The Effect of Supply Chain Agility and Supply Chain Resilience on Firm Performance: A Study of the Marmara Organized Industrial Zones

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Abstract

Today, supply chain agility and supply chain resilience are two important concepts that companies try to invest in with their existing resources. In the rapidly changing and complex global world, the survival of companies and the ability to cope with their competitors resiliently depend on using their resources most efficiently.

In addition, if these companies integrate digital technologies into their operations so they can quickly respond to customer expectations and increase the satisfaction of their customers who play a key role today. The first aim of this study is to investigate the effects of supply chain agility, supply chain resilience, and perceived customer satisfaction on firm performance. Another aim is to investigate the moderator effect of digital transformation between supply chain agility and perceived customer satisfaction. Lastly, the mediation roles of supply chain resilience and perceived customer satisfaction between supply chain agility and firm performance were examined separately and together by including them in the model.

To our knowledge, this is one of the first studies that indicate the mediator role of perceived customer satisfaction between supply chain agility and firm performance and the moderator effect of digital transformation between supply chain agility and perceived customer satisfaction. Thus, it is expected that both the examination of these relations and the creation of the model by the researcher will contribute to the literature and fill the existing gap.

The population of the research consists of manufacturing companies registered with OSBUK (Organized Industrial Zones Senior Organization)operating in the Marmara Region.The sample group was selected from top and middle managers in supply chain field.The data were analyzed by using SmartPLS4 program structural equation modeling (SEM). Finally, the results of the research were discussed, the importance and contributions of the study were explained. In addition, the limitations and implications related to management are discussed.

INTRODUCTION

Today, the world has become a global market thus it has become inevitable for companies to focus on competition and increase their options that will provide a competitive advantage (Güner, 2018). Therefore, businesses are looking for new factors to overcome market conditions that become more complex and competitive every day (Hopkinson et al., 2018).

Two basic paradigms in strategic management science explain the creation of unique values for businesses and the creation of sustainable competitive advantage. These are; "industrial organization theory" and "resource-based theory". The theory of industrial organization is a competitive strategy that focuses on the external analysis of businesses in creating strategies that will provide competitive superiority. This theory starts from the idea that the determinant of superiority is the industrial structure and businesses operating in the same industry are homogeneous (Öztürk, 2003). However, the widely accepted view of homogeneous companies of the 1980s was replaced by the resource-based theory arguing that companies are heterogeneous in the 1990s.

However, the widely accepted "industrial organization theory" of homogeneous companies of the 1980s became more important in the 1990s, instead of the "resource-based theory", it was argued that companies were heterogeneous (Güleş and Özilhan, 2010). The main dynamic of the theory is the view that converting the unique resources of businesses into distinctive capabilities will positively affect business performance (Brandon-Jones et al., 2014).

It should also be known that the performance of businesses today depends not only on their capabilities. Increasing commercial competition and customers' expectations for the products they purchase to reach them more quickly have increased the dependence of companies on outsourcing and suppliers in addition to their own resources today. Nowadays, where the key factor in the growth and development of businesses is the customer, the effort to increase customer satisfaction and loyalty has become very important for competition. Therefore, today, supply chains should blend the service they offer with technology, and should take into account customer satisfaction and competition. They should be aware that this effort will increase customer satisfaction and therefore the company's performance also (Yıldız & Cetintas, 2019).

The process of integration into the supply chain involves the planning, coordination, and control of the flow of raw materials, parts, and finished products from suppliers to customers at the strategic, tactical, and operational levels. Thus, agile, resilient, customer satisfaction-oriented companies achieve high performance in the supply chain. Consequently, the performance of suppliers on issues such as quality, distribution, cost, and service directly affects the performance and success of businesses.

Supply chain resources were identified as the most significant factors in improving performance (Yilmaz et al., 2020). Firms that are aware of their resources and try to be resilient and agile realize the importance of issues such as planning, forecasting, and strategic decision-making, and they can survive more easily in difficult times. However, some companies that fail to grasp the importance of the supply chain continue to keep firm performance low. They have very serious problems in terms of supply since they do not even have emergency plans for situations such as a sudden epidemic like Covid-19. Thus, companies with high foresight attach great importance to technology and agility, which also play important roles in marketing and supply chain management, in order to provide the most precise solutions for market and consumer needs while keeping costs in balance. The concepts of digital transformation, supply chain agility, and resilience are very important factors for increasing the competitiveness of companies and creating customer satisfaction.

The operation of creating an agile supply chain stands out as one of the important competitive power factors for both supplier businesses and industrial businesses making purchases. The primary goal of any supply chain is to provide the appropriate product at the right time and in the right place, and agility helps companies with this process (Calvo et al., 2020). Thereby, agility is the primary quality of a supply chain required for survival in turbulent and volatile markets, which are increasingly the norm as product life cycles shorten and environmental influences contribute to unpredictability, resulting in higher risk in supply chain management.

Businesses need to use technology very effectively as well as to create an agile supply chain. Businesses need to adapt to the digital age to respond to changing and evolving needs and requirements. In particular, the coexistence of technology and life makes digitalization and digital transformation, not an alternative way that we can take advantage of anymore, but also the key to the system that will shape the future.

Digitalization is reflected not only in the sales of businesses but also in all areas of life. Every part of life, product development process, and various sectors such as education, health, trade, and art are also affected by digitalization. Thus, it is vital to adapt to the digital age to respond to changing and evolving needs and requirements. With all these important factors, understanding the sources of competitive advantage in challenging conditions has long been among the most important research areas of strategic management. Ensuring sustainability starts with getting out of these difficult conditions and recognizing what internal resources are. Important and extraordinary resources contribute to the value creation of companies and thus customer satisfaction is achieved. Therefore, this study also will be identified the lack of empirical research studying the relationships between agility and digital transformation, as well

as their combined interactions with customer satisfaction from the standpoint of company performance.

In this context, the importance and questions of the study will be introduced then the important concepts of supply chain agility, Supply chain resilience, digital transformation, customer satisfaction, and firm performance and their relationships with each other in the literature were explained.

Importance and the Research Questions of the Study

Today, it is obvious that businesses competing in a continuously changing and dynamic supply chain adopted ''the big fish who eat the small fish'' motto, instead of the 'it's the fast fish who eat the slow fish' motto (Çalışkan et al. 2016).

In general, manufacturing companies aim to sustain their long-term existence. However, epidemics such as COVID-19, wars, and natural disasters showed that companies should use their resources more efficiently. In this sense, they need to build agile and resilient supply chains to survive and increase their performance.

In addition, they are expected to use the contribution of information technologies to create customer satisfaction by complying with the requirements of the age.

Therefore, to make their operational performance superior, companies have to create and maintain a competitive advantage.

As for the contribution of the subject to the literature, very few studies have discussed the relationships between sc agility, sc resilience, customer satisfaction, and firm performance together.

To our knowledge, also the mediating effect of customer satisfaction between sc agility and firm performance and the moderator effect of digital transformation on the relation between sc agility and customer satisfaction for the first time were analyzed. Therefore, the study is expected to fill an important gap in the literature.

Thus, the purpose of this research is to see how supply chain agility, supply chain resilience, and perceived customer satisfaction affect firm performance. The research also looks into the function of digital transformation as a moderating effect between supply chain agility and perceived customer satisfaction.

In light of these theoretical syntheses, the creation of the conceptual model of study by the researcher will also contribute to the literature.

In a summary, the conclusion to be obtained as a result of the research will provide administrative implications to the supply chain managers and senior executives of the

companies in supply chain management about how they should approach the concept of agility from the supply chain applications in the uncertainties that may arise.

In addition, the study is supported by the resource-based theory.

Consequently, the research questions were:

Do supply chain agility and supply chain resilience affect firm performance?

Is there a mediating role of perceived customer satisfaction between supply chain agility and firm performance?

Is there a mediating role of supply chain resilience between supply chain agility and firm performance?

Does supply agility affect supply chain resilience and perceived customer satisfaction?

Does perceived customer satisfaction affect firm performance?

What is the moderating effect of digital transformation between supply chain agility and perceived customer satisfaction?

Hypotheses Development of the Study

The concept of 'agility' in the supply chain can be explained as rapid reorganization and re-adaptation.

Resilience in supply chain management refers to the ability of companies to withstand unexpected shocks and recover quickly from disruptions. This requires redundancy in supply sources, inventory buffers, and contingency plans.

Jüttner & Maklan (2011) in the research which investigated empirically, 'how the resilience of extended supply chains can be strengthened 'applied to three international companies, it has shown that agile supply chains provide support in detecting and overcoming disruptions. Thus, the network can provide an agile response to potential disruptions, enhancing supply chain resilience with enhanced entirely visibility throughout supply chain operations.

These findings give way to hypothesis H1:

H1: Supply chain agility has a positive significant effect on supply chain resilience.

According to Weni, (2018), every organization should target and promote agility within its customer service framework. Otherwise, it will have to face dire consequences such as operational regression, loss of customers, employee indifference, and general management failure.

the aim of Barve's study (2011) was to represent the effect of agility in supply chains on customer satisfaction. According to the emerging hierarchical structure, agility indicators such as organizational integration and desire for improvement, and cooperative relations among

partners have more driving force, while variables such as customer satisfaction are found to be a weaker factor, not negative.

All these findings lead to the following hypothesis:

H2: Supply chain agility has a positive significant effect on perceived customer satisfaction.

As the digital transformation of companies increases, they can both offer more personalized services and reduce their sales costs, thereby increasing customer satisfaction (Nwankpa & Roumani, 2016).

In this study, since it is thought that the relationship between sc agility and customer satisfaction will increase when digital transformation is increased by the companies, the moderator effect of DT is also wanted to be examined. The moderator variable means that when included in the relationship between an independent variable and a dependent variable, it strengthens, weakens, or reverses the existing relationship.

To examine this relationship the hypothesis is formed as follows:

H3: Digital Transformation plays a significant moderating effect in the relationship between supply chain agility and perceived customer satisfaction.

In addition, in a study conducted by Willie (2021) on a company called Multnum in Africa with 150 employee surveys, it was determined that customer satisfaction has an important role in improving organizational performance. So the fourth hypothesis formed as follows:

H4: Perceived customer satisfaction has a significant effect on firm performance.

Yang, (2014), reported that supply chain agility has a significant positive effect on cost-effectiveness, but has no effect on firm performance. However, considering all the studies in the literature, this study proposes the following hypothesis.

H5: Supply chain agility has a significant direct effect on firm performance

In the liner shipping industry Liu and others 2018, who have studied, firm performance, sc resilience, and management policies, argued that supply chain resilience can improve the performance of Taiwan's shipping industry by improving the agility of organizations and performing supply chain restructuring.

Thus another hypothesis is determined as below:

H6: Supply chain resilience has a significant effect on firm performance.

few studies have empirically examined the perceived customer's mediating role in supply chain management. Also, for the first time in the related literature, this study will examine the mediating role of customer satisfaction between agility and firm performance, thus suggesting the following hypothesis:

H7: Perceived Customer satisfaction has a significant mediating role in the relationship between supply chain agility and firm performance.

Sc agility creates resilience which in turn increases firm performance, based on this idea in this study the mediating role of supply chain resilience will be examined.

H8: Supply chain resilience has a significant mediating role in the relationship between supply chain agility and firm performance.

Conceptual Model

The resource-based perspective is used as a foundation for developing a conceptual model for this investigation. The model has been developed by the researcher and the conceptual model is presented below:
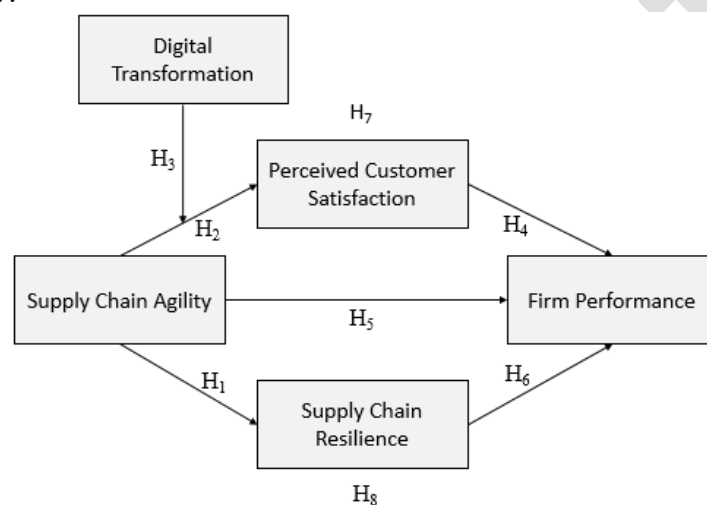

Figure 1 Conceptual model of the study (developed by researcher)

Research Population and Sampling

The population of the research consists of manufacturing companies registered to OSBUK (Organized Industrial Zones Senior Organization) operating in the Marmara Region. At end of the 2022 Total OSB (Organized industrial Zone) numbers reached 387.

The surveys were applied to these companies via e-mail. Top and middle-level managers of the companies answered the survey questions. Respondents to the surveys were managers who are experts in logistics, planning, purchasing, production, or distribution in the supply chain field. Data were collected from June 1 till November 20.

A sample is a subgroup with characteristics appropriate for deducing from the population. Attention should be paid to the sample's representability and size (Özen & Gül, 2007).

The type of this study is a quantitative-based approach with cross-sectional data and the simple random sampling technique, which is one of the probabilistic sampling methods, was preferred for the study. The member companies of OSBUK operating in the Marmara region were randomly selected from the list and surveys were sent via e-mail.

To determine the sample size there is the "10 times" rule which is one method for calculating the minimal sample size required for a model estimate in a PLS path model. Kline's (2012) method was used to calculate the sample size. Accordingly, it is stated that 10 times the number of variable items in the study will be sufficient to determine the sample size. Within the scope of the study, 22 items (22*10=220) belonging to 5 variables were determined as 220, based on the rule of 10 times. In this context, to ensure that the sample represents the population at a high level, it was aimed to collect data above the calculated sample size, and the survey was completed with 228 company participants reached via the online form.

Data Collection Method and Measurements

To collect data, the questionnaire has been distributed to manufacturing companies in the Marmara region. Since the center of the Turkish economy is the Marmara Region as a traditional structure, it was found appropriate to choose this region. It has had an important position in trade throughout history, as it is the region that connects Europe and Asia. In addition, The Marmara Region, which plays a key role in the manufacturing industry and employment of the country, is the region that has the largest share of the country's economy (Selamci & Cetin, 2020).

The survey was divided into two sections. In the first section, there was a brief introduction and 6 questions related to the profile of respondents and characteristics of the companies such as levels of administrators, educational status, the industry of the company, number of employees, and annual turnover. In the second section, the survey includes 22 of them regarding supply chain agility, supply chain resilience, digital transformation, perceived customer satisfaction, and firm performance.

"All the questions in the second part were prepared according to the Likert scale: (1 = Strongly Disagree, 2 =Disagree, 3 =Neither/Nor Agree, 4 =Agree, 5 = Strongly Agree). 5 point scale was used.

The survey instruments for each of the constructs were adapted from the literature, including environmental knowledge - Customer satisfaction (Yee et al., 2010); Supply chain agility and

firm performance (Abeysekara et al., 2019); Supply chain resilience (Um & Han, 2021); Digital transformation scale (Nwankpa & Roumani, 2016).

The questionnaire was translated into Turkish while keeping the essence of the original. The questionnaire was distributed to companies, and 228 of them were included in the study due to incomplete or wrongly answered questionnaires.

IBM SPSS program was used to evaluate descriptive statistics. Besides, confirmatory factor analysis and structural model analysis were performed through the SmartPLS 4 software data analysis program. Model fitness and the study's hypothesis were tested after the validity and reliability of the measurement model.

Pre Test-Pilot Study of the Research

A pilot study was conducted to test the questionnaire. After the pre-test, reliability of the questionnaire was approved through a pilot study of 50 respondents. The 50 respondents were asked to assess the comprehensibility of the survey's questions. Pre-data from respondents of manufacturing enterprises were obtained by conducting a pilot test based on interviews to check that questions were understood without any hesitation or confusion. The form was tested and finalized after the assessments. Following this revision, the application was completed by academics who have studied the supply chain.   were examined.

Smart PLS 4 has been used to evaluate the data. After that, the confirmatory factor analysis results of the pilot study are given in figure x to measure the validity of the measurement model. In studies, factor loadings are expected to be greater than 0,5, and 0,7 and above under ideal conditions (Hair et al., 2009). , in the preliminary analysis cronbach's alpha should be above 0.70 to test the reliability of the measurement model.

As a result, variables of this study are found as reliable no correction was needed to be done in the items and the questionnaire was stayed in its original form. The survey was provided to the manufacturing companies once the pilot study was finished.

Figure 2 Pilot study- Path model
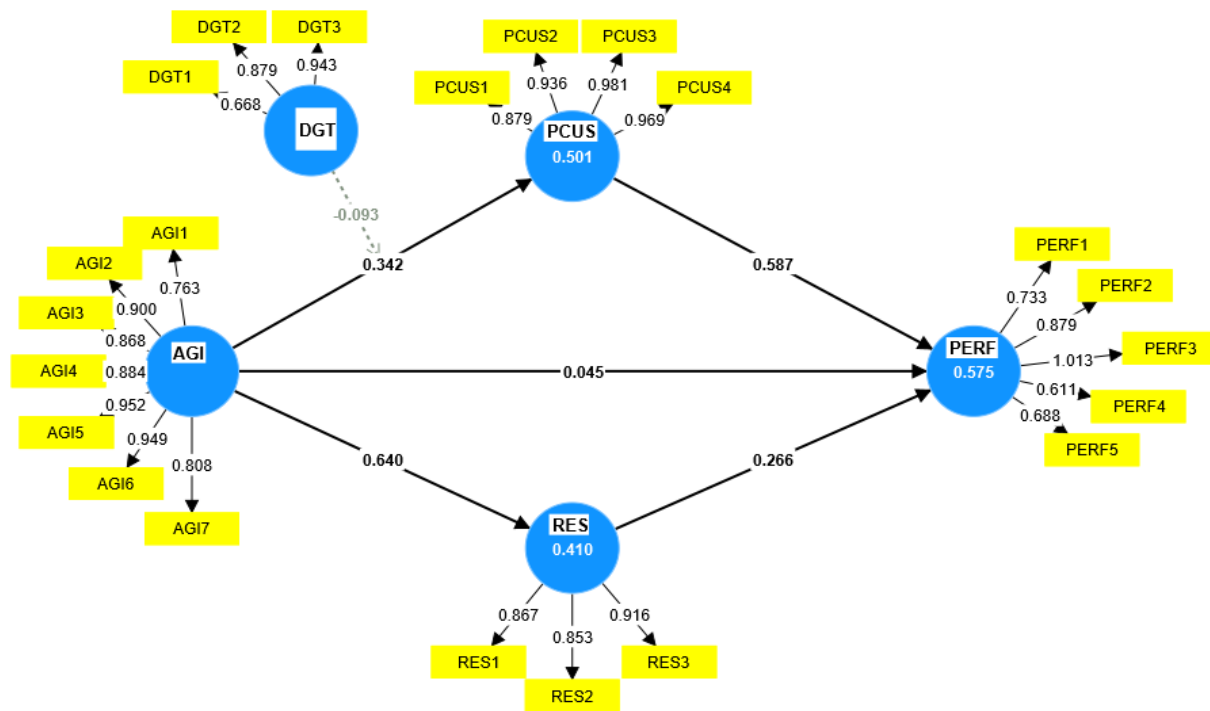
Pilot study 's construct reliability and validity test

As a result, the variables of this study are found as reliable and the items were not needed correction, and the questionnaire was left in its final form. The survey was provided to the manufacturing companies once the pilot study was finished.

Table 1 Pilot study 's construct reliability and validity test

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	The average variance extracted (AVE)
AGIL	0,959	0,962	0,959	0,769
DGT	0,878	0,895	0,874	0,703
PCUS	0,968	0,971	0,969	0,888
PERF	0,900	0,92	0,894	0,636
RES	0,911	0,912	0,911	0,7736

RESULTS

Data Analysis

IBM SPSS program was used to evaluate descriptive statistics. Besides, confirmatory factor analysis and structural model analysis were performed through the SmartPLS 4 software data analysis program.

SmartPLS is the most accepted technique for testing various hypotheses, as evidenced by several studies (Hair et al., 2014).

With this data analysis program, analysis can be carried out with both reflective and formative variables without any problems (Ozgül, 2020). In addition, it is one step ahead of other data analysis programs that do not require questioning whether the data is normally distributed or not.

Therefore, for this study, PLS-SEM is preferred to analyze the data, and the study is divided into two sections for analysis. Part one is based on an evaluation of the outer model's reliability and validity. The second part is based on a model evaluation within which hypotheses were evaluated (Ul-Hameed et al., 2019).

Descriptive Statistics and Response Rate

This section presents the profile of respondents and characteristics of the companies that they work for, such as administrator level, educational status, sector, employee number, and annual turnover.

The characteristics of the companies participating in the research and the respondents who answered the questionnaire are presented in Table 2, based on frequency (N) and percentage.

Table 2 Descriptive statistics of company and managers' profiles.

	Frequency (n)	Percent (%)
Administrator level		
Administrative, Top manager	87	38,2
Executive, Middle-level manager	141	61,8
Sector		
Plastic	20	8,8
Textile	45	19,7
Shoes	13	5,7
Food	10	4,4
Automotive	11	4,8
Chemical	32	14,0
Furniture	6	2,6
Metal	8	3,5
Others	83	36,4
Employee number		
0-100	141	61,8

100-200	43	18,9
200<+	44	19,3
Annual turnover		
<1 million Turkish liras	25	11,0
1-5 million Turkish liras	49	21,5
5-10 million Turkish liras	40	17,5
10 million Turkish liras < +	114	50,0
Educational status		
High school	84	36,8
University	123	53,9
Master or PhD	21	9,2

Regarding the administrator level of the participants, 38.2% of the participants are top managers, and 61.8% are mid-level managers.

Considering the sector they work in, 19.7% of the companies operating in the textile, 14% in chemical, 8.8% in plastic, 5.7% in shoes, 4.8% in automotive, 4.4% in food, 3.5% in metal, 2.6% in furniture and 36.4% of them are operating in other sectors.

According to employee numbers, 61,8% have 0-100, 18,9 % have 100-200 and 19,3% have 200 and more employees.

Regarding annual turnover 11% of them earned less than one million Turkish liras, 17,5% earned between 5-10 million Turkish liras, 21,5 % earned 1-5 million Turkish liras, and 50% earned more than 10 million Turkish liras.

Considering the level of education of the participants, 9.2% completed a master's or Ph.D., 36.8% from high schools, and 53.9% from universities.

Confirmatory Factor Analysis

Confirmatory factor analysis is a multivariate statistical method that aims to find a small number of unrelated and significant new conceptual variables (dimensions, factors), or to test models that have already been found, by bringing together observable or measurable interrelated variables (İslamoglu & Alniacik, 2019).

Confirmatory factor analysis is carried out to test whether the scales obtained and combined under fewer factors are similar to the sample of the research.

It is also worth noting that it should be questioned whether the variables in the model are reflective or formative. It is recommended to use the Consistent PLS Algorithm/PLSc method when all variables are reflective.

On the other hand, if only one of the variables in the research model is a formative variable, the PLS Algorithm method should be used (Henseler et al., 2014). Since all variables are reflective in this research model, analyses were performed using the PLSc Consistent PLS Algorithm/PLSc method. Confirmatory factor analysis was carried out and has shown in table 3:

Table 3 Confirmatory factor analysis results

Latent Variables	Indicators	Outer loadings				
		1	2	3	4	5
AGI	AGI1	0,790				
	AGI2	0,788				
	AGI3	0,834				
	AGI4	0,787				
	AGI5	0,771				
	AGI6	0,808				
	AGI7	0,768				
DGT	DGT1		0,765			
	DGT2		0,916			
	DGT3		0,948			
PCUS	PCUS1			0,793		
	PCUS2			0,897		
	PCUS3			0,912		
	PCUS4			0,828		
PERF	PERF1				0,843	
	PERF2				0,781	
	PERF3				0,972	
	PERF4				0,631	
	PERF5				0,691	
RES	RES1					0,784
	RES2					0,824
	RES3					0,923

Confirmatory factor analysis was carried out by using the Smart PLS 4 tool to test the validity of the measurement model including 22 items describing 5 latent constructs.

Factor loadings are supposed to be greater than 0.5, and in ideal conditions 0.7 and greater (Hair et al., 2009). Consequently, the constructs of the measurement model are represented well as in above table .

As a result of the initial confirmatory factor analysis of the measurement model, revisions were not necessary.
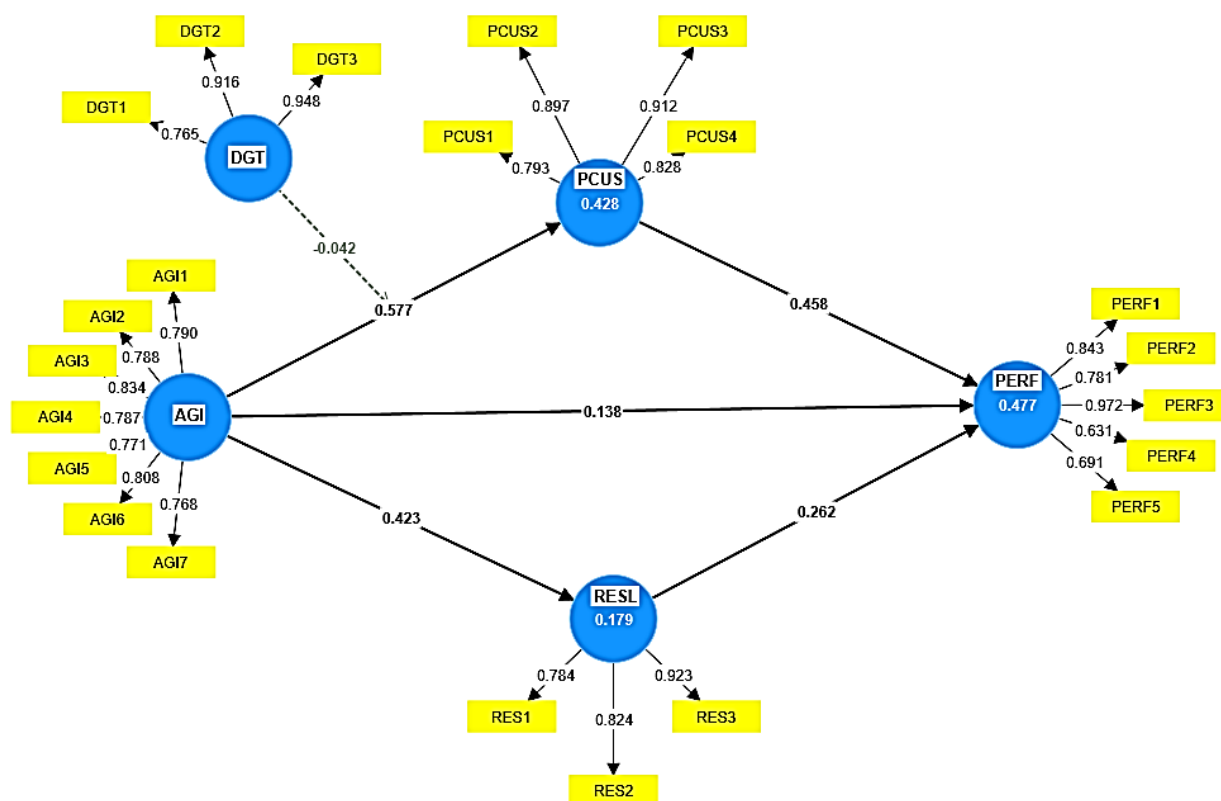
Figure 3 Conceptual model of the study

Validity and Reliability Analysis

Reliability is the ability of a measurement tool to provide similar and consistent results in various measurements, while validity is the measurement tool's ability to measure the intended phenomenon. Reliability tests of the reflective scales in the study were carried out considering internal consistency analysis and average variance extracted (AVE). Most studies in the literature examine internal consistency with the Cronbach Alpha coefficient. However, recently, many researchers, particularly Hair et al (2017), suggest that the composite reliability coefficient should be preferred instead of Cronbach's Alpha coefficient when evaluating the internal consistency of scales regarding reflective variables.

