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From the Global Pandemic and Business Practice Special Issue Editor

It's my privilege to receive the invitation to guest edit this special issue from my colleagues and friends at St. John's University. I would like to sincerely thank the editor of the *Review of Business*, Professor Yun Zhu, and his colleague, Professor Anna Martin, for this invitation.

The COVID-19 pandemic, as a black swan event, has unprecedented impact on various aspects of business practices, such as customer brand engagement, international trade, and the activities of entrepreneurs. This special issue hosts three papers, covering each of these aspects.

Yanni Ping and Alexander Buoye contributed the first paper, "The Moderating Impact of COVID-19 Attitudes on Customer Brand Engagement and Loyalty." Yanni and Alexander study the link and interaction between brand engagement and customers' COVID attitudes using customer survey data. They report that COVID anxiety and trust moderate the effect of customer brand engagement on customer loyalty. On the other hand, consumers' reaction to government COVID policies has a direct effect on customers' likelihood to recommend e-commerce platforms.

In the second paper, "The Impact of COVID-19 on Global Import and Export Trade," Rui Wang and Yanying Mo examine the impact of the pandemic on international trades of nine countries. They report that the pandemic had a large impact on trade volumes initially. This impact was eased by the end of 2020. They also discover that the pandemic impacted import more than export trade. The number of deaths had more influence on trade than the number of infections. Governmental prevention and control policies also had negative impact on trade.

In the last paper, "Features of the Termination of Their Activities by Entrepreneurs in 2020," Iuliia Pinkovetskaia examines five indicators illustrating the opinions of entrepreneurs who left their businesses from a survey in 39 countries. Iuliia reports that, on average, the number of people that stopped entrepreneurial activity in 2020 accounted for about 6 percent of total economically active population in sample countries. In addition, about five out of every six entrepreneurs who went out of business did so for negative reasons. Within these negative-reason exiting entrepreneurs, about a third did so due to the pandemic. Overall, the findings show a negative impact of the pandemic on entrepreneurship.

It is our hope that the papers in this special issue are informative to policy makers, academics, and general readers, especially as they pertain to the impact of a pandemic on business practices.

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The Moderating Impact of COVID-19 Attitudes on Customer Brand Engagement and Loyalty

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Abstract

Motivation: The COVID-19 pandemic has changed consumer behaviors spanning all areas of life and signaled a profound and long-term challenge to businesses. Understanding the impact of customers' attitudes toward COVID-19 on the established positive association between customer engagement and customer loyalty is essential for firms' engagement initiatives during this unprecedented time.

Premise: This research creates a new vision for the relationship between customers' COVID-19 attitudes and engagement construct and their moderating effects toward customer brand engagement on customer loyalty.

Approach: Based on designed surveys, three dimensions of COVID attitude: COVID anxiety, COVID reaction, and COVID trust were extracted using Principal Component Analysis (PCA) and included in Hierarchical Cross-Classified regression models.

Results: COVID anxiety and trust are found to moderate the effect of customer brand engagement on customer loyalty, while consumers' reaction to government COVID policies has a direct effect on customers' likelihood to recommend e-commerce platforms.

Conclusion: This research furthers the theoretical development of contextual influence on customer engagement effects and makes contributions to both the academic and practitioner literature on customer engagement and the COVID-19 pandemic.

Consistency: This research provides insights into an updated framework for digital engagement to help businesses improve customer brand relationship and create loyalty outcomes under the unprecedented impact of COVID-19, which is consistent with the purpose of this journal.

Keywords: COVID-19 attitudes, customer engagement, customer loyalty, Net Promoter Score (NPS)

JEL Classification Codes: C2, I1, M3

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INTRODUCTION

The COVID-19 pandemic has significantly impacted public health, economies, and social life since the beginning of 2020. At the time of our writing in early March 2021, countries and territories worldwide have reported over 118 million cases of COVID-19 and more than 2.62 million confirmed deaths. "Lockdowns," "mask mandates," and "social distancing" were unknown to most of the people before this pandemic but have become part of everyday life. World Bank Blogs quantify and display 12 major impacts of COVID-19, which include increasing poverty, accelerated economic downturn, closing classrooms, and intense strain on business and jobs (Blake and Wadhwa 2020). The uncertainties from COVID-19 generate unprecedented challenges for businesses with significant variance in how they are affected. COVID-19 boosts e-commerce demand and accelerates the shift toward a more digital business environment. Businesses achieve rising revenue and enhanced competitiveness due to an agile adaption to digital-centric mode. According to a recent article from *Forbes* (Kinahan 2021), Walmart's online sales in the last quarter were ablaze, shooting 79 percent higher on a year-over-year basis, accounting for a greater share of the retailer's $134.7 billion in revenue. As the world responds to the repercussions of the COVID-19 pandemic, it is important for businesses to understand how their customers are behaving, and comprehend how their needs may evolve in the aftermath of the crisis (Visa Consulting and Analytics 2020).

As manifested in a recent report from McKinsey & Company (Kohli, Fabius, and Veranen 2020), periods of contagion, self-isolation, and economic uncertainty have changed consumer behaviors spanning all areas of life, causing a decline in consumption, a shake-up of preferences, and digital acceleration. Sheth (2020) summarizes eight immediate effects of the COVID-19 pandemic on consumption and consumer behavior and indicates businesses must learn to improvise and become more resilient during the pandemic crisis. Simultaneously, consumers' attitudes on public health orders that limit person-to-person interaction and guidance on personal protective practices are important to businesses' response to consumer needs and future planning (Czeisler et al. 2020). Accenture highlights the essential role of customer engagement in business's reactions to COVID-19 and suggests that companies focus customer engagement on reassurance and confidence building to continuously reinforce the value of products, services, and the organization itself (Accenture 2020). With social distancing and limited in-person interactions and experiences, businesses need to rethink what that might mean for their engagement with customers (Karpen and Conduit 2020) and how engagement is affected by consumers' attitudes toward COVID-19. These are the primary research questions discussed in this research.

Brodie et al. (2011) define customer engagement broadly as "… a multidimensional concept subject to a context—and/or stakeholder-specific expression of relevant cognitive, emotional and/or behavioral dimensions." Extant research demonstrates customer engagement will promote value creation for both businesses and customers and enhance customer loyalty outcomes (Bijmolt et al. 2010; Brodie et al. 2013; Nambisan and Baron 2007; Prahalad and Ramaswamy 2004). An individual's disposition to engage, and how that manifests in customer

engagement behaviors, is largely influenced by the context (Alexander, Jaakkola, and Hollebeek 2018). Under the continuing impact of COVID-19 that restricts in-person engagement, firms should create new marketing initiatives by increasing digital engagement (social media, influencers, direct-to-customer business) and reducing out-of-home advertising, print, and trade marketing (Kohli, Fabius, and Veranen 2020; Taylor 2020).

> *"Exceptional customer engagement means changing how we understand and respond to customer behavior, needs, and attitudes. Forward-thinking engagement models will make digital experiences more human at a global scale."*
>
> *—Matteo Maga, Managing Director, Growth Markets Lead, Accenture*

Firms that responded to COVID-19 by embracing digital-only customer engagement, even if only for a limited time, have seen a corresponding acceleration in business change (Forrester 2021). While living in a more digital-centric world, customers who shop online possess diversified attitudes toward COVID-19, spanning governmental policies for virus containment to public reactions to social distancing. How do customers' varying opinions on COVID-19 affect the impact of engagement on loyalty outcomes in e-commerce sites such as Amazon and eBay? The impact of customer engagement has received considerable attention from marketing scholars, while the impact of customers' COVID attitudes on engagement and their interaction still remain unexplored and unclear.

To address this research question, we fielded an online survey to collect customers' brand engagement, COVID attitudes, and activity-based data specifically focused on five e-commerce platforms: Amazon, eBay, Facebook Marketplace, Etsy, and Poshmark. We use Principal Components Analysis (PCA) to estimate customer engagement components as well as COVID attitudinal measures based on the original survey measures and include the extracted components in Hierarchical Cross-Classified regression models. We find that COVID attitudes are correlated with customer brand engagement and that these COVID attitudes moderate the effect of customer brand engagement on customer loyalty. This work considers the effect of the COVID pandemic as a novel context for customer brand engagement, which contributes to the theoretical literature on engagement, as well as practitioner strategy to engage customers during the pandemic.

LITERATURE REVIEW

The Impact of COVID-19 on Consumer Behavior

Since the first description of a coronavirus-related pneumonia outbreak in December 2019, COVID-19 has evolved into a pandemic and global health crisis. The outbreak of COVID-19 has had severe economic consequences across the globe and all society, which has led to dramatic changes in how businesses act and consumers behave (Donthu and Gustafsson 2020). Consumers may become accustomed to working out at home, subscribe to online fitness classes, and be more likely to purchase an in-home exercise bike than work out at a gym

(Roggeveen and Sethuraman 2020). Besides turning to home-bound activities, Kirk and Rifkin (2020) document some of the other unusual consumer behavior patterns that came to dominate the early days of the COVID-19 pandemic, including hoarding and changing views of brands. Sheth (2020) examines the impact of the COVID-19 pandemic on consumer behavior, revealing that businesses were capable of merging their brick-and-mortar stores with their online sales and even omnichannel delivery.

The unprecedented impact of COVID-19 signals a profound and long-term challenge to all sectors of the economy. Extant literature exhibits various efforts that firms can make to cope with the crisis and provide innovative solutions for business survival. For the retailing industry, Wang et al. (2020) identify a typology of marketing innovation strategies for firms to survive COVID-19 based on two dimensions: the motivation for innovations (problemistic search or slack search) and the level of collaborative innovations (independent or collaborative). Bartsch et al. (2020) investigate the effectiveness of leadership on service employees' work performance and provide guidance on how firms can effectively lead in times of crisis. Pantano et al. (2020) demonstrate the challenges that retailers are facing and suggest that retailers should put consumers at the core with effective online communication. Knowing customers' needs and providing acute responses have been more crucial than ever during this pandemic. Recently, Accenture documented the significance of customer engagement in business's reaction to COVID-19 and suggests companies focus customer engagement on reassurance and confidence building to continuously reinforce the value of products, services, and the organization itself (Accenture 2020). Not much literature discusses COVID-19 and customer engagement jointly, but this work will amplify the literature on COVID-19 by considering its impact and customers' COVID attitudes on customer engagement.

Customer Engagement and COVID-19

With the continued impact of COVID-19, most people intend to leave home to shop only for necessities and maintain low engagement in those out-of-home services (Charm et al. 2020). Digital is believed to be less hard hit than some other media as those quarantined can spend time on the internet (Taylor 2020). Businesses need to rethink what that might mean for their engagement with customers and consider new approaches to engage their customers, especially digitally (Karpen and Conduit 2020).

The COVID-19 pandemic represents one of the most significant environmental changes in modern marketing history, which has a profound impact on corporate social responsivity (CSR) (He and Harris 2020). Many companies not only have resisted unethical business practice during this crisis, but have proactively engaged in various CSR activities, particularly those that can offer immediate help and assistance to the fight against the virus to engage customers spiritually (He and Harris 2020). Enhanced spiritual activities are important for customer engagement during the pandemic. Meanwhile, understanding the impact of customers' COVID-19 concerns on the established positive association between customer engagement and their value co-creation is prominent for firms' more comprehensive engagement initiatives. To the best of our knowledge, this topic had not been discussed yet and this paper will contribute to fill this gap.

Studies of customer engagement have focused primarily on engagement of a customer with a brand. Hollebeek (2011) defines "customer brand engagement" as "the level of an individual customer's motivational, brand-related, and context-dependent state of mind characterized by specific levels of cognitive, emotional, and behavioral activity in brand interactions." Customer engagement can be explicitly operationalized as consisting of the same three parts: cognitive processing (CP), affection (i.e., emotion), and activation (i.e., behavior) (Hollebeek, Glynn, and Brodie 2014). These three components are implemented in this study to define customer engagement in the context of online shopping sites.

Increasing levels of customer engagement will generally enhance customer loyalty outcomes (Brodie et al. 2013). One of the most prevalent metrics used by brands to gauge consumer loyalty is the Net Promoter Score (NPS) (Reichheld 2003), which is an aggregate measure based on individual level responses to the likelihood to recommend scale. But the relationship between engagement and loyalty outcomes is highly context dependent (Hollebeek 2011). Extant literature suggests that more stimulating interactions between a customer and a brand (i.e., engagement) linearly and monotonically produce positive effects on customer loyalty (Bowden 2009; Patterson, Yu, and De Ruyter 2006). In contrast, Hollebeek (2011) argues that customers may suffer from engagement "burnout" with a brand (Bakker, Van Emmerik, and Euwema 2006); that it is possible for customers to have too much engagement and that the relationship between engagement and loyalty may be curvilinear rather than linear. Moreover, Hollebeek (2011) presents a 2×2 typology that segments customers based on their engagement with and behavioral loyalty toward a brand. The typology consists of the following segments:

1. *Apathists* (low engagement, high loyalty), whose behavior toward the brand may result more from brand-related inertia than strong feelings about the brand
2. *Exits* (low engagement, low loyalty), who are high risk for attrition
3. *Activists* (high engagement, high loyalty), who appear to be the ideal customers
4. *Variety seekers* (high engagement, low loyalty), who are behaviorally fickle despite positive stimulation through interacting with the brand

The impact of the compelled interaction between customers and e-commerce platforms resulting from the physical constraints imposed in response to the COVID pandemic is unclear with respect to how customers distribute across these four segments. Open questions include, What impact will these interactions have on the quality of customers' engagement with the brand(s)? and, Will this engagement produce the positive effects on customer loyalty that most researchers anticipate?

