lnE variable for the balance is 73%. In relation to world imports it is verified that variations in this are more than transferred to the balance, indicating that the balance is highly sensitive to the variation of external income. Finally, variations in domestic GDP end up having a negative pass-through on the balance indicating a negative long-run relationship between the variables, because the increase in income in Brazil facilitates access to beef products, and the increase in domestic demand reduces the exportable surplus.

In relation to the short-term coefficients, these can be interpreted as the speed of the adjustment towards the long term. It is possible to verify that the trade balance is the fastest to adjust in direction to the long run, presenting a speed of 13.4% in each period, so that its total adjustment occurs less than 6 periods. The other

variables present low adjustment velocity in the long run, all of which require at least 11 periods to adjust.

From Table 7, we analyze the long-term β estimates for the chicken meat. It is observed that the balance is elastic in relation to the exchange and world imports.

Table 6 - Estimates of the short and long term coefficients of the VEC model – Beef

Variable	Estimates of short-term adjustment coefficients α	P-value	Estimates of long run coefficients β	P-value
lnTBB	-0.1341	0.006	1	
lnE	-0.0309	0.004	0.7324	0.000
lnWI	0.0606	0.001	2.8549	0.000
lnGDP	0.0154	0.330	-0.3186	0.089
lnDCO	0.0648	0.251	0.0483	0.396

Source: the author, from the data on labor in the research.

An interesting result is that the variations in domestic GDP turn out to be more than transmitted to the balance, thus indicating an elastic relationship between the variables, an inverse result to that found for beef, thus stressing the substitution effect between the two meats, and the increase in income can influence the consumer to migrate from the consumption of chicken meat to the consumption of beef. It should be noticed that the increase in the degree of trade liberalization also generates an improvement in the balance performance. The Estimates of short-term adjustment coefficients once again demonstrate that the trade balance (in this case of the chicken meat) is the fastest to adjust to the long run, settling in less than 5 periods.

Table 7 - Estimates of the short and long term coefficients of the VEC model - Chicken meat

Variable	Estimates of short-term adjustment	P-value	Estimates of long run coefficients β	P-value
lnTBC	-0.1609	0.003	1	
lnE	0.0279	0.034	1.4319	0.000
lnWI	0.0648	0.002	1.1160	0.000
lnGDP	0.0581	0.002	1.3094	0.000
lnDCO	0.0416	0.539	0.2645	0.001

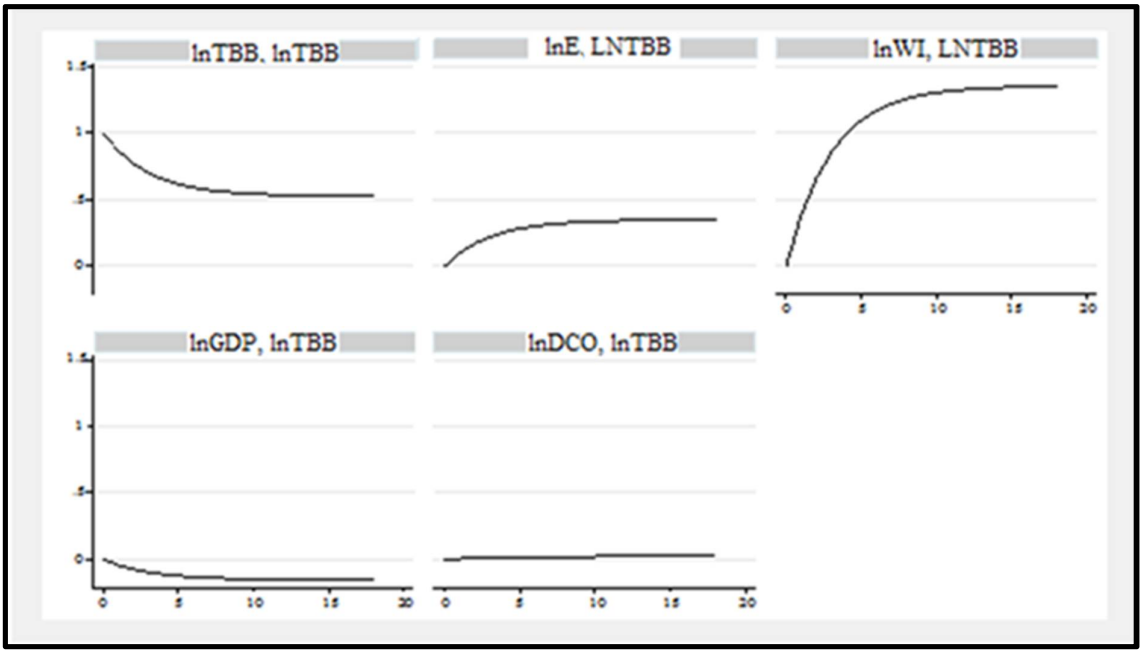
Source: the author, from the data on labor in the research.

