Using Brazilian slaughters variability as a coordination measure[1]

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Abstract: Supply chain coordination pursuits several objectives, where a higher stability of raw material flow is one of the most important because it reduces idle time costs. In the Brazilian meat industry there are several types of supplying organizations, and its diversity is widespread. However, there are some patterns depending on product, region and time, which can explain differences in coordination performance. The goal is to characterize coordination performance in the Brazilian meat industry, by measuring slaughters variability. It defines coordination performance as the stability of slaughters, which is measured by its annual coefficient of variation. The methodology uses quantitative and qualitative techniques to analyze data from the Quarterly Survey of Animal Slaughter conducted by the Brazilian Geographical and Statistical Institute (IBGE). This survey collect data of the number of heads and total carcass weight from bovine, swine and poultry slaughters, in a monthly basis, since 1997, in all 27 Brazilian states. The results do not reject the four hypothesis assumed by this study, with a coherent relationship between analyzed data, the recent development of the three meat supply chains and theoretical proposals. In general, results reinforce that a more integrated supply chain strengths the coordination effort to reduce slaughters variability.

Keywords: supply chain, coefficient of variability, meat industry.

Uso da variabilidade de abate no Brasil como medida de coordenação

Resumo: A coordenação da cadeia de suprimentos persegue diversos objetivos. Uma elevada estabilidade na oferta de matéria-prima é um dos mais importantes porque reduz custos com a ociosidade. Existem diversos tipos de organização de suprimento da indústria de carne brasileira, entretanto, os padrões variam conforme o produto, a região e o período, os quais podem explicar diferenças de desempenho dos esforços de coordenação. O objetivo deste artigo é caracterizar o desempenho da coordenação na indústria brasileira de carnes, por meio da mensuração da variabilidade de abate. O desempenho da coordenação está associado à estabilidade de abate, a qual é medida pelo coeficiente de variação anual. A metodologia utiliza técnicas quantitativas e qualitativas para analisar dados da Pesquisa Trimestral do Abate de Animais do Instituto Brasileiro de Geografia e Estatística (IBGE). Esta pesquisa levanta o abate de bovinos, frangos e suínos em número de cabeças e em peso total, em base mensal, desde 1997, nos 27 estados da Federação. Os resultados não rejeitam as hipóteses propostas, apontando para uma relação coerente entre os dados, o desenvolvimento da

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indústria de carnes e as proposições teóricas. Em geral, os resultados sugerem um melhor desempenho entre as cadeias de suprimentos integradas no sentido de reduzir a variabilidade dos abates.

Palavras-chave: cadeia de suprimento, coeficiente de variação, indústria de carnes.

Introduction

Several changes in the competitive environment[4] are pushing agribusiness towards more coordinated supply chains. This effort developed by managers and policy makers pursuits standards assurance (for food quality), higher stability of raw material flow (to reduce idle time costs), raw material standardization (to reduce the setup costs) and risk and profit sharing. This trend has increased during the last two decades, and shows a diversity of coordination instruments (market contracts, production contracts and suppliers development programs), which may differ considering producers and industries characteristics (ALTMANN, 1997; HAYENGA et al., 2000; MACDONALD et al., 2005; VUKINA, 2003; ZYLBERSZTAJN, 2005).

Most of the global meat players (beef, pork and poultry) adopt integration through contracts as the main form to coordinate the transaction between producers and slaughterhouses. (LAWRENCE et al., 2001; MARTINEZ, 1999; MENARD, 1996). The predominant strategies of the main Brazilian pork and poultry companies and cooperatives rely on the guarantees of raw material supplying, with desirable quantity and quality, as well as the pursuit for logistic efficiency. This has been achieved by the coordination of the supply chain through contracts and other administrative tools such as suppliers development programs. This organization model is named by practitioners as integration, in which the producer is tied to a slaughterhouse or a processing industry which, in most cases, also coordinates the feed production and other upstream activities (ALTMANN, 1997; CARLETTI FILHO, 2005; GUEDES, 2001; IPARDES, 2000a, 2000c; MIELE; WAQUIL, 2007; NOGUEIRA, 2003; WEYDMANN, 2004). The Brazilian beef meat companies strategies are more divers, but a major characteristic is the low coordination of the supply chain with high speculative and opportunistic behaviors. But even in this supply chain there are some coordinated sub-systems oriented to high quality products (BUNAIN; BATALHA, 2007; CARLETTI FILHO, 2005; FERREIRA; PADULA, 2002; IPARDES, 2000b; MIELE; WAQUIL, 2007; PAULA XAVIER, 2004; ZYLBERSTAJN; MACHADO FILHO, 2003).

There are several types of supplying organizations, and its diversity is widespread. However, there are some patterns depending on product, region and time. In Brazil, like most countries in the world, the beef industry is less coordinated than swine production, which in turn is less integrated than poultry. In regional terms, the integration prevails on southern Brazil in poultry and swine, but it is also increasing in other regions like the South-East and the Central-West, going along with the geographic expansion that is taking place by leading companies. In temporal/chronological terms, coordination is increasing in almost all products and regions in the past 10 to 20 years (ALTMANN, 1997; FERREIRA; PADULA, 2002; GUEDES, 2001; IPARDES, 2000a, 2000b, 2000c; NOGUEIRA, 2003; PAULA XAVIER, 2004; ZYLBERSTAJN; MACHADO FILHO, 2003).

These patterns can explain differences in coordination performance. Coordination efforts pursuit several objectives, where a higher stability of raw material flow is one of the most important because it reduces idle time costs. The goal of this study is to characterize coordination performance in the Brazilian poultry, swine and bovine industries, by measuring slaughters variability.

[4] Like more diversified and exigent consumers, higher regulatory controls and increasing competition.

Methodology and hypothesis

The methodology uses quantitative and qualitative techniques to analyze data from the Quarterly Survey of Animal Slaughter conducted by the Brazilian Geographical and Statistical Institute (IBGE, 2009). This survey collect data of the number of heads and total carcass weight from bovine, swine and poultry slaughters, in a monthly basis, since 1997, in all 27 Brazilian states.

Initially, some data were grouped together by regional similarities, with the group "South" (S) grouping the southern states of Rio Grande do Sul (RS), Santa Catarina (SC) and Paraná (PR) and the group "Central-West" (CW) grouping the states of Mato Grosso do Sul (MS) and Mato Grosso (MT). The states of São Paulo (SP), Minas Gerais (MG) and Goiás (GO) were analyzed separately. These eight states were responsible for 97% of swine, 93% of poultry and 68% of bovine slaughters in 2008 (IBGE, 2009). The others 19 states were analyzed together in the group "North-Northeast" (NNE). Consequently, this study utilizes 18 slaughter time series (six Brazilian states or regions x three animal species), with 144 months of observations.

In order to obtain a measure of annual variability, the coefficient of variation (CV), for each year, was calculated. The CV is defined as the ratio of the standard deviation (σ) and the mean (μ), and its formula is $CV = \sigma/\mu \times 100$. In this study, the variability of the slaughters (in heads or total carcass weight) measured by the CV was considered a proxy to the supply chain coordination. High CV represents a lower coordination performance, considering that slaughterhouses and processors pursuits stability of raw material flow to reduce idle time costs. Finally, the results were compared by their regional, time and organizational differences. Empirical patterns were analyzed considering theoretical proposals, following the hypothesis bellow.

$$H_1 : CV_{poultry} < CV_{swine} < CV_{bovine}$$

$$H_2 : CV_{South\ poultry\ and\ swine} = CV_{SP\ poultry} = CV_{MG\ poultry} < CV_{Others\ poultry\ and\ swine}$$

$$H_3 : CV_{2003\text{-}2008} < CV_{1997\text{–}2002}$$

$$H_4 : -\Delta CV_{industrial\ structure\ change} > -\Delta CV_{industrial\ structure\ stability}$$

Brazilian slaughters variability

The results do not reject the hypothesis assumed by this study. Considering the first one (H_1), poultry slaughters have less variability than swine slaughters, which in turn have less variability than bovine slaughters. In fact, among the first nine smaller CV of the number of heads slaughtered (Table 1 and Figure 1), six are poultry and three are swine slaughters. Among the first nine smaller CV of the total carcass weight slaughtered (Table 2 and Figure 2), six are poultry, two are swine and only one is bovine slaughters. In turn, among the nine higher CV, six are bovine and three are swine when considering the number of heads slaughtered (Table 1 and Figure 1), and five are bovine and four are swine when considering the total carcass weight slaughtered (Table 2 and Figure 2).

Considering the second hypothesis (H_2), poultry and swine slaughters in the South (S) region and poultry slaughters in São Paulo (SP) and Minas Gerais (MG) states have less variability than other regional or bovine slaughters. The four smaller CV are poultry slaughters in South, SP and MG, and swine slaughters in the South region (Tables 1 and 2, Figures 1 and 2).

Considering the third hypothesis (H_3), slaughters in the second half of the period analyzed (2003–2008) have less variability than slaughters in the first period (1997–2002). In fact, among the 18 time series, 12 shoed a reduction of the CV of the number of heads slaughtered (Table 1 and Figure 1), with an average decrease of -14,9%. Further, 13 shoed a reduction of the CV of the total carcass weight slaughtered (Table 2 and Figure 2) , with an average decrease of -17,4%.

Considering the forth hypothesis (H_4), slaughters where industrial structure have changed drastically towards a more integrated

Table 1. Coefficient of variation (CV) of the heads slaughtered in Brazil.

Ranking	Region/ species	Period		Variation (%)
		1997–2002	2003–2008	
1	Poultry S	5,40	5,65	4,6
2	Swine S	5,68	5,91	4,0
3	Poultry SP	6,85	6,09	-11,0
4	Poultry MG	9,65	6,48	-32,9
5	Poultry CW	5,68	6,95	22,4
6	Swine MG	12,49	6,97	-44,2
7	Poultry NNE	7,65	7,11	-7,1
8	Poultry GO	10,54	7,14	-32,3
9	Swine GO	15,35	7,46	-51,4
10	Bovine NNE	8,81	7,78	-11,7
11	Swine CW	12,95	8,05	-37,9
12	Bovine GO	10,30	8,25	-19,9
13	Bovine SP	8,99	8,69	-3,3
14	Swine NNE	14,98	8,95	-40,3
15	Bovine CW	8,58	9,43	9,9
16	Swine SP	13,65	10,04	-26,5
17	Bovine MG	9,79	10,07	2,8
18	Bovine S	11,02	11,75	6,6

Source: calculated by the authors from IBGE (2009).

Table 2. Coefficient of variation (CV) of the total carcass weight slaughtered in Brazil.

Ranking	Region/ species	Period		Variation (%)
		1997–2002	2003–2008	
1	Poultry S	6,25	6,02	-3,7
2	Poultry SP	7,55	6,08	-19,4
3	Poultry MG	9,97	6,11	-38,7
4	Swine S	6,53	6,63	1,5
5	Swine MG	12,88	7,06	-45,2
6	Poultry GO	12,10	7,24	-40,2
7	Poultry NNE	8,25	7,32	-11,3
8	Bovine NNE	9,04	7,75	-14,3
9	Poultry CW	6,43	7,76	20,7
10	Swine GO	15,04	7,78	-48,3
11	Swine CW	12,61	8,70	-31,0
12	Bovine GO	11,15	8,86	-20,6
13	Swine NNE	17,22	9,03	-47,6
14	Bovine SP	9,46	9,06	-4,2
15	Bovine CW	8,65	9,35	8,1
16	Swine SP	13,35	9,77	-26,8
17	Bovine MG	10,44	10,62	1,8
18	Bovine S	11,37	12,12	6,6

Source: calculated by the authors from IBGE (2009).

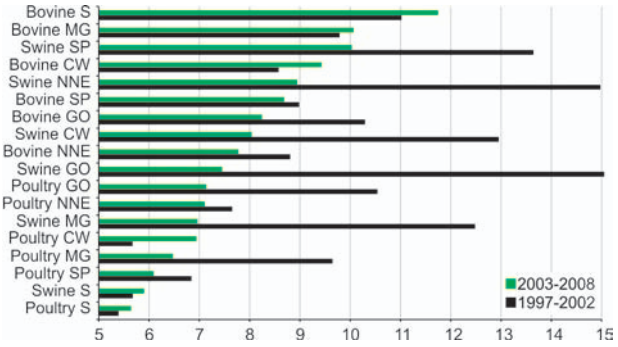

Figure 1. Coefficient of variation (CV) of the heads slaughtered in Brazil.

Source: calculated by the authors from IBGE (2009).

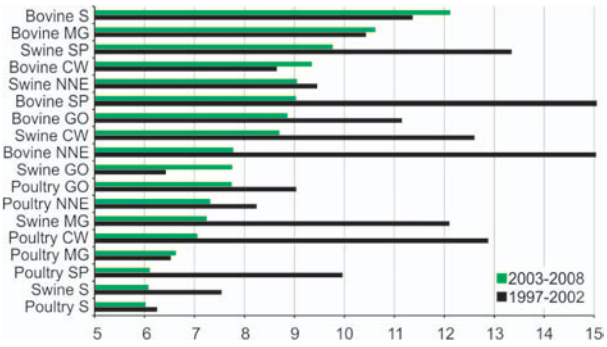

Figure 2. Coefficient of variation (CV) of the total carcass weight slaughtered in Brazil.

Source: calculated by the authors from IBGE (2009).

supply chain presented a more expressive increase in its stability when compared the two periods analyzed. In fact, among the 6 higher decreases in the CV, 5 are in states, regions and supply chains where the industrial structure changed, like swine and poultry in MG and GO and swine in the Central-West region (Tables 1 and 2, Figures 1, 2 and 3).

Table 3 shows the supply chains with the smaller CV (considering the second period analyzed) and with higher decrease in the CV. The "L" marcs supply chains with low CV, and "D" marcs supply chain with higher decreases in CV.

Final considerations

Considering that the CV is an adequate proxy for the coordination effort to stabilize slaughters supply, there is a coherent relationship between analyzed data, the recent development of the three meat supply chains and theoretical proposals.

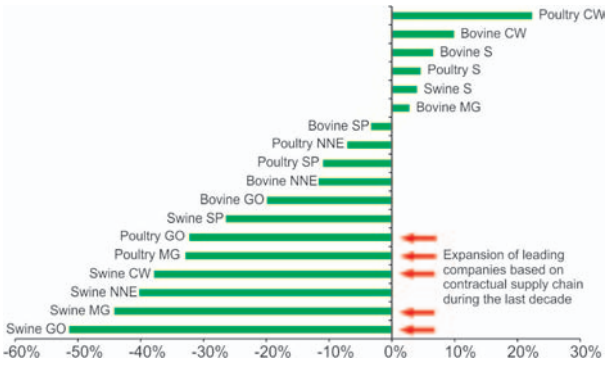

Figure 3. Change in the coefficient of variation (CV) of the heads slaughtered in Brazil.

Source: calculated by the authors from IBGE (2009).

Table 3. Smaller CV and higher decrease in the CV, by region and species.

State or region	Poultry	Swine	Bovine
South (S)	L	L	
São Paulo (SP)	L		
Minas Gerais (MG)	L / D	L / D	
Goiás (GO)	L / D	L / D	
Central-West (CW)	L	D	
North-Notheast (NNE)	L	D	L

First, poultry is the most integrated supply chain, where almost all the production is tied to slaughterhouses and processors by contracts in all Brazilian regions and states. In turn, swine supply chain is more integrated than the bovine one, but shows more accentuated regional differences.

The South region is the origin of leading companies and cooperatives in poultry and swine meat, which strategies are based on supply contracts. Poultry slaughterhouses and processors in São Paulo, SP, and Minas Gerais, MG, are also precursors of supply integration. These supply chains showed the smaller variability in slaughters.

The swine and poultry meat industry structure in Minas Gerais, Goiás, GO, and in the other two states in the Central-West region (CW) is facing structural changes in the last decade, toward a more integrated supply strategy, above all due to the expansion of southern leading companies. These supply chains not only showed a low variability in slaughters, but also, the larger decrease in this variable when considering the two analyzed periods, which coincide with investments made during the beginning of this century.

Higher variability in slaughters occurs in the SP swine industry and in MG and Southern bovine industry, which are characterized by spot market or speculative behavior. The North-Northeast regions are characterized by a less developed swine meat industry, with high variability in the slaughters. The only result not expected is the North-Northeast bovine slaughters, which appears with a low variability, despite its not integrated supply strategy. In general, the results reinforce that a more integrated supply chain strengths the coordination effort to reduce slaughters variability.

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