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Moderating the impact of global sourcing on inventories through supply chain management

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MODERATING THE IMPACT OF GLOBAL SOURCING ON INVENTORIES THROUGH SUPPLY CHAIN MANAGEMENT

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ABSTRACT

In the last years companies have paid growing attention towards the management of their supply chain at a global level. Considering the upstream part of the supply chain, the need for better suppliers, the research of specific competences and the international competition have forced companies to improve their ability to cope with suppliers located in different countries around the world. Literature suggests that the geographical distance of suppliers should cause higher inventory levels primarily because of longer and more uncertain lead times. However, as this paper aims at demonstrating, companies can limit this effect by means of specific investments in the supply chain and in the relationships with suppliers. Results show that companies performing global sourcing have invested in supply chain management, thus keeping their inventories at an acceptable level, even if slightly higher than those performing local sourcing. Data from the last edition of the International Manufacturing Strategy Survey (IMSS) project are used.

Keywords: Global sourcing, inventories, supply chain management, IMSS

1. INTRODUCTION

During the last twenty years companies have witnessed a considerable expansion of supply chains into international locations (Taylor, 1997; Dornier *et al.*, 1998). This growth in globalization has motivated both practitioner and academic interest in *global supply chain management* (Prasad and Babbar, 2000).

Looking only at the upstream part of the supply chain, *global sourcing* (i.e. the management of supplier relationships on a global perspective) has been considered and analyzed (e.g., Kotabe and Omura, 1989; Murray *et al.*, 1995). Recent studies (Trent and Monczka, 2003; Cagliano *et al.*, 2008) show that the adoption of global sourcing, even if still relatively diffused, is significantly growing. Cagliano *et al.* (2008), for example, provide evidence on global sourcing practice, based on more than 600 companies belonging to the assembly industry from 20 different countries. The authors report that the majority of the companies considered in their study (about 64% of the sample) purchases only 4% of their spending outside their continent. Nevertheless, the overall sample had an average growth of purchases outside their continent of about 4% between 2001 and 2004.

There are several factors influencing adoption of global sourcing. It is to a large extent dependent on the company, the sector in which it operates, the type of product purchased as well as the country where the foreign supplier is located (Quintes *et al.*, 2005). Company size is not always relevant in determining the global sourcing strategy even if smaller companies appear to be more willing to globalize their sourcing (Cagliano *et al.*, 2008; Cavusgil *et al.*, 1993, Quintes *et al.*, 2005; Leonidu, 1999; Scully and Fawcett, 1994). However small companies may face difficulties since appropriate resources (i.e. people, money, and competences) are required to effectively operate purchasing on a global scale (Arnold, 1989; Narasimhan and Carter, 1990; Ellram, 1991). Moreover companies with a higher level of sourcing outside their continent tend to have also worldwide production facilities (Trent and Monczka, 2003; Cagliano *et al.*, 2008). Next, as presupposed by Hofstede (2001) typologies, companies belonging to countries that have cultural differences may adopt different approaches to manage suppliers internationally (Monczka and Giunipiero, 1984; Matthyssens and Wursten, 2003; Bello *et al.*, 2004; Quintes *et al.*, 2005). Finally also institutional factors have been considered, such as regulative and normative elements (Grewal and Dharwadkar, 2002). These may influence the ability of

companies to develop relationships with suppliers overseas, thus reducing the possibility of extending the supply chain.

One major issue regarding global purchasing is why companies extend their relationships internationally and to what extent this practice contributes to increase their competitive advantage (Alguire *et al.*, 1994; Ettlíe and Sethuraman, 2002; Frear *et al.*, 1992; Smith, 1999; Trent and Monczka, 2003; Birou and Fawcett, 1993; Womack and Jones, 1996). Bozarth *et al.* (1998) identify different motivators for global sourcing: offset requirements, currency restrictions, local content and counter-trade, lower prices, quality, technology access, access to new markets, shorter product development and life cycles, comparative advantage. In some cases, internal factors (e.g., company image) can be the principal motivators (Alguire *et al.*, 1994).

The counterpart is that global supply chains are more difficult to manage than domestic supply chains (Dornier *et al.*, 1998; Wood *et al.*, 2002; MacCarthy and Atthirawong, 2003). Geographical distances not only increase transportation costs, but complicate decisions because of inventory cost tradeoffs due to increased lead-time in the supply chain. Moreover, infrastructural deficiencies in developing countries (e.g., transportation and telecommunications, inadequate worker skills, supplier availability, supplier quality, etc.) provide challenges normally not experienced in developed countries (Meixell and Gargeya, 2005). Furthermore, global supply chains carry specific risks such as variability and uncertainty in currency exchange rates, economic and political instability, and changes in the regulatory environment (Dornier *et al.*, 1998; Carter and Vickery, 1988, 1989).

