

# LINKING EXTERNAL INTEGRATION TO SUPPLY CHAIN RISK REDUCTION AND PERFORMANCE OUTCOMES: AN EMPIRICAL STUDY

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*Supply chain risk (SCR) has been identified as one of the most important issues in industrial management literature. However, despite considerable attention since the early 2000s, many aspects of SCR are largely unexplored. One area that is deficient in research is related to ways to reduce supply and demand risk. Thus, the purpose of this paper is to explore linkages among external integration, supply chain risk reduction, and firm performance. Based on a survey questionnaire with 96 participants, we have analyzed the total sample using ANOVA and we have used the Wilcoxon-Mann-Whitney Test to compare the two sets of companies, i.e., large companies (annual sales > US\$ 5 million), and non-large companies (annual sales US\$ 1-5 million). Our results indicate that a higher level of external integration impacts risk reduction and improving firm performance. In addition, we found that higher levels of external integration, risk reduction, and firm performance are perceived in large rather than non-large companies.*

*Palavras-chaves: Supply chain risk, external integration, performance, survey, Brazil.*

## 1. Introduction

Over the years the attention of practitioners and academics on integration practices into supply chain context has grown significantly (DANESE *et al.*, 2013). External integration (EI) is often mentioned as a key driver to enable long-term competitiveness of the supply chain as a whole (CAO & ZHANG 2011). For this reason, linkages with suppliers and customers, aimed at coordinating upward information and downward material flows along the supply chain is viewed as a crucial issue in industrial management (DANESE *et al.*, 2013). In previous studies (e.g. FROHLICH & WESTBROOK, 2001; SWINK *et al.*, 2007; FLYNN *et al.*, 2010; WONG *et al.*, 2011) researchers have detached a positive influence played by EI on supply network performance. However, the literature supports that supply chains are naturally affected by risks (JÜTTNER *et al.*, 2003; PECK, 2006) threatening their performance (RITCHIE & BRINDLEY, 2007).

In order to avoid such fails, studies addressing the identification and mitigation of possible disturbances (CHOPRA & SODHI, 2004; CHRISTOPHER & PECK, 2004), minimization of uncertainties (JÜTTNER *et al.*, 2003; PECK, 2005) or interruptions (SHEFFI & RICE, 2005; WAGNER & BODE, 2006) has assumed a new degree of relevance in supply chain management literature (PECK, 2005). In fact, studies that have addressed forms to reduce risks into supply chains have captured considerable attention since the early 2000s (e.g. JÜTTNER *et al.*, 2003; ZSIDISIN, 2003; CHRISTOPHER & PECK, 2004; PECK, 2005; TANG, 2006; WAGNER & BODE, 2007; MANUJ & MENTZER, 2008; TUMMALA & SCHOENHERR, 2011). However, the debate is still open in the literature on ways to reduce supply and demand risk.

There are two main objectives for this research. First, we explore if high levels of supply chain risk reduction and performance outcomes are perceived in an industrial environment with satisfactory levels of external integration. Second, we determine if higher levels of external integration, supply chain risk reduction, and firm performance are perceived in largest rather than non-large companies, in order to analyze similarities or differences in these two sets of companies.

In the following section, we review briefly the literature and we presented the hypothesized research model. Next, the research methodology is described followed by research results.

Finally, the main conclusions are drawn, together with limitations of this study and suggestions for future research.

## 2. Background

In this paper, we have carefully defined each construct in terms of essential characteristics from the relevant literature base (Yang et al., 2011). The definition for each construct and the supporting literature is summarized in Table 1.

Table 1 – Constructs, definition, supporting literature

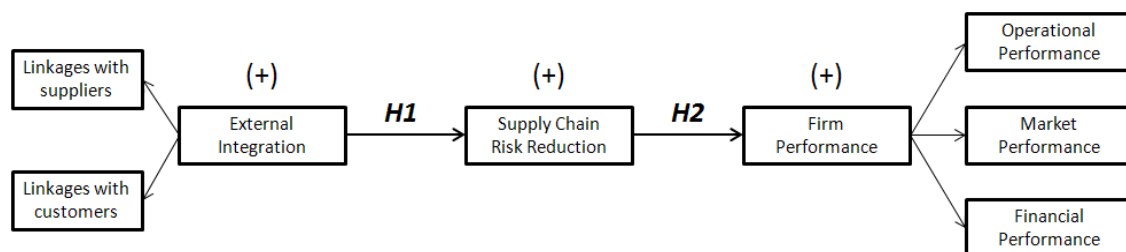
Construct	Definition	Supporting literature
Supplier and customer integration	A set of practices focused on integration with its key supply chain members in order to fulfill end customer requirements.	Stank <i>et al.</i> (2001), Chen & Paulraj (2004), Won Lee <i>et al.</i> (2007), Quesada <i>et al.</i> (2008), Zhao <i>et al.</i> (2011).
Supply Chain Risk	The potential occurrence of anything that may disrupt or impede the information, material or product flows from original suppliers to the ultimate user, affecting the performance.	Harland <i>et al.</i> (2003), Jüttner <i>et al.</i> (2003), Zsidisin (2003), Peck (2006), Ritchie & Brindley (2007)
Market Share Performance (MP)	The organization's ability to increase sales and expand market share as compared to its competitors.	Droge <i>et al.</i> (2004), Green Jr. <i>et al.</i> (2008)
Operational Performance (OP)	The efficiency and effectiveness of internal areas of a firm.	Stock <i>et al.</i> (2000), Zacharia <i>et al.</i> (2011), Deravaj <i>et al.</i> (2007)
Financial Performance (FP)	The organization's profitability and return on investment as compared to its competitors.	Droge <i>et al.</i> (2004), Green Jr. <i>et al.</i> (2008), Lanier Jr. <i>et al.</i> (2010), Wagner <i>et al.</i> (2012)

Source: Elaborated by the authors

Effective external integration with suppliers may enable organizations to reduce supply-side risks (TANG, 2006; SWINK *et al.*, 2007; LIN & ZHOU, 2011). Effective external integration with customers may enable organizations to reduce demand-side risks, and to minimize potential occurrences of anything that may affect the focal firm ability to meet the requirements of customers and end-users (WAGNER & BODE, 2007; MANUJ & MENTZER, 2008). In the modern management decision context, it is accepted that risk and performance are directly and positively related (RITCHIE & BRINDLEY, 2007). Melnyk *et al.* (2009) highlights some risks which affect performance that can be grouped into three sets, namely, financial (e.g. inventory levels, costs, penalty clauses and others), market share (e. g. lost sales), and operational (lead time, quality, flexibility, fill rates).

Finally, there are evidences that supplier and customer integration positively impacts risk reduction and contributes to better firm performance. Support for this interpretation can also be found in the broad literature on supply chain management which indicates supply chain integration practices can act as attenuators of supply chain risk (e.g. TANG, 2006; SWINK *et al.*, 2007; MANUJ & MENTZER, 2008; LIN & ZHOU, 2011). However, several researchers highlight that this research field is not clearly verified in the literature, and those that are verified in many cases contain conflicting arguments. Figure 1 illustrates the hypothesized research framework of our study.

Figure 1 – The hypothesized research framework



Source: Elaborated by the authors

### 3. Methodology

We conducted a nationwide survey with 250 top agribusiness (in sales for the year 2011) industries in Brazil. We decided to direct the survey to directors or managers of the supply chain, purchasing, logistics or other leaders in the firm who have clarity and visibility of supply chains, logistics, purchasing and operations. The data collection was realized between June and July 2012.

The survey instrument consists of four parts. In the first part, we asked for information about the function of respondent and their company. In the second part, these respondents were asked about degree of external integration of their company. Next, they indicated the levels of supply chain risk reduction. Finally, the participants described the degree of firm performance, compared with five years ago. Of 250 surveys sent out, 98 surveys were returned 96 were complete and useable responses. The response rate was 38.4 percent (96/250). This response rate compares closely to that reported in recent supply management and operations management papers (e.g. SCHMOLTZI & WHU, 2012; KOUFTEROS *et al.*, 2012). The characteristics of respondents and companies are summarized in Table 2.

Table 2 – Characteristics of respondents and companies

Characteristics	Respondents	Characteristics	Companies
<i>Job title</i>		<i>Industry type</i>	
Director	9	Sugar and ethanol	18
Manager	71	Beef	12
Supervisor	10	Poultry and pork	8
Others	6	Milk and dairy products	8
		Fertilizers and pesticides	13
<i>Job functions</i>		Agricultural machines	10
SC Management	48	Wood and pulp	11
Purchasing	2	Oils and canned	15
Logistics	18	Tobacco	1
Distribution	6	<i>Number of employees</i>	
Operations Management	13	< 100	1
Others	9	101-250	8
		251-500	27
<i>Years worked at organization</i>		501-1,000	36
< 2	19	> 1,000	24
2-5 years	60	<i>Annual sales</i>	
6-10 years	10	US\$ 1-5 million	70
> 10 years	7	> US\$ 5 million	26

Source: Elaborated by the authors

We adapted existing scales to measure constructs of hypothesized research framework, as follows:

- a) External integration: items adapted from Droge *et al.* (2004), Devaraj *et al.* (2010), Flynn *et al.* (2010), and Shoenherr & Swink (2012);
- b) Supply chain risk reduction: items operationalized by following attributes: production rescheduling or disruptions of planning (TANG & TOMLIN, 2009), demand fluctuations due to sales promotions, order batching, and price (WAGNER & BODE, 2009), insufficient or distorted information from customers about orders and disruptions in the physical distribution of products (WAGNER & BODE, 2009), capacity constraints and threat of financial instability of suppliers (ZSIDISIN, 2003) and supplier quality problems and poor information sharing (WAGNER & BODE, 2009);
- c) Performance outcomes (market, operational, and financial performance): items adapted from Droge *et al.* (2004), Devaraj *et al.* (2010), Nyaga Jr. *et al.* (2010), and Lanier *et al.* (2010).

To test our hypotheses we have used ANOVA two-way (non-parametric test). Next, using the Mann-Whitney-Wilcoxon Test, we have compared the two sets of companies, i.e., large

companies (annual sales > US\$ 5 million), and non-large companies (annual sales US\$ 1-5 million). Results are discussed next.

#### 4. Results

Measurement items and descriptive statistics are presented in Table 3. The results (as shown in Table 4) indicate that our hypotheses were supported broadly. External integration (EI) is related to risk reduction and this relationship positively impacts firm performance.

Table 3 – Measurement items and descriptive statistics

Variables and scale scores	Results	
	(Mean)	(SD <sup>a</sup> )
<b>External Integration<sup>b</sup></b>		
Supplier Integration		
1 My company provides suppliers with information forecasting demand	5.779	0.865
2 My company shares important information with our suppliers	5.906	0.919
3 My company shares its production plans with suppliers	5.750	0.962
4 My company has integrated management of demand forecast	6.010	0.801
5 My company shares important information with our suppliers	5.604	1.119
6 Our suppliers participate in the design phase of our products	3.969	2.110
7 There is connection between the computers of our company and our suppliers	4.760	1.665
8 Our company knows of production capacity of our suppliers	5.979	0.917
9 Our company shares the cost information with our main suppliers	5.385	1.226
10 Our company share information on production in real-time with suppliers	5.271	1.388
Customer Integration		
1 Our clients provide their forecast demand for our company	6.125	0.771
2 Our clients can easily monitor the status of their orders placed in our company	5.985	1.055
3 Our customers jointly coordinate with my company the planning of production	5.985	0.939
4 My company shares resources with the clients, such as deposits and facilities	5.938	1.150
5 Our clients and my company do jointly development of new products	5.344	1.758
6 Our customers and my company jointly identify opportunities for new markets	5.948	1.040
7 Our company carries out integrated management of demand with our customers	5.938	0.892
8 Our company carries out management of customer relationships	6.229	0.900
9 Our customers have access in real time about the availability of products	5.458	1.123
<b>Supply Chain Risk Reduction<sup>b</sup></b>		
1 In my company the variations in demand casually impact the supply	2.063	1.343
2 The main suppliers are triggered when there are sudden changes in demand	5.854	1.187
3 My company has access to financial and operational performance of suppliers	4.802	1.343
4 My company obtain flexibility of its suppliers when occur emergency requests	5.615	1.070
5 Distribution operations are casually affected by events of variability in demand	2.500	1.536
6 Key suppliers are able to meet a minimum of 90% of deliveries on-time	6.221	0.901
7 Our company has the flexibility to solve problems of supply deliveries out time	5.792	1.085
<b>Market Performance<sup>c</sup></b>		
1 Sales volume	3.677	0.979
2 Market share	3.656	0.982
<b>Financial Performance<sup>c</sup></b>		
1 Return on investment (ROI)	3.396	0.957
2 Net Profit	3.406	0.936
3 Return on sales (ROS)	3.406	0.913
<b>Operational Performance<sup>c</sup></b>		
1 Lead time production	3.396	0.968

2 Perfect order	3.417	0.981
3 Inventory levels (raw material, materials in process and finished goods)	3.404	0.994
4 Defect and rework rates	3.958	1.146

**Notes:** <sup>a</sup>Standard Deviation; <sup>b</sup> Items were measured using a seven-point Lykert-type scale, where 1 = strongly disagree and 7 = strongly agree. <sup>c</sup> Items were measure using a five-point scale, where 1 = worse, 2 = stayed about the same, 3 = improved 10-30%, 4 = improved 30-50%, 5 = improved more than 50%, if compared to five years ago.

Source: Elaborated by the authors

Table 4 – SPSS output for ANOVA two-way (non-parametric test)

Path model	Sum of Squares	d.f	Mean Square	Adjusted R Square	F	Sig.
<b>H1</b> EI → SCRR	53.311	2	17.005	.816	0.850	0.02*
<b>H2</b> SCRR → Firm Performance	23.771	2	11.822	.794	0.828	0.04*

**Note:** \*Considering  $p$  value < 0.05, as suggest by Dancey and Reidy (2007).

Source: Elaborated by the authors

Consistent with our hypothesized framework (Figure 1), the findings indicate that a higher level of external integration impacts risk reduction and improving firm performance. Our results are supported by the early literature showing that EI has a beneficial effect on risk reduction (e.g. TANG, 2006; SWINK *et al.*, 2007; MANUIJ & MENTZER, 2008; LIN & ZHOU, 2011). Table 5 shows the two hypotheses considered in this research and the results from the statistical tests performed on them.

Table 5 – Results for hypotheses test

Path model	Status	Reason
<b>H1</b> EI → SCRR	Supported	SPSS output for ANOVA two-way proved results $F(2) = 0.85$ ; $p < 0.05^*$ .
<b>H2</b> SCRR → Firm Performance	Supported	SPSS output for ANOVA two-way proved results $F(2) = 0.83$ ; $p < 0.05^*$ .

**Note:** \* Considering  $p$  value < 0.05, as suggest by Dancey and Reidy (2007).

Source: Elaborated by the authors

According to the response profile in Table 6, we found that levels higher of external integration, risk reduction, and firm performance are perceived in largest companies rather



than non-large companies. Our findings show that non-large companies not are engaged in external integration such which large companies. In this sense, the samples of the tests showed a  $p$  value lower than 0.001 which means that the results could be viewed as highly significant (HU & BENTLER, 1999). In terms of risk reduction our findings allow to state that levels higher also are perceived in large companies rather than non-large industries (10.9 and 4.2 respectively). Another very interesting finding is the level higher of market, financial and operational performances are perceived in large companies rather than non-large companies. Results of the tests were significant for the path with a performance variation that favored the large companies group ( $p$  value < 0.01). Previous research indicates that risk reduction and performance are directly and positively related (RITCHIE & BRINDLEY, 2007).

Table 6 – Comparison between large and non-large companies

Variables	Companies	Mean Rank	Sum Rank	$\chi^2/d.f^a$	$p$ -value	Relationship
Supplier Integration	Large (L)	14.80	148.0	1.503	***	<b>L &gt; NL</b>
	Non-large (NL)	6.20	62.0			
Customer Integration	Large (L)	14.0	126.0	1.279	***	<b>L &gt; NL</b>
	Non-large (NL)	5.0	45.0			
SC Risk Reduction	Large (L)	10.9	76.0	0.916	**	<b>L &gt; NL</b>
	Non-large (NL)	4.2	29.0			
Market Performance	Large (L)	3.5	7.0	0.240	**	<b>L &gt; NL</b>
	Non-large (NL)	1.5	3.0			
Financial Performance	Large (L)	5.0	15.0	0.386	**	<b>L &gt; NL</b>
	Non-large (NL)	2.0	6.0			
Operational Performance	Large (L)	6.5	26.0	0.533	**	<b>L &gt; NL</b>
	Non-large (NL)	2.5	10.0			

**Notes:** \*\* < 0.01; \*\*\* < 0.001. <sup>a</sup> Acceptable values: equal or less than 5.0 (Hair Jr. et al., 2010)

Source: Elaborated by the authors

## 6. Conclusions

Using a nationwide survey with Brazilian agribusiness companies, we show that: (a) supply chain risk reduction and better performance outcomes are perceived in companies with satisfactory levels of external integration, and; (b) higher levels of external integration, supply



chain risk reduction, and firm performance are perceived in largest companies rather than non-large companies. Other important contribution of this research lies with the embedding of these concepts in analyze from the perspective of a developing economy. Seen in this light it is noteworthy that such findings may contribute to the understanding of risk reduction outcomes in companies from other developing countries.

While this study extends the supply chain risk literature, there are also some limitations along with more opportunities for future research. First, our findings are based on single respondent data. Even though the respondents were prequalified and had direct experience with supply chain management, the same individual provided information on all measures of constructs, which could potentially bias the results. Second, because the data were only collected from agribusiness industries, future studies can broaden their scope by collecting data from several supply chains, including suppliers, manufacturers, and customers. Third, although this research provided some interesting findings about this complex relationship in Brazil, it is not clear whether these relationships will be the same in other countries. Future research should examine differences in this relationship in others countries, in particular, in developed versus developing economies.

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