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Vertical integration in the Brazilian orange juice sector: power and transaction costs

RESEARCH ARTICLE

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Abstract

This paper aims to investigate the role of market power on vertical integration choices in the Brazilian orange juice sector. The main hypothesis states that market power, along with economizing drivers, has had an important role in the economic organization of the orange juice sector. In order to accomplish this task, we examine the make-or-buy decision of juice-processing firms in procurement of inputs (fruits), through a 15-year panel of five firms (more than 90% of the market). Empirical results offer new theoretical insights on role of market power in vertical integration decision. From these theoretical advancements, as implications for practitioners, market power raises attention for critical strategizing issues and antitrust remedies.

Keywords: transaction costs, power, vertical integration, orange juice
JEL code: D23, L22, L49

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1. Introduction

The presence of juice processors in the citrus growing activity has been a characteristic in the Brazilian orange juice sector since its beginning (Hasse, 1987; Neves and Lopes, 2005). However, during the 1990s, this presence became increasingly large, which led to citrus growers' accusation that vertical integration was harming competition. The Administrative Council of Economic Defense, the Brazilian antitrust office, received citrus growers' complaints, but, in the 1990s, antitrust intervention in the sector did not address any constraints to vertical integration. Nonetheless, accusations of market power through vertical integration are persistent in the sector throughout the 2000s and the 2010s. In fact, partial backward vertical integration of juice processors into orange production increased, inasmuch as the production of oranges in the farms owned by juice processors scaled up from more than 20 million boxes in 2002 to 130 million boxes in 2012 (CADE, 2014). The research question is: how power affects juice processor's vertical integration choice in orange juice sector after 1990?

The distinction of economic power from efficiency arguments in vertical integration decision is an ambiguous matter in economic theory (Lafontaine and Slade, 2008). Transaction Costs Economics (TCE) literature points to economizing on transaction costs as the main case and applied to all situations, while power explanations are applied to small number situations (Williamson, 1991a,b, 1995). Recognition of power as determinant of vertical integration decision is limited and no efforts have been made to investigate which are the special case situations in which power is relevant. According to Joskow (2002: 105):

> essentially no effort has been made to harmonize the large body of theoretical and empirical work in the TCE tradition that is relevant to understanding why specific governance arrangements emerge, and for performing any trade-offs that may arise between increases in market power and reduction in the costs of transacting à la Williamson.

The paper aims to analyze vertical integration choice of juice processors in the orange juice chain, in order to highlight the determinants of the increasing in vertical integration after 1993. One of the hypotheses posits that vertical integration is more likely to occur as the relationship specific investments deepen through time. A second hypothesis states that inefficiencies caused by antitrust intervention contributed to increasing vertical integration. Finally, a third hypothesis states that power has an important role in the economic organization of the orange juice chain due to structural changes in the sector. Thus, the hypotheses are grounded in the economizing on transaction costs and strategizing through market power, in order to explain the vertical integration path of the orange juice sector. Nevertheless, a simultaneous effect of economizing and strategizing is expected (Williamson, 1991b). The empirical evidence contributes to understand the special case situations in which power is relevant, with implications to business practice and antitrust authorities.

The paper is organized in six sections including this introduction. The second section presents the transaction costs arguments to vertical integration decision and role of power under this theoretical lens. The third section analyzes the history of orange juice sector in São Paulo state, located in Brazil, emphasizing the previous events that have led to increasing vertical integration after 1993. The fourth section presents data and methods and, in the fifth section, results are discussed. Finally, in the sixth section, concluding remarks follow.

2. Vertical integration choice

It is possible to split the production process in many technologically separable activities and the firm is a combination of these activities to transform inputs in outputs. Vertical integration occurs when the firm internalizes technologically separable activity that was originally carried on outside the firm, i.e. through the market. In the standard view of industrial organization theorists, the firm combines economic activities that are technologically similar or activities that are clearly physically related, in order to minimize production costs (Joskow, 2005). Considering this perspective, there is no point in joining two industrial plants in the absence of technological relationship.

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As consequence of this traditional approach of vertical relationships among firms, those non-standard vertical integrations were usually seen as some kind of monopoly power. According to Coase (1972: 67):

> one important result of this preoccupation with the monopoly problem is that if an economist finds something – a business practice of one sort or other – that he does not understand, he looks for a monopoly explanation. And as in this field we are very ignorant, the number of ununderstandable practices tends to be rather large, and the reliance on a monopoly explanation, frequent.

Nevertheless, the firm's vertical boundaries are not determined solely by technical criteria such as economies of scale and production technology (Williamson, 1971). TCE (Williamson, 1975, 1985) exploits organizational choices of vertical boundaries that are determined by relational features among economic agents. The perspective that market organization and firm's internal organization can be substitute rather than complementary was conceptualized by the seminal work of Ronald H. Coase (1937). Neoclassical economic theory disseminates the idea that markets are the coordination mechanism that maximizes resources allocation. Thus, if it is true, why do firms exist? Or conversely, why does not just one big firm exist? Coase's (1937) answer to these questions states that there is a cost to use the price mechanism, called transaction costs. Firms can economize those transaction costs and, therefore, market and non-market organizations can be compared in terms of costs of transacting.

In TCE framework, the vertical integration decision depends upon the transaction costs involved on the comparative analysis of different forms to organize a transaction; which are under market, contracts, and bureaucracy within firms. Thus, transaction is the ultimate unit of analysis in TCE (Williamson, 1975, 1985), since it can capture the essence of the decision of produce in-house versus buying in the market. The choice for these types of governance structures occurs taking into account three transaction attributes: (1) uncertainty, which are disturbances in quantity, quality, or prices; (2) asset specificity, which are the relationship-specific investments that lose value in alternative uses; and (3) frequency, in terms of transaction recurrence (Williamson, 1985).

Among transaction attributes, asset specificity received more attention in both theoretical models (Williamson, 1985, 1991a) and empirical analyses (Masten and Saussier, 2000). The main hypothesis states that as relationship-specific investments deepen, risks of renegotiation and quasi-rent appropriation become higher (Klein *et al.,* 1978) and safeguards are required, i.e. in presence of asset specificity, long length contracts and vertical integration are more likely to be adopted – the alignment hypothesis (Williamson, 1991a). TCE hypothesis finds incontrovertible empirical support (Masten, 1993, 1996; Masten and Saussier, 2000; Shelanski and Klein, 1995).

TCE's empirical tests use measurements of asset specificity (independent variables) and correlate it to observed governance structure – usually using limited dependent variable (Maddala, 1983). Parameter shifts in TCE's empirical inquiries were disregarded. Parameter shifts are factors that affect governance costs, such as property rights, contract law, uncertainty, and reputation (Williamson, 1991a). Property rights are related to value expropriation by the firms' lack of capacity to protect property rights against Government, rivals, suppliers or buyers. Changes in contract law can affect governance costs, because it alters contract enforcement. Uncertainty is disturbances in factors that affect the transaction. Finally, reputation represents a behavioral standard that can or cannot guarantee contracts. Furthermore, empirical research in TCE tradition has limited efforts in testing power explanations for economic organization along with transaction costs variables. Nevertheless, power is not disregarded in transaction costs lens.

As mentioned before, TCE framework emerged in a context in which power explanations for non-standard organizational forms prevail (Coase, 1972). TCE had an important role in emphasizing the efficiency explanations that were disregarded. In doing so, theorists of TCE assigned higher weight to efficiency purpose organizations, in order to counterbalance the previous perspective of monopoly power. Williamson (1985: 17) made it clear asserting that:

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> the economic institutions of capitalism have the main purpose and effect of economizing on transaction costs. The main purpose is not, however, to be confused with solely purpose. Complex institutions commonly serve a variety of objectives. This is no less true here. The inordinate weight that I assign to transaction costs economizing is a device by which to redress a condition of previous neglect and undervaluation.

Power is one of the factors composing these complex institutions, but Williamson (1995) contrasts and describes transactions using efficiency and power purposes. When contracting is voluntary, knowledgeable, and farsighted, there is no room for power. Actually, power is present in the opposite situation, when contracting is involuntary, uninformed, and myopic. Williamson (1995) claims that contracting processes are frequently voluntary, knowledgeable, and farsighted, especially in intermediate product markets, and economizing lens is a useful place to start the analysis.

Williamson (1995) points to another two problems when power is considered in economic analysis. First, its concept is vaguely defined and fails to identify the critical dimensions in which power makes difference. Definition of power ends in *ex post* rationalization, i.e. an artifice that explains the event after the occurrence. Second, still related to the first one, the concept of power is tautological. It is a concept that explains everything and, consequently, explains nothing. The concept of transaction costs also faced this tautological problem, but defining the transaction as unit of analysis, distinguishing transactions by its attributes, and measuring those attributes could solve the problem. Despite this, power can be an attribute of the transactions, since it characterizes a relationship; it is not possible to distinguish transactions by power features because robust measurements are not available.

Williamson (1991b) also considers the concept of power in the Strategic Management literature. Among several streams of thoughts, Strategic Management field can be grouped into two main rationales: strategizing and economizing. The first one, strategizing, is rooted in market power and it is the most disseminated in the field. The second is the economizing, which is more theoretically refined – in price theory and the firm as production function – but has received less attention.

In order to understand the differences in the strategizing and economizing perspectives, it is necessary to understand the economies of first and second orders. The source of these economies is the potential unnecessary bureaucracies and waste due to maladaptation problems, which is neglected by a firm as production function model. Maladaptation problems are related to bad choices in organizational forms. Transactions differ in terms of attributes and governance structures distinguish by costs and competences. In effect, misalignments in transaction features and the chosen organization – maladaptation problems – create waste. First and second order economies are the result of the solution of these maladaptation problems.

Using a simple model of partial equilibrium (Williamson, 1991b), represented in Figure 1, it is possible to visualize the effects of first and second order economies. Assuming a firm selling a given product in the quantity q_1 for the price of p_1, which is higher than average costs c_0. In this situation, due to maladaptation problems, there is an excess in costs equal to b that results in production and transaction costs equal to c_0+b. If the activity reorganization removes maladaptation problems, therefore, the excess b is eliminated. Holding prices constant, social gains are promoted by the elimination of waste $W=bq_1$. This is the first order economizing in which changes in governance structure eliminates the waste, W. In the case of change in price from p_1 to p_2, reducing the price to the level of average costs c_0, we add benefits from allocative efficiency equal to $L=½b\Delta q$, where $\Delta q= q_2–q_1$. This is the second order economizing, given by L. Although the second order economizing is also significant, it is less than first order economizing.

Williamson's (1991b) critics consist that economists usually focus on second order economizing, while first order is neglected, even whether the waste is greater than the deadweight losses (triangles). In effect, the dominant perspective emphasizing in market power and strategizing could be substituted by the refinements of economizing perspective, suggesting that 'between economizing and strategizing, economizing is much

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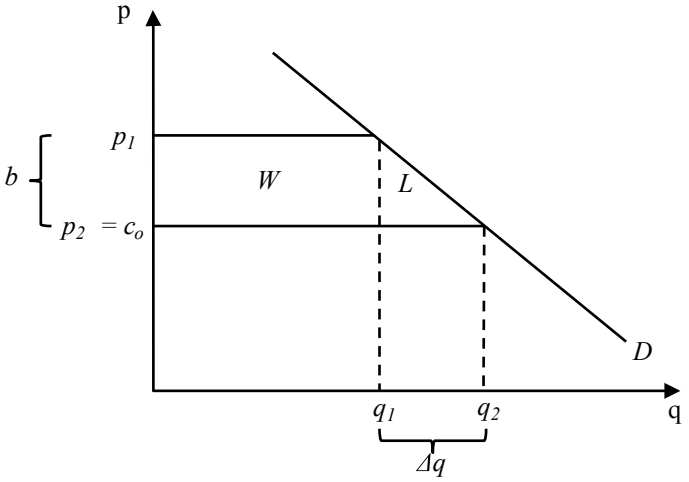

Figure 1. First and second order economizing (adapted from Williamson, 1991b).

more fundamental' (Williamson, 1991b: 75). Finally, the author argues that strategizing and economizing are not mutually exclusive drivers for economic organization, but strategizing is relevant to a small number of situations, while economizing is relevant to all situations.

Azevedo (1996), in turn, uses bargaining power as the main factor to explain vertical integration choice. Using game theory, Azevedo (1996) analyzed the partial vertical integration in the Brazilian orange juice sector during the 1990s. Taking into account the presence of specific investments and barriers to forward vertical integration of citrus growers, vertical integration can serve as a bargaining instrument over surpluses. The model showed that an optimal degree of vertical integration is chosen when marginal benefit is equal to marginal cost of organizing this activity under contracts. Nevertheless, the model also showed how juice processors could extrapolate the optimal degree of vertical integration in order to appropriate part of the surplus generated from cooperation. In fact, when higher than optimal vertical integration degree is found, welfare losses will take place according to the author. Thus, vertical integration can be used as strategic means to redistribute wealth through bargaining power with implications to welfare.

Transaction costs arguments highlight non-technological determinants to vertical integration, represented by transaction attributes. This is a significant contribution, since in standard neoclassical theory, combination of economic activities under non-technological features were solely viewed as market power exertion. Nevertheless, investigations in TCE traditionally did not debate a possible trade-off between economizing on transaction costs and power explanations. Indeed, debates between power and efficiency arguments to vertical integration are ambiguous. Vertical integration is efficient when avoiding the double marginalization in a sequence of two monopolists (Tirole, 1988) or when mitigating risks from opportunistic renegotiation in contracts (Klein *et al.*, 1978). However, under power perspective, vertical integration creates barriers to entry, raises rivals costs, affects prices (Joskow, 2005; Riordan, 1998), or serves as a bargaining instrument (Azevedo, 1996). Despite TCE provides additional information about efficiency reasons to vertical integration, it fails to recognize and give sufficient attention to special case situations in which power is relevant (Dorward, 2001). There is a risk in conclusions for efficiencies purpose in every non-standard – different from minimize production cost – vertical integration, because power is also potentially present.

3. Orange juice sector: transaction costs and power

The large-scale production and exportation of high quality orange juice in Sao Paulo initiated in 1960s, after an intense freeze that devastated orange crops in Florida. The origins of Brazilian juice processing firms are related to large orange producers, which were able to employ their fruits excess in an alternative product.

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Initially complementary, juice production in Brazil presented rapid growth during the 1970s and 1980s. Exportation of orange juice scaled up from 531 tons in 1963 to more than 33 thousand tons in 1970 and, then, to more than 401 thousand tons in 1980. The sector also became more specialized in juice production, as 2% of the orange production in São Paulo was used to produce juice in 1970, while this figure changed up to 81% in 1980.

As a result, large citrus growers became large juice-processing firms. The industry structure is concentrated since its beginning, given that the top four processors controlled 97% of the market in 1967, 80% in 1990 (Hasse, 1987; Maia, 1996), and 96% in 2010[1]. These large juice processing-firm depended upon thousands citrus growers, which had heterogeneous features. In effect, given that juice-processing industry structure is persistently more concentrated than citrus industry structure, market power has been potentially present throughout the history of the sector. Additionally, partial vertical integration has been present in the organization of the orange juice sector since 1963, since large juice-processing firm kept a small amount of their previous main occupation, i.e. orange production. However, starting in the beginning of 1990s, there was a remarkable acceleration in the growth rate of backward vertical integration of juice-processing firms. In other words, large juice firms were producing more oranges, as Figure 2 shows.

The traditional TCE analysis would look for efficiency explanations in terms of transaction costs. Relationship-specific investments are the most important dimension to be empirically analyzed under transaction costs arguments and there are several relationship specific investments in the juice production chain. Regarding citrus production, first, it is a perennial crop and new trees remain unproductive for long periods; second, it is an immobile investment in terms of geographic location; and third, types of oranges destined to juice production are not appreciated by fresh fruit consumers. In juice processing, the production plants used to process orange juice are requiring very specific investments, which often times minimizes the value of the asset beyond the citrus grower and juice processor's relationship.

Analyzing the relationship between citrus growers and juice processors, the distance between farms and processor plants are called site specificity. According to Williamson (1985), 'cheek-by-jowl' relationships are more specific, due to redeployment and set up costs. Distances between farms and production plants reduce transportation and coordination costs and reduce transportation time. There is also a temporal specificity, because oranges are perishable and it must be processed quickly after harvest. According to Masten *et al.*

[1] Calculated by IEA, the Agricultural Economics Institute. The institute is the research branch of São Paulo state government and it focuses on agriculture.

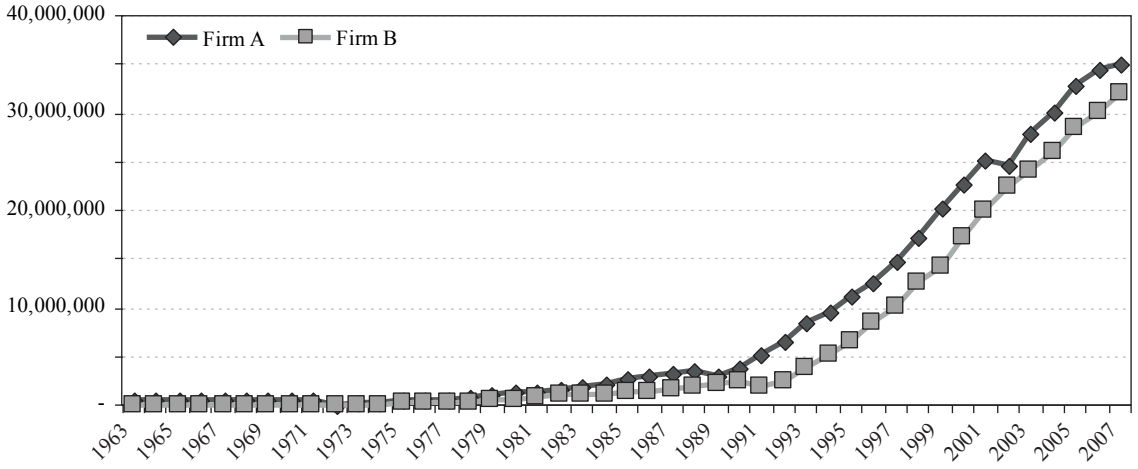

Figure 2. Two largest juice processing firm's investment in orange production.

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(1991), temporal specificity occurs when threats of delays are conditions to extract price concessions, which is the case in the orange juice production chain. Thus, as distances between production plants and farms decrease, more specific are the investments, in terms of site and temporal specificity, and more vertical integration is expected.

The relationship between citrus growers and juice processors also presents physical specificity. According to Williamson (1985), physical specificity is related to investments in equipment, machines, and other physical assets with characteristics that are designed to a specific transaction. In the citrus growers' activity, trees are physically specific because orange type destined to juice production loses value in alternative use, i.e. for fresh fruit consumers. The investment in trees requires time – around 4 years – to be fully productive and redeployment of land to other uses is quite restricted. Thus, as physical asset specificity increases, greater will be transaction costs associated and more vertical integration will be expected. Thus, as the relative quantity of oranges delivered in juice-processing plants grows (compared to oranges destined to fresh fruit consumer), more specific are the investments in orange production. Joskow (1987) used a similar relative quantity of supply as asset specificity measurement in coal mining sector.

Finally, in juice production side, juice-processing plants have no alternative use other than orange juice production. It is possible to note that investments in juice distribution such as ports terminals, trucks and ships would follow investments in processing plants. Thus, as the number of plants increase, more specific are those investments. Hypothesis 1 is then a hypothesis of economizing on transaction costs.

> H_1: (a) site specificity; (b) physical specificity in orange crop; and (c) physical specificity in processing-plants are positively associated to vertical integration.

Relationship-specific investments create a situation of small number bargaining, i.e. bilateral monopoly between citrus growers and juice processors (Williamson, 1985). This asset specificity analysis, however, is a cross-sectional view of transaction that does not include the process perspective (Zajac and Olsen, 1993). Structural changes in the sector could affect the relationship between citrus growers and juice processors after specific investments. The immediate effect of this situation is the change in governance costs, even keeping the asset specificity constant, In other words, under TCE lens, parameter shifts could affect governance costs and, therefore, vertical integration decision. In the case under analysis, the change occurred in contract law.

In the orange juice sector, there were an important antitrust contentious in the 1990s. In this contentious, citrus growers were complaining about some of the terms in the standard contract in force at that time. The standard contract was a result of learning and collective negotiations between citrus growers and juice-processing firms, which was pursued for more than 15 years in the sector. The contract design proposed attached orange prices to juice prices in the international markets, and it was voluntarily and massively adopted by the parties. Despite the spontaneous adoption, the accusation targeted the methodology to calculate orange prices, claiming that it is an instrument to raise profits, i.e. oranges would be underpriced.

Antitrust Council accepted the accusations and initiated the legal process, but citrus growers and juice processors decided to sign an agreement, called commitment term to conduct cessation. Antitrust authorities suspended the use of a standard contract and collective negotiations were forbidden. In fact, citrus growers were not asking for the termination of standard contracts, but advocating for punctuated changes in its provisions. Antitrust Council, in turn, decided to not interfere in contractual practices, and extinguished the standard contract as an attempt to re-establish more competitive conditions. The rationale that underlies antitrust decision counted on the competition and individual negotiations as a mechanism to achieve efficiency through multiple contracting practices. Furthermore, antitrust office disregarded the vertical integration, which was part of the complaints made by citrus growers, i.e. juice-processing firms backward vertical integration would harm competition. In practice, the major organizational arrangement at the time was forbidden and did not leave a viable means to carry out the transactions. This lack of means moved up the hybrid governance costs, which turned the contracting costlier and led to higher degrees of vertical integration.

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(H_2): antitrust intervention and standard contract prohibition is positively associated to vertical integration.

Still regarding dynamic aspects of the organizing process (Zajac and Olsen, 1993), there were technological changes in the sector that affected not only the industrial organization but also the viable safeguards available. During the 1980s, the distribution of frozen orange juice using steel drums was substituted by a bulk system. This innovation required large investments in special-purposes trucks and ships, as well as dedicated port terminals, to transport the production from Brazil to Europa and the USA. Yet immense investments were necessary, the cost reduction was huge, and all large juice processing-firms adopted the new technology. As consequence, the barriers to entry increased in the sector of juice-processing, as new players must invest not only in production plants, but also create an expensive and complex logistic structure, dealing with the saturated port system in Brazil. Beyond initial investments, incumbent juice-processing firms developed close ties to buyers in international markets, which create another barrier to entry by difficult access to buyers.

The barrier to entry introduced by the new distribution system transformed the industrial organization. The largest juice-processing firm consolidated their positions, as concentration increased from 74% in 1997 to 96% in 2010 – considering the sum of market share of the four largest orange juice producers. This concentration growth per se creates condition to market power. However, there is another effect from the technological transformation, impacting the safeguards to transactions. Before the 1990s, citrus growers could protect their specific investments through vertical integration and they did it, as well as these juice processors maintained low levels of investments in orange production. Nevertheless, changes in the relationship and market context led to a situation in which only juice processors could protect their specific investments through vertical integration. Citrus growers remained vulnerable to opportunistic price renegotiations after the transformations caused by the technological innovations. The year of 1993 marked this disadvantageous context to citrus growers, when Frutesp, one of top four juice-processing firms and the last controlled by citrus grower's co-operative, was acquired by an international trading company. From this point, there were no forward vertical integration options to farmers.

The contracting is no longer voluntary, knowledgeable, and farsighted (Williamson, 1995), because non-predictable changes occurred after specific investments were made. The barriers to entry in the juice processing industry and the absence of citrus growers' efforts in forward vertical integration are transformations in the evolution process of the relationship. In the presence of barriers to farmer's forward vertical integration, due to barriers to entry, juice-processing firms had increasing market power. In this context, juice processing-firms could take advantage of market power and choose higher degrees of vertical integration to achieve bargaining power over citrus growers (Azevedo, 1996). As juice processors control greater market share, the market power will higher and, then, more vertical integration will be expected. The hypothesis 3 is then a hypothesis of power explanations for vertical integration.

(H_3): market share of juice-processing firms are positively associated to vertical integration.

Economizing and strategizing are frequently treated as mutually exclusive in the literature, i.e. there is a trade-off between transaction costs and market power (Joskow, 2002; Williamson, 1991b). Using TCE's lens, backward vertical integration could be the solution to coordinate orange transactions to economize on transaction costs. Another explanation is consistent with power purposes to vertical integration, as conditions of voluntary, knowledgeable and farsighted contracting are not satisfied. Instead of taking one side or another, economizing or strategizing, in our hypotheses setting, we claim that both drivers are simultaneously found in the economic organization of orange juice sector.

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4. Data and methods

The following functional form represents the basic model:
$VI = f(K, SHIFTPAR, POWER, LAND, SUGC)$
where,

VI_{it} = Investments in orange production made by juice processing firms, given by the quantity of orange boxes produced by *i*th firm in the *t*th period (million boxes; data provided by Associtrus).

K = Asset Specificity:
K_CROP_t = physical specificity[2] of orange crop, sum of the quantity of orange boxes processed by all firms in the *t*th period divided by total boxes produced in São Paulo state in the *t*th period. This measure is not firm specific (data provided by CitrusBR[3] and Agricultural Economics Institute (IEA));
K_PLANT_{it} = physical specificity of processing plants, dummy variable where 0 denotes the period before installation of new processing plant by *i*th firm and 1 denotes the period after installation of new processing plant by *i*th firm (data provided by Associtrus); and
K_SITE_{it} = site specificity[4], given by the concentration ratio of orange production around juice-processing plants. It is the average of the quotient of quantity of oranges produced in *j*th city over distance between the *j*th city and the city where juice-processing plant is located (adapted from IEA data).

$SHIFTPAR$ = Parameter shifts:
$ANTIT_t$ = changes in contract law due to antitrust intervention through standard contract prohibition. It is a dummy variable where 0 denotes period before antitrust intervention and 1 denotes the period after intervention;
$UNCERT_t$ = uncertainty, standard deviation of orange boxes annual prices in the last five years for *t*th period (data provided by Informa Economics (FNP)[5] and CEPEA[6]); and
$PROP_R_t$ = overall score of economic freedom index for *t*th period, which measures elements such as property rights, business freedom, labor freedom, among others. (adapted from Heritage Foundation; http://tinyurl.com/zgdx9wd).

$POWER_{it}$ = power, given by market share of *i*th firm in the *t*th period (adapted from IEA, FNP, and Sabes, 2010).

$LAND_{it}$ = Land value, average price of land in the region of the *i*th firm in the *t*th period. Prices deflated using Índice Geral de Preços Disponibilidade Interna (IGP-DI) index (data provided by IEA).

$SUGC$ = Influence of sugarcane sector in orange juice sector:
$SUGC_P_{it}$ = average value of tenancy for sugarcane production in the region of *i*th firm in the *t*th period. Prices deflated using IGP-DI index (data provided by IEA); and
$SUGC_A_{it}$ = production area of sugarcane in the region of *i*th firm in the *t*th period (data provided by IEA).

Initially, some commentaries about dependent variable are needed, which is a measure for vertical integration. Backward vertical integration is the production of oranges by juice-processing firms. One can say that some

[2] This variable also captures temporal specificity effects.
[3] CitrusBR is a representative association of the biggest Brazilian producers and exporters of citrus juices and derivatives; http://www.citrusbr.com.
[4] Concentration ratio indicates the extent in which orange production is geographically concentrated around cities where processing plants are installed in each firm and each year.
[5] Informa Economics (FNP) is a consulting group focused on agribusiness information; http://www.informaecon-fnp.com.
[6] CEPEA is a research center located in the agronomics school of University of São Paulo; https://www.cepea.esalq.usp.br/br.

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kind of degree of vertical integration is better than the dependent variable used in this study. Nevertheless, there is no available data about the number of orange boxes processed by each juice-processing firm.

Despite the lack of available data, the chosen dependent variable can capture the increase of vertical integration. Indeed, it is possible to state that the chosen variable is more accurate in terms of underlying rationality of decision-makers, because it is more likely that people decide over quantities rather than percentages. It is not the relative quantity of inside production versus outside procurement, but the simple fact that juice-processing firms are increasing the quantity of inside orange production of oranges, regardless the quantity of juice produced. Conversely, if managers in juice-processing firms decided to reduce juice production, it is not necessarily true that they also decided to increase vertical integration.

Interest variables are asset specificity (H_1), antitrust intervention (H_2), and power (H_3). In addition, consistent with transaction costs propositions, parameter shifts can influence the choice for governance structures. Whereas TCE's theoretical propositions do not specify expected effects for parameter shifts, it is expected that uncertainty is positively associated to vertical integration because more hierarchical coordination deals with uncertainty. Regarding property rights, it is expected that increases in the quality of property rights index are negatively associated to vertical integration, because it is less costly to avoid value expropriation through markets or contracts. Parameter shifts variables are not firm specific.

Control variables include: land value and sugarcane influence over orange sector. It is expected that land value is negatively associated to vertical integration, since increases in land prices can inhibit expansion of vertical integration. The sugarcane crop is located in the same region as the orange crop and these two products compete for land. Thus, price of land tenancy to sugarcane production can attract citrus growers to change their crop from orange to sugarcane. Furthermore, increases in the production area of sugarcane can also threaten orange supply. We expect an ambiguous effect, because, on the one hand, sugarcane crop is positively associated to vertical integration, because juice processors will seek to guarantee their supply of fruits. On the other hand, sugarcane can increase the overall land opportunity cost, with negative influence to vertical integration.

This is an exploratory study. This study advances in empirical inquiry under TCE lens using longitudinal data of just one transaction, which is not the traditional approach. Inclusion of parameter shifter effects is not frequent in empirics of TCE as well, which is made in this study. The model tests power explanations along with TCE's traditional measures of asset specificity and institutional changes like antitrust intervention, which is also not frequent in this kind of investigation. The sample considered a 15-years period, from 1993 to 2007, for the five largest juice-processing firms. This is an unbalanced panel data, since there was a juice processor that closed its operations during this period and there is no available information about market share in 1993 for one of juice processors. Hence, a total of 70 observations are available for major part of variables. Property rights index, land prices and tenancy prices for sugarcane are available between 1995 and 2007. Table 1 presents descriptive statistics and correlation matrix.

$$VI_{it} = \beta_0 + \underset{(+)}{\beta_1 K_CROP_t} + \underset{(+)}{\beta_2 K_SITE_t} + \underset{(+)}{\beta_3 K_PLANT_{it}} + \underset{(+)}{\beta_4 UNCERT_t} + \underset{(-)}{\beta_5 PROP_R_t}$$

$$+ \underset{(+)}{\beta_6 POWER} + \underset{(-)}{\beta_7 LAND_{it}} + \underset{(+/-)}{\beta_7 SUGC_P_{it}} + \underset{(+/-)}{\beta_8 SUGC_A_{it}} + \underset{(+)}{\beta_9 ANTIT_t}$$

The econometric model is specified as follow:

The dataset is organized in a panel data. This is a long panel, since it has relatively many time periods and few firms. Regarding estimation techniques, the main distinction in those datasets is random or fixed effects (Cameron and Trivedi, 2009). As the five largest juice-processing firms constitute the sample, it is reasonable to assume that fixed effects estimates are suitable to data characteristics. Nevertheless, estimations using fixed effects and random effects were assessed by the Hausman test, indicating that fixed effects provide

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Table 1. Descriptive statistics and correlation matrix.[1]

Variable	N	Average	Std. dev.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.
1. VI	70	11.26	9.92	1										
2. K_CROP	70	0.77	0.08	0.34*	1									
3. K_SITE	70	15,500	2,945	-0.31*	-0.06	1								
4. K_PLANT	70	ND**	ND**	0.20	-0.27*	0.25*	1							
5. UNCERT	70	1.04	0.26	0.04	-0.10	0.05	-0.07	1						
6. PROP_R	61	57.89	5.11	0.43*	0.16	0.01	0.23	0.66*	1					
7. POWER	70	0.17	0.09	0.77*	0.28*	-0.11	-0.03	0.08	0.49*	1				
8. LAND	61	10,427	3,745	0.14	-0.17	-0.01	-0.09	-0.27*	0.19	0.15	1			
9. SUGC_P	61	603	100	0.06	-0.05	-0.29*	0.15	-0.33*	-0.15	-0.13	-0.03	1		
10. SUGC_A	70	131,219	24,061	0.11	0.17	0.17	0.08	0.084	0.27*	0.34*	-0.23	-0.06	1	
11. ANTIT	70	ND**	ND**	0.47*	0.38*	-0.01	0.28*	-0.10	0.37*	0.35*	-0.41*	-0.10	0.39*	1

[1] * = significant at $P \leq 0.05$; ** = dummy variable.

more consistent estimators. Finally, natural log transformations of both dependent and independent variables were performed, exception made for dummy variables.

5. Results

Table 2 presents the results. In general, all three hypotheses are supported: economizing on transaction costs as asset specificity deepens (H_1); antitrust intervention as a shifter parameter (H_2); and power exertion (H_3). Regarding the traditional TCE's alignment hypothesis, physical specificity plays an important role influencing the vertical integration trend in the analyzed period because it presents a positive and significant effect ($H_{1b,c}$). Site specificity, in turn, has no statistically significant effect over vertical integration (H_{1a}). This last result does not mean that economizing on transaction costs has limited influence in vertical integration

Table 2. Results of panel data analysis.

Variables	VI 1993-2007	VI 1995-2007	VI[1] 1993-2007	VI[1] 1995-2007
K_CROP	0.664* (0.367)	0.694** (0.314)	0.664 (0.333)	0.694* (0.302)
K_SITE	-0.183 (0.287)	-0.485 (0.340)	-0.183 (0.476)	-0.485 (0.382)
K_PLANT	0.576*** (0.101)	0.556*** (0.0928)	0.576*** (0.0470)	0.556*** (0.116)
UNCERT	0.387*** (0.131)	0.501*** (0.184)	0.387** (0.130)	0.501** (0.174)
PROP_R		1.715*** (0.559)		1.715** (0.529)
POWER	0.339*** (0.0644)	0.320*** (0.102)	0.339*** (0.0253)	0.320 (0.217)
LAND		-0.165 (0.143)		-0.165 (0.134)
SUGC_P		0.154 (0.211)		0.154 (0.149)
SUGC_A	-0.530** (0.260)	-0.507** (0.229)	-0.530** (0.161)	-0.507* (0.194)
ANTIT	0.813*** (0.104)		0.813*** (0.116)	
Constant	9,932** (4.001)	6,899 (5.723)	9,932 (5,344)	6,899 (4,943)
Observations	70	61	70	61
Adjusted R-squared	0.827	0.826	0.838	0.840

[1] Using cluster robust.

*** = significant at $P \leq 0.01$; ** = significant at $P \leq 0.05$; *= significant at $P \leq 0.10$; *t*-statistic in parentheses.

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in this case because our focus is vertical integration decision made by juice-processors. In this sense, since physical specificity in juice-processing plants is highly significant in all estimated models, results point to strong evidence that relationship specific investment affected the vertical integration decision.

Antitrust intervention also contributed to increasing vertical integration of firms during the analyzed period. Antitrust decision influence was positive and statically significant (H_2). Given the prohibition of a contract that was a voluntary and privately negotiated contract type, the hybrid governance curve became more expensive due to negotiations of juice-processing firms with thousands of different suppliers. In effect, contracting became more expensive after antitrust intervention, which moved up the hybrid governance curve. In fact, antitrust intervention created inefficiencies in terms of transaction costs minimization, since it substituted contracts by greater internal production.

Supporting the third hypothesis, vertical integration path has also a power component. In other words, changes in market share have a positive and statistically significant association to vertical integration (H_3). This result indicates that gains in bargaining power can play an important role in the decision of vertically integrate the production. The empirical evidence is consistent to Azevedo's (1996) arguments, suggesting that, in the presence of specific investments and barrier to forward vertical integration of the supplier, the buyers tend to pursuit backwards vertical integration. The high level of partial vertical integration would allow the buyers appropriate part of the surplus generated in the transaction. The evidence is also consistent with farmers' formal accusations in the antitrust contentious during the 1990s.

Also related to TCE's prediction, the other parameter shifts presented positive and statistically significant association to vertical integration. Uncertainty about orange prices contributed to a vertical integration trend, as expected, because internal production is better to deal with prices changes. However, property rights also influenced the vertical integration trend but in the opposite direction. It was expected that better quality institutional environment would induce more contracts in the sector. This is a longitudinal analysis and these variables controlled potential changes in competitive environment, which serve as parameter shifts for governance curves.

Finally, the control variable of land price has no statistically significant association to the dependent variable, while competition with sugarcane production presents negative and statistically significant association in terms of area used to produce sugarcane. This evidence, on one hand, indicates that sugarcane production is raising the opportunity cost for the land, which is reducing the expansion of orange production by juice-processing firms. On the other hand, value tenancy for sugarcane production is not a threat to juice-processing firms, i.e. citrus growers are not attracted to change their production to sugarcane.

6. Conclusions and implications

The paper aimed to analyze the partial backward vertical integration trend of juice-processing firms into orange production after 1993, in order to highlight the main determinants of this path. In this endeavor, beyond traditional determinants of vertical integration in TCE literature, such as asset specificity, we also included institutional features like antitrust intervention and market power as influencing factors in make-or-buy decisions. In fact, the discussion can approach both theoretical and practical implications, as follow.

6.1 Implications for theory building

It is not simple to investigate power as determinant of vertical integration, since it is an ambiguous matter in economic theory and it has a limited role in TCE models. Power, in TCE literature, is present only in special case situations, whereas economizing on transaction costs is much more recurrent and it is the starting point for the analysis. This study advances in the exploration of those special case situations in which power is relevant, more specifically, showing that the market dynamics can change conditions to build safeguards to relationship-specific investments. The barrier to entry in juice-processing activity, accompanied to barriers

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to grower's forward vertical integration, are the mechanisms that determined these unpredictable conditions to market power. Investigations into which are the special case situations where power is relevant are rare and this paper is an attempt in this direction.

Theory suggests that: (1) when contracting process take place under voluntary, knowledgeable, and farsighted situations, there is no room for market power; and (2) economizing is more frequent than strategizing in real world transactions. Nonetheless, theory also assumes that bounded rationality and the consequent incomplete contracting for the transactions. Thus, in presence of incomplete contracts, there is some limited foreseen situations when relationship specific investments are made, which make room for market power. Firms can actively introduce changes in the environment, affecting the bilateral dependence from those specific assets. Thus, this study also contributes to providing a dynamic view of the process involved in the vertical integration decision, especially in how changes in relevant factors across time can help to understand organizational evolution.

Another advancement in this study is the explicit consideration of parameter shifts in the econometric model. This procedure is not frequent in empirical investigation of vertical integration under TCE lens, since investigations use cross-sectional data – e.g. Masten *et al.* (1991) and Monteverde and Teece (1982). The inclusion of parameter shifts proved to be fruitful, when antitrust intervention showed important role in the formation of the new arrangement for transactions. In this sense, cross-sectional investigations using asset specificity can produce inaccurate estimations, as vertical integration trend are also affected by environmental dynamic dimensions; i.e. keeping asset specificity constant, the increasing or decreasing vertical integration can be related to changes in contract law, for instance.

We emphasize that this balance between economizing and strategizing is the core element in antitrust analysis. Failures in addressing this issue can lead to mistakes in the identification of the anticompetitive conduct and/or its remedy, which practical implications is explored in the following subsection. After analyzing those factors that determined vertical integration choice between 1993 and 2007 in the Brazilian juice sector, econometric evidence showed that economizing on transaction costs, antitrust intervention and power are relevant factors to explain vertical integration in this context. The results showed that economizing on transaction costs is not necessarily the starting point to organizational analysis, therefore, it is critical to take into account the balance between economizing and strategizing.

6.2 Implications for practice

The fact of distinctions from efficiency and strategic purposes are blurry in this situation creates challenges for antitrust analysis. As it was difficult to anticipate indirect effects from the antitrust decision, there is a risk to produce more inefficiency after interventions than the previous situation. This problem occurred in the case of orange juice sector, as the antitrust intervention contributed to increasing vertical integration of juice-processing firms. The consequence was the adoption of more expensive arrangement for transactions, in term of governance costs, and generated no beneficial results to citrus growers. In fact, the intervention can harm growers' conditions when the consequences to firm strategy are taking into account. Therefore, it is possible to indicate a relationship between hypotheses 2 and 3, since antitrust intervention not only increased transaction costs, but also was not capable of avoiding the juice-processor's bargaining power.

The results also indicate practical implications for firm competitive strategy. The role of vertical integration to bargaining power in the buyer-supplier relationship is explored by competitive strategy model, more specifically the five competitive forces (Porter, 1980). Thus, in the case of orange juice sector, after no antitrust office disregarded any actions against vertical integration path in the sector, juice-processing firms increased the partial backward vertical integration. Despite the econometric analysis cannot evaluate the financial results from the vertical integration strategy, the five competitive forces model suggests that this kind of strategy create conditions to price or concessions renegotiations, which has positive impacts on juice-processing firms performance.

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6.3 Limitations

First, from the empirical evidence it is possible to indicate the concomitant role of market power and transaction costs in the explanation of vertical integration decision. However, it is not possible to estimate the size of the effect these different mechanisms, and, therefore, it is not possible to conclude about the welfare effects of the increasing vertical integration in the sector. Second, another limitation of this study is related to the dependent variable, as data on new farms owned by juice-processing firms was obtained from public information in press or firm's reports. Thus, it is possible that data underestimate the amount of internal fruit productions of juice firms. Finally, third, constraints for forward vertical integration of citrus growers in 1993 is temporally close to antitrust intervention in 1994. This proximity can influence the interpretation of the results of the dummy variable labeled as *ANTIT*, because constraints for forward vertical integration of citrus growers can increase the bargaining power of juice-processing firms through backward vertical integration.

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