Several studies have failed to detect any significant impact on general business success of global supply chain (Kotabe and Omura, 1989; Steinle and Schiele, 2008) and specifically of global sourcing. Only some weak evidences have been found: it seems that global sourcing can improve product innovation, process innovation and asset specificity in terms of financial, but it seems to have no impact on strategic performances (Kotabe, 1990; Murray *et al.*, 1995). This may be due to several reasons. First of all different companies may move globally for different purposes, i.e. cost reduction, technology, quality, etc. (Handfield, 1994). This implies that if we do not consider why companies extend their boundaries abroad it may be very difficult to compare performances. A second reason is that different companies may have gained different results from the

investments in globalization: several companies may have also changed their global strategy according to the results achieved (Leonidu, 1999).

In the rather developed literature on global sourcing, however, there are limited contributions regarding the impact of this practice on inventory performances. In particular, limited empirical research is provided; this claims the need of evidence from the field. This paper aims at contributing to this issue, by providing evidence on the relationship between global purchasing, supply chain management and inventory performances. The remainder of the paper is structured as follows. In the next section literature regarding the relationship between global sourcing, supply chain management and inventory performances is taken into account. Following, research objectives and methodology are detailed and empirical analyses are described. Then proper discussion of empirical results is provided and, in the end, we draw some conclusions and suggest potential future developments.

2. THE IMPACT OF GLOBAL SOURCING ON INVENTORY PERFORMANCE

While much has been written on international purchasing, inventory management and logistics, research on the connections of these areas is sporadic (Babbar and Prasad, 1998). In particular, there seems to be a linkage between international purchasing and inventory management that needs to be explored. According to the most consolidated inventory management models (e.g., economic order quantity), the average stock depends on the supply lead time and variability. It is quite intuitive that geographical distance should require longer lead time and increase the variability, e.g., different means of transportation may be required thus involving transshipments time and increasing the risk exposure. This is confirmed by Handfield (1994): among the top five costs problems experienced in using international sources there are long lead time and inventory costs. In the same study it is also shown that an international sourcing systematically causes less on-time deliveries, longer lead times and higher lead times.

One way suggested by literature to reduce inventories or, at least, to keep them under control, is supply chain management (e.g., Tan, 2001; Watts and Hahn, 1993; Krause *et al.*, 1998). Supply chain management involves focusing on the efficiency of the entire chain; for example, Adair-

Heeley (1988) show that Just-In-Time (JIT) purchasing allows reducing inventories along all the value chain instead of simply pushing back inventories on suppliers.

Beside JIT, different leverages are available to effectively manage the supply chain, such as supply strategy and purchasing organization, supplier development, vendor rating, coordination with suppliers. Some of them are directly related to inventories reduction , the others can have an indirect effect reducing lead times and variability.

One of the most analyzed practices in a global sourcing context is JIT (Babbar and Prasad, 1998). These studies have highlighted that JIT sourcing requires specific conditions (e.g., frequent and fast deliveries, small lots, etc.) that can be difficult to be performed in an international environment. So, even if it is possible to achieve efficiency in a global sourcing context through JIT, they are not yet comparable to what can be gained at domestic level (Das and Handfield, 1997). More specifically, the key success factors for achieving international JIT sourcing are different from that one used for domestic JIT and include strong investments in the relationships among supplier and customer especially in terms of communication and coordination in order to exploit all the possible benefits (Vickery, 1989).

Other practices have been also analyzed in literature. Zeng (2003) points out the importance of designing global sourcing process in all its sub-phases (scouting and qualifying, negotiation and selection, etc.). Petersen *et al.* (2006) show that structures, processes, business capabilities, international language capabilities, and top management commitment are critical to the effectiveness of a global sourcing strategy. This is in line with Quintens *et al.* (2006): global purchasing requires a global alignment of purchasing-related decisions in the organization, especially those related to product (quality, specifications) and services. Gelderman and Semejin (2006) found benefits in adopting Kraljic's purchasing portfolio approach both for developing effective purchasing strategies as well as for managing a global supply base.

In conclusion, companies willing to control inventories in a global sourcing context need to invest both internally (purchasing strategy, organization and processes) and externally in the communication and coordination tools and procedures with suppliers.

3. RESEARCH OBJECTIVES

Given the research background discussed so far, the main goal of this paper is to investigate the impact of global sourcing on inventory performances. Literature has provided several contributions on this issue, however empirical evidence is still limited. Furthermore, limited analysis can be found regarding how supply chain management investments, global sourcing and inventory level can interact among themselves. In order to focus our analysis we decided to take into account only upstream supply chain practices and to evaluate the impact of global sourcing only on materials inventory level. The research questions we aim at answering are as follows:

- What is the impact of global sourcing on materials inventory?
- Does proper supply chain management contribute in increasing the amount of global sourcing that companies can afford without suffering inventory management problem?

In order to answer these questions, we formulate 4 hypotheses based on available literature on these issues that we are going to test in the next sections.

First of all we aim at understanding what is the direct impact that global sourcing has on inventories. Literature suggests that using foreign and far suppliers increases lead times and thus increases material inventories (Carter and Narasimhan, 1990; Frear *et al.*, 1992; Zeng and Rosetti, 2003). Consequently literature suggests that the adoption of a global procurement strategy is positively related to materials inventory level. For this reason, we formulate the following hypothesis:

H1. Global sourcing positively influences materials inventory level.