Despite concerns about the ability of Net Promoter Score (NPS) to link to actual business outcomes (Keiningham et al. 2007), it has still become a dominant metric among practitioners for summarizing the brand-customer relationship (Fernandes and Esteves 2016). NPS is an aggregate calculation based on individual-level responses to a recommendation intention question. Investigation of the impact of engagement and COVID attitudes, as well as their interactions on this loyalty outcome, will contribute to the existential operationalization and theorization of customer engagement and create new managerial insights for practitioners.

DATA

The data were collected via online survey. Respondents for the survey were recruited from a professionally managed, nationally representative online panel in January 2021. To qualify for the study, respondents had to be at least 18 years old and have made a purchase from an e-commerce site within the past six months. The study focused specifically on five e-commerce platforms: Amazon, eBay, Facebook Marketplace, Etsy, and Poshmark. In total, 446 respondents qualified for the study. Of these, 391 had made a purchase from Amazon in the past six months, 166 from eBay, 89 from Facebook Marketplace, 95 from Etsy, and 42 from Poshmark. Respondents were asked about their relationship with and activity on each of the sites they used, as well as their attitudes regarding the COVID pandemic. The sample was 43 percent male and 56 percent female (with 1 percent "other" or declining to identify) and well-represented across age groups: 23 percent age 18 to 24, 24 percent age 25 to 34, 22 percent age 35 to 44, 13 percent age 45 to 54, 9 percent age 55 to 64, and 9 percent age 65+.

For the final models, ratings of the five focal brands were "stacked" for analysis (i.e., each row represents a unique combination of respondent and brand), resulting in a final data file of 783 records. Approximately 50 percent of the respondents had purchased from only one of the five sites in the past six months, 33 percent had purchased from two, 10 percent from three, 5 percent from four, and 2 percent from all five.

METHOD

To accommodate the cross-nested structure of the data (i.e., respondents within brands and brands within respondents), we used PROC MIXED in SAS to perform Hierarchical Cross-Classified modeling (HCM), which fits both fixed and random effects (Singer 1998). HCM is an extension of multilevel marketing. In this case, we are treating the respondents as level 1 units and the brands as level 2. HCM allows the level 1 units to belong to multiple non-nested level 2 units. We estimate random intercepts for both brand and respondent to account for dependence among the observations within these cross-classified units.

Because we are interested in latent constructs, such as the three components of engagement (Hollebeek et al. 2014), we use Principal Components Analysis (PCA) with a varimax rotation to calculate factor scores based on the original survey measures for inclusion in our hierarchical models. PCA is also used to estimate factors based on the COVID attitudinal measures. Since the data are hierarchically organized (i.e., "stacked"), each case represents the rating of a brand, and most respondents provide multiple brand ratings. When a respondent provides multiple ratings, variables relating to the respondent (e.g., COVID attitudes) appear on each rating provided by that respondent, resulting in redundant information at the rating level. Thus, the PCA of COVID attitudes is performed at the respondent level (N = 446), with the factor scores appended to the rating level data by respondent ID. The engagement PCA is based on unique brand ratings, thus these scores are calculated at the rating level (N = 783).

MEASURES

Descriptive statistics for the original survey measures are presented in Table 1.

The likelihood to recommend is the dependent variable of the analysis. This variable was measured in the survey using an 11-point scale, where 0 = Definitely would not recommend and 10 = Definitely would recommend. As the basis for Net Promoter Score (Reichheld 2003), it is an important key performance indicator (KPI) used by many firms to assess the overall quality of customers' relationships with the brand (Safdar and Pacheco 2019).

COVID Attitude Measures

The survey included nine statements related to respondents' opinions and attitudes toward the COVID pandemic and the response of public health and government officials to the pandemic. The questions were adapted from Fetzer et al.

TABLE 1. Descriptive Statistics

Respondent Level Variables	N	Mean	Standard Deviation	Minimum	Maximum
Do you think the reaction of your country's government to the current coronavirus outbreak is not sufficient, appropriate, or too extreme?	446	2.77	1.31	1	5
How much do you trust your country's government to take care of its citizens?	446	3.04	1.28	1	5
How factually truthful do you think your country's government has been about the coronavirus outbreak?	446	3.13	1.30	1	5
Do you think the reaction of your country's public is not sufficient, appropriate, or too extreme?	446	3.00	1.29	1	5
How effective are social distancing measures (e.g., through a general curfew) to slow down the spread of the coronavirus?	446	3.71	1.12	1	5
To which extent do the following statements apply to you right now? —I am nervous when I think about current circumstances	446	3.62	1.16	1	5
To which extent do the following statements apply to you right now? —I am worried about my health	446	3.56	1.20	1	5
To which extent do the following statements apply to you right now? —I am worried about the health of my family member(s)	446	3.77	1.16	1	5
To which extent do the following statements apply to you right now? —I feel stressed about leaving my house	446	3.36	1.28	1	5
Brand Rating Level Variables	**N**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**
Using [brand] gets me to think about [brand]	783	5.07	1.54	1	7
I think about [brand] a lot when I'm using it	783	4.93	1.59	1	7
Using [brand] stimulates my interest to learn more about [brand]	783	4.77	1.59	1	7
I feel very positive when I use [brand]	783	5.29	1.46	1	7
Using [brand] makes me happy	783	5.20	1.45	1	7
I feel good when I use [brand]	783	5.18	1.48	1	7
I'm proud to use [brand]	783	5.17	1.53	1	7
I spend a lot of time using [brand], compared to other online shopping sites	783	5.00	1.63	1	7
Whenever I'm shopping online, I usually use [brand]	783	4.89	1.62	1	7
[brand] is one of the sites I usually use when I shop online	783	5.00	1.66	1	7

(2020) as well as a COVID survey conducted by Cornell Health.[1] For each statement, respondents were asked to respond using a five-point scale:

- Do you think the reaction of your country's government to the current coronavirus outbreak is appropriate, too extreme, or not sufficient? (1 = not at all sufficient, 2 = somewhat insufficient, 3 = appropriate, 4 = somewhat too extreme, 5 = much too extreme)
- How much do you trust your country's government to take care of its citizens? (1 = strongly distrust, 2 = somewhat distrust, 3 = neither trust nor distrust, 4 = somewhat trust, 5 = strongly trust)
- How factually truthful do you think your country's government has been about the coronavirus outbreak? (1 = very untruthful, 2 = somewhat untruthful, 3 = neither truthful not untruthful, 4 = somewhat truthful, 5 = very truthful)
- Do you think the reaction of your country's public is appropriate, too extreme, or not sufficient? (1 = not at all sufficient, 2 = somewhat insufficient, 3 = appropriate, 4 = somewhat too extreme, 5 = much too extreme)
- What do you think: How effective are social distancing measures (e.g., through a general curfew) to slow down the spread of the coronavirus? (1 = not at all effective, 2 = not effective, 3 = neither effective nor ineffective, 4 = effective, 5 = very effective)
- To which extent do the following statements apply to you right now? I am nervous when I think about current circumstances (1 = does not apply at all, 2 = somewhat does not apply, 3 = neither applies nor does not apply, 4 = somewhat applies, 5 = strongly applies)
- To which extent do the following statements apply to you right now? I am worried about my health. (1 = does not apply at all, 2 = somewhat does not apply, 3 = neither applies nor does not apply, 4 = somewhat applies, 5 = strongly applies)
- To which extent do the following statement apply to you right now? I am worried about the health of my family member(s). (1 = does not apply at all, 2 = somewhat does not apply, 3 = neither applies nor does not apply, 4 = somewhat applies, 5 = strongly applies)
- To what extent does the following statement apply to you right now? I feel stressed about leaving my house. (1 = does not apply at all, 2 = somewhat does not apply, 3 = neither applies nor does not apply, 4 = somewhat applies, 5 = strongly applies)

These nine statements were analyzed using PCA with varimax rotation and resulted in three orthogonal factors: COVID anxiety, COVID reaction, and COVID trust (Table 2).

Three factors were selected as the appropriate number based on three eigenvalues greater than one. Cronbach's alpha, composite reliability and average variance extracted (AVE) for each of the sets of loading variables are also

[1] https://health.cornell.edu/COVID-19-survey-data-tables.

TABLE 2. Rotated Factor Loadings for Principal Components Analysis of COVID Attitude Measures (N = 446)

Description	Factor 1 Anxiety	Factor 2 Trust	Factor 3 Reaction
To which extent do the following statements apply to you right now? —I am nervous when I think about current circumstances	**0.851**	–0.058	–0.079
To which extent do the following statements apply to you right now? —I am worried about my health	**0.809**	0.173	–0.110
To which extent do the following statements apply to you right now? —I am worried about the health of my family member(s)	**0.792**	–0.049	–0.144
To which extent do the following statements apply to you right now? —I feel stressed about leaving my house	**0.773**	0.133	0.033
How effective are social distancing measures (e.g., through a general curfew) to slow down the spread of the coronavirus?	0.245	**0.777**	–0.192
How much do you trust your country's government to take care of its citizens?	–0.061	**0.771**	0.362
How factually truthful do you think your country's government has been about the coronavirus outbreak?	–0.008	**0.770**	0.387
Do you think the reaction of your country's government to the current coronavirus outbreak is not sufficient, appropriate, or too extreme?	–0.089	0.105	**0.863**
Do you think the reaction of your country's public is not sufficient, appropriate, or too extreme?	–0.110	0.177	**0.862**
Cronbach's Alpha (Standardized)	0.828	0.718	0.765
Composite Reliability	0.882	0.816	0.853
Average Variance Extracted	0.651	0.597	0.744

presented in the table. All alphas exceeded the standard cut-off value of 0.7, all composite reliability scores exceeded 0.8 and AVE > 0.5 for all sets.

Engagement Measures

The engagement measures for this study are taken from the scale developed and validated by (Hollebeek et al. 2014). These measures include ten statements:

1. I'm proud to use [brand]
2. I feel good when I use [brand]
3. Using [brand] makes me happy
4. I feel very positive when I use [brand]
5. Whenever I'm shopping online, I usually use [brand]
6. [brand] is one of the sites I usually use when I shop online
7. I spend a lot of time using [brand], compared to other online shopping sites
8. I think about [brand] a lot when I'm using it
9. Using [brand] gets me to think about [brand]
10. Using [brand] stimulates my interest to learn more about [brand]

The first four statements are intended to measure the affection component of customer brand engagement. Statements 5 to 7 measure the activation component, and statements 8 to 10 measure the cognitive processing component. Respondents rated each statement using a seven-point agreement scale, where 1 = strongly disagree, 2 = disagree, 3 = somewhat disagree, 4 = neither agree nor disagree, 5 = somewhat agree, 6 = agree, and 7 = strongly agree.

These ten statements were included in a PCA with varimax rotation specifically set to produce three factors based on prior validation of the scale. The variables loaded on the appropriate factors, consistent with the previous literature. The Cronbach alpha and composite reliability values for each subset all exceeded 0.8; for each subset AVE > 0.6 (Table 3).

These engagement factors are used as independent variables in the likelihood to recommend model.

HYPOTHESES

Brodie et al. (2013) identify several consumer engagement consequences. Among them is increased customer loyalty. One of the most prevalent metrics used by brands to gauge consumer loyalty is the Net Promoter Score (Reichheld 2003), which is an aggregate measure based on individual level responses to the likelihood to recommend scale. While a positive relationship between customer engagement and likelihood to recommend is strongly suggested by the extant literature, the impact of customer engagement on loyalty outcomes is known to be highly context dependent (Fernandes and Esteves 2016; Hollebeek 2011). The physical, logistical, and legal constraints of the COVID-19 pandemic and

TABLE 3. Rotated Factor Loadings for Principal Components Analysis of Customer Engagement Measures (N = 783)

	Factor 1 Affection	Factor 2 Activation	Factor 3 Cognitive Processing
I'm proud to use [brand]	**0.838**	0.262	0.252
I feel good when I use [brand]	**0.831**	0.280	0.322
Using [brand] makes me happy	**0.747**	0.365	0.320
I feel very positive when I use [brand]	**0.679**	0.436	0.311
Using [brand] gets me to think about [brand]	0.262	**0.813**	0.307
I think about [brand] a lot when I'm using it	0.316	**0.795**	0.301
Using [brand] stimulates my interest to learn more about [brand]	0.392	**0.739**	0.198
Whenever I'm shopping online, I usually use [brand]	0.287	0.270	**0.847**
[brand] is one of the sites I usually use when I shop online	0.372	0.183	**0.818**
I spend a lot of time using [brand], compared to other online shopping sites	0.241	0.402	**0.770**
Cronbach's Alpha (Standardized)	0.920	0.898	0.873
Composite Reliability	0.858	0.826	0.853
Average Variance Extracted	0.603	0.613	0.660

their associated psychological and emotional impacts on consumers create a new context in which e-commerce platforms must engage with consumers.

Hollebeek (2011) suggests several possible effects of COVID-19 on the customer engagement-loyalty relationship through the aforementioned typology. Consumers have certainly been presented with additional reasons to engage with e-commerce platforms during the pandemic, so the opportunity for more engagement naturally begets an opportunity to increase customer loyalty. Fundamentally, we expect that the positive relationship between engagement and loyalty should remain, thus we propose the following:

H1: Customer brand engagement with e-commerce platforms will have a positive effect on loyalty (measured as likelihood to recommend) to those e-commerce platforms during the COVID-19 pandemic.

However, the nature of customer interactions with e-commerce platforms during the pandemic may mitigate or enhance this relationship. In particular, consumers' attitudes about the pandemic and the restrictions imposed by local governments may alter their perception of these interactions, making them feel more or less engaged with the brand. To the extent the pandemic is making consumers more anxious and/or fearful, we expect that their engagement with e-commerce platforms is perceived as more forced than chosen; that they may prefer to shop at physical locations under safer circumstances, but are resigned to shop online to protect themselves and their families.

Thus, we propose the following:

H2: COVID anxiety will have a negative moderating effect on the relationship between customer brand engagement and customer loyalty (measured as likelihood to recommend).

Similarly, consumers who feel that public health measures and government enforced lockdowns are excessive or ineffective at controlling the spread of COVID may turn to e-commerce only begrudgingly, thus mitigating the effect of engagement on loyalty.

Thus, we propose the following:

H3: An assessment by a consumer that the public health measures are too extreme will have a negative moderating effect on the relationship between customer brand engagement with e-commerce platforms and loyalty (measured as likelihood to recommend).

Lastly, we expect that consumers that trust in the efficacy of social distancing to prevent the spread of the virus and who find the information they are receiving from public health and government sources as trustworthy will be more likely to eschew shopping at traditional brick-and-mortar retailers and, consequently, to be more engaged with online shopping. Thus, we propose the following:

H4: A greater level of trust in the COVID-related information provided by public health and government officials will enhance the positive effect of customer brand engagement on loyalty (measured as likelihood to recommend).

FIGURE 1. Conceptual Model and Hypotheses

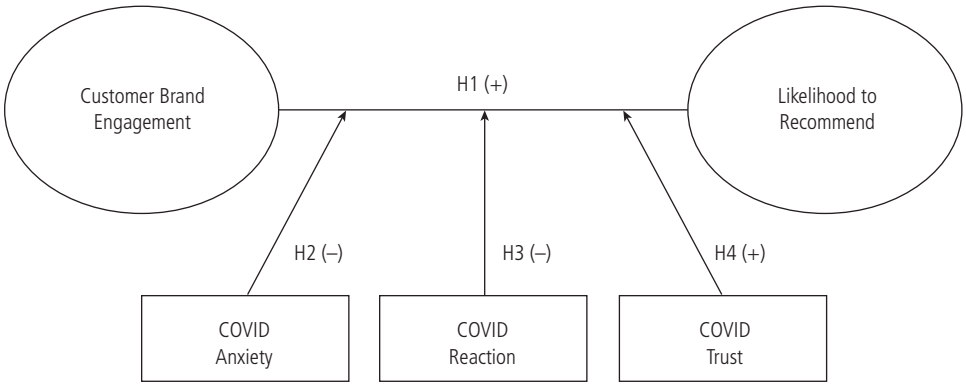

Figure 1 presents a summary of our conceptual model and hypotheses.

FINDINGS

As part of the exploratory analysis of this data, we analyzed the bivariate correlation of the engagement constructs with customers' COVID-19 attitudes. The results of this analysis are presented in Table 4.

COVID anxiety demonstrates significant, but weak, relationships with all three components of engagement. Both COVID reaction and COVID trust demonstrate only weak or statistically insignificant correlations with all of the engagement constructs, indicating that COVID attitudes are not particularly strong drivers of customer engagement with these e-commerce platforms.

Results of the HCM models analyzing the effects of engagement on loyalty, as well as the moderating effects of COVID attitudes on that relationship, are presented in Table 5.

Model 1 evaluates the effect of engagement on loyalty for these e-commerce platforms during the pandemic. The coefficients presented in the table are standardized. As expected, all of the customer engagement constructs demonstrate significant and positive effects on loyalty, consistent with previous research, thus supporting H1. Affection exhibits the strongest effect on loyalty among the three engagement components ($\beta = 0.3701$). The pseudo R-square for the model, based on the proportional reduction in variance is 29.7 percent. The random intercept for brand is not significant, indicating that the observed effects are consistent across the five platforms included in the study.

TABLE 4. Pearson Correlations of COVID Attitudes with Engagement Dimensions

	CP		Affection		Activation	
COVID Anxiety	0.21492	***	0.29343	***	0.17158	***
COVID Reaction	0.15837	***	–0.00334		0.16313	***
COVID Trust	0.04232		0.03678		0.12081	***

*p < .05, ** p < .01, ***p < .001

TABLE 5. Hierarchical Cross-Classified Model of Customer Engagement and COVID Attitudes on Recommend Intention (Standardized Coefficients)

	DV = Recommend Intention					
Fixed Effects	**Model 1**		**Model 2**		**Model 3**	
Intercept	–0.07089	***	–0.07039	***	–0.07366	***
	(0.06797)		(0.06691)		(0.06856)	
Engagement: Cognitive Processing (CP)	0.2511	***	0.2478	***	0.2473	***
	(0.02742)		(0.02813)		(0.02961)	
Engagement: Affection	0.3701	***	0.3576	***	0.3632	***
	(0.02859)		(0.02971)		(0.03118)	
Engagement: Activation	0.1654	***	0.1613	***	0.1773	***
	(0.03137)		(0.0323)		(0.03302)	
COVID Anxiety			0.06527		0.03848	
			(0.0397)		(0.04062)	
COVID Reaction			–0.08252	*	–0.0924	*
			(0.03758)		(0.03856)	
COVID Trust			0.004861		0.001501	
			(0.03755)		(0.03817)	
Interactions						
CP*COVID Anxiety					–0.057	*
					(0.02692)	
CP*COVID Reaction					–0.00656	
					(0.02833)	
CP*COVID Trust					0.01728	
					(0.02785)	
Affection*COVID Anxiety					–0.05787	*
					(0.02837)	
Affection*COVID Reaction					–0.02933	
					(0.02782)	
Affection*COVID Trust					0.05502	*
					(0.02552)	
Activation*COVID Anxiety					0.05592	
					(0.03069)	
Activation*COVID Reaction					0.0722	*
					(0.03068)	
Activation*COVID Trust					0.07839	**
					(0.02964)	
Random Effects						
Intercept, Brand	0.01406		0.01341		0.01359	
	0.01402		0.01355		0.01333	
Intercept, ID	0.4166	***	0.4116	***	0.4035	***
	0.04613		0.04597		0.04519	
Residual	0.3049	***	0.3042	***	0.2951	***
	0.02421		0.02419		0.02366	
Fit Statistics						
Pseudo R-Square	29.70%		30.30%		32.00%	

*p < .05, ** p < .01, ***p < .001

Model 2 adds the COVID attitudes as main effects on loyalty. Only COVID reaction is significant, demonstrating a small negative effect on loyalty ($\beta = -0.0825$). There is some very mild attenuation of the coefficients of the engagement constructs, but not sufficient to suggest any meaningful level of mediation.

Model 3 provides our tests of H2, H3, and H4 by including multiplicative interaction terms between the COVID attitude and engagement constructs. COVID anxiety demonstrates significant negative interactions with cognitive processing (CP) and affection, but no significant effect on activation. But as affection and CP are stronger determinants of loyalty than activation, H2 is supported: COVID anxiety mitigates the positive impact of these components of engagement on loyalty. COVID reaction also moderates the effect of engagement but demonstrates only a small positive interaction with the activation component. This effect is counter to our reasoning and expectations, thus H3 is not supported. Lastly, COVID trust demonstrates significant positive interactions with both affection and activation, supporting H4. In summary, there is strong evidence that COVID attitudes alter the context of the engagement-loyalty relationship, albeit sometimes in unexpected ways. A summary of the hypothesis tests and results is provided in Table 6.

DISCUSSION

The intensive and prolonged impact of pandemic rapidly reshapes the way customers shop and behave. More home-bound activities accelerate digitalization and generate new opportunities for customer engagement. As the impact of customer engagement on loyalty outcomes is highly context dependent, the physical, logistical, and legal constraints of the COVID-19 pandemic and their associated psychological and emotional impacts on consumers have created a new context in which e-commerce platforms must engage with consumers. Using survey questions adopted from Fetzer et al. (2020) and a COVID survey conducted by Cornell Health, three dimensions of COVID attitude—COVID anxiety, COVID reaction, and COVID trust—were extracted using PCA to formulate this new

TABLE 6. Hypothesis Testing Results

No.	Hypothesis	Hypothesis Supported?
H1	Customer brand engagement with e-commerce platforms will have a positive effect on loyalty (measured as likelihood to recommend) to those e-commerce platforms during the COVID-19 pandemic.	Yes
H2	COVID anxiety will have a negative moderating effect on the relationship between customer brand engagement and customer loyalty (measured as likelihood to recommend).	Yes
H3	An assessment by a consumer that the public health measures are too extreme will have a negative moderating effect on the relationship between customer brand engagement with e-commerce platforms and loyalty (measured as likelihood to recommend).	No
H4	A greater level of trust in the COVID-related information provided by public health and government officials will enhance the positive effect of customer brand engagement on loyalty (measured as likelihood to recommend).	Yes

context. Including the extracted components in Hierarchical Cross-Classified regression models, this research creates a new vision for the relationship between customers' COVID-19 attitudes and engagement construct and their moderating effects toward the impact of customer brand engagement on customer loyalty.

This work makes three primary contributions. First, it validates the importance of context in assessing the relationship of engagement with loyalty outcomes. Along with the continuing impact of the COVID pandemic on customer behavior, the nature of customer engagement becomes different, and consequently, the effects of engagement necessarily vary as well. All three of the dimensions of COVID attitudes have significant effects on the relationship between customer engagement and customer loyalty. To the best of our knowledge, no extant research has theorized the impact of COVID attitudes in the customer engagement context. The empirical findings in this work illuminate a developing understanding of engagement under the continuing global pandemic.

Second, it adds to the existing theory on customer engagement consequences by investigating the interaction effects of COVID attitude on the positive impact of customer engagement on loyalty outcomes. COVID anxiety is found to mitigate the positive impact of customer engagement constructs on loyalty (measured as likelihood to recommend). When customers are more fearful and anxious about COVID, they will voluntarily choose to avoid physical stores and shop online. Such self-protection behavior makes their engagement with e-commerce platforms perceived as more forced than chosen, which could explain the lower level of intention to recommend the e-commerce sites. COVID reaction is demonstrating a significant negative effect on loyalty, and we anticipate COVID reaction to have similar moderating effect as COVID anxiety. If customers feel the public health measures and government enforced lockdowns are excessive, they may turn to e-commerce only begrudgingly. However, the model output did not demonstrate significant impact. Our findings also exhibit sufficient evidence on the enhancing effect of COVID trust. A greater level of trust in the COVID-related information provided by public health and government officials will strengthen the positive effect of customer brand engagement on loyalty. Trust in government is founded on citizens' perceptions of its competence and intent (Chew et al. 2021). Government actions and interactions with constituents—such as delivering services, enforcing regulations, and rapid transition to digitalization—increase the public trust. Simultaneously, people's growing trust and confidence in governments' measures and strategy to mitigate the impact of pandemic effectively motivate customers to accept and adapt to this new norm of online shopping, which strengthen the impact of engagement on loyalty outcome.

Third, the findings have practical implications for e-commerce sites to revise their customer engagement initiatives. Customers' expanding online shopping habits developed during pandemic stimulate the sales for those online shopping sites, which can be reflected through the significant and positive impacts of all of the customer engagement constructs on recommend intention. For e-commerce sites, an updated framework for digital engagement will play a significant role in improving customer brand relationship and creating loyalty outcomes. In addition to knowing customer needs, the findings in this work also highlight the importance of knowing their attitude toward public situation and government's strategy and responses.

LIMITATIONS AND FUTURE RESEARCH

The current research focused on only five (albeit prominent) e-commerce platforms. As such, the results are representative only of customers of these platforms. Future research should examine the customer engagement-loyalty linkage among a broader set of e-commerce and traditional retailers. Attitudes toward COVID are likely to have effects in traditional retail as well.

In addition, our analysis focused on only one specific outcome: likelihood to recommend. And while we have argued for its appropriateness as a general barometer of the health of the customer-brand relationship, it is clearly just one metric, and one that captures more of the attitudinal dimension of customer loyalty without a strong linkage to customer behavior. Future research should investigate the impact of attitudes toward COVID (and other pandemics) on the effect of customer engagement on behavioral outcomes as well.

Lastly, these results represent a snapshot in time, during which the COVID pandemic was still raging uncontrollably in the United States and before vaccinations were readily available to the general population. Consumers' attitudes toward COVID will change in response to the evolution of the pandemic, and as this research demonstrates, the context of the customer engagement, as defined by the psychological and emotional state of consumers, as well as the actions of brands, has a significant impact on the linkage between engagement and loyalty.

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The Impact of COVID-19 on Global Import and Export Trade

Rui Wang

Yanying Mo

Abstract

Motivation: This article discusses the impact of COVID-19 on import and export trade, and what roles the degree of epidemic spread, the degree of malignancy, and the governments' epidemic prevention and control responses have played in the waves of COVID-19 infections.

Premise: Since the beginning of 2020, COVID-19 has had a huge impact on the world health system and has profoundly affected the global economy and import and export trade. The volume of import and export trade in most countries around the world has experienced a significant decline. The global supply chain system has suffered huge challenges due to the epidemic, its management, and each country's governmental response.

Approach: This article describes the spread and development of COVID-19 and its phased impact on international trade. This article also discusses the impact mechanism of the epidemic on international import and export trade and the global supply chain system. The study uses trend analysis and fixed effects models to analyze the influence factor on import and export trade of nine major economies (the United States, China, the United Kingdom, Germany, Italy, Japan, Canada, India, and Australia) in 2020.

Results: This study explores COVID-19's effects on international import and export trade. It estimates the impact of COVID-19 on the import and export trade of each country, discussing the relationship between the whole epidemic situation, the number of epidemic infections and deaths, and how governments responded to international trade in this epidemic. The study also groups nine countries from four aspects and analyzes the differences in the impact of import and export trade among different groups.

Conclusion: This study has found that for most countries, the COVID-19 epidemic had greater impact on the import trade than export trade. The number of deaths caused by the epidemic had a greater impact on import and export trade than the number of epidemic infections. Each government's epidemic prevention and control policy had a negative impact on the import and export trade.

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Discovering appropriate policies that could reduce the impact on the economy while preventing and controlling an epidemic is of great importance. The further impact of COVID-19 might change the global industrial layout in the future, but the global supply chain system will not experience huge changes in the short term.

Consistency: This research explores the fluctuations and the recovery cycles of the international trading system. The quantitative analysis finds out the negative effects of regional control policies and mobility restriction policies in different countries. It contributes to the business for coping with sudden risks in international supply chain system.

Keywords: COVID-19, government response, import and export trade

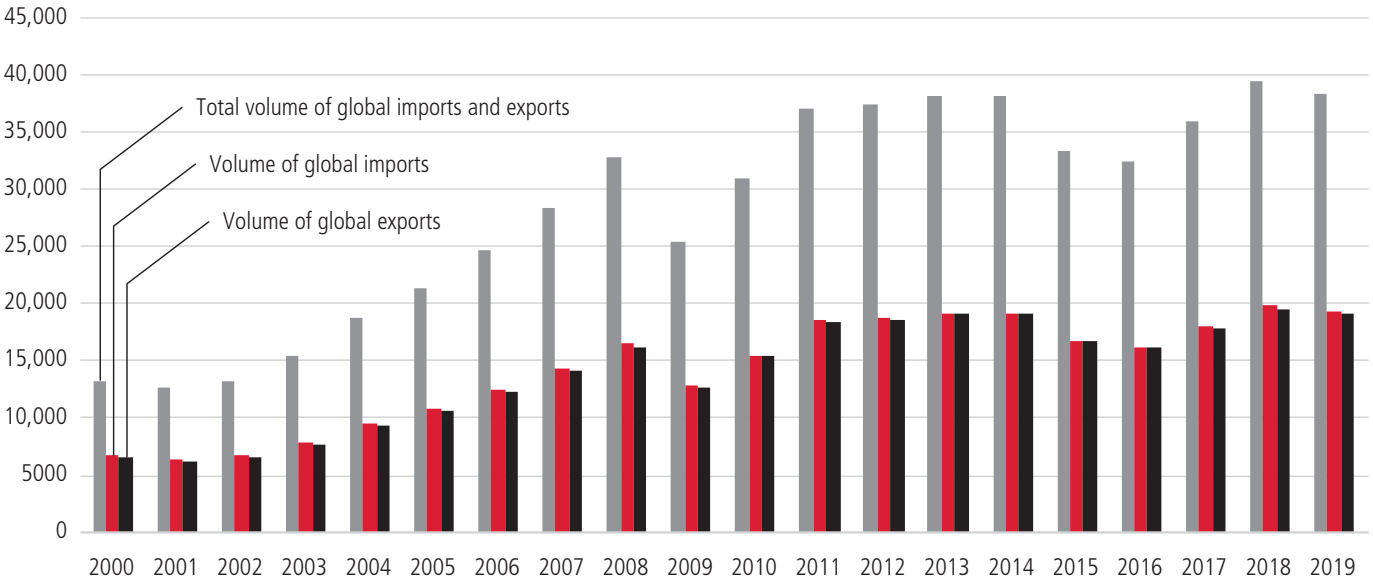
JEL Classification Codes: F14, F17

INTRODUCTION

At the beginning of 2020, the coronavirus pandemic broke out and became an ongoing global pandemic within a few months. As of May 16, 2021, there had been more than 160 million cases and 3.3 million total deaths worldwide, which has profoundly changed both the social economy and people's everyday lives. The economic operation and import and export trade of all countries in the world have been significantly affected. The COVID-19 pandemic has impacted global economic and trade activities from different perspectives, including, but not limited to, business shutdowns, reductions in daily consumption of residents, stricter customs quarantines, and rising logistics costs.

Figure 1 illustrates the changes in global import and export trade volume from 2000 to 2019. In the past 20 years, with the acceleration of global economic integration, the international multilateral trading system has been gradu-

FIGURE 1. Volume of Global Imports and Exports, 2000 to 2019 (in Billions of USD)



Source: Data from The World Bank.

ally improving, regional economic cooperation has been continuously strengthened, the global industrial chain and the international industrial division of labor have been constantly optimized, and international import and export trade has generally shown a trend of rapid development. In 2019, the total amount of global import and export trade reached $38.4 trillion, showing an increase of 191 percent compared to $13.2 trillion in 2000. Since 2007, although international import and export trade has been affected by global events several times, such as the financial crisis, Sino–U.S. trade war, and so on, leading to the decreasing growth rate and even decline in some years, international import and export trade still maintained an upward tendency. The structure of global trade integration and global industry chain has not been fundamentally changed. The international import and export trade is still an important pillar of world economic development.

Under such circumstances, the influences of the COVID-19 pandemic will not be contained within each country, they will spread throughout the global industrial chain. The systemic impact of the COVID-19 pandemic on the global economy will first be reflected in the international merchandise import and export trade. Research on the changes in the global and major trading countries' merchandise imports and exports since the outbreak will be helpful to better understand the impact of the coronavirus pandemic on global economy.

The study selects the 15 countries with the highest total volume of import and export trade in Table 1. However, it has been found that some countries, including France and New Zealand, are seriously short of data. The import and export data of other countries in 2020 were not updated at the time of this study. Therefore, we temporarily excluded these countries, which need to be further investigated in the future research. In addition, due to the similar geographical location and similar structure of import and export between Australia and New Zealand, we include Australia in the study as a supplement.

TABLE 1. Top 15 Countries in Total Import and Export Volume in 2019

Ranking	Country	Total Exports and Imports (USD)
1	China	4.57E + 12
2	United States	4.21E + 12
3	Germany	2.73E + 12
4	Japan	1.43E + 12
5	France	1.2E + 12
6	United Kingdom	1.16E + 12
7	China and Hong Kong	1.11E + 12
8	Netherlands	1.09E + 12
9	Republic of Korea	1.05E + 12
10	Italy	1.01E + 12
11	Mexico	9.16E + 11
12	Canada	8.99E + 11
13	India	8.02E + 11
14	Singapore	7.49E + 11

STAGES OF COVID-19 DEVELOPMENT AND THE IMPACT TO GLOBAL IMPORT AND EXPORT TRADE

It has been more than one year since the first COVID-19 outbreak. During this period, governments have taken various measures to prevent the further spread of the epidemic and ease the impact of the epidemic on the economy.

The toll of the COVID-19 pandemic is shown in Table 2 and Table 3. The measures taken by each country and the epidemic's impact on social activities and global economies can be divided into four stages, described next. Due to the inter-country differences in the speed of disease spreading, the response policies, and the economic impacts, there are correspondingly some differences in COVID timeline in each country. Some countries even skipped certain stages. Therefore, the four stages in this study are based on the overall situation of the epidemic's spread and its impact around the world.

The First Stage (Early 2020 to Late February 2020)

The first stage refers to the initial outbreak stage of the epidemic: In January 2020, the COVID-19 pandemic broke out in China and showed explosive growth. The number of confirmed cases in February in China was nearly 7 times what it was in January. What's more, the number of confirmed cases in China accounted for more than 90 percent of the world's total. To prevent further spread of the epidemic, the Chinese government took strict measures, including quarantine and lockdown. A large number of companies suspended work and production. In those two months, the economy in China was practically at a standstill. Meanwhile, some sporadic cases appeared in other countries, though many believed that the COVID-19 epidemic would be confined to China. This point of view was blindly optimistic (Peterson and Arun 2020). During these two months the main impact of the epidemic on the economy was indeed due to

TABLE 2. Monthly COVID-19 Confirmed Cases

	Global	United States	China	Japan	Italy	Germany	United Kingdom	India	Australia	Canada
Jan. 2020	9.93E + 03	8.00E + 00	9.81E + 03	1.50E + 01	2.00E + 00	5.00E + 00	2.00E + 00	1.00E + 00	9.00E + 00	4.00E + 00
Feb. 2020	7.61E + 04	1.70E + 01	6.96E + 04	2.30E + 02	1.13E + 03	7.40E + 01	5.90E + 01	2.00E + 00	1.60E + 01	1.60E + 01
Mar. 2020	7.96E + 05	1.92E + 05	3.21E + 03	2.01E + 03	1.05E + 05	7.17E + 04	3.88E + 04	1.39E + 03	4.53E + 03	8.51E + 03
Apr. 2020	2.42E + 06	8.89E + 05	1.78E + 03	1.20E + 04	9.97E + 04	9.12E + 04	1.40E + 05	3.35E + 04	2.21E + 03	4.59E + 04
May 2020	2.91E + 06	7.18E + 05	2.03E + 02	2.47E + 03	2.75E + 04	2.04E + 04	7.88E + 04	1.56E + 05	4.36E + 02	3.80E + 04
Jun. 2020	4.27E + 06	8.43E + 05	6.44E + 02	1.86E + 03	7.58E + 03	1.20E + 04	2.77E + 04	3.95E + 05	7.18E + 02	1.36E + 04
Jul. 2020	7.15E + 06	1.93E + 06	2.89E + 03	1.76E + 04	6.96E + 03	1.50E + 04	1.96E + 04	1.11E + 06	9.36E + 03	1.22E + 04
Aug. 2020	7.91E + 06	1.46E + 06	2.28E + 03	3.22E + 04	2.17E + 04	3.44E + 04	3.33E + 04	2.00E + 06	8.54E + 03	1.26E + 04
Sep. 2020	8.52E + 06	1.21E + 06	6.57E + 02	1.52E + 04	4.56E + 04	4.81E + 04	1.18E + 05	2.62E + 06	1.28E + 03	3.02E + 04
Oct. 2020	1.22E + 07	1.93E + 06	8.62E + 02	1.77E + 04	3.65E + 05	2.39E + 05	5.59E + 05	1.87E + 06	4.99E + 02	7.62E + 04
Nov. 2020	1.73E + 07	4.50E + 06	1.66E + 03	4.76E + 04	9.22E + 05	5.38E + 05	6.19E + 05	1.28E + 06	3.17E + 02	1.44E + 05
Dec. 2020	2.03E + 07	6.43E + 06	3.19E + 03	8.68E + 04	5.06E + 05	6.91E + 05	8.62E + 05	8.04E + 05	5.13E + 02	2.03E + 05
Jan. 2021	1.95E + 07	6.15E + 06	4.21E + 03	1.54E + 05	4.46E + 05	4.65E + 05	1.33E + 06	4.91E + 05	3.93E + 02	1.99E + 05
Feb. 2021	1.12E + 07	2.40E + 06	9.46E + 02	4.19E + 04	3.72E + 05	2.25E + 05	3.61E + 05	3.55E + 05	1.60E + 02	8.80E + 04

TABLE 3. Monthly Deaths Toll from COVID-19

	Global	United States	China	Japan	Italy	Germany	United Kingdom	India	Australia	Canada
Jan. 2020	2.13E + 02	0.00E + 00	2.13E + 02	0.00E + 00	0.00E + 00	0.00E + 00	0.00E + 00	0.00E + 00	0.00E + 00	0.00E + 00
Feb. 2020	2.73E + 03	1.00E + 00	2.63E + 03	6.00E + 00	2.90E + 01	0.00E + 00	0.00E + 00	0.00E + 00	0.00E + 00	0.00E + 00
Mar. 2020	4.18E + 04	5.37E + 03	4.76E + 02	6.10E + 01	1.24E + 04	7.75E + 02	2.46E + 03	3.50E + 01	1.80E + 01	1.52E + 02
Apr. 2020	1.94E + 05	6.09E + 04	1.33E + 03	4.14E + 02	1.55E + 04	5.85E + 03	2.43E + 04	1.12E + 03	7.50E + 01	4.03E + 03
May 2020	1.38E + 05	4.16E + 04	2.00E + 00	4.17E + 02	5.45E + 03	1.92E + 03	1.08E + 04	4.25E + 03	1.00E + 01	3.73E + 03
Jun. 2020	1.33E + 05	1.98E + 04	3.00E + 00	7.40E + 01	1.35E + 03	4.50E + 02	2.95E + 03	1.20E + 04	1.00E + 00	8.74E + 02
Jul. 2020	1.67E + 05	2.65E + 04	2.00E + 01	3.60E + 01	3.74E + 02	1.57E + 02	7.95E + 02	1.91E + 04	9.70E + 01	2.45E + 02
Aug. 2020	1.76E + 05	2.96E + 04	6.20E + 01	2.90E + 02	3.42E + 02	1.56E + 02	3.15E + 02	2.88E + 04	4.56E + 02	1.68E + 02
Sep. 2020	1.64E + 05	2.34E + 04	1.60E + 01	2.77E + 02	4.11E + 02	1.92E + 02	6.44E + 02	3.34E + 04	2.31E + 02	1.98E + 02
Oct. 2020	1.82E + 05	2.45E + 04	0.00E + 00	1.94E + 02	2.72E + 03	9.88E + 02	4.41E + 03	2.34E + 04	1.90E + 01	8.85E + 02
Nov. 2020	2.75E + 05	3.92E + 04	4.00E + 00	3.07E + 02	1.70E + 04	6.21E + 03	1.19E + 04	1.55E + 04	1.00E + 00	1.96E + 03
Dec. 2020	3.54E + 05	8.10E + 04	3.90E + 01	1.22E + 03	1.86E + 04	1.71E + 04	1.51E + 04	1.11E + 04	1.00E + 00	3.52E + 03
Jan. 2021	4.12E + 05	9.71E + 04	3.60E + 01	2.46E + 03	1.44E + 04	2.34E + 04	3.27E + 04	5.65E + 03	0.00E + 00	4.28E + 03
Feb. 2021	2.97E + 05	6.51E + 04	1.90E + 01	2.14E + 03	9.18E + 03	1.30E + 04	1.67E + 04	2.77E + 03	0.00E + 00	1.95E + 03

the decline in demand for various commodities from China, especially industrial intermediate products. According to statistics, in January 2020, 17 days after the Chinese New Year holiday (from February 10, 2020), the number of workers returning from their hometown to the place they work was only 44 million, which was 111 million fewer than that in the same period in 2019 (Zheng, Fu, and Tao 2020). In January 2020, China's total export trade fell by 2.94 percent on the year-on-year basis, and the decline reached 40.61 percent in February.

During the time when Chinese enterprises lacked production, many countries also adopted import restrictions on Chinese products, more or less. The simultaneous compression of both supply and demand further contributed to the broken international production line (Shen 2020), leading the import and export trade volume of many countries to fall to different degrees.

The Second Stage (Late February 2020 to Mid-May 2020)

This was the early spread of the epidemic and the national control stage. In this stage, the COVID-19 pandemic gradually spread to various countries. The world's major economies including Japan, South Korea, the United States, the United Kingdom, France, Germany, and other countries, experienced explosive growth in the number of infections in differing time periods. Countries took different measures, including curfews and blockades, to deal with this crisis, which achieved certain results. The growth of new cases in most countries slowed down significantly between April and May 2020. Despite this, the impact of the epidemic and social distancing policies on each economy was obvious. The import and export trade volume of many countries dropped significantly, including some countries that experienced growth in mid-January and February. There proved to be some relationship between the global pandemic and the economic crisis (Aayush and Shah 2020). According to Table 4 and Table 5, in March

TABLE 4. Import Trade Volumes in 2020 (in Billions of USD)

	United States	China	United Kingdom	Germany	Japan	India	Australia	Canada	Italy
Jan. 2020	202.04	156.91	56.55	103.40	63.71	37.39	17.95	36.26	27.36
	–4.14%	*–12.67%*	*5.88%*	*10.66%*	*2.48%*	*–1.23%*	*–6.55%*	*5.21%*	*–12.77%*
Feb. 2020	183.26	142.37	64.10	96.93	54.14	39.56	18.54	36.81	40.18
	–4.16%	*7.56%*	*15.21%*	*–4.92%*	*–15.67%*	*–12.67%*	*8.85%*	*–0.17%*	*–6.62%*
Mar. 2020	199.55	164.61	36.46	105.22	57.34	17.12	20.20	25.85	36.15
	–6.56%	*–1.35%*	*–39.80%*	*–0.92%*	*4.52%*	*–59.18%*	*11.34%*	*–27.20%*	*–11.98%*
Apr. 2020	170.47	154.52	50.60	101.48	47.75	37.50	19.30	32.17	37.31
	–20.61%	*–14.41%*	*7.19%*	*–10.64%*	*–24.07%*	*–15.03%*	*11.68%*	*–10.82%*	*–0.99%*
May 2020	168.99	144.51	56.99	108.96	50.26	31.18	19.06	35.42	28.14
	–25.51%	*–16.36%*	*5.08%*	*6.06%*	*–16.66%*	*–24.03%*	*8.00%*	*0.98%*	*11.61%*
Jun. 2020	184.89	168.05	50.38	92.27	56.86	22.20	17.87	24.69	40.43
	–13.23%	*3.22%*	*–1.80%*	*15.56%*	*–3.87%*	*–38.79%*	*1.49%*	*–22.30%*	*–1.35%*
Jul. 2020	206.51	176.37	47.88	104.68	47.05	21.07	18.85	34.79	33.31
	–8.26%	*–0.78%*	*–28.95%*	*0.89%*	*–17.08%*	*–51.76%*	*–11.56%*	*–9.08%*	*–14.64%*
Aug. 2020	209.44	177.12	64.49	95.06	46.85	29.47	19.08	33.80	37.22
	–5.58%	*–1.69%*	*11.29%*	*–6.37%*	*–15.60%*	*–28.26%*	*2.97%*	*–15.46%*	*–6.47%*
Sep. 2020	212.44	203.03	54.10	93.89	59.19	30.32	17.99	34.68	41.01
	0.01%	*13.34%*	*5.13%*	*–10.61%*	*–1.45%*	*–33.14%*	*–1.79%*	*–0.46%*	*2.54%*
Oct. 2020	226.16	178.73	64.84	109.15	47.42	33.59	16.71	36.66	41.90
	0.44%	*4.72%*	*23.14%*	*0.98%*	*–20.22%*	*–16.70%*	*5.52%*	*–4.52%*	*–0.06%*
Nov. 2020	219.39	192.15	35.89	112.46	61.73	33.39	20.49	35.53	40.43
	7.12%	*4.28%*	*–40.67%*	*3.48%*	*0.10%*	*17.32%*	*30.11%*	*–6.81%*	*0.16%*
Dec. 2020	222.25	204.84	58.87	104.37	50.81	42.54	16.71	40.09	38.93
	6.86%	*7.03%*	*–1.32%*	*32.31%*	*–16.30%*	*13.93%*	*–9.15%*	*2.05%*	*–0.15%*

The percentage represents year-on-year growth rate. Data from UNCOMTRADE and China Customs, calculated and sorted by the authors.

2020, Britain's import trade volume fell by nearly 40 percent on the year-on-year basis while its export trade volume fell by 8.9 percent on the year-on-year basis. For Canada, its import trade volume fell by 32 percent and exports fell by 27 percent. In some other countries, imports and exports experienced the largest decline in April. For example, the import and export trade volume of the United States in April dropped by 20.6 percent and 29.2 percent on the year-on-year basis respectively. According to some previous research, it is not the increase in the number of confirmed cases, but the new policy formulated in response to the spread of the virus that really changed the state of economic activities (Peterson and Arun 2020).

After the epidemic in China had been controlled effectively, companies resumed work and production. Due to the rising global demand for anti-epidemic substances and the important role of China in the global industrial chain, the export trade in China gradually recovered after April and the import trade gradually recovered after June.

TABLE 5. Export Trade Volumes in 2020 (in Billions of USD)

	United States	China	United Kingdom	Germany	Japan	India	Australia	Canada	Italy
Jan. 2020	128.98	211.60	44.87	119.51	62.40	26.03	21.87	38.52	40.77
	–0.37%	*–2.94%*	*13.79%*	*6.91%*	*7.84%*	*9.62%*	*8.91%*	*3.79%*	*–5.23%*
Feb. 2020	131.99	80.38	37.07	125.63	64.55	10.27	18.08	36.24	41.78
	1.19%	*–40.61%*	*–8.50%*	*9.24%*	*5.17%*	*–63.11%*	*–25.40%*	*0.47%*	*–4.13%*
Mar. 2020	134.40	184.57	38.41	123.43	58.55	27.66	21.35	23.06	43.83
	–9.25%	*–6.89%*	*–8.94%*	*–2.10%*	*–6.15%*	*–0.80%*	*–2.10%*	*–32.63%*	*7.27%*
Apr. 2020	95.68	199.48	29.28	108.56	49.35	21.46	19.21	30.23	32.78
	–29.17%	*3.04%*	*–32.35%*	*–15.05%*	*–19.43%*	*–20.31%*	*–13.16%*	*–21.19%*	*–24.16%*
May 2020	90.58	206.43	34.68	108.45	45.21	19.18	23.02	34.45	49.38
	–36.27%	*–3.50%*	*3.01%*	*–9.92%*	*–24.19%*	*–30.65%*	*–0.90%*	*–5.69%*	*4.71%*
Jun. 2020	104.97	212.85	31.93	109.43	50.32	21.74	18.61	24.30	40.35
	–23.94%	*0.18%*	*–20.16%*	*–13.26%*	*–15.08%*	*–33.34%*	*–22.48%*	*–38.87%*	*21.67%*
Jul. 2020	112.58	236.84	36.40	117.76	48.24	23.46	20.19	35.55	48.35
	–15.20%	*6.80%*	*–3.76%*	*–8.25%*	*–30.74%*	*–9.73%*	*–10.45%*	*–8.04%*	*–5.54%*
Aug. 2020	117.96	234.36	30.40	130.19	39.01	22.71	19.59	33.46	47.33
	–14.89%	*9.07%*	*–30.08%*	*–3.00%*	*–35.99%*	*–24.14%*	*–9.37%*	*–11.44%*	*8.38%*
Sep. 2020	121.38	238.62	33.42	120.98	59.26	27.60	21.18	31.94	49.93
	–9.79%	*9.35%*	*–0.74%*	*–2.51%*	*–8.50%*	*6.42%*	*6.97%*	*–22.39%*	*7.45%*
Oct. 2020	132.40	236.26	26.85	132.54	57.48	24.93	19.71	35.09	47.50
	–6.87%	*10.93%*	*–29.53%*	*60.51%*	*–1.97%*	*–7.81%*	*–5.87%*	*–2.81%*	*6.20%*
Nov. 2020	126.85	266.93	36.88	132.92	49.70	23.55	23.77	32.77	48.43
	–7.55%	*20.54%*	*–8.74%*	*51.45%*	*–13.24%*	*–10.65%*	*10.05%*	*–11.55%*	*–6.46%*
Dec. 2020	132.47	281.83	37.03	120.16	59.25	27.15	19.87	35.95	47.27
	–2.42%	*18.10%*	*–1.09%*	*1.06%*	*–2.60%*	*5.35%*	*3.68%*	*10.94%*	*41.17%*

The percentage represents year-on-year growth rate. Data from UNCOMTRADE and China Customs, calculated and sorted by the authors.

The Third Stage (Mid-May 2020 to December 2020)

This stage was one of vicious disease growth and spread of the epidemic. Although some studies have pointed out that short-term curfews have limited effects and cannot replace long-term control policies from the perspective of preventing the spread of the pandemic (Khosrawipour et al. 2020), active intervention measures still need at least 44 days to effectively curb the development of COVID-19 (Tellis, Sood, and Sood 2020). As the growth rate of the epidemic slowed down from April to May 2020, in order to help the economy recover, most countries loosened their controls, and the epidemic rebounded significantly. After June 2020, the number of new confirmed cases had risen rapidly every month worldwide. The number of new confirmed cases worldwide in June was equivalent to 70 percent of that in the first five months of 2020. Since July 2020, the number of new confirmed cases each month has exceeded the sum of the previous 5 months in 2020. Besides, due to the seasonal factor, the number of new cases exceeded 10 million worldwide after October, and reached a peak

in December, with more than 20 million new cases per month. The epidemic had reached the most severe and darkest moment.

The rapid rebound of the epidemic made many countries, like the United Kingdom and Japan, implement multiple rounds of short-term, strict controlling measures after the first-time deregulation policy. However, as the scope of potential infections reached a certain scale and control policies were discontinuous, subsequent rounds of tightened control measures for epidemic prevention only slowed the growth rate of new infections. As a result, they failed to reduce the spread of the epidemic to a low level.

Also unfortunately, unlike China, which has achieved constant growth of import and export trade volume from June 2020 to December 2020, the relaxation of control policies has not allowed most countries to achieve such a rapid recovery after the epidemic. For the major economies, including the United Kingdom, Japan, and Germany, their export trade volumes have been declining, in contrast to the ups and downs of their import trade volumes in the same period of 2019.

The Fourth Stage (January 2021 to Present)

With the peak of the epidemic during the previous winter gone and the gradual popularization of vaccination, the number of new cases in major economies around the world has shown an obvious downward trend. This marked the preliminary control stage of the epidemic. The global economy and import and export trade have also shown a recovery. Relevant international organizations have generally held an optimistic attitude toward the economic situation in the post-epidemic era. On January 26, 2021, the International Monetary Fund (IMF) published its World Economic Outlook. According to this report, the global economy will grow by 5.5 percent in 2021, which is 0.3 percent higher than the figure predicted in October 2020. Based on the current data, the import and export trade levels of the major economies in the world have partly recovered. The improvement of the epidemic situation has led to a higher demand for goods globally. Meanwhile, due to the impact of the longer-term epidemic worldwide, the supply of goods has declined. As a result, the prices of international commodities have increased. For instance, in March 2021, the price of crude oil increased by 29 percent compared with the beginning of the year. Other commodity price increases included copper (15.7 percent), aluminum (6.7 percent), corn (13.9 percent), soybeans (5.1 percent), and soybean oil (11.6 percent). The Commodity Research Bureau (CRB) index, which refers to the level of international commodity prices, has risen 15 percent cumulatively (Zhu, Zhang, and Liu 2021). International import and export trade is expected to achieve a rapid rebound this year.

Although the economic and international trade indicators in 2021 are generally optimistic, it cannot be ignored that sudden changes may lead to deterioration. In late April 2021, the rapid deterioration of the epidemic situation in India, and the long-term lack of testing in underdeveloped areas causing the inaccurate number of confirmed cases, were potential crises for the global economy. With vaccines spreading in the post-epidemic era, how to thoroughly overcome the crisis and recover the economy still requires coordination and cooperation among countries.

HOW THE EPIDEMIC IMPACTS THE MECHANISM OF IMPORTS AND EXPORTS

The Main Impact of the COVID-19 Pandemic on Import and Export Trade Comes from the Simultaneous Reduction of Export Trade and Import Trade under the Global Supply Chain System

Due to the epidemic, employees might be absent from work if they get infected. Long-distance mobility might be restricted by quarantine and control policies. During the process of production, employees need to keep social distance, which might lead to less efficient production and fewer workers to complete contracts on time. All the above will further affect the stability of the production of intermediate products and final stage distribution both in and outside the epidemic area. Uncompleted orders reduce the trust of enterprise decision makers in the companies both inside and outside the epidemic area, which leads to a decline in new orders.

Since 1980, a global supply chain system has been gradually established. In this system, before the final products are exported to final consumers around the world, raw materials and intermediate products will be frequently distributed and transported around the world based on factors such as global labor arbitrage, cost minimization, lean inventory management, tax avoidance, and so on (Free and Hecimovic 2020). Insufficient production capacity of enterprises in the epidemic area has led to a decline in exports. At the same time, their demand for upstream raw materials and intermediate products has also decreased (Luo and Tsang 2020), which further results in a reduction in goods flowing and a shortage of supplies in countries that rely on imports.

Anti-Epidemic Policy Will Deepen Its Impact on Import and Export Trade

Due to the possibility of spreading the virus through the cold chain and goods, people involved in cross-border transportation need to be quarantined, and those imported goods need sanitary inspections by port countries, which increases the time for customs clearance and the cost of goods transportation. As a result, the structure of buyers' demand has transferred from relying on imported goods to seeking cross-border substitutes.

As the epidemic worsened, the need for medical protection products and necessities, such as food, increased. In the first quarter of 2020, China's imports of medicinal materials and medicines increased by 14.8 percent (Shen and Xu 2020). Within a week of the announcement of the epidemic, the demand for bread increased by 76 percent and the demand for vegetables increased by 52 percent (Barman, Das, and De 2021). However, in consideration of epidemic prevention and food security, many countries took measures to control or restrict export at different times. Therefore, necessities played a limited role in maintaining the level of imports and exports.

Changes in Consumer Behavior Will Also Affect Import Trade from the Side of Demand

The impact of the epidemic on consumers can affect imports indirectly through the following four aspects. First, due to the suspension of production activi-

ties of enterprises, the unemployment rate rose, and the income of residents decreased. Second, the unclear future of the epidemic brought a sense of insecurity among customers, which encouraged them to increase their savings. Third, at various times during the epidemic, cinemas, shopping malls, and restaurants were all closed. Daily consumption and entertainment needs of customers declined. Fourth, due to insufficient trust in the control of epidemics in other countries, consumers reduced the frequency of buying imported products. These four aspects all led to a decline in consumer demand and further affected the imports of commodities.[1]

MODEL

To explore the impact of the COVID-19 pandemic on the import and export of countries, this study looked at the relationship among the epidemic statistics, the COVID-19 prevention and control policies, and the impact of import and export trade. This study first applied trend decomposition and the model of autoregressive integrated moving average (ARIMA) to train the data on the monthly import and export amount of some countries. Examining data from the United States, China, United Kingdom, Germany, Japan, Canada, Italy, India, and Australia, the theoretical value of the import and export trade of these countries in 2020 can be obtained under the non-pandemic condition. This study also compared the theoretical value with the actual value of import and export of these countries in 2020 and evaluated the specific impact of COVID-19 on import and export trade. Further, through the method of fixed effects models, this study analyzed the relationship between the import and export trade volumes and the epidemic situation, characterized by the number of epidemic infections and deaths and the epidemic prevention policies.

The study used the monthly import and export data of countries from 2010 to 2020,[1] as well as the data on the epidemic prevention policies in these countries since the outbreak of the epidemic.[2]

Analyzing the Impact of Countries' Import and Export Trade through Trend Decomposition

Monthly import and export data are time series with monthly and seasonal factors. By using the trend decomposition method, it can be decomposed into a sequence of deterministic trend components, a sequence of seasonal periodic components, and a sequence of random factors, which can help us better understand the regularity of data changes for further analysis.

This article uses the X12 trend decomposition method proposed by U.S. Census Bureau. The basic idea is to use the centralized moving weighted average method to decompose item by item. The main difference from other trend decomposition methods is that its component sequence is achieved through multiple iterations and decomposition, which can decompose the time series more accurately. The basic decomposition model of the X12 method includes an addition model and a multiplication model. This article chooses to use the addition model, and the model is established as follows:

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[1]The data is from UN Comtrade Database and China Customs.

[2]The data is from a public research project called "COVID-19 Government Response Tracker," https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker.

$$Y\_I/E\_C_t = TC\_I/E\_C_t + S\_I/E\_C_t + IR\_I/E\_C_t \quad (1)$$

Where

Y_I/E_C_t	represents the original sequence of the monthly import and export data of each country from 2000 to 2019
C	represents the country
I/E	represents the import/export
t	represents the time
TC_I/E_C_t	represents the deterministic trend sequence of import and export data of various countries, which is obtained after the decomposition by the X12 method
S_I/E_C_t	is the sequence of seasonal factors
IR_I/E_C_t	is the sequence of irregular factors

After obtaining the deterministic trend series and seasonal factor series of the import and export data of these countries through the trend decomposition method, this study applied the ARIMA model for the deterministic trend series and calculated the historical average component of the seasonal factor series. The import and export value was measured and the differences between the actual values were calculated.

After decomposing the import and export data of these countries to obtain the deterministic trend series TC_I/E_C_t, this study used the augmented Dickey–Fuller (ADF) method to test the stability of the deterministic trend series, and its difference series to determine the ARIMA of the TC_I/E_C_t series. After the ADF test, the study found that all of the deterministic trend series or the difference series were stationary series. The results of the difference order d of the model in this study are shown in Table 6.

After obtaining the stationary series of TC_I/E_C_t after the difference, through the test of autocorrelation and partial correlation, this study obtained the lag autocorrelation and partial autocorrelation diagrams of each order of the series, thereby determining the lag order (p and q) of the ARIMA model to the deterministic trend TC_I/E_C_t, and establishing the ARIMA (p,d,q) model of the TC_I/E_C_t sequences (Table 7).

At the same time, this study used the monthly seasonal factor average value of the same period of the seasonal factor series S_I/E_C_t (the import and export data of these countries) to express the monthly seasonal factor expectations of the import and export data of each country. Also, according to the ARIMA model corresponding to each set of data and the monthly seasonal factor expectations, this study calculated the theoretical value of imports and exports for each country in 2020 (Table 8 and Table 9).

The Impact Factors of the Imports and Exports of Countries during the Epidemic through the Fixed Effects Model

Data and Variables

To explore the impact of the COVID-19 epidemic on the import and export trade of various countries, the article took the monthly import and export panel data of nine countries from 2011 to 2020 as the research object. The dummy

TABLE 6. Order of Stationary Sequence and ADF Test Results

Series	Difference Order	t-Statistic	Probability
$TC\_I\_USA_t$	1	–3.0962	0.0298**
$TC\_E\_USA_t$	0	–3.1379	0.0265**
$TC\_I\_CHN_t$	1	–2.7949	0.0621*
$TC\_E\_CHN_t$	1	–3.0171	0.0362*
$TC\_I\_UK_t$	1	–7.1061	0.0000***
$TC\_E\_UK_t$	1	–3.0951	0.0297**
$TC\_I\_GER_t$	0	–3.1917	0.0231**
$TC\_E\_GER_t$	0	–3.2002	0.0225**
$TC\_I\_JAP_t$	1	–3.4378	0.0116**
$TC\_E\_JAP_t$	1	–3.9012	0.0028***
$TC\_I\_CAN_t$	1	–7.7144	0.0000***
TC_E_CAN	1	–4.2604	0.0008***
$TC\_I\_ITA_t$	1	–2.7890	0.0630*
$TC\_E\_ITA_t$	1	–4.5781	0.0003***
$TC\_I\_IND_t$	1	–4.0485	0.0018***
$TC\_E\_IND_t$	1	–2.9272	0.0457**
$TC\_I\_AUS_t$	0	–2.9391	0.0443**
$TC\_E\_AUS_t$	1	–2.7300	0.0724*

The ADF test results from the stationary sequence after order difference.

*Significant values in statistics at the 1, 5, and 10 percent levels are denoted by ***, **, and *, respectively.

variable is the presence of epidemic. The increment of monthly epidemic cases and deaths and the response data of epidemic prevention and control policies from each country respectively have been used as explanatory variables by building fixed effects model.

COV This is a dummy variable. The month in which the total number of COVID-19 cases in each country exceeds 1000 is defined as 1, the other month is defined as 0. COV_STR is used to measure COVID-19 epidemic itself.

LNCASE This is the increment of monthly COVID-19 epidemic cases, taking the Ln(1 + X) transformation to the counts. It is used to measure the epidemic spreading degree.

LNDEATH This is the increment of monthly COVID-19 epidemic deaths, taking the Ln(1 + X) transformation to the counts. It is used to measure the degree of malignancy.

RESSTR This is the variable of the response data of epidemic prevention and control policies. RES_STR is used to measure intensity of epidemic prevention and control policies in various countries. It comes from The Oxford COVID-19 Government Response Tracker (OxCGRT). This study chooses the Stringency Index to represent the epidemic prevention and control policies of the governments.

TABLE 7. ARIMA model with TC_I/E_C$_t$(Δ = First Difference)

Data From	ARIMA (p, d, q)	Model
United States import	(2, 1, 0)	$\Delta TC\_I\_USA_t = 1.90 * \Delta TC\_I\_USA_{t-1} - 0.92 * \Delta TC\_I\_USA_{t-2} + \epsilon_t$ (59.94***) (–29.53,***)
United States export	(1, 0, 0)	$TC\_E\_USA_t = 1.00 * TC\_E\_USA_{t-1} + \epsilon_t$ (1636.16,***)
China import	(3, 1, 0)	$\Delta TC\_I\_CHN_t = 2.26 * \Delta TC\_I\_CHN_{t-1} - 1.94 * \Delta TC\_I\_CHN_{t-2} + 0.64 * \Delta TC\_I\_CHN_{t-3} + \epsilon_t$ (31.36,***) (–14.87,***) (8.83,***)
China export	(4, 1, 3)	$\Delta TC\_E\_CHN_t = 2.60 * \Delta TC\_E\_CHN_{t-1} - 2.99 * \Delta TC\_E\_CHN_{t-2} + 1.71 * \Delta TC\_E\_CHN_{t-3}$ (25.03,***) (–12.28,***) (7.07, ***) $-0.39 * \Delta TC\_E\_CHN_{t-4} + \epsilon_t - 0.27 * \epsilon_{t-1} + 0.27 * \epsilon_{t-2} + 0.70 * \epsilon_{t-3}$ (–3.92, ***) (–3.16, ***) (3.39, ***) (8.92, ***)
United Kingdom import	(2, 1, 0)	$\Delta TC\_I\_UK_t = 1.82 * \Delta TC\_I\_UK_{t-1} - 0.91 * \Delta TC\_I\_UK_{t-2} + \epsilon_t$ (44.83, ***) (–22.30, ***)
United Kingdom export	(3, 1, 0)	$\Delta TC\_E\_UK_t = 1.98 * \Delta TC\_E\_UK_{t-1} - 1.23 * \Delta TC\_E\_UK_{t-2} + 0.20 * \Delta TC\_E\_UK_{t-3} + \epsilon_t$ (20.34, ***) (–6.74, ***) (2.00, ***)
Germany import	(3, 0, 0)	$TC\_I\_GER_t = 2.87 * TC\_I\_GER_{t-1} - 2.81 * TC\_I\_GER_{t-2} + 0.94 * TC\_I\_GER_{t-3} + \epsilon_t$ (99.42, ***) (–49.16, ***) (32.61, ***)
Germany export	(3, 0, 0)	$TC\_E\_GER_t = 2.89 * TC\_E\_GER_{t-1} - 2.85 * TC\_E\_GER_{t-2} + 0.96 * TC\_E\_GER_{t-3} + \epsilon_t$ (102.19, ***) (–50.59, ***) (33.62, ***)
Japan import	(2, 1, 0)	$\Delta TC\_I\_JAP_t = 1.73 * \Delta TC\_I\_JAP_{t-1} - 0.87 * \Delta TC\_I\_JAP_{t-2} + \epsilon_t$ (38.15, ***) (–19.15, ***)
Japan export	(2, 1, 0)	$\Delta TC\_E\_JAP_t = 1.87 * \Delta TC\_E\_JAP_{t-1} - 0.92 * \Delta TC\_E\_JAP_{t-2} + \epsilon_t$ (57.90, ***) (–28.54, ***)
Canada import	(2, 1, 0)	$\Delta TC\_I\_CAN_t = 1.82 * \Delta TC\_I\_CAN_{t-1} - 0.92 * \Delta TC\_I\_CAN_{t-2} + \epsilon_t$ (43.98, ***) (–21.99, ***)
Canada export	(2, 1, 0)	$\Delta TC\_E\_CAN_t = 1.80 * \Delta TC\_E\_CAN_{t-1} - 0.88 * \Delta TC\_E\_CAN_{t-2} + \epsilon_t$ (41.99, ***) (–20.49, ***)
Italy import	(3, 1, 0)	$\Delta TC\_I\_ITA_t = 2.11 * \Delta TC\_I\_ITA_{t-1} - 1.37 * \Delta TC\_I\_ITA_{t-2} + 0.24 * \Delta TC\_I\_ITA\_t\_3 + \epsilon_t$ (19.19, ***) (–6.50, ***) (2.18, **)
Italy export	(2, 1, 0)	$\Delta TC\_E\_ITA_t = 1.88 * \Delta TC\_E\_ITA_{t-1} - 0.94 * \Delta TC\_E\_ITA_{t-2} + \epsilon_t$ (61.91,***) (–31.09,***)
India import	(3, 1, 0)	$\Delta TC\_I\_IND_t = 2.33 * \Delta TC\_I\_IND_{t-1} - 2.07 * \Delta TC\_I\_IND_{t-2} + 0.69 * \Delta TC\_I\_IND_{t-3} + \epsilon_t$ (32.58, ***) (–16.19, ***) (9.55, ***)
India export	(3, 1, 0)	$\Delta TC\_E\_IND_t = 2.47 * \Delta TC\_E\_IND_{t-1} - 2.08 * \Delta TC\_E\_IND_{t-2} + 0.59 * \Delta TC\_I\_IND_{t-3} + \epsilon_t$ (26.82,***) (–11.74,***) (6.42,***)
Australia import	(2, 0, 0)	$TC\_I\_AUS_t = 1.92 * TC\_I\_AUS_{t-1} - 0.92 * TC\_I\_AUS_{t-2} + \epsilon_t$ (50.99,***) (–24.46,***)
Australia import	(2, 1, 3)	$\Delta TC\_E\_AUS_t = 1.36 * \Delta TC\_E\_AUS_{t-1} - 0.58 * \Delta TC\_E\_AUS_{t-2} + \epsilon_t + 0.90 * \epsilon_{t-1} + 1.06 * \epsilon_{t-2} + 0.75 * \epsilon_{t-3}$ (15.65, ***) (–6.71, ***) (12.99, ***) (45.34, ***) (11.39, ***)

The numbers in parentheses represent t-statistics.

*Significant values in statistics at the 1, 5, and 10 percent levels are denoted by ***, **, and *, respectively.

The Stringency Index is a comprehensive index provided by The Oxford COVID-19 Government Response Tracker. It included eight indicators as follow: C1_School closing, C2_Workplace closing, C3_Cancel public events, C4_Restrictions on gatherings, C5_Close public transport, C6_Stay at home requirements, C7_Restrictions on internal movement, and H1_Public information campaigns.

TABLE 8. The Theoretical Values of Imports and the Difference with Actual Value in Sample Countries (in Billions of USD)

	Theoretical	Difference	Theoretical	Difference	Theoretical	Difference	Theoretical	Difference	Theoretical	Difference
	United States		China		United Kingdom		Germany		Japan	
Jan.	202.50	–0.46	170.45	–13.55	56.53	0.02	100.26	3.14	62.61	1.10
Feb.	187.01	–3.75	142.99	–0.49	57.04	7.06	105.94	–9.00	62.12	–7.98
Mar.	209.95	–10.40	180.51	–15.74	57.26	–20.80	104.36	0.86	59.84	–2.51
Apr.	204.92	–34.45	176.10	–21.49	56.72	–6.12	107.22	–5.74	61.85	–14.10
May	211.44	–42.45	176.49	–32.61	54.54	2.45	110.25	–1.29	60.12	–9.87
Jun.	209.33	–24.44	173.04	–6.41	56.35	–5.97	105.01	–12.74	60.83	–3.97
Jul.	207.77	–1.26	178.45	–3.47	56.98	–9.11	104.33	0.35	59.69	–12.64
Aug.	209.85	–0.41	179.00	–3.05	54.16	10.33	109.88	–14.82	59.81	–12.96
Sep.	203.85	8.58	186.29	15.68	52.70	1.40	106.00	–12.11	61.10	–1.91
Oct.	213.32	12.85	170.80	7.37	52.18	12.65	109.55	–0.41	59.02	–11.60
Nov.	203.46	15.93	184.87	6.63	55.63	–19.73	109.33	3.12	62.31	–0.58
Dec.	197.43	24.82	194.10	9.65	51.70	7.16	105.43	–1.06	60.55	–9.73
	Canada		Italy		India		Australia			
Jan.	37.40	–1.15	40.08	–12.72	38.30	–0.91	18.56	–0.60		
Feb.	37.67	–0.86	38.91	1.26	36.12	3.44	16.69	1.85		
Mar.	36.60	–10.75	42.80	–6.65	36.47	–19.35	16.85	3.35		
Apr.	36.74	–4.58	42.14	–4.83	36.20	1.30	16.61	2.70		
May	37.43	–2.01	44.18	–16.05	33.15	–1.97	16.75	2.31		
Jun.	36.10	–11.41	45.09	–4.65	38.78	–16.58	17.37	0.50		
Jul.	37.49	–2.70	46.18	–12.87	36.51	–15.44	17.46	1.38		
Aug.	36.54	–2.74	41.07	–3.85	35.60	–6.13	17.94	1.14		
Sep.	35.15	–0.47	46.37	–5.35	36.79	–6.47	18.62	–0.64		
Oct.	37.54	–0.87	48.63	–6.72	35.90	–2.30	16.98	–0.28		
Nov.	36.63	–1.10	46.96	–6.53	33.65	–0.26	17.48	3.01		
Dec.	34.16	5.93	46.23	–7.30	35.60	6.94	18.46	–1.75		

The Stringency Index is a simple average of the individual component indicators. This is described in equation (2):

$$\text{Stringency Index} = \frac{1}{k}\sum_{j=1}^{k} I_j \qquad (2)$$

Where

- k is the number of component indicators in an index
- I_j is the sub-index score for an individual indicator

Some indicators—C1 through C7 and H1—have an additional binary flag variable that can be either 0 or 1. It corresponds to the geographic scope of the policy. For these indicators that do have a flag variable, if this flag is recorded as 0 then this is treated as a half-step between ordinal values.

TABLE 9. The Theoretical Values of Exports and the Difference with Actual Value in Sample Countries (in Billions of USD)

	Theoretical	Difference	Theoretical	Difference	Theoretical	Difference	Theoretical	Difference	Theoretical	Difference
	United States		China		United Kingdom		Germany		Japan	
Jan.	126.92	2.06	207.62	3.97	34.67	10.21	105.52	13.99	53.52	8.88
Feb.	127.72	4.28	157.44	–77.06	35.35	1.72	106.19	19.44	61.33	3.22
Mar.	144.71	*–10.31*	201.03	–16.45	35.31	3.10	104.16	19.27	63.25	*–4.71*
Apr.	135.44	*–39.76*	204.21	–4.69	35.51	*–6.23*	110.42	*–1.85*	59.44	*–10.09*
May	138.86	*–48.28*	212.52	–6.03	36.10	*–1.41*	108.82	*–0.37*	55.11	*–9.90*
Jun.	141.16	*–36.20*	210.56	2.35	35.42	*–3.49*	110.01	*–0.58*	61.08	*–10.76*
Jul.	133.05	*–20.47*	212.35	24.51	31.77	4.63	112.66	5.09	57.75	*–9.52*
Aug.	138.05	*–20.09*	208.88	25.55	33.90	*–3.50*	115.03	15.16	54.90	*–15.89*
Sep.	137.49	*–16.11*	208.12	30.60	34.71	*–1.29*	115.26	5.71	59.66	*–0.40*
Oct.	144.82	*–12.41*	201.93	34.31	32.66	*–5.82*	123.80	8.74	57.65	*–0.17*
Nov.	139.27	*–12.41*	227.40	39.59	32.89	3.99	116.08	16.84	54.99	*–5.29*
Dec.	139.32	*–6.85*	258.60	23.33	31.17	5.86	121.11	*–0.95*	58.17	1.08
	Canada		Italy		India		Australia			
Jan.	35.88	2.64	43.71	*–2.94*	25.36	0.67	20.21	1.66		
Feb.	37.79	*–1.55*	45.47	*–3.69*	27.25	*–16.98*	21.27	*–3.18*		
Mar.	35.31	*–12.25*	47.09	*–3.26*	25.88	1.79	19.69	1.67		
Apr.	38.31	*–8.08*	46.24	*–13.45*	25.25	*–3.79*	19.21	0.01		
May	37.14	*–2.69*	48.52	0.86	27.16	*–7.98*	20.68	2.34		
Jun.	38.69	*–14.39*	46.55	*–6.20*	25.37	*–3.63*	20.43	*–1.82*		
Jul.	35.32	0.23	47.69	0.66	24.13	*–0.67*	20.57	*–0.38*		
Aug.	35.87	*–2.41*	39.59	7.73	23.75	*–1.04*	20.35	*–0.76*		
Sep.	37.86	*–5.92*	43.03	6.90	24.30	3.31	20.11	1.07		
Oct.	38.48	*–3.39*	45.25	2.25	23.39	1.54	20.28	*–0.57*		
Nov.	36.96	*–4.19*	40.43	8.00	24.18	*–0.63*	20.12	3.65		
Dec.	37.05	*–1.10*	42.91	4.36	22.61	4.54	19.86	0.01		

In the OxCGRT project, each indicator variable is given on the daily basis. In this study, the COUNTRY_RSTR is obtained by adding up the daily index scores of each country in each month and being standardized as the monthly comprehensive index of the government response of each country.

Total reserves (**TR**) is used as control variable. The control variables like GDP, industrial value-added are commonly used in the study of international trade. However, most of these indicators are quarterly data or annual, which are not suitable for this study. Therefore, the article chose TR as an alternative variable.

Average exchange rate against U.S. dollar during the period (EX) is used as a control variable.

The data of TR and EX come from the Economist Intelligence Unit (EIU) country data.

Model

First, building model (3) and model (4) with the explanatory variable COV_SIT through fixed effects model:

$$IMP_i = \beta * COV_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (3)$$

$$EMP_i = \beta * COV_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (4)$$

Where

IMP	represents monthly import volume
EMP	represents monthly export volume
i	indicates different countries, and the model controls the fixed effects between countries
β, γ, ρ	are the coefficients corresponding to each variable
ε	is the residual term

As a further study of the relationship between international trade and the COVID-19 pandemic, the fixed effects models were built with **LNCASE**, **LNDEATH**, and **RESSTR** as the explanatory variables. Each of the three variables represents parts of the epidemic. Theoretically, there is multicollinearity between **LNCASE**, **LNDEATH**, and **RESSTR**. Therefore, the models are built with each of the variables:

$$IMP_i = \beta * LNCASE_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (5)$$

$$EMP_i = \beta * LNCASE_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (6)$$

$$IMP_i = \beta * LNDEATH_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (7)$$

$$EMP_i = \beta * LNDEATH_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (8)$$

$$IMP_i = \beta * RESSTR_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (9)$$

$$EMP_i = \beta * RESSTR_i + \gamma * TR_i + \rho * EX_i + \delta_i + \varepsilon_i \quad (10)$$

The results of model (3) through model (10) are shown in Table 10.

After building model (3) through model (10) to explore the differences between different countries, the robustness check was conducted by grouping the countries in four ways: geographical location, national development level, volume of imports and exports, and trade balance.

1. Grouped by geographical location: Germany, the United Kingdom, and Italy were grouped as EUR. The United States and Canada were grouped as NOA. China, India, Japan, and Australia were grouped as AOC.
2. Grouped by national development level: China and India were grouped as DEI. The United States, the United Kingdom, Germany, Italy, Japan, Canada, and Australia were grouped as DED.
3. Grouped by total import and export trade volume in 2019. China, the United States, Germany, and Japan with higher import and export volume

TABLE 10. Coefficients and Significances of Model (3) to Model (10)

	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)	Model (9)	Model (10)
TR	5.73E–03	1.05E–02	6.13E–03	1.11E–02	6.28E–03	1.14E–02	5.65E–03	1.05E–02
	(5.15)***	(8.26) ***	(6.29) ***	(3.84)***	(6.47) ***	(3.97) ***	(4.67)**	(7.31)***
EX	–4.65E + 08	3.61E + 08	–4.61E + 08	–3.52E + 08	–4.61E + 08	–3.46E + 08	–4.65E + 08	–3.60E + 08
	(–6.05)***	(–19.61) ***	(–6.26)***	(–6.28)***	(–6.43) ***	(–6.22) ***	(–6.23)***	(–19.18)***
COV	–4.09E + 09	–3.64E + 09						
	(–2.77) **	(–1.29)						
LNCASE								
			–4.05E + 08	–4.52E + 08				
			(–3.09)**	(–4.78)***				
LNDEATH								
					–6.46E + 08	–8.47E + 08		
					(–3.38)***	(–6.01) ***		
RESSTR							–1.85E + 06	–1.70E + 06
							(–2.55)**	(–1.16)

The numbers in parentheses represent t-statistics. Significant values in statistics at the 1, 5, and 10 percent levels are denoted by ***, **, and *, respectively.

were grouped as TVH. The United Kingdom, India, Australia, Canada, and Italy were grouped as TVL.

4. Grouped by trade balance. China, Germany, Japan, Australia, Canada, and Italy with positive trade balance were grouped as PTB. The United States, the United Kingdom, and India with adverse trade balance were grouped as ATB.

Table 11, Table 12, Table 13, and Table 14 show the results of robustness check.

Results

As revealed through Table 4, Table 5, Table 8, and Table 9, at the beginning of the COVID-19 outbreak, the international trade of all countries suffered a great impact, and the import and export trade volume decreased significantly. China's import and export trade was affected first. In February 2020, China's export trade volume decreased by 40.61 percent year-on-year and the actual value decreased by $77.06 billion compared with the predicted value.

In other countries, the international trade effects started later than China. The decline of most countries' import and export trade volumes peaked from March to May. In March 2020, Britain's import trade volume decreased by 39.8 percent year-on-year, and the actual value decreased by $20.80 billion compared with the predicted value. In April 2020, the import and export trade volumes of Germany decreased by 10.64 percent and 15.05 percent year-on-year, respectively, and the actual value decreased by $5.74 billion and $1.85 billion, respectively, compared with the predicted value. In May 2020, the import and export trade volumes of the United States decreased by 25.51 percent and 36.27 percent year-on-year, and the actual value decreased by $42.45 billion and $48.28 billion, respectively, compared with the predicted value. Fortunately, the decline

TABLE 11. Coefficients and Significances of Model (3) and Model (4) After Grouping

	Model (3)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
COV	–4.44E + 08	–8.52E + 09	–3.88E + 09	–4.74E + 09	–1.11E + 09	–4.35E + 09	–2.87E + 09	–2.61E + 09	–7.17E + 09
	(–0.37)	(–4.43)***	(–2.62)***	(–5.47)***	(–0.40)	(–2.38)**	(–4.66)***	(–2.33)**	(–4.68)***
TR	–1.50E–02	2.60E–01	5.70E–03	1.21E–02	6.58E–03	7.05E–03	–1.59E–02	6.67E–03	1.85E–02
	(–0.55)	(4.32)***	(2.05)**	(1.08)	(1.80)*	(1.99)**	(2.07)**	(2.51)**	(1.29)
EX	–1.86E + 10	–2.15E + 10	–4.64E + 08	–4.04E + 08	–6.95E + 08	–3.96E + 08	–5.26E + 08	–4.02E + 08	–6.83E + 08
	(–3.79)***	(–3.60)***	(–8.55)***	(–8.44)***	(–4.96)***	(–5.10)***	(–7.93)***	(–6.89)***	(–5.66)***
	Model (4)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
COV	–8.70E + 08	–1.38E + 10	1.10E + 08	–5.79E + 09	5.25E + 09	–4.74E + 09	–1.81E + 09	–7.50E + 08	–1.07E + 10
	(–0.60)	(–9.98)***	(0.06)	(–6.95)***	(1.40)	(–2.16)**	(–3.05)***	(–0.52)	(–9.35)***
TR	–5.94E–02	2.96E–01	1.08E–02	–1.99E–03	1.25E–02	1.14E–02	–2.27E–02	1.12E–02	2.95E–02
	(–1.81)*	(6.87)***	(3.04)***	(–0.18)	(2.51)**	(2.67)***	(–3.08)***	(3.29)***	(2.75)***
EX	–1.32E + 10	–2.28E + 10	–3.79E + 08	–3.39E + 08	–5.18E + 08	–3.48E + 08	–1.95E + 08	–3.59E + 08	–4.03E + 08
	(–2.23)**	(–5.32)***	(–5.47)***	(–7.37)***	(–2.72)***	(–3.74)***	(–3.06)***	(–4.80)***	(–4.46)***

The numbers in parentheses represent t-statistics. *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively.

TABLE 12. Coefficients and Significances of Model (3) and Model (4) After Grouping

	Model (5)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
LNCASE	–1.92E + 07	–7.13E + 08	–4.65E + 08	–4.44E + 08	–1.67E + 08	–4.63E + 08	–2.49E + 08	–2.77E + 08	–5.53E + 08
	(–0.14)	(–4.66) ***	(–3.01)***	(–5.64)***	(–2.61)	(–2.76)***	(–4.24)***	(–2.40)**	(–4.67)***
TR	–1.56E–02	2.63E–01	6.12E–03	1.24E–02	6.65E–03	7.26E–03	–1.40E–02	6.80E–03	1.93E–02
	(–0.46)	(4.39) ***	(2.20) ***	(1.10)	(13.00) **	(2.06)**	(–1.77)*	(2.56)**	(1.34)
EX	–1.92E + 07	–2.22E + 10	–4.55E + 08	–4.05E + 08	–6.80E + 08	–3.95E + 08	–5.34E + 08	–4.02E + 08	–6.89E + 08
	–0.14	(–3.75) ***	(–8.37)***	(–8.46)***	(–31.22)**	(–5.10)***	(–8.00)***	(–6.89)***	(–5.71)***
	Model (6)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
LNCASE	–6.06E + 07	–1.18E + 09	–1.63E + 08	–5.76E + 08	1.40E + 08	–6.79E + 08	–1.64E + 08	–1.69E + E08	–8.75E + 08
	(–0.47)	(–11.01)***	(–0.82)	(–7.65)***	(0.38)	(–3.39)***	(–2.91)***	(–1.14)	(–9.99)***
TR	–5.98E–02	3.02E–01	1.10E–02	–4.19E–04	1.19E–02	1.15E–02	–2.12E–02	1.12-E02	3.29E–02
	(–1.81)*	(7.24)***	(3.08)***	(–0.04)	(2.39)**	(2.73)***	(–2.79)***	(3.29)***	(3.09)***
EX	–1.34E + 10	–2.38E + 10	–3.68E + 08	–3.40D+08	–4.61E + 08	–3.45E + 08	–2.01E–08	–3.57E + 08	–4.18E + 08
	(–2.25)**	(–5.76)***	(–5.29)***	(–7.44)***	(–2.36)**	(–3.73)***	(–3.14)***	(–4.78)***	(–4.69)***

The numbers in parentheses represent t-statistics. *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively.

TABLE 13. Coefficients and Significances of Model (3) and Model (4) After Grouping

	Model (7)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
LNDEATH	−6.50E + 07	−1.03E + 09	−8.41E + 08	−6.61E + 08	−4.31E + 08	−7.91E + 08	−3.77E + 08	−4.71E + 08	−8.02E + 08
	(−0.42)	(−4.72)***	(−3.36)***	(−5.67)***	(−2.14)	(−3.09)***	(−4.35)***	(−2.56)**	(−4.87)***
TR	−1.46e−02	2.61E−01	6.35E−03	1.04E−02	6.71E−03	7.33E−03	−1.35E−02	6.84E−03	1.92E−02
	(−0.53)	(4.37)***	(2.28)**	(0.93)	(31.53)**	(2.08)**	(−1.71)*	(2.58)**	(1.35)
EX	−1.86E + 10	−2.25E + 10	−4.51E + 08	−4.04E + 08	−6.56E + 08	−3.96E + 08	−5.36E + 08	−4.02E + 08	−6.90E + 08
	(−3.79)***	(−3.81)***	(−8.29)***	(−8.45)***	(−33.27)**	(−5.12)***	(−8.03)***	(−6.91)***	(−5.73)***
	Model (8)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
LNDEATH	−1.08E + 08	−1.72E + 09	−6.80E + 08	−9.05E + 08	−4.92E + 08	−1.45E + 09	−2.33E + 08	−5.43E + 08	−1.24E + 09
	(−0.68)	(−11.44)***	(−2.13)**	(−8.15)***	(−0.89)	(−4.78)***	(−2.79)***	(−2.32)**	(−10.17)***
TR	−5.87E−02	3.00E−01	1.13E−02	−1.96E−03	1.18E−02	1.15E−02	−2.14E−02	1.12E−02	3.17E−02
	(−1.78)**	(7.29)***	(3.20)***	(−0.18)	(2.38)**	(2.77)***	(−2.81)***	(3.30)***	(3.00)***
EX	−1.32E + 10	−2.43E + 10	−3.51E + 08	−3.40E + 08	−3.68E + 08	−3.43E + 08	−2.01E + 08	−3.54E + 08	−4.166E + 08
	(−2.23)**	(−5.97)***	(−5.06)***	(−7.48)***	(-1.88)*	(−3.76)***	(−3.13)***	(−4.76)***	(−4.69)***

The numbers in parentheses represent t-statistics. *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively.

TABLE 14. Coefficients and Significances of Model (3) and Model (4) After Grouping

	Model (9)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
RESSTR	−1.45E + 05	−4.27E + 06	−1.52E + 06	−2.23E + 06	−3.47E + 05	−1.99E + 06	−1.22E + 06	−1.04E + 06	−3.11E + 06
	(−0.24)	(−4.53) ***	(−2.04)**	(−5.01) ***	(−0.29)	(−2.02)**	(−4.13) ***	(−1.77)*	(−4.35)***
TR	−1.54E−02	2.62E−01	5.64E−03	6.56E−03	6.64E−03	6.90E−03	−1.62E−02	6.63E−03	1.81E−02
	(−0.56)	(4.37)***	(2.02)**	(0.59)	(1.81)*	(1.94)*	(−2.09)**	(2.49)**	(1.25)
EX	−1.87E + 10	−2.16E + 10	−4.67E + 08	−4.01E + 08	−7.00E + 08	−3.98E + 08	−5.22E + 08	−4.04E + 08	−6.74E + 08
	(−3.81)***	(−3.63) ***	(−8.55) ***	(−8.35) ***	(−4.96) ***	(−5.12) ***	(−7.85) ***	(−6.92) ***	(−5.57) ***
	Model (10)								
	Grouped by Geographical Location			Grouped by National Development Level		Grouped by the Volume of Imports and Exports		Grouped by Trade Balance	
	EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
RESSTR	−6.15E + 05	−6.92E + 06	5.68E + 05	−3.01E + 06	2.08E + 06	−2.29E + 06	−8.71E + 05	−2.71E + 04	−4.96E + 06
	(−0.85)	(−10.31) ***	(0.60)	(−7.04) ***	(1.26)	(−1.94)*	(−3.07)***	(−0.04)	(−9.30)***
TR	−5.80E−02	3.00E−01	1.09E−02	−7.41E−03	1.24E−02	1.12E−02	−2.21E−02	1.13E−02	3.14E−02
	(−1.76)*	(7.03)***	(3.05)***	(−0.70)	(2.48)**	(2.62)***	(−2.97)***	(3.31)***	(2.89)***
EX	−1.30E + 10	−2.30E + 10	−3.85E + 08	−3.36E + 08	−5.15E + 08	−3.51E + 08	−1.95E + 08	−3.60E + 08	−3.95E + 08
	(−2.19)**	(−5.42) ***	(−5.55) ***	(−7.30) ***	(−2.68) ***	(−3.76) ***	(−3.05) ***	(−4.82) ***	(−4.37) ***

The numbers in parentheses represent t-statistics. *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively.

of international trade caused by the epidemic did not last for a long time. The impact of the epidemic on the import and export trade of countries in the second half of 2020 reduced, while the global trade rebounded after experiencing a sharp drop. The rapid recovery of China's international trade played a great role in maintaining the stability of the global supply chain. Some other countries, including Germany and India, had also achieved positive growth in import and export trade in some months. As of December 2020, five of the nine major economies in this article achieved the positive year-on-year growth in import and export trade volume. The extent of decrease of import and export trade volume in the other four major economies had also sharply slowed.

Based on the coefficients and significance of explanatory variables in Table 10, the study found some valuable results. First, COV's absolute value of influence coefficient in model (3) is 4.09E + 09, which is more than the 3.64E + 09 from model (4). The significance of COV variable in model (4) did not pass. This shows that the impact of the COVID-19 epidemic on imports is greater than that on exports. Second, comparing the coefficients of **LNCASE** and **LNDEATH** in model (5) through model (8), **LNDEATH**'s absolute value of influence coefficients in model (5) and model (6) are 6.46E + 08 and 8.47E + 08, respectively, which were higher than **LNCASE**'s 4.05E + 08 and 4.52E + 08 in model (5) and model (6). It shows that the negative impact of the death toll on import and export trade is much higher than that of infection. This is consistent with the characteristics of the COVID-19 epidemic, which has high infectivity, low mortality, mostly mild diseases, and usually a quick recovery. Compared with epidemic spreading degree, the degree of malignancy affects the import and export trade more.

Table 15 shows the results of the explanatory variables from Table 11 to Table 14.

The model results of geographical location groups show that all of the explanatory variables are not significant in EUR. European countries' year-on-year growth rates in 2020 (Table 4, Table 5) and the difference between predicted value and actual value (Table 8, Table 9) can also find out that the import and export trade of European countries was less affected by the COVID-19 epidemic. There are obvious differences between the NOA group and the AOC group. The absolute values of the coefