SUPPLY CHAIN DYNAMICS AFTER THE COVID-19 PANDEMIC AND STOCK MARKET PERFORMANCE: EVIDENCE FROM THE US

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Original Article

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ABSTRACT

Supply chain risk is a strategic issue for managing multinational companies, and Covid-19 has shown the relevance of this type of risk for the firm's survival probability. The market may perceive the choice of replacing some of the main customers or suppliers as an increase or a decrease of the risk based on the features of the new supply chain members, and markets tend to penalize companies that increase their exposure to unaffordable events. During the pandemic, many supply chains suffered from glitches and companies were obliged to redefine their network by selecting their new strategic customers and/or suppliers.

The paper evaluates the supply chain composition strategies of a set of multinational companies based in the US during the last decade. It highlights the differences in supply chain management behavior before and during the pandemic. Data collected allow testing the impact on the stock market performance of modifying the supply chain network by adding new members that may have a different level of risk. Results show that the market reaction to supply chain updates changed after the Covid-19, and nowadays there is greater attention on the credit risk of the new companies entering the supply chain.

Keywords: Supply chain, Pandemic, Stock performance.

1. INTRODUCTION

Globalization and the increase of competition worldwide have driven companies to adopt longer supply chains that allow them to exploit the advantages related to strategic cost management and compete in an international scenario (Anderson & Dekker, 2009). The growth of the e-commerce solutions has increased the interest to serve customers based in a foreign country (Đerić, 2016), and nowadays the internationalization option is currently mandatory even for small and medium enterprises.

Supply chains have suffered in the past from epidemics and pandemics but the sanitary emergency in 2020-21 was something unexpected and unmanageable for the existing supply chains (Boccaletti, Ditto, Mindlin & Atangana, 2020). The Covid-19 has highlighted the limits of the global strategy adopted by several companies due to the slowdown of international trade and the longer times for the procurement or the sales strategy adopted by multinational companies (Free & Hecimovic, 2021).

The international trade market is experiencing unexpected dynamics that make the current supply

chain model unsustainable for many companies operating worldwide. Empirical evidence on the dynamics of international trade (cost of freight, usage of ships, and time to delivery) and corporate dynamics (warehouse policy, time to procurement, and time to sell) have shown new dynamics that are not comparable with the last decades (Figure 1).

Figure 1. The Global Supply Chain Pressures index.
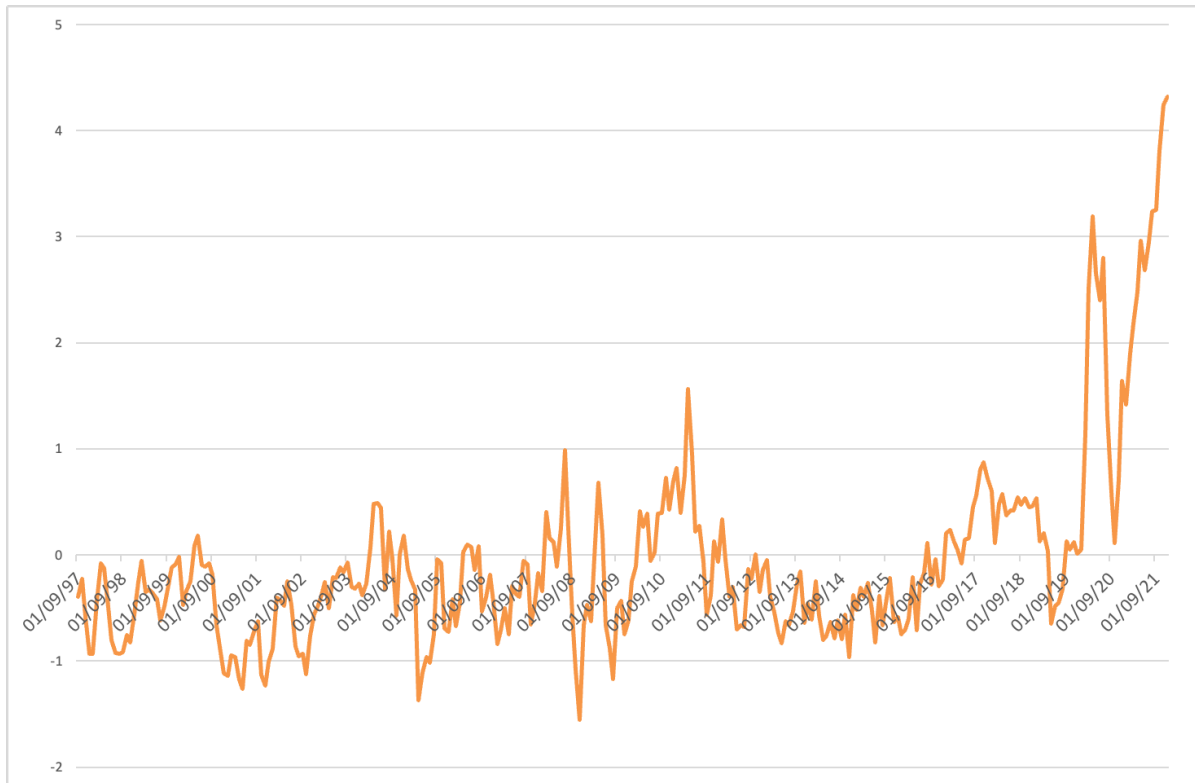
Source: Refinitiv Eikon data processed by the authors.

The global supply chain pressure since 1997 was around a zero value up to the Covid-19 pandemic. At the end of 2019, the value started to grow to 3.18 in April 2020, representing the end of the lockdown for many countries worldwide. This result is mainly related to the panic demand for some goods (food, medicine, etc.…) on online channels (Mollenkopf, Ozanne, & Stolze, 2020) and the closure of supplying factories and warehouses (Van Hoek, 2020). After a few months of reduction related to the optimism for the end of the first wave of the virus, the index started to increase again up to the new maximum of 4.32 in December 2021, and the trend is not showing a slowdown.

The Covid-19 pandemic had an impact on the supply chain risk that is not comparable with other diseases that we had worldwide in the 21st century (like SARS in 2009 or H1N1 in 2009) because it had an impact simultaneously on nodes (supply chain members) and edge (commercial ties and contracts) (Gunessee & Subramanian, 2020). Stock market has penalized companies with global supply chains more exposed to Countries more severely affected by the pandemic (Ding, Levine, Lin & Xie, 2021). Even among the EU countries there were a lot of differences in the solution adopted for managing the sanitary crisis and so the effects of the pandemic on the macro-economic fundamentals in the medium-long term (Đukic, Štaka, & Draškovic, 2021). Empirical evidence has shown that its impact is relevant for almost all the most prominent companies worldwide (Sherman, 2020), but there are some country-specific factors related to the strategies adopted by Governments for containing the pandemic that matter (Xu, Elomri, Kerbache & El Omri, 2020). The paper aims to analyze the impact of supply chain changes on the stock market performance of

a set of representative companies for the US market. After studying literature on the effect of supply chain features on stock performance and, more generally, on market behavior (section 2), the paper presents an empirical analysis of the top 100 companies listed in the US (Section 3). Results show that due to Covid-19, the supply chain features are changing rapidly and the market reaction to the change of suppliers or customers is different during the pandemic period with respect to the average trend of the last decade, and the reaction is different on the basis of the risk of the new member added to the supply chain (section 3). The last section summarizes the main results and the policy implications of the analysis (section 4).

2. LITERATURE REVIEW

Production and selling strategies adopted by companies matter for the financial market, and there is empirical evidence of the positive impact of better production, inventory and marketing strategies adopted by entrepreneurs (Modi & Mishra, 2011). The effect on the stock market is related to the event date and not to the disclosure date (that could be some days after) because investors are monitoring the supply chain of corporations in which they invest and try to anticipate the events before they become public information (Liu, Sarkar, Kumar, & Jin, 2018).

Supply chain disruptions may be distinguished in natural disasters (earthquakes, floods, cyclones, etc..), man-made and discrete events (diseases, strikes, operation failures, etc…), and financial disruptions (exchange rates, interest rates, import-export restrictions, etc…) (Chowdhury, Paul, Kaisar, & Moktadir, 2021).

Supply chain glitches of large multinational companies have shown an adverse and unexpected loss related to the events in the supply chain. The main consequences of supply chain disruptions at the company level are the reduction of operating income, the return of assets, the return on sales, and, more generally, the shareholders' value (Hendricks & Singhal, 2005a). The effects are different based on the presence of high or low-density ties that may make the glitches more or less relevant and more generally on the basis of the complexity and adaptability of the supply chain (Bier, Lange, & Glock, 2020).

The impact matters the most for smaller and innovative firms that may lose their market reputation due to the supply chain disruption event and suffer from a significant increase in the cost of resources (Hendricks, & Singhal, 2003). The impact in the medium-long term of supply chain disruptions is long-lasting. Companies are typically riskier for several years after the event due to the higher cost of replacing customers and suppliers (Hendricks & Singhal, 2005b).

Literature has related the topic of supply chain glitches with the behavioral finance theory showing that the higher the attention given to the news, the worse the impact on the company's performance (Schmidt, Wuttke, Ball, & Heese, 2020). Some of the evidence provided in the literature has shown differences in the impact of supply chain disruptions on the company's performance based on the Country and financial markets features (Hendricks, Jacobs, & Singhal, 2020).

The impact of supply chain disruptions on multinational geographically diversified companies may be different concerning local players due to other opportunities related to selecting new customers or suppliers. Empirical evidence on the role of geographic diversification in mitigating supply chain risk is still limited. Still, multinational companies seem to suffer more from these events, probably due to the longer time necessary for replacing the supply chain member in the global framework (Hendricks, Singhal, & Zhang, 2009).

In the event of a bankruptcy of one of the members of the supply chain, the impact on the other members of the supply chain may be particularly relevant because there is empirical evidence that suggests the possibility of having a cross-default if the supplier or the customer cannot be replaced easily (Gibilaro & Mattarocci, 2019). The impact may be different based on the supply chain structure, and more complex and diversified supply chains can better avoid credit risk transmission among the members of the same supply chain (Agca, Birge, Wang, & Wu, 2021).

The Covid-19 pandemic has shown the limits of the current supply chains and the need to act to improve resilience to extreme global events like Covid-19. The main issues that have to be considered are the resource allocation strategy (Golan, Jernegan, & Linkow, 2020), the supply chain structure and its concentration (Rowan & Laffey, 2020), and the opportunities for a more collaborative approach between suppliers and customers in the supply chain (Paul and Chowdhury, 2020).

Literature has focused on the adverse events related to the supply chain without considering all the strategic choices a company may adopt to replace suppliers and customers before default and/or can no longer respect the existing contracts. The paper tries to fill this gap by analyzing the supply chain strategies and their impact on the shareholders' performance during a stress scenario.

3. EMPIRICAL ANALYSIS

3.1 SAMPLE

The sample considers the top 100 companies listed on the NYSE and domiciliated in the United States based on their market capitalization (Table 1).

Table 1. Sample composition.

Sector of activity	N° companies	Market capitalization (bln $)	N° of Relevant Customers	% Customers local	N° of Relevant Suppliers	% Suppliers local
Consumer Cyclicals	12	4010.18	264	68.56%	735	67.21%
Consumer Non-Cyclicals	12	2395.57	245	50.61%	628	68.79%
Energy	3	739.51	127	21.26%	244	41.39%
Financials	11	1564.52	5	60.00%	222	72.07%
Healthcare	18	3176.99	307	66.45%	435	70.34%
Industrials	9	1043.72	329	42.25%	546	62.64%
Real Estate	3	272.36	0	-	4	25.00%
Technology	29	5384.93	1590	58.99%	2244	62.52%
Utilities	3	306.63	14	92.86%	27	77.78%
Overall	100	18894.42	2881	56.54%	5085	64.11%

Notes: N° of Relevant customers/suppliers: customers or suppliers for which on the basis of news, filings, and other information sources there is an ongoing commercial relationship. Data are collected and processed by Refinitiv Eikon. Local customers or suppliers are the companies with a commercial relationship based in USA.

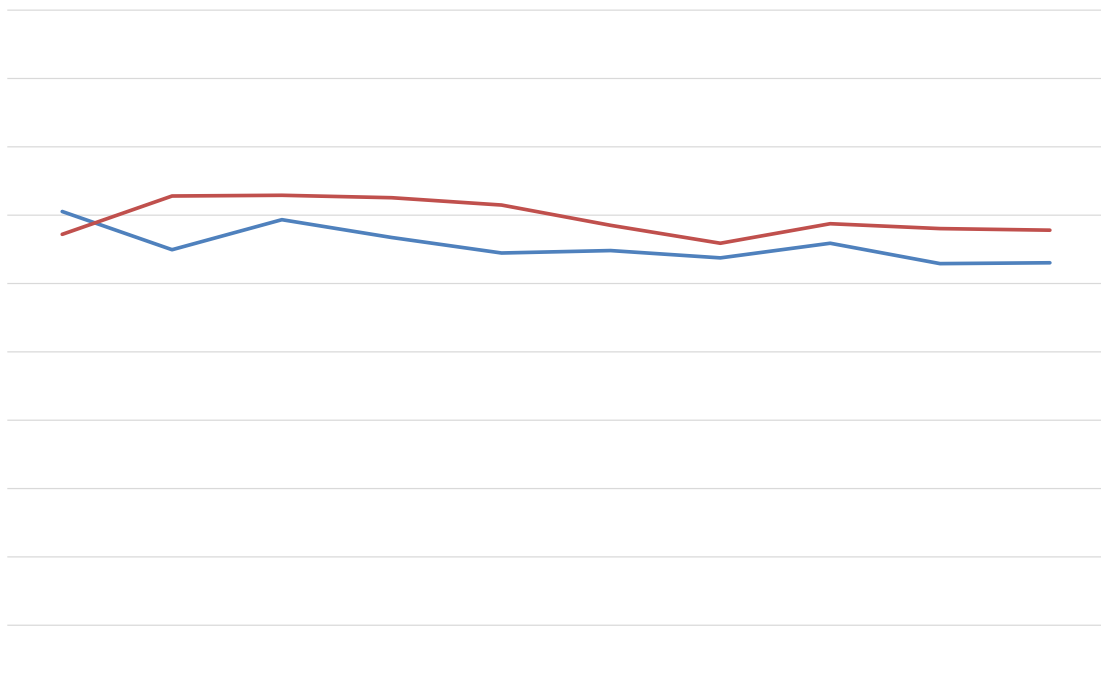Source: Refinitiv Eikon data processed by the authors.

The sample considers companies that are representative of different sectors, and they mainly come from technology (29), Consumer services (24), Healthcare (18), and Financials (11). Considering the number of relevant customers and suppliers by company, the sample includes 2881 strategic customers and 5085 strategic suppliers mainly based in the USA, respectively, for 56.34% and 64.11%. The overall market capitalization of the sample is around 18.9 trillion of US dollars that is representing more the 72.12% of the NYSE's overall capitalization (26.2 trillion on December 2021) The supply chain structure is changing year by year, and the turnover and the number of new strategic suppliers are higher yearly than the number of new customers (Figure 2 and 3).

Figure 2. New suppliers and new customers by year.
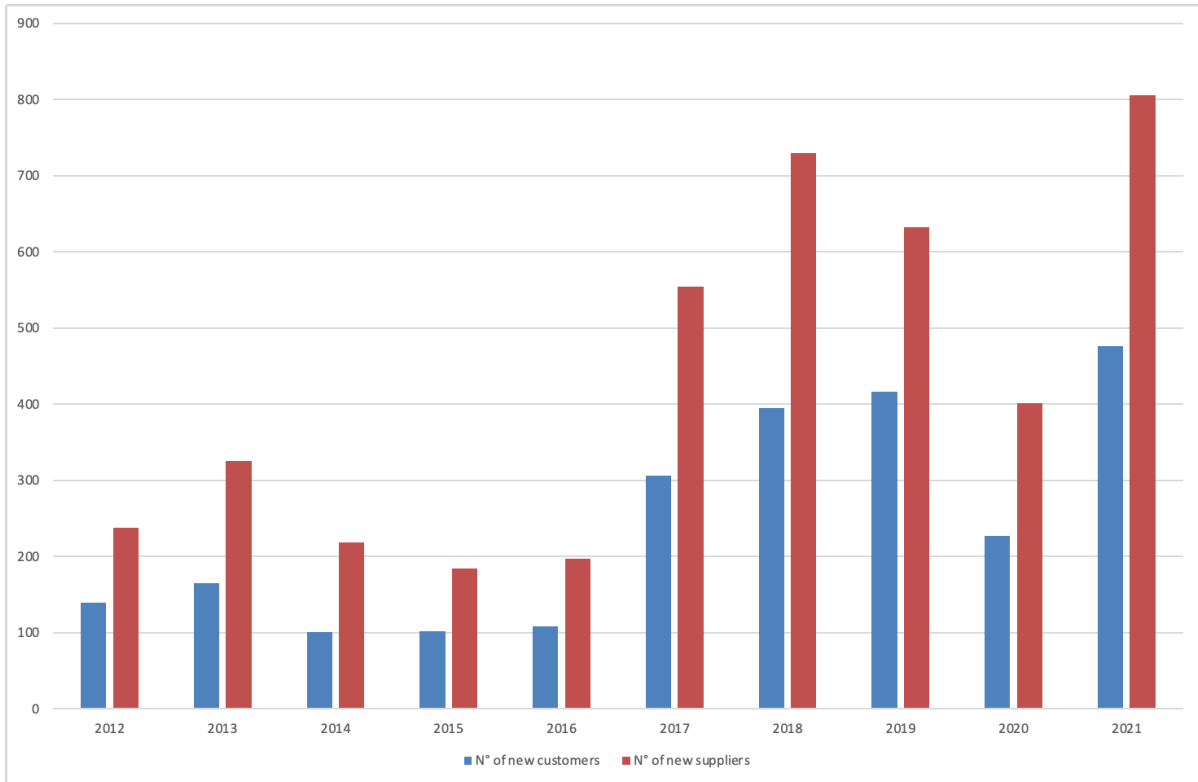
Source: Refinitiv Eikon data processed by the authors.

Figure 3. Percentage of local supply chain members.

Source: Refinitiv Eikon data processed by the authors.

From 2017 to 2019, the number of new members has grown significantly, but in 2020 the turnover is at the minimum due to the volume of economic activity during the pandemic lockdown. 2021 is the year with the higher number of new suppliers and customers concerning the ten years analyzed.

The evidence related to the pandemic period shows that, once the lockdown ended, companies were able to recover from the crisis scenario with a short delay by making a network reconfiguration (Queiroz, Ivanov, Dolgui, & Wamba, forthcoming).

The percentage of local strategic suppliers has not changed significantly during the period considered (67.19% in 2012 vs. 67.78% in 2021), while the rate of U.S. customers has decreased from 70.49% in 2012 to 63.02% in 2021.

The turnover of the supply chain members has also changed the average risk of the member during the period analyzed, moving to a less risky structure (Figure 4 and 5).

The average rating[1] of both customers and supplies has slightly decreased in the overall period due to the increase in the number of supply chain members with a rating AA, AA or A. The primary evidence is related to the decrease in the number of unrated customers or suppliers moving from more than 30% in 2012 to less than 12% in 2021.

Figure 4. Rating of the main customers.
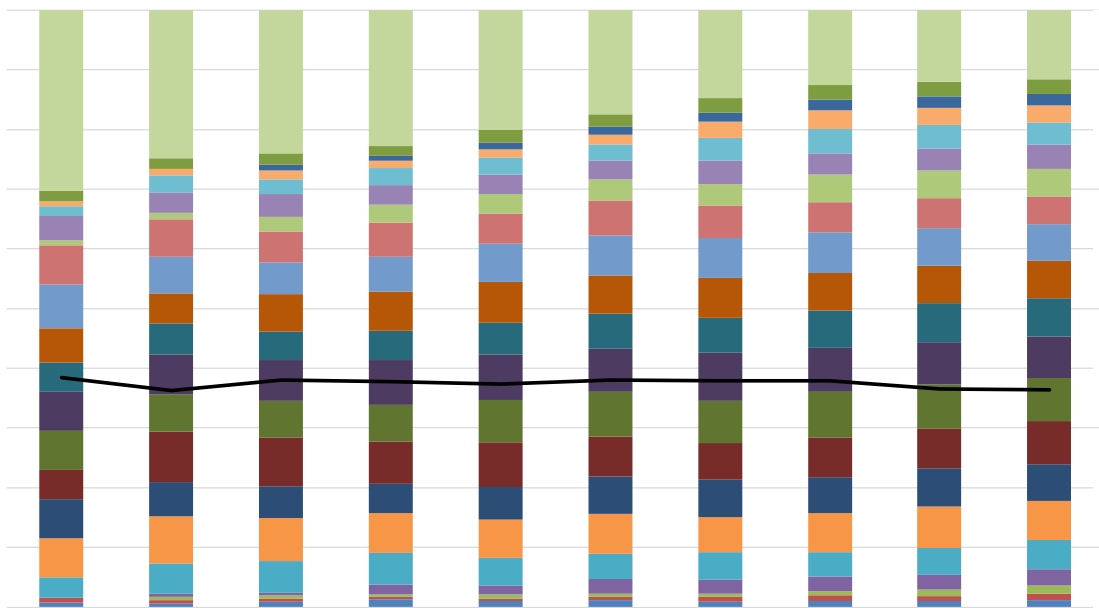
Source: Refinitiv Eikon data processed by the authors.

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1   The rating used for the analysis is computed by Eikon for each of the companies and it measures the probability of default of the company at the one-year time horizon. The value come for the Moody's model for listed companies and by a proxy constructed on the basis of available data for private companies not listed.

Figure 5. Rating of the main suppliers.
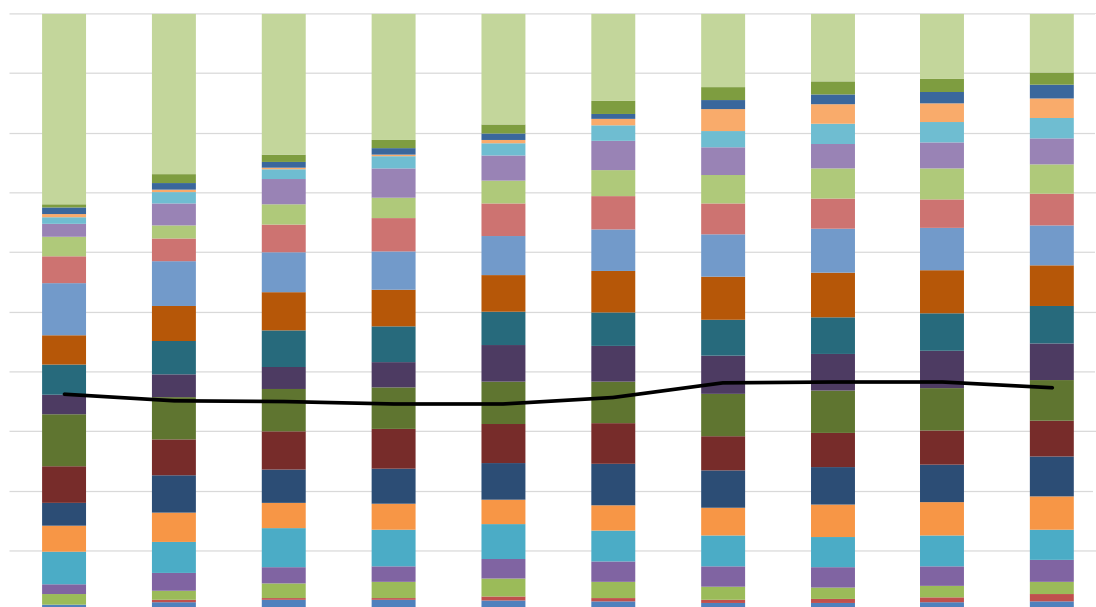
Source: Refinitiv Eikon data processed by the authors.

3.2 METHODOLOGY

The analysis considers the impact of the supply chain members' turnover on the stock market performance using an event study methodology. For each of the companies in the sample, the daily return is computed by using the following formula:

$$r_{it} = \ln\left(\frac{P_{it}}{P_{it-1}}\right) \tag{1}$$

Where P_{it} and P_{it-1} are the closing price for the firm I at time t and t-1, and $\ln$ is the natural logarithm.

The abnormal return is computed by using the CAPM formula (Sharpe, 1964) as follows:

$$AR_{it} = r_{it} - \left[r_{ft} + \beta_{it}\left(R_{mt} - r_{f_t}\right)\right] \tag{2}$$

Where the abnormal return depends on the daily return of the share (r_{it}), the return of the T-bill three months issued by the U.S. Government (r_{ft}), the sensitivity of the return of the share concerning the market (β_{it}), and the performance of the S&P500 index (R_{mt}).

The abnormal return proxy is used for computing the cumulative abnormal return (MacKinlay, 1997) for an event window based on the supply chain events. In formulas:

$$CAR_{it} = \sum_{t=t_1}^{t_n} AR_{it} \tag{3}$$

The event window $(t_1 - t_n)$ is computed by considering only the supply chain event date or a time horizon of 1, 3, or 5 days around the event date. The periods selected are showed in table 2.

Table 2. Event windows.

Post – Event window	Pre – Event window	Around the event window
t – t+1	t-1 – t	t-1 - t+2
t – t+3	t-3 – t	t-2 - t+3
t – t+5	t-5 – t	t-2 - t+1
		t-3 - t+2

Source: Authors' elaboration.

The event study analysis is performed by considering all the supply chain events (new supply chain members) and distinguishing them based on their role in the supply chain (customers vs. suppliers) and the information asymmetry (rated vs. unrated).

3.3 RESULTS

The preliminary analysis considers the impact of events on the supply chain on the abnormal daily performance of stock by considering different event windows (Table 3).

The average impact of the supply chain turnover is negative, but the values are not stable over time depending on the number and type of events affecting the supply chains. The year 2020 was characterized by a negative impact of the supply chain changes on the company's performance mainly because during that year, the turnover of supply chain members was forced primarily by the default of one of the suppliers or the customers. The market frequently cannot anticipate the change in the supply chain member regardless of the year selected. Still, when it happens, the market reacts positively in the short term (up to 3 days from the event). The trend in 2021 is comparable to the trend analyzed in the previous years, and the market seems to be back at its standard trend after the pandemic.

Table 3. - Event study on the effect of the supply chain turnover.

Event window	2012	2013	2014	2015	2015	2017	2018	2019	2020	2021	Average
t - t+1	0.12%	-0.05%	0.13%	-0.08%	-0.05%	0.03%	-0.32%	0.07%	-0.37%	0.03%	-0.05%
t - t+3	0.07%	-0.02%	-0.03%	-0.01%	-0.08%	0.06%	-0.20%	0.18%	-0.23%	0.07%	-0.02%
t - t+5	-0.25%	-0.06%	0.04%	-0.04%	-0.02%	0.08%	-0.35%	0.22%	-0.54%	-0.03%	-0.10%
t-1 – t	-0.07%	-0.06%	0.10%	-0.19%	0.10%	0.10%	0.07%	-0.02%	-0.16%	0.06%	-0.01%
t-3 – t	-0.21%	-0.13%	0.19%	-0.27%	-0.02%	0.13%	-0.11%	-0.04%	-0.18%	-0.04%	-0.07%
t-5 – t	-0.12%	-0.16%	0.15%	-0.38%	0.00%	0.32%	-0.14%	-0.10%	-0.30%	-0.02%	-0.08%
t-1 - t+2	-0.05%	-0.09%	0.19%	-0.12%	0.12%	0.17%	-0.08%	0.04%	-0.24%	0.05%	0.00%
t-2 - t+3	-0.09%	-0.02%	0.06%	-0.13%	-0.01%	0.19%	-0.22%	0.05%	-0.16%	0.03%	-0.03%
t-2 - t+1	-0.04%	-0.05%	0.21%	-0.20%	0.02%	0.15%	-0.34%	-0.07%	-0.30%	-0.01%	-0.06%
t-3 - t+2	-0.19%	-0.15%	0.28%	-0.20%	0.01%	0.21%	-0.25%	0.03%	-0.26%	-0.05%	-0.06%

Source: Refinitiv Eikon data processed by the authors.

Table 4 . Event study on the effect of the suppliers and customers turnover.

Event window	Supplier										
	2012	2013	2014	2015	2015	2017	2018	2019	2020	2021	Average
t - t+1	0.28%	0.02%	0.10%	-0.08%	-0.07%	0.06%	-0.49%	0.12%	-0.28%	0.00%	-0.03%
t - t+3	0.32%	0.10%	-0.01%	0.00%	-0.19%	0.05%	-0.32%	0.27%	-0.26%	0.03%	-0.00%
t - t+5	0.02%	0.10%	0.09%	-0.12%	-0.15%	0.12%	-0.49%	0.38%	-0.46%	-0.06%	-0.06%
t-1 – t	-0.20%	0.03%	0.05%	-0.18%	0.09%	0.13%	0.12%	0.01%	-0.18%	0.04%	-0.01%
t-3 – t	-0.22%	-0.08%	0.09%	-0.24%	-0.06%	0.21%	-0.11%	0.03%	-0.19%	-0.16%	-0.07%
t-5 – t	-0.27%	-0.19%	0.02%	-0.29%	-0.07%	0.32%	-0.13%	0.01%	-0.25%	-0.19%	-0.10%
t-1 - t+2	0.09%	0.04%	0.21%	-0.15%	0.08%	0.20%	-0.11%	0.04%	-0.35%	0.03%	0.01%
t-2 - t+3	0.10%	0.12%	0.08%	-0.13%	-0.17%	0.20%	-0.29%	0.10%	-0.23%	-0.07%	-0.03%
t-2 - t+1	0.07%	0.04%	0.19%	-0.21%	-0.05%	0.20%	-0.45%	-0.05%	-0.26%	-0.10%	-0.06%
t-3 - t+2	0.07%	-0.07%	0.25%	-0.21%	-0.07%	0.28%	-0.33%	0.05%	-0.36%	-0.17%	-0.05%

Event window	Customer										
	2012	2013	2014	2015	2015	2017	2018	2019	2020	2021	Average
t - t+1	-0.18%	-0.17%	0.20%	-0.09%	-0.03%	-0.03%	0.00%	-0.02%	-0.52%	0.08%	-0.08%
t - t+3	-0.37%	-0.24%	-0.07%	-0.02%	0.10%	0.08%	0.03%	0.05%	-0.18%	0.13%	-0.05%
t - t+5	-0.72%	-0.37%	-0.10%	0.12%	0.21%	0.01%	-0.07%	-0.04%	-0.70%	0.02%	-0.16%
t-1 – t	0.17%	-0.26%	0.22%	-0.20%	0.11%	0.03%	-0.03%	-0.08%	-0.12%	0.10%	-0.01%
t-3 – t	-0.18%	-0.23%	0.45%	-0.33%	0.07%	-0.02%	-0.12%	-0.15%	-0.16%	0.15%	-0.05%
t-5 – t	0.14%	-0.09%	0.47%	-0.58%	0.11%	0.32%	-0.17%	-0.28%	-0.39%	0.26%	-0.02%
t-1 - t+2	-0.29%	-0.34%	0.13%	-0.04%	0.20%	0.12%	-0.01%	0.04%	-0.05%	0.09%	-0.02%
t-2 - t+3	-0.42%	-0.29%	0.01%	-0.11%	0.28%	0.17%	-0.09%	-0.03%	-0.02%	0.19%	-0.03%
t-2 - t+1	-0.23%	-0.22%	0.27%	-0.19%	0.16%	0.07%	-0.11%	-0.10%	-0.37%	0.14%	-0.06%
t-3 - t+2	-0.65%	-0.32%	0.36%	-0.17%	0.16%	0.07%	-0.10%	-0.02%	-0.09%	0.14%	-0.06%

Table 5. Event study on the average effect of the rated and unrated supply chain members' turnover.

Event window	2012	2013	2014	2015	2015	2017	2018	2019	2020	2021	Average
						Unrated					
t - t+1	-0.03%	0.09%	0.16%	-0.02%	-0.18%	0.08%	-0.01%	0.20%	-0.72%	0.02%	-0.04%
t - t+3	-0.08%	0.09%	-0.03%	0.23%	-0.59%	0.08%	0.15%	0.20%	-0.68%	-0.09%	-0.07%
t - t+5	-0.26%	0.05%	-0.06%	0.22%	-0.48%	0.12%	-0.06%	0.26%	-1.53%	-0.22%	-0.19%
t-1 - t	-0.18%	0.04%	0.18%	-0.12%	0.05%	0.16%	-0.19%	0.05%	-0.57%	-0.11%	-0.07%
t-3 - t	-0.18%	-0.05%	0.28%	-0.19%	-0.09%	0.14%	-0.14%	-0.18%	-1.16%	-0.26%	-0.18%
t-5 - t	-0.09%	-0.14%	0.21%	-0.29%	-0.10%	0.33%	-0.17%	-0.10%	-1.27%	-0.12%	-0.17%
t-1 - t+2	-0.07%	0.04%	0.26%	0.07%	-0.39%	0.29%	-0.07%	0.11%	-0.71%	-0.09%	-0.06%
t-2 - t+3	-0.24%	0.08%	0.11%	0.17%	-0.62%	0.26%	0.08%	-0.13%	-1.18%	-0.23%	-0.17%
t-2 - t+1	-0.19%	0.08%	0.30%	-0.08%	-0.20%	0.25%	-0.08%	-0.13%	-1.21%	-0.12%	-0.14%
t-3 - t+2	-0.07%	-0.04%	0.36%	0.00%	-0.54%	0.27%	-0.02%	-0.12%	-1.30%	-0.24%	-0.17%
						Rated					
t - t+1	0.29%	-0.29%	0.08%	-0.16%	0.04%	-0.01%	-0.47%	-0.01%	-0.20%	0.03%	-0.03%
t - t+3	0.24%	-0.20%	-0.02%	-0.32%	0.30%	0.05%	-0.38%	0.17%	0.00%	0.14%	-0.00%
t - t+5	-0.23%	-0.26%	0.17%	-0.39%	0.33%	0.05%	-0.49%	0.20%	-0.05%	0.06%	-0.06%
t-1 - t	0.07%	-0.25%	-0.02%	-0.27%	0.13%	0.04%	0.19%	-0.06%	0.05%	0.14%	-0.00%
t-3 - t	-0.24%	-0.27%	0.08%	-0.37%	0.04%	0.12%	-0.09%	0.03%	0.31%	0.06%	-0.03%
t-5 - t	-0.17%	-0.18%	0.08%	-0.51%	0.07%	0.31%	-0.13%	-0.11%	0.18%	0.03%	-0.04%
t-1 - t+2	-0.02%	-0.32%	0.08%	-0.36%	0.51%	0.08%	-0.08%	0.01%	0.00%	0.12%	-0.00%
t-2 - t+3	0.09%	-0.19%	-0.01%	-0.52%	0.45%	0.13%	-0.37%	0.14%	0.35%	0.15%	0.02%
t-2 - t+1	0.14%	-0.28%	0.09%	-0.36%	0.20%	0.07%	-0.47%	-0.03%	0.16%	0.04%	-0.04%
t-3 - t+2	-0.33%	-0.34%	0.18%	-0.47%	0.43%	0.15%	-0.37%	0.10%	0.26%	0.04%	-0.03%

Source: Refinitiv Eikon data processed by the authors.

The event analysis based on the type of companies involved (customers vs. suppliers) allows us to point out some interesting differences in the market reaction to news related to the different kinds of new network members (Table 4).

A key customer's turnover has ex-post a more negative effect on the company's value concerning the change of suppliers. In the case of the suppliers, the time necessary for adjusting the production to the new suppliers' policy is quite long, and, in the case of concentrated suppliers, the turnover of one of them may imply the risk of stopping and/or delaying the production process (Wagner & Bode, 2006). In the event of a change of strategic customers, usually, the effect is more direct because one of the primary sources of income is lost. So the profitability in the short term is expected to suffer from it. After the pandemic, many companies worldwide were obliged to revise their supply chain policy. Therefore, the turnover of both suppliers and customers was no longer perceived as an adverse event for the company.

The credit risk of the new member for the supply chain matters for the stock market investors, and it is possible to identify a different stock market reaction based on the risk of the new member selected (Table 5).

Unrated companies are generally perceived as riskier than other companies because they suffer more from a lack of information transparency. The choice of adding a new unrated customer or supplier increases the losses in the stock market. The higher uncertainty that characterizes the post-Covid-19 scenario has maximized the relevance of the rating for the investors, and the impact of adding a rated supplier or customers is positive independently concerning the event window considered.

4. CONCLUSION

Covid-19 has shown some of the limits of the global supply chain, highlighting the impact of glitches that may affect suppliers and customers on a company's performance. Data have shown that the number of foreign strategic customers decreases over time. The new members selected (for both customers and suppliers) are prevalently more transparent companies for which a rating is already outstanding. During the pandemic, companies did not change their strategy radically, and local players' roles did not significantly increase.

A supply chain turnover impacts the company's risk, and more frequently, it is perceived as an additional problem that a company may face in a short time due to the cost and time of replacement. The effect on the performance is expected to be relevant in the medium-long term, but the market news may immediately affect shareholders' wealth. Before the pandemic, every glitch in the supply chain network negatively impacted the stock market performance.

During the pandemic, the uncertainty related to the lockdowns and the slowdown of international trade has increased the frequency of turnovers in the supply chain. The most relevant issues were related to the customers, representing one of the primary sources of income. Adding new members unrated was less common during the Covid-19 period. When this option is selected, the shareholders may reduce their wealth because the stock price will decrease, while investors usually appreciate a rated new customer.

Supply chain risk management is a critical strategic issue for every corporation worldwide. Its role increases in global crisis scenarios, like Covid-19, when international trade may suffer from unforeseen events that may affect international trade (Ferguson & Drake, 2020). Empirical evidence provided in the paper sheds some light on the supply chain policy adopted by multinational companies and the impact of the pandemic on the selection of key suppliers and customers. A more detailed analysis of the network structure may allow testing empirically the main drivers of a resilient supply chain (Craighead, Blackhurst, Rungtusanatham, & Handfield, 2007).

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