In order to control inventories, upstream supply chain management can provide useful practices (e.g., Tan, 2001; Watts and Hahn, 1993; Krause *et al.*, 1998) both in terms of investments that influence how internal processes are conducted (e.g., restructuring and designing purchasing strategy, organization and processes) and in terms of investments that involve other parties in the supply chain (e.g., coordination and communication tools and procedures with suppliers). These practices can contribute to keep inventories under control and to reduce the amount of materials needed at stock level. Thus we formulate the following hypothesis:

H2. Upstream supply chain management investments reduce materials inventory level.

Literature suggests that an effective implementation of a global sourcing strategy requires investments in the upstream supply chain management (e.g., Vickery, 1989; Petersen *et al.*, 2006) in order to efficiently manage the increased complexity of the supply network. We aim at testing whether this relationship is verified empirically. Thus we formulate the following hypothesis:

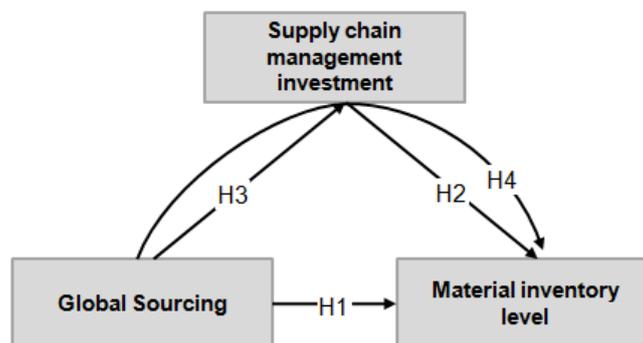
H3. Global sourcing positively influences upstream supply chain management investments.

Finally, if the previous three effects are confirmed, than global sourcing has a twofold effect on inventory levels. The former is a direct positive effect (H1); the second one is an indirect negative effect (H2+H3): companies that perform global sourcing invest in upstream supply chain management and thus reduce inventory levels. However literature does not specifically consider this double effect. So we aim at verifying that this relationship exists. To do so, we formulate the following hypothesis:

H4. The effect of global sourcing on materials inventory level is significantly moderated by upstream supply chain management investments.

Figure 1 summarizes the research framework and the research hypotheses considered.

Figure 1 – Research framework and hypotheses



4. RESEARCH METHODOLOGY

In this section details regarding the research methodology adopted are provided. First the sample of data used is presented and then measures adopted are described.

The Sample

In order to investigate the above research questions, data have been collected within the fourth edition of the International Manufacturing Strategy Survey (IMSS), a research project carried out in 2005 by a global network. This project, originally launched by London Business School and Chalmers University of Technology, studies manufacturing and supply chain strategies within the assembly industry (ISIC 28-35 classification), through a detailed questionnaire that is administered simultaneously in many countries by local research groups; responses are gathered in a unique global database (Lindberg *et al.*, 1998).

The sample consisted of 711 companies from 23 countries, with an average response rate of 34%. The usable sample included 540 companies, which provided enough information for the purpose of this study. The distribution of the sample in terms of country, size and ISIC code is shown in the next tables.

Table I a, b – Distribution sample in terms of country (a) and size (b)

(a)			(b)		
Country	N	%	Country	N	%
Argentina	40	7.4%	Israel	14	2.6%
Australia	10	1.9%	Italy	37	6.9%
Belgium	25	4.6%	Netherlands	53	9.8%
Brazil	11	2.0%	New Zealand	23	4.3%
Canada	19	3.5%	Norway	8	1.5%
Denmark	25	4.6%	Portugal	9	1.7%
Estonia	19	3.5%	Sweden	66	12.2%
Germany	17	3.1%	Turkey	32	5.9%
Greece	6	1.1%	United Kingdom	10	1.9%
Hungary	52	9.6%	United States	30	5.6%
Ireland	9	1.7%	Venezuela	25	4.6%
Total			540	100%	

Size	N	%
Small	312	57.8%
Medium	103	19.1%
Large	121	22.4%
NA	4	0.7%
Total	540	100%

Table II – Distribution of the sample in terms of ISIC code

ISIC Code	Industry description	N	%
28	Manufacture of fabricated metal products, except machinery and equipment	213	39.4%
29	Manufacture of machinery and equipment not elsewhere classified	103	19.1%
30	Manufacture of office, accounting and computing machinery	9	1.7%
31	Manufacture of electrical machinery and apparatus not elsewhere classified	68	12.6%
32	Manufacture of radio, television and communication equipment and apparatus	30	5.6%
33	Manufacture of medical, precision and optical instruments, watches and clocks	23	4.3%
34	Manufacture of motor vehicles, trailers and semi-trailers	57	10.6%
35	Manufacture of other transport equipment	33	6.1%
NA		4	0.7%
Total		540	100%

Measures

In order to measure the extent of globalization of sourcing activities, we collected information regarding the percentage of purchases outside the region where the plant was based. Eight regions were identified in the questionnaire, namely South America, North America, West Europe, East Europe & Middle East, Far East, Oceania, and Africa.

Since we are interested in the impact of sourcing on inventories, we took into consideration the raw material and components inventory level. We measured material inventory level in terms of days of production (on average) that are carried in the raw material/components inventory.

In order to measure supply chain management investments we defined a latent variable based on three items that were available in the questionnaire. Companies were asked to provide information regarding the degree of use in the last three years of the following action programs:

- Rethinking and restructuring supply strategy and the organization and management of suppliers portfolio through e.g., tiered networks, bundled outsourcing, and supply base reduction
- Implementing supplier development and vendor rating programs
- Increasing the level of coordination of planning decisions and flow of goods with suppliers including dedicated investments (e.g., Extranet/EDI systems, dedicated capacity/tools/equipment, dedicated workforce, etc.)

The degree of adoption was measured on a 1-5 Likert scale where 1 represents no use and 5 represents high adoption. Cronbach's alpha of the latent factor based on these three items is 0.76

claiming that reliability is guaranteed. Factor loads are all above 0.80. The supply chain management investments construct has been calculated as the mean of the three items that compose it, in order to report descriptive statistics and contingency analyses, in this way results are also more interpretable and replicable.

Descriptive statistics for such variables are shown in Table III. We can see that companies purchase globally about 18% of their total spending, but the half of the companies purchase globally less than 10% indicating a very left skewed distribution. This confirms the low diffusion of global sourcing that other contributions previously identified (see literature review section). Considering inventory level, we can see that companies have on average 27 days of stocks, but half of the company have less than 20 days. In the end, supply chain management investments are more symmetrically distributed with an average of 2.69 on 5.

Table III - Descriptive statistics for inventory level, global sourcing and supply chain management investments

	Measure	Min	Max	Average	Median	St. Dev
Material inventory level	n. of days of production	0	120	27.44	20	26.801
Global sourcing	% purchasing out of region	0%	98%	18.44%	10%	23.138
Supply chain management investments	1-5 Likert scale	1	5	2.69	2.667	0.837

In order to check for the reliability of the data and the constructs adopted, we analysed the relationships existing between the considered items and the contingency variables that literature commonly suggests to be significant. The contingency variables selected for the analysis and the descriptions are reported in Table IV.

Table IV – Contingency variables description

Name	Description
Size	Current number of employees (continuous)
Localization of production	Local / Global (South America, North America, West Europe, East Europe, Middle East, Far East, Oceania, Africa) (binary)
Geographical region	South America, North America, West Europe, East Europe, Middle East, Far East, Oceania, Africa. (categorical)
ISIC Code	From 28 to 35 (see table II) (categorical)
Position in the Supply Chain	Percentage of sells to system integrators and finished products manufacturers (respect to wholesalers / distributors and end users) (continuous)

In order to identify the impact of contingent variables, categorical and continuous contingencies have been put together as regressors in three univariate linear models having global sourcing, material inventory level, and supply chain management investments as target variables. Results are summarized in table V; only significant p-values (i.e. < 0.050) are reported.

Table V – Effect of contingencies on the main variables; only significant p-values (i.e. < 0.05) are reported

	Global Sourcing	Material Inventory Level	Supply Chain Management Investments
Size	-	-	0.002
Localization of production	0.018	-	0.029
Geographical region	0.000	0.006	-
ISIC Code	0.000	-	-
Position in the Supply Chain	-	0.013	-

Since the goal of this analysis is only to verify the reliability of the current dataset, we will not go into detail in the description of these results. On an overall perspective, the results of this analysis confirm the contribution of previous works. Global sourcing is significantly affected by localization of production, geographical region and ISIC code (Quintes *et al.*, 2005; Trent and Monczka, 2003). Inventory level depends on geographical region and position in the supply chain (Lee *et al.*, 1997). Finally supply chain management investments are linked to company size and localization of production (Trent and Monczka, 2003)

Given the structure of the research hypotheses and the quite big size of the sample we applied a Structural Equation Modelling approach. In the next section details on the model adopted and statistical results are provided.

5. EMPIRICAL ANALYSIS

The conceptual model represented by Figure 1 was used to test our hypotheses. Chi-square of the model is 2.998 with 4 degrees of freedom (probability level is 0.558, thus the model is not rejected). We evaluated model fit by measuring the Normed Fit Index (NFI, Bentler and Bonnet, 1980), the Comparative Fit Index (CFI, Bentler, 1990) and RMSEA, as literature suggests (e.g., Hu and Bentler, 1999; Bentler and Bonett, 1980). NFI is 0.994, which is significantly above the

suggested minimum of 0.90, CFI is 1.00 which is above the limit of 0.95 and RMSEA is 0.00. Thus the model fits very well. The results of the structural analysis are shown in Figure 2. It is also necessary to check that the model presents a good incremental fit. This is based on checking the increase in the fit between the null model and the proposed model. In the model proposed all indicators are above the minimum threshold of 0.90. In the end we studied the proposed model's parsimony by considering the normed chi-square. This measurement must take values below three to ensure that the data is not over-fitted (Hair *et al.*, 1998). In our case the value is 0.75 and therefore acceptable. We also verified the reliability of the relationships between all variables by running several alternative models built from the one considered by eliminating each of the hypothesized relationships. Two out of the three models considered were rejected; besides, the improved fit of the proposed model compared to the other models was always significant ($p < 0.02$).

This model allows us to test our hypotheses. Table VI provides details regarding the relationships between the different variables.

Figure 2 - Results of structural equation model. Numbers on arrows represent standardized estimates (***) sig. < 0.001, ** sig. < 0.005; * sig. < 0.05). NFI = 0.994, CFI = 1.00, RMSEA = 0.00. Chi-square = 2.998, df = 4, p level = 0.558

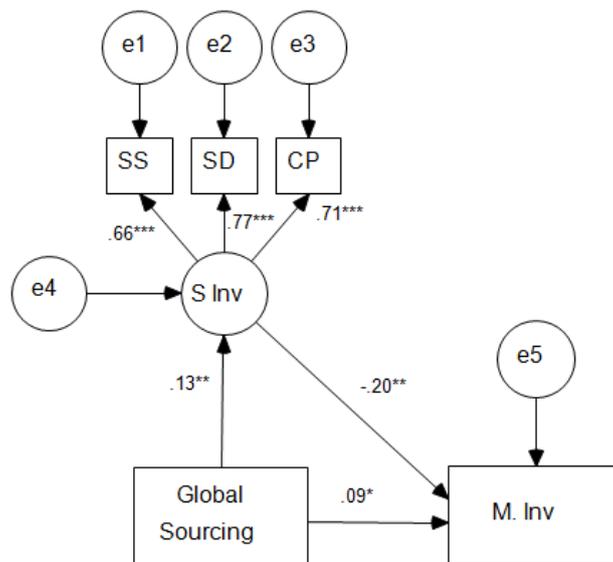


Table VI – Statistical results of the relationships between considered variables

Relationships	Estimate	Std. Err.	Critical Ratio	P-value
Global Sourcing – Supply chain investments	0.004	0.001	2.825	0.005
Supply chain investments – Material inventory level	-7.797	1.929	-4.041	< 0.001
Global sourcing – Material inventory level	0.111	0.049	2.276	0.023

In particular, we can see that global sourcing is positively correlated with materials inventory, thus H1 cannot be rejected in favour of the null hypothesis. Hypothesis H2 cannot be rejected either, since there is a significantly negative relationship between supply chain management investments and material inventory. In the end hypothesis H3 cannot be rejected since the positive relationship between global sourcing and supply chain management investments is confirmed.

In order to test hypothesis H4 we have considered the overall contribution of global sourcing on materials inventory. From figure 2 we can identify that there is significant positive direct effect of global sourcing (standardized estimate is 0.094), but that there is a negative impact through supply chain management investments (standardized estimate is -0.026 obtained by multiplying the standardized estimated of the indirect path). Table VII provides the overall evaluation of direct and indirect effects.

Table VII – Direct, indirect and total effect of global sourcing on material inventory level

	Standardized estimate	Unstandardized estimate
Direct effect	0.094	0.111
Indirect effect	-0.026	-0.031
Total effect	0.068	0.081

This result provides evidence that hypothesis H4 cannot be rejected since there the impact of global sourcing on material inventory is moderated by supply chain management investments.

Discussion of these results is provided in the next section.

6. DISCUSSION

In order to properly discuss the results of the statistical analyses conducted, the implications of the four hypotheses are here considered.

H1. Global sourcing positively influences materials inventory level.

A first interesting result is that there is a positive relationship between the extent to which companies purchase internationally and the amount of stock companies need to have. This result is consistent with what literature suggests and validates, by means of a relevant and reliable sample, results of previous works. This result highlights the importance for companies to take into in deep consideration the secondary effects that global sourcing may have. Companies seldom tend to purchase globally in order to reduce procurement and manufacturing costs, however, as our analysis demonstrates, this may lead to inventory increment with a negative impact on companies' profitability. On a general perspective, companies should pay attention when deciding to increase their international purchasing to the impact on inventories.

H2. Upstream supply chain management investments reduce materials inventory level.

A second interesting result is the confirm of a negative relationship between investments in upstream supply chain and materials inventory level. Even if this result was quite expected given the huge amount of literature on this issue, it is interesting to notice that investments in the internal procedures or in the relationship with the suppliers can be effective, beside Just-In-Time, in reducing the inventory level.

H3. Global sourcing positively influences upstream supply chain management investments.