The acceptable limit for internal consistency is accepted as Cronbach's alpha and CR coefficients should be above $\geq 0,60$ in explanatory models and $\geq 0,70$ in confirmatory models (Henseler et al., 2014).

In addition, the average variance extracted (AVE) reflects the average commonality of the indicators of each latent factor in reflective structures (Garson, 2016). In a structure that can be expressed reliably, the AVE value should be $\geq 0,50$ for each latent factor (Duran, 2021).

As a result of the reliability and validity test of the reflective scales used in the research, the values in Table 4 were obtained.

Table 4 Construct Reliability and Validity Analysis

Scales		Standardized Factor Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)	rho-A
AGI	AGI1	0,79	0,922	0,922	0,628	0,922
	AGI2	0,788				
	AGI3	0,834				
	AGI4	0,787				
	AGI5	0,771				
	AGI6	0,808				
	AGI7	0,768				
DGT	DGT1	0,765	0,911	0,911	0,774	0,92
	DGT2	0,916				
	DGT3	0,948				
PCUS	PCUS1	0,793	0,916	0,918	0,738	0,921
	PCUS2	0,897				
	PCUS3	0,912				
	PCUS4	0,828				
PERF	PERF1	0,843	0,896	0,892	0,628	0,911
	PERF2	0,781				
	PERF3	0,972				
	PERF4	0,631				
	PERF5	0,691				
RES	RES1	0,784	0,883	0,882	0,715	0,888
	RES2	0,824				
	RES3	0,923				

When Cronbach's alpha and CR coefficients were examined for internal consistency reliability, Cronbach's alpha coefficient and CR coefficient of each scale were obtained between 0,882 and 0,922. Cronbach's alpha and CR coefficients should be 0,70 and above to ensure internal consistency. According to these coefficients, reliability was provided in the study.

Cronbach's alpha, composite reliability and rho_A values should be greater than 0,70, If the factor loadings are between 0,40 and 0,70 and above the threshold values of the AVE and CR coefficients, the items are not removed from the scale. When we examine the factor loadings first, the factor loadings of the items vary between 0,631 and 0,948. As the AVE values of the scales were obtained as higher than 0,50 and the factor loadings were obtained higher than 0,40,

convergent validity was ensured.

Validity of Reflective Scales

The analyzes conducted to determine the convergent and discriminant validity of the reflective scales used in the study are presented in detail below.

First, discriminant validity was tested. Discriminant validity reveals the extent to which a variable used in the research diverges from other variables.

Discriminant validity can be examined in different ways:

First, the Fornell-Larcker criterion was used. As a result of the analysis, since the

AVE square root coefficients were obtained higher than the correlation coefficients in their row and column, and discriminant validity was ensured.

Table 1 Discriminant Validity (Fornell-Larcker)

	AGI	DGT	PCUS	PERF	RES
AGI	**0,792**				
DGT	0,561	**0,880**			
PCUS	0,651	0,395	**0,859**		
PERF	0,547	0,446	0,621	**0,792**	
RES	0,423	0,530	0,279	0,448	**0,846**

Second, the heterotrait-monotrait ratio of correlations (HTMT) was also used in assessing the discriminant validity of reflective constructs.

HTMT coefficients should be below 0,90, Since all of the HTMT coefficients obtained were below 0,90, discriminant validity was ensured.

Table 2 Heterotratit-Monotrait Ratio (HTMT)

	AGI	DGT	PCUS	PERF	RES
AGI	---				
DGT	0,562				
PCUS	0,652	0,395			
PERF	0,540	0,441	0,608		
RES	0,421	0,540	0,280	0,449	---

9 Structural Model

The path coefficient estimates for the structural model relationships, which represent the hypothetical linkages between the reflective constructs, were produced after the PLS-PM

method was run. The bootstrapping procedure was used to determine the statistical significance of the path coefficients (5,000 sub-sample).

The significance of path coefficients and the R2 values were tested to analyze the structure model. R2 value shows what percentage of the exogenous variables explain the endogenous variable; R2 values are supposed to be between 0 and 1. R2 values of all variables in this study are between 0 and 1 as shown in Table 15. (Hair et al., 2011).

To see whether the β values obtained as a result of the analysis were significant at the 5% significance level, the t-test and p-values were examined. For the 5% significance level, the p-value should be <0,05.

Table 3 Path coefficients of the structural model

	Stand. Beta	St. deviation	t-statistics	P	VIF	f^2	R^2	Adjusted R^2	Hypothesis
AGI -> PCUS	0,577	0,118	4,888	**<0,001**	2,722	0,214			H₂ Supported
AGI*DGT -> PCUS	-0,042	0,07	0,6	0,549	2,018	0,003	0,428	0,42	H₃ Rejected
AGI -> PERF	0,138	0,138	0,998	0,318	1,951	0,019			H₅ Rejected
PCUS -> PERF	0,458	0,132	3,467	**0,001**	1,737	0,231	0,477	0,47	H₄ Supported
RES -> PERF	0,262	0,076	3,467	**0,001**	1,218	0,108			H₆ Supported
AGI -> RES	0,423	0,065	6,474	**<0,001**	1	0,218	0,179	0,175	H₁ Supported
Model fit indices	SRMR=0,059; NFI=0,774; GoF=0,824								

The relationship between AGI and PCUS was found to be significant and AGI variables had a positive impact on PCUS (β=0,577; p<0,001). The relationship between PCUS and PERF was found to be significant and PCUS variables had a positive impact on PERF (β=458; p=0,001). The relationship between RES and PER was found to be significant and RES variables had a positive effect on PERF (β=262; p=0,001). The relationship between AGI and RES was found to be significant and AGI variables had a positive impact on RES (β=423; p<0,001).

It has shown that DGT does not have a positive and statistically.

To summarize, all hypotheses from hypothesis 1 to hypothesis 6 are supported in this research

except for the hypothesis 3 and 5.

Table 4 Examination of the total effects of the structural model

Variable Relationships	Total effects (Standardized)	S. deviation	t-statistics	P
AGI -> RES	0,423	0,065	6,474	**<0,001**
AGI -> PCUS	0,577	0,118	4,888	**<0,001**
AGI -> PERF	0,513	0,088	5,857	**<0,001**
RES -> PERF	0,262	0,076	3,467	**0,001**
PCUS -> PERF	0,458	0,132	3,467	**0,001**

When we look at the direct effect of the structural model, it is indicated that the direct effect of the AGI variable on PERF was found to be statistically significant. However, when we included all the relationships in the model, it was seen that the relationship between AGI and PERF was not found significant. Therefore, mediation impact was examined in detail; the results of PCUS and RES analyzed both separately and together are shown as follows.

Mediation Analysis for Perceived Customer Satisfaction and Supply Chain Resilience

First, the mediating role of PCUS and SC RES was analyzed together. To see the mediating role of these variables separately, we then reanalyzed without adding them together to the model and compared the results.

Table 5 Examining the indirect effects of the structural model

	Indirect effects (Standardized)	S. deviation	t-statistics	P
AGI -> PCUS -> PERF	0,264	0,095	2,773	**0,006**
AGI -> RES -> PERF	0,111	0,034	3,256	**0,001**

The indirect effect of the AGI variable on PERF through PCUS was found to be statistically significant (β=0,264; p=0,006). The indirect effect of the AGI variable on PERF through RES was found to be statistically significant (β=0,111; p=0,001).

Table 6 Examining the mediation role of the study

Hypothesis		B	S. deviation	t-statistics	P	Result	H
	Step 1						
	AGI -> PCUS -> PERF	0,264	0,095	2,773	**0,006**	**Full Mediation**	H₇ **Supported**
	Step 2					**Indirect Only**	
	AGI -> PERF	0,138	0,138	0,998	0,318		
	Step 1						
	AGI -> RES -> PERF	0,111	0,034	3,256	**0,001**	**Full Mediation**	H₈ **Supported**
	Step 2					**Indirect Only**	
	AGI -> PERF	0,138	0,138	0,998	0,318		

The direct and indirect effects of the mediator model showed that the indirect effect of the AGI variable on PERF through PCUS was statistically significant, whereas the direct effect of the AGI variable on PERF was not significant, and it can be said that the PCUS variable had a full mediation role-indirect only. The indirect effect of the AGI variable on PERF through RES was found to be statistically significant. Since the direct effect of the AGI variable on PERF was not significant, According to Zhao et al (2010) it was found that the RES variable had a full mediation role -indirect only because the direct effect is not significant.

 Mediation Analysis for Perceived Customer Satisfaction

For mediation roles of perceived customer satisfaction and SC resilience were also analyzed separately, and their mediation powers were examined. The below tables indicate the results of the analysis:

Table 7 The mediation role of perceived customer satisfaction

	β	S, deviation	t	P		H
Direct Effect						
AGI -> PERF	0,547	0,082	6,656	**<0,001**		
Direct Effect					**Partial Mediation (Complementary)**	**H₇ Supported**
AGI -> PCUS	0,652	0,086	7,544	**<0,001**		
AGI -> PERF	0,244	0,120	2,024	**0,043**		
PCUS -> PERF	0,465	0,117	3,967	**<0,001**		
Indirect Effect						
AGI -> PCUS -> PERF	0,303	0,083	3,648	**<0,001**		

The direct effect of AGI on PERF was obtained as 0,547. AGI has a statistically significant effect on PERF (p<0,001).

The effect of the mediator variable PCUS on PERF was 0,465, which was found statistically significant (p<0,001). It means if perceived customer satisfaction increases it makes company PERF values increase. When the mediator variable was in the model, the effect of AGI on PERF was obtained as 0,244 and it was not found to be statistically significant (p=0,043).

41.8% of AGI, PCU, and Perf variables are explained. The effect of the AGI variable on PCUS was 0,652 and it was found to be statistically significant (p<0,001).

The indirect effect of the AGI variable on PERF via PCUS was found to be statistically significant (β=0,303; p<0,001).

The direct and indirect effects of the AGI variable on PERF are significant, and it can also be said that the PCUS variable has a complementary partial mediator effect.

Mediation Analysis for Supply Chain Resilience

Table 8 Mediating role of supply chain resilience

	β	Std.Dev	T	P		H
Total Effect						
AGI -> PERF	0,549	0,081	6,755	**<0,001**		
Direct Effect						
AGI -> PERF	0,435	0,088	4,966	**<0,001**	**Partial Mediation (Complementary)**	**H₇ Supported**
AGI -> RES	0,428	0,064	6,651	**<0,001**		
RES -> PERF	0,265	0,085	3,122	**0,002**		
Indirect Effect						
AGI -> RES -> PERF	0,113	0,038	2,985	**0,003**		

The direct effect of AGI on PERF was obtained as 0,549, and there is a positive effect of AGI on PERF was found (p<0,001).

The effect of the mediator variable RES on PERF was 0,265, which was statistically significant (p=0,002). It means increasing the Resilience of the company increases the PERF values. When the mediator variable was in the model, the effect of AGI on perf was obtained as 0,435, which was statistically significant (p<0,001). The effect of the AGI variable on the RES was obtained as 0,428, which was statistically significant (p<0,001). These two variables explain 35.3% percent of the variation in performance.

The indirect effect of the AGI variable on PERF through RES was found to be statistically significant (β=0,113; p=0,003).

It was found that the direct and indirect effects of the AGI variable on PERF were significant and the multiplication of the direct effects (a*b*c) was positive, so the RES variable had a complementary partial mediator effect.

As a result, the following evaluations can be made when the separate mediating role analyzes are compared:

The effect of PCUS, which mediated the relationship between AGI and PERF, was found to be more effective than the other variable RES, which mediated the relationship as well.

Taken separately, PCUS and RES, which are complementary mediators, act as full mediators on the relationship between AGI and PERF when included in the analysis together.

DISCUSSION

For data analysis, SmartPLS 4 and IBM SPSS V23 programs were used.

According to the descriptive statistics and response rate, 61.8 percent of the managers participating in the survey were top managers and 38.2 percent were mid-level managers.

The distribution of the companies participating in the study according to the industry 19.7% of the companies are operating in the textile, 14% are in the chemical, 8.8% are in plastic, 5.7% in shoes,4.8% in automotive, 4.4% in food, 3.5% in metal, 2.6% in furniture sector of the companies and 36.4% of them are operating in other sectors. According to employee numbers, 61,8% have between 0-100, 18,9 % have between 100-200 and 19,3% have 200 and + employees.

Regarding annual turnover, 11% of them had less than one million Turkish liras, 17,5% had between 5-10 million Turkish liras, 21,5 % had 1-5 million Turkish liras and 50% had more than 10 million Turkish liras. Considering the level of education of the participants, 9.2% completed a master's or Ph.D., 36.8 % graduated from high school, and 53.9 % of them graduated from university.

After descriptive statistics, Structural Equation Modeling (SEM) was used to examine the reliability and validity of the measurement model and to test the path. The analysis was made based on the bootstrap method in the examination of the direct, indirect, and total effects of the constructs on each other.

As for the bootstrap analysis, 5000 resamples were preferred and the significance level was determined as $p<0,05$.

The reliability and validity test for the reflective model used in the research. In the studies, it was determined that the scales of all items used in the research provided a very good level of convergent and divergent validity. Considering the evaluations regarding convergent validity, the factor loadings of the indicators forming the variables, and the AVE values of the variables; Evaluations of discriminant validity were carried out by considering cross-loadings, Fornell Larcker criterion, and HTMT ratios.

When convergent validity is examined, factor loadings must be ≥0,70, as recommended by Hair et al. (1998), and AVE coefficients ≥0,50 for convergent validity. If the factor loadings are between 0,40 and 0,70 and above the threshold values of the AVE and CR coefficients, the items are not removed from the scale. When we examine the factor loadings first, the factor loadings of the items vary between 0,631 and 0,948. As the AVE values of the scales were obtained as higher than 0,50 and the factor loadings were obtained higher than 0,40, convergent validity was ensured.

When Cronbach's alpha and CR coefficients were examined for internal consistency reliability, Cronbach's alpha coefficient and CR coefficient of each scale were obtained between 0,882 and 0,922. Cronbach's alpha and CR coefficients should be 0,70 and above to ensure internal consistency. According to these coefficients, internal consistency reliability was provided.

According to path coefficients of the structural model results; The relationship between supply chain agility and supply chain resilience was found to be significant and SC agility variables had a positive impact on SC resilience (β=423; p<0,001). H1 stated that supply chain agility has a positive effect on supply chain resilience, and it has been accepted.

The relationship between supply chain agility and perceived customer satisfaction was found to be significant and the SC agility variable had a positive impact on perceived customer satisfaction (β=0,577; p<0,001.). Therefore, H2, stating that supply chain agility has a positive effect on perceived customer satisfaction, has been accepted.

H3 states that Digital transformation plays a significant moderating effect in the relationship between supply chain agility and customer satisfaction, and it has been rejected.

The Relationship between perceived customer satisfaction and firm performance was found to be significant. (β=458; p=0,001). So H4, states that perceived customer satisfaction has a positive effect on firm performance, and it has been accepted.

The direct effect of the supply chain agility variable on firm performance was not statistically significant (p=0,318). So, H5, Supply chain agility has a direct significant impact on the firm performance hypothesis, and it has been rejected.

The relationship between supply chain resilience and firm performance was found to be significant and SC resilience variables had a positive impact on firm performance (β=262; p=0,001). H6 stated that supply chain resilience has a positive effect on firm performance, and it has been accepted.

Lastly, the mediation effect was examined. The direct and indirect effects of the mediator model showed that the indirect effect of the AGI variable on PERF through PCUS was statistically significant, whereas the direct effect of the AGI variable on PERF was not significant, and the PCUS variable had a full mediator role.

The indirect effect of the AGI variable on PERF through RES was found to be statistically significant. Since the direct effect of the AGI variable on PERF was not significant, it was found that the RES variable had a full mediation role between the SC agility and company performance relationships.

To see the mediating role of PCUS and RES between SC agility and company performance separately, two separate path analyses were performed.

First, the effect of the mediator variable PCUS on PERF was 0,465, which was found statistically significant (p<0,001). It means if perceived customer satisfaction increases, it makes company PERF values increase. When the mediator variable was in the model, the effect of AGI on PERF was obtained as 0,244 and it was not found to be statistically significant (p=0,043).

41.8% of AGI, PCUS, and PERF variables are explained. The effect of the AGI variable on PCUS was 0,652 and it was found to be statistically significant (p<0,001).

The indirect effect of the AGI variable on PERF via PCUS was found to be statistically significant (β=0,303; p<0,001).

The direct and indirect effects of the AGI variable on PERF are significant, and it can also be said that the PCUS variable has a complementary partial mediator effect since the multiplication of the direct effects (a*b*c) is positive.

According to the mediator effect analysis of the RES variable: the effect of the mediator variable RES on PERF was 0,265, which was statistically significant (p=0,002). It means increasing the resilience of the company increases the PERF values. When the mediator variable was in the model, the effect of AGI on perf was obtained as 0,435, which was statistically significant (p<0,001). 35.3% of AGI and RES variables are explained. The effect of the AGI variable on the RES was obtained as 0,428, which was statistically significant (p<0,001). 18% of RES and AGI are explained.

The indirect effect of the AGI variable on PERF through RES was found to be statistically significant (β=0,113; p=0,003).

It was found that the direct and indirect effects of the AGI variable on PERF were significant and the multiplication of the direct effects (a*b*c) was positive, so the RES variable had a complementary partial mediator effect, too.

As a result, the following evaluations can be made when the separate mediating role analyzes are compared:

The effect of PCUS, which mediated the relationship between AGI and PERF, was found to be more effective than the other variable RES, which mediated the relationship as well.

Taken separately, PCUS and RES, which are complementary mediators, act as full mediators on the relationship between AGI and PERF when included in the analysis together.

H7, 'Customer satisfaction has a significant mediating role on the relationship between supply chain agility and firm performance, and it has been accepted.

H8, Supply chain resilience has a significant mediating role in the relationship

between supply chain, agility, and firm performance, and it has been accepted.

CONCLUSION

Theoritical Implications

The study aimed to contribute to the literature in several aspects.

The first aim of this study was to investigate the effects of supply chain agility, supply chain resilience, perceived customer satisfaction on firm performance and the moderator effect of digital transformation between supply chain agility and perceived customer satisfaction.

In addition, the mediation roles of supply chain resilience and perceived customer satisfaction between supply chain agility and firm performance were examined separately and together by including them in the model.

Our study extends the literature on SCRes and cus sat in a comprehensive way and investigates such mediation effects.

Consequently, the findings provided a theoretical perspective and explanations for the following research questions:

RQ1:Do supply chain agility and supply chain resilience affect firm performance?

In the study, the direct effect of the supply chain agility variable on firm performance was not found statistically significant from the perspectives of turnover, net profit, and market share. Thus, this hypothesis has been rejected.

The results differed from the common literature in terms of how agility affects firm performance as shown in the study conducted by Abeysakara et al (2019), Swafford et al. (2008), Yusuf and Adeleye (2002), (Degroote & Marx, 2013)

Contrary to these studies, some studies did not find an effect of agility on firm performance parallel to our findings. Gligor, Esmark, and Holcomb (2015) looked at how supply chain agility affected financial performance and found that only cost and customer effectiveness were positively correlated with agility. Yang (2014) discovered in a similar manner that supply chain agility has no impact on firm performance.

This result and mediation analysis shows that sc agility has to be transformed into resilience before it can enhance firm performance. In addition, sc agility can enhance firm performance through customer-oriented performance (Liu et al., 2018). Our study extends the literature on SCRes in a comprehensive way and investigates such mediation effects.

In the study, SC resilience variables had a positive impact on firm performance This result coincides with the results of the positive relationship between SC resilience and performance

as shown in the study conducted by Kumar & Anbanandam, (2020), (Liu et al., 2018), (Lotfi & Saghiri, 2018), (Chowdhury et al., 2019), (Carvalho, 2012) and common literature.

Under environmental uncertainties supply chain resilience was viewed as a type of resource that can help reduce supply chain risks to the rapidly changing customer profile and environment, protect continuity against disruption, increase productivity (Liu et al., 2018), and regain performance (Tuğrul, 2005).

RQ2:Is there a mediating role of perceived customer satisfaction between supply chain agility and firm performance?

Customer satisfaction has a significant mediating role in the relationship between supply chain agility and firm performance.

The study aims to contribute to the literature with mediation analyses. We provide a new insight not previously reported in the literature, the mediating effect of perceived customer satisfaction on this causality cannot be ignored. Supply chain agility affects company performance through perceived customer satisfaction.

With effective and agile supply chain management, companies can meet the expectations of their customers for the timely delivery of their products and services, offering customers at the right time and place with the most affordable prices, enabling them to increase customer satisfaction. (Wisner et al., 2013).

RQ3:Is there a mediating role of supply chain resilience between supply chain agility and firm performance?

Supply chain resilience has a significant mediating role in the relationship between supply chain, agility, and firm performance.

Some suggest that agility and resilience can be considered separately, but this study was also consistent with Christopher & Peck, (2004) 's study and concluded that supply chain agility provides resilience. Because also mediation role of resilience shows that sc agility should first create sc resilience to affect performance.

A company with an agile supply chain can maintain its profitability by responding more quickly when demand increases, but it has been seen that agility alone is not enough in the face of a sudden decrease in that demand. The agile company needs to be resilient to risks because resilience is a business strategy today (Banker, 2021).

Agile systems, such as Dell's make-to-order model, are used by companies that launch products with very short product life cycles, such as electronic goods (Yagmur & Tazegul, 2016). For this reason, it can be said that agile systems should create resilience which in turn increases firm performance.

RQ4:Does supply agility affect supply chain resilience and perceived customer satisfaction?

According to the study, supply chain agility has a positive effect on supply chain resilience. This result coincides with common literature and the results of the positive relationship between SC resilience and SC agility as shown in the study conducted by Kumar & Anbanandam, (2020), Agarwal (2006), and (Gunasekaran et al., 2015). Agility and resilience complement each other because an agile supply chain is inherently more resilient (Henrich et al., 2022).

Also, the supply chain agility has a positive effect on perceived customer satisfaction hypothesis was accepted.

Company capabilities such as agility, responsiveness, and quickness enhance customer satisfaction (Pantouvakis & Dimas, 2013). Quick and efficient service delivery can strengthen customer relationships and increase satisfaction (Ying et al., 2016).

RQ5: Does perceived customer satisfaction affect firm performance?

The relationship between perceived customer satisfaction and firm performance was found to be significant. This outcome is consistent with the findings of Willie's study, which demonstrated a significant relationship between customer satisfaction and performance. Customer satisfaction determinants such as service quality are important factors in improving company performance.

RQ6:What is the moderating effect of digital transformation between supply chain agility and perceived customer satisfaction?

Contrary to popular belief, digital transformation does not play a significant moderating effect in the relationship between supply chain agility and customer satisfaction as expected. The same model has not been found in the literature on this subject, so the result could not be compared with previous studies in the literature. Companies are investing billions of dollars in digital technologies (Kuscu, 2019) , and also logistics companies in Turkiye are very open to innovation, but they see technology investments as a major cost item. In addition, they use these investments, especially in transportation and warehousing instead of the entire logistics process (Doyduk & Karagoz, 2020).

Digital applications also require digital customer experience design and digital value creation (Schallmo et al., 2022). Perhaps for this reason, they may not be able to fully ensure that their customers benefit from these technologies. This may be justified by companies that do not know how to take full advantage of digital technologies to increase customer satisfaction, they may need a holistic view for digital transformation

This study, which takes a resource-based approach, also focuses on how businesses use their resources in the supply chain and how they exhibit agility and resilience in challenging and unforeseen circumstances.

According to the resource-based theory, the ability to supply chain agility and resilience are necessary both for small companies that do not need investment and for large companies (Ying et al., 2016).

To summarize the contributions to the literature: It can be said that very few studies have discussed the relationships between sc agility, sc resilience, customer satisfaction, and firm performance together.

To our knowledge, also the mediating effect of customer satisfaction between sc agility and firm performance and the moderator effect of digital transformation between sc agility and customer satisfaction for the first time were analyzed. Our study extends the literature on SCRes in a comprehensive way and investigates such mediation effects.

The research also looks into the function of digital transformation as a moderating effect between supply chain agility and perceived customer satisfaction. Therefore, the study is expected to fill an important gap in the literature.

In light of these theoretical syntheses, the creation of the conceptual model of study by the researcher differentiates the subject from previous studies.

Managerial Implications

The COVID-19 pandemic, in particular, has exposed significant weaknesses in supply chains worldwide and shed light on the need for smart supply chains that enable faster decision-making. Businesses should now see risks as a disease or viruses, and resilience as an immune system that shows the strength of the business against these viruses. Because the more resilient the business, the more likely it will be able to respond to risks (Tuğrul, 2005).

The pandemic has caused disruptions in supply chains and accordingly companies have started to develop different strategies. Companies need to make emergency plans with the awareness of their scarce intangible or tangible assets with a resource-based approach.

That is why academia and companies have begun to pay more attention to supply chain agility and resilience. Increasing difficulties, uncertainty, and complexity in the global supply chain have necessitated the need for manufacturers to focus more on supply chain strategies and firm performance.

Based on the research findings, some managerial suggestions can be presented to the practitioners.

According to the results of the analysis, supply chain resilience has a positive effect on firm performance. Companies can positively affect firm performance by taking precautions against risks and distractions in the supply chain. Firms that eliminate risks or are prepared for risks for suppliers, consumers, and company operations can cope with problems much more easily. Consistent with the study of (Um & Han, 2021), there was also a positive effect in this study. Adopting an appropriate mitigation strategy in various risk environments is a critical decision to achieve supply chain resilience.

Understanding customer demands correctly, analyzing competitors in the market well, and using all this information within their capabilities are the factors that help companies to create an agile supply chain. Also by looking at other significant hypotheses, it can be said that agile companies can increase company performance by providing customer satisfaction or gaining resilience first, instead of directly affecting performance.

Also, according to another hypothesis, supply chain resilience has a significant mediating role in the relationship between supply chain agility and firm performance. This indicates that although firm supply chain agility is not directly reflected in firm performance, it can positively affect firm performance by providing a resilient supply chain. It is also possible to see the contribution of agility to resilience here. Firms can provide resilience by meeting demands quickly and adequately, thus increasing firm performance.

The study concluded that agility not only provides resilience but also creates customer satisfaction and positively affects firm performance. In today's world where the supply chains of companies are competing, it is an inevitable fact that companies that understand the consumer, plan their demands in advance, and make fast and reliable deliveries satisfy their customers. This will have a significant impact on company performance.

Digital transformation is inevitable for supply chains. However, the expected benefit of digital technologies that produce solutions to agile expectations such as traceability and speed may also be different according to customers. Perhaps for these reasons, these technology resources used for customers may be perceived as unimportant or unpriority. For this reason, it can be suggested to practitioners that they first understand the needs of the customers and offer digital solutions accordingly.

Limitations and Future Research Directions

Although this study was conducted to contribute to the literature and managers, this research is still limited in some concerns.

Although the Marmara region is representing the economy of Turkiye well, taking only this region as a basis and applying a survey only to supply chain managers can be accepted as another limitation.

Future studies may include other regions of Turkiye. Comparisons can be made with different countries.

It would be interesting to find out the moderator effect or mediating role of digital transformation between SC agility and firm performance.

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