The results can be confirmed by analyzing the impulse response functions, disposed in Figures 2 and 3. The time horizon chosen for the response to the shock

was 18 months, and the effect of shocks on all variables on the variables lnTBB and lnTBC in their respective models was therefore sought.

From Figure 2, it is found that shocks in lnTBB on itself have an initial growth effect, followed by falls in the following months. However, it keeps up its initial level at the end of the period. Shocks in the lnE variable increases lnTBB during the period. The impulse in lnWI shows that the trade balance of beef is highly elastic in relation to world imports. In turn, the trade balance worsens its result against a positive shock in the lnGDP, reflecting once again that beef is a normal commodity and that increasing GDP would increase the domestic consumption of this product. Finally, the shock in the degree of commercial opening of beef did not generate impact on the trade balance of beef.

Figure 2 - Effects of shocks on lnTBB, lnE, lnWI, lnGDP and lnDCO at lnTBB.

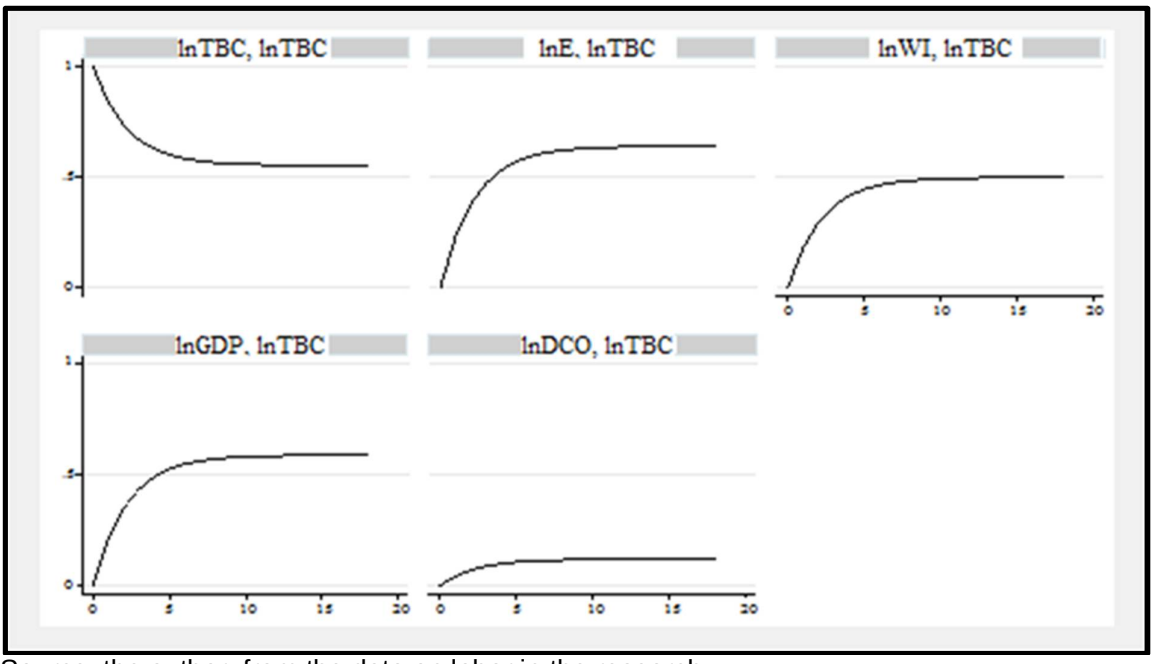


Source: the author, from the data on labor in the research

Analyzing Figure 3, it is found that shocks in lnTBC on itself have an initial growth effect, followed by falls in the following months. The result for lnE is similar to that of the beef model, showing that a cambial shock (depreciation) would improve the result of lnTBC, being this variable that generated the greatest growth in the Trade Balance. It can be identified that lnTBC also responds positively to lnWI. Unlike beef, a shock in lnGDP increases considerably lnTBC at the end of the period, demonstrating once again the substitution effect between the two products and that

the chicken meat, from a certain level of income, can become a lower good. Again, the impulse in the degree of commercial opening of chicken meat did not generate significant impacts on the trade balance, albeit positive.

Figure 3 - Effects of shocks on lnTBC, lnE, lnWI, lnGDP e lnDCO at lnTBC



Source: the author, from the data on labor in the research

We also performed the variance decomposition of forecast errors (Tables 8 and 9). According to Table 8, the decomposition of the variance of lnTBB is explained by over 84% by variations of lnTBB itself and by approximately 15% by variations of lnWI. With this result, it is possible to affirm that variations in external income or the level of world imports would cause the trade balance to vary.

Table 8 - Variance decomposition of lnBCB forecast errors

Period	lnTBB	lnE	lnWI	lnGDP	lnDCO
0	0	0	0	0	0
1	1	0	0	0	0
2	99.28	0.03	0.68	0.01	0.003
3	98.02	0.07	1.88	0.02	0.01
4	96.53	0.13	3.28	0.04	0.01
5	95.01	0.19	4.72	0.06	0.02
6	93.56	0.24	6.09	0.08	0.03
7	92.23	0.29	7.36	0.09	0.03
8	91.02	0.34	8.50	0.11	0.04
9	89.95	0.38	9.52	0.12	0.04
10	90.00	0.41	10.42	0.13	0.04
11	88.15	0.44	11.21	0.14	0.05

12	87.41	0.47	11.92	0.15	0.05
13	86.75	0.50	12.54	0.16	0.05
14	86.17	0.52	13.09	0.16	0.05
15	85.65	0.54	13.59	0.17	0.06
16	85.18	0.56	14.03	0.18	0.06
17	84.76	0.57	14.42	0.18	0.06
18	84.39	0.59	14.78	0.19	0.06

Source: the author, from the data on labor in the research.

Regarding the decomposition of the variance of lnTBC, we can see that this is explained in 85% by variations in lnTBC itself. Again, the second most important variable in the decomposition of prediction errors was the lnWI variable, showing that variations in world income would contribute to variations in the trade balance of this product.

Table 9 - Variance decomposition of lnBCF forecast errors

Período	lnTBC	lnE	lnWI	lnGDP	lnDCO
0	0	0	0	0	0
1	1	0	0	0	0
2	99.05	0.16	0.50	0.15	0.15
3	97.49	0.43	1.30	0.38	0.39
4	95.79	0.72	2.19	0.65	0.65
5	94.14	1.01	3.04	0.90	0.91
6	92.66	1.26	3.81	1.13	1.14
7	91.36	1.48	4.49	1.33	1.34
8	90.23	1.68	5.07	1.50	1.52
9	89.27	1.84	5.58	1.65	1.67
10	88.43	1.99	6.01	1.78	1.80
11	87.71	2.11	6.38	1.89	1.91
12	87.09	2.22	6.71	1.98	2.00
13	86.55	2.31	6.99	2.07	2.09
14	86.07	2.39	7.24	2.14	2.16
15	85.65	2.46	7.45	2.20	2.23
16	85.28	2.53	7.65	2.26	2.29
17	84.94	2.58	7.82	2.31	2.34
18	84.64	2.64	7.98	2.36	2.38

Source: the author, from the data on labor in the research.

4 CONCLUSION

The present study aimed to analyze the determinants of beef and chicken meat trade balances between 2000 and 2015. The analysis of the beef model showed that the exchange rate, and the level of world imports, contributed to improving the trade balance. On the other hand, the increase in domestic GDP worsens the balance. When analyzing the chicken meat model, the exchange rate, the level of world imports, the degree of commercial opening and domestic GDP improve the trade balance. The results indicate that the two meats are substitutes. In

addition, in this case, the chicken meat is an inferior good, because from a certain level of income, an increase in this, generates a decrease in the consumption of this protein, in this way, the brazilian production is directed to the foreign market. Beef can be understood as a normal good, that is, an increase in domestic income increases the demand for the product internally so that less of this product is offered to the foreign market.

The analysis of the impulse response functions showed that shocks in the level of world imports generates greater impact on the trade balance of beef. For the chicken meat, the greatest impact would be explained by the exchange rate. In relation to the analysis of variance decomposition, it is verified that the most important variables that explain the variance of the models are the balances of beef and chicken, followed by the world imports index.

Thus, from the results, it can be stated that for the maintenance of the good performance of balances it is fundamental that the external income continues to grow. In addition, it is necessary for Brazil to confirm and improve production processes, taking into account sanitary issues, thus avoiding the loss of important markets for Brazilian products, which are expected to grow in the coming years.

For future studies, it is suggested to analyze the substitution relation between the meats, as well as the effect of the increase of the internal income on the production and export of beef. In addition, for greater efficiency in the productive chain of the sectors, it is essential to study factors related to logistical issues and their bottlenecks, once productive and commercial efficiency will be fundamental to feed a world with expanding food and protein needs.

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