The relationship between global sourcing and upstream supply chain management investments is confirmed. This result highlights that companies that are purchasing internationally have also invested in their supply chain. We can argue regarding the causal relationship between the two variables. From one side, we may consider that companies that have invested in international purchasing have been induced to reshape their supply chain so to be able to manage their global

network. For instance, if we consider H1 and H2: global sourcing has a potential impact on inventories performances and so companies try to compensate to the negative effects of this practice by improving their supply chain processes. On a similar perspective, we can also consider that purchasing globally can be a tough job, since companies have to deal with far suppliers, on a more complex market. This raising complexity forces companies to prepare properly to manage such a risky activity.

On a second hand we can also argue that the relationship may be reversed. Companies trying to improve their supply chain will invest also in extending their suppliers' network and will look for more efficient ways to purchase. Companies will then extend their activities on global markets, looking for best-in-class suppliers and trying to leverage on more efficient processes, thus leading to a growing adoption of international purchasing. Actually, this view is not supported by literature, so that it could be interesting to further analyze the casual relationship or correlation between global sourcing and supply chain management investments.

H4. The indirect effect of global sourcing through supply chain management investments on materials inventory level is significant

The last hypothesis provides an interesting perspective on the previous three hypotheses. The impact of global sourcing on materials inventory is reduced through the increased investments in supply chain. However this indirect effect only partially contributes to keep inventories under control; the total effect is still positive but at least reduced compared to the direct effect.

This result claims that companies investing in global sourcing are aware of the potential counter effects of this choice and so increase their investments into supply chain management to compensate them. Nevertheless, the fact that the overall effect of global sourcing on inventories is still positive can be due to different causes.

First of all it can be due to the difficulties that companies have in implementing proper supply chain investments due to lack of competences, resources or money. Next, globalization of sourcing is quite a recent trend and it is likely to require a shorter time than invest and fully exploit supply chain management benefits. This effect is even stronger if we consider that cultural and geographical buyer-supplier distance may require longer times to completely

implement supply chain management practices. Because of that companies face higher inventory levels, while waiting to get the full return of their investments. In the meantime, competitors performing a more regional sourcing may invest too in supply chain management, e.g. in Just-In-Time practices, with better results (Handfield, 1994). This last point shows that "global sourcers" can hardly have lower inventories levels than their regional sourcing competitors and that, of course, global sourcing is not a strategy for reducing inventories. Last, companies can consciously decide to keep higher inventory levels if investments in supply chain management become too expensive. In addition, if we consider that in some cases global sourcing leads to a lower cost of materials, a higher inventory level can be, from the financial point of view, acceptable.

All these considerations show that further research is needed, in particular it would be interesting to analyze the evolution of sourcing globalization and investments in supply chain to better understand their mutual dynamics and linkages with inventory levels.

7. CONCLUSIONS

This work studies the impact of global sourcing on inventory levels. The results of the paper provide evidence of a relevant impact of this practice on inventories performances that can be partially reduced by the adoption of proper supply chain practices. Managers should pay attention when they decide to extend their purchasing internationally; proper investments should be planned in order to align the supply chain and to be prepared to cope with the counter effects of global sourcing. Even if the paper provides an original contribution, we would like to highlight its major limitations and possible developments of this works. First of all, we measured global sourcing only in terms of percentage of purchases done outside the company's continent. Differences however may arise according also to where purchasing is done, since there can be different logistical infrastructures, country-specific risks, etc. This may also depend from the country to which companies belong, since, again, different logistical limitations can exist.

Second, we analysed supply chain investments as a whole and we didn't consider which practices can be more effective to compensate the increase of inventory level. Future studies could significantly contribute by analysing the efficacy of different supply chain investments so to guide companies in defining investment priorities.

Third, we limited our analysis to the impact of global sourcing on material inventory level. Future studies should take into account others performances (e.g., service level to production, quality of materials, etc.) to completely assess the counter effects of global sourcing. In particular, we could expect that global sourcing can lead to lower operational performances other than inventory level (e.g., on-time delivery, lead time, etc.) but that there are some other managerial motivators, such as costs, innovativeness, and technology, which induce the globalization of purchasing. Literature, however, lacks of significant contributions to show if empirically these relationships really exist.

In the end it would be interesting to analyse the impact of the globalization of downstream processes (i.e. global distribution) on inventory performances. Replication of this study on the downstream supply chain could be helpful for companies to identify how global distribution should be managed.

The paper also highlights some contingency factors that seem to explain the different companies' behaviours. From one side there seems to be a strong relationship between the globalization of production activities and the globalization of the supply chain. Since we have considered only the globalization effect at plant level, this result arises the hypothesis that companies producing globally are managing all local activities on a global perspective. From another side, globalization of the supply chain seems to be strongly related to the country where the plant resides. This result is coherent with previous contributions in current literature regarding the effect of different environmental elements (e.g., import/export taxation) on the globalization of companies' activities. Future studies should consider in deeper detail what are the reasons that force companies to globalize their processes.

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REFERENCES

- Adair-Heeley, C.B., 1988, "JIT purchasing: seven steps for successful implementation", *Production and Inventory Management Review and APICS News*, Vol. 8, No. 12, pp. 22–23.
- Alguire, M.S., Frear, C.R., Metcalf, L.E., 1994, "An examination of the determinants of global sourcing strategy". *Journal of Business & Industrial Marketing* Vol. 9, No. 2, pp. 62–74.
- Arnold, U., 1989, "Global sourcing—an indispensable element in worldwide competition". *Management International Review* Vol. 29, No. 4, pp. 14–28.
- Bello, D.C., Lohtia R., Sangtani V., 2004, "An institutional analysis of supply chain innovations in global marketing channels", *Industrial Marketing Management*, Vol. 33, pp. 57– 64
- Bentler, P.M., 1990, "Comparative fit indexes in structural models", *Psychological Bulletin*, Vol. 107, pp. 238-246.
- Bentler, P.M., Bonett, D.G., 1980, "Significance tests and goodness of fit in the analysis of covariance structures", *Psychological Bulletin*, Vol. 88, pp. 588-606.
- Birou, L.M., Fawcett, S.E., 1993, "International purchasing: benefits, requirements, and challenges", *International Journal of Purchasing and Materials Management*, Vol. 29, No. 2, pp. 28–36.
- Bozarth, C., Handfield, R., Das, A., 1998, "Stages of global sourcing strategy eVolution: an exploratory study", *Journal of Operations Management*, Vol. 16, No. 2-3, pp. 241–255.
- Cagliano, R., Golini, R., Caniato, F., Kalchschmidt, M., Spina, G., 2008, "Supply chain configurations in a global environment: a longitudinal perspective", *EUROMA 2008 conference proceedings*, Groningen.
- Carter, J.R., Narasimhan, R., 1990, Purchasing in the international marketplace: implications for operations, *Journal of Purchasing and Materials Management*, Vol. 26, No. 2, pp. 2–11
- Carter, J.R., Vickery, S.K., 1988, "Managing volatile exchange rates in international purchasing". *Journal of Purchasing and Materials Management*, Vol. 24, pp. 13–20.
- Carter, J.R., Vickery, S.K., 1989, "Currency exchange rates: their impact on global sourcing". *Journal of Purchasing and Materials Management*, Vol. 25, pp. 19–25.
- Cavusgil, S.T., Yaprak, A., Yeoh, P.-Y., 1993, "A decision-making framework for global sourcing". *International Business Review*, Vol. 2, No. 2, pp. 143–152.
- Das, A. & Handfield, R.B. 1997, "Just-in-time and logistics in global sourcing: An empirical study", *International Journal of Physical Distribution & Logistics Management*, Vol. 27, No. 3, pp. 244.
- Dornier, P.P., Ernst, R., Fender, M., Kouvelis, P., 1998, *Global Operations and Logistics: Text and Cases*, John Wiley & Sons, Inc., New York, NY.
- Ellram, L.M., 1991. "Key success factors and barriers in international purchasing partnerships". *Management Decision*, Vol. 29, No. 7, pp. 38–44.
- Ettlie, J.E., Sethuraman, K., 2002. "Locus of supply and global manufacturing". *International Journal of Operations & Production Management*, Vol. 22, No. 3, pp. 349–370.
- Frear, C.R., Metcalf, L.E., Alguire, M.S., 1992. "Offshore sourcing: its nature and scope". *International Journal of Purchasing and Materials Management*, Vol. 28, No. 3, pp. 2–11.
- Gelderman, C.J. & Semeijn, J. 2006, "Managing the global supply base through purchasing portfolio management", *Journal of Purchasing and Supply Management*, Vol. 12, No. 4, pp. 209-217.
- Grewal, R., & Dharwadkar, R. 2002, "The role of institutional environment in marketing channels". *Journal of Marketing*, Vol. 66, pp. 82–97.

- Hair, J.F., Anderson, R.E., Tatham, R.L., Black, W.C., 1998, *Multivariate data analysis*, Prentice-Hall, Englewood Cliffs, NJ.
- Hu, L., Bentler, P.M., 1999, "Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria versus New Alternatives", *Structural Equation Modeling*, Vol. 6, No. 1, pp. 1-55.
- Handfield, R.B., 1994, "US Global Sourcing: Patterns of Development", *International Journal of Operation & Production Management*, Vol. 14, No. 6, pp. 40-51.
- Hofstede, G., 2001, *Culture's Consequences*. Sage, London, UK.
- Kotabe, M. and Omura, G.S. 1989, "Sourcing Strategies of European and Japanese Multinationals: a Comparison", *Journal of International Business Studies*, Vol. 20, No. 1, pp. 113-130.
- Kotabe, M., 1990, "The Relationship between Offshore Sourcing and Innovativeness of U.S. Multinational Firms: an Empirical Investigation", *Journal of International Business Studies*, Vol. 21, No. 4, pp. 623-638.
- Krause, D.R., Handfield, R.B. & Scannell, T.V. 1998, "An empirical investigation of supplier development: reactive and strategic processes", *Journal of Operations Management*, Vol. 17, No. 1, pp. 39-58.
- Lee, H.L., Padmanabhan, V., Whang, S. (1997), "The bullwhip effect in supply chains", *Sloan Management Review*, Vol. 38, No. 3, pp. 93-102.
- Leonidu, L.C., 1999, "Barriers to international purchasing: the relevance of firm characteristics", *International Business Review*, Vol. 8, pp. 487-512.
- Lindberg, P., Voss, C.A., Blackmon, K., 1998, *International Manufacturing Strategies*, Context, Content, and Change, Kluwer Academic Publishers, Dordrecht, NL.
- MacCarthy, B.L., Atthirawong, W., 2003, "Factors affecting location decisions in international operations—a Delphi study", *International Journal of Operations & Production Management*, Vol. 23, pp. 794-818.
- Matthyssens, P., Wursten, H., 2003, "Internal marketing" in: Rugimbana, R., Nwankwo, S. (Eds.), *Cross-Cultural Marketing*, Thomson Learning, Australia, pp. 243-256.
- Meixell, M.J., Gargeya, V.B., 2005, "Global supply chain design: A literature review and critique", *Transportation Research Part E*, Vol. 41, pp. 531-550.
- Monczka, R. M., & Giunipero, L. C., 1984, "International purchasing: characteristics and implementation". *Journal of Purchasing and Materials Management*, Vol. 20, pp. 2-9.
- Murray, J.Y., Kotabe, M. & Wildt, A.R. 1995, "Strategic and Financial Performance Implications of Global Sourcing Strategy: a Contingency Analysis", *Journal of International Business Studies*, Vol. 26, No. 1, pp. 181-202.
- Murray, J.Y., Wildt, A.R., Kotabe, M., 1995, "Global sourcing strategies of US subsidiaries of foreign multinationals". *Management International Review*, Vol. 35, No. 4, pp. 307-324.
- Narasimhan, R., Carter, J.R., 1990, "Organisation, communication and coordination of international sourcing". *International Marketing Review*, Vol. 7, No. 2, pp. 6-20.
- Petersen, K.J., Frayer, D.J., Scannell, T.V. 2000, "An Empirical Investigation of Global Sourcing Strategy Effectiveness", *Journal of Supply Chain Management: A Global Review of Purchasing & Supply*, Vol. 36, No. 2, pp. 29-38.
- Prasad, S., Babbar, S., 2000, "International operations management research", *Journal of Operations Management*, Vol. 18, pp. 209-247.

- Quintens L., Matthyssens P., Faes W., 2005, "Purchasing internationalisation on both sides of the Atlantic", *Journal of Purchasing & Supply Management*, Vol. 11, pp. 57–71.
- Quintens L., Pauwels P., Matthyssens P., 2006, "Global purchasing: State of the art and research directions", *Journal of Purchasing & Supply Management*, Vol. 12, pp. 170–181.
- Scully, J.I., Fawcett, S.E., 1994, "International procurement strategies: challenges and opportunities for the small firm". *Production and Inventory Management Journal*, Vol. 35, No. 2, pp. 39–46.
- Smith, J.M., 1999, "Item selection for global purchasing." *European Journal of Purchasing & Supply Management*, Vol. 5, pp. 117–127.
- Steinle, C., Schiele, H., 2008, "Limits to global sourcing? Strategic consequences of dependency on international suppliers: Cluster theory, resource-based view and case studies", *Journal of Purchasing & Supply Management*, Vol. 14, pp. 3–14.
- Tan, K.C. 2001, "A framework of supply chain management literature", *European Journal of Purchasing & Supply Management*, Vol. 7, No. 1, pp. 39-48.
- Taylor, D., 1997, *Global Cases in Logistics and Supply Chain Management*. International Thompson Business Press, Boston, MA.
- Trent, R.J., Monczka, R.M., 2003, "Understanding integrated global sourcing". *International Journal of Physical Distribution & Logistics Management*, Vol. 33, No. 7, pp. 607–629.
- Vickery, S.K. 1989, "International Sourcing: Implications for Just-In-Time Manufacturing", *Production & Inventory Management Journal*, Vol. 30, No. 3, pp. 66.
- Watts, C.A. & Hahn, C.K. 1993, "Supplier Development Programs: An Empirical Analysis", *International Journal of Purchasing & Materials Management*, Vol. 29, No. 2, pp. 11-17.
- Womack, J., Jones, D.T., 1996, *Lean Thinking*, Rawson Ass, New York, NY.
- Wood, D.F., Barone, A.P., Murphy, P.R., Wardlow, D.L., 2002, *International Logistics*, AMACOM, New York, NY.
- Zeng, A.Z., 2003, "Global sourcing: process and design for efficient management", *Supply Chain Management*, Vol. 8, No. 4, pp. 367.
- Zeng, A.Z., Rosetti, C., 2003, Developing a framework for evaluating the logistics costs in global sourcing processes. An implementation and insights, *International Journal of Physical Distribution and Logistics Management*, Vol. 33, No. 9, pp. 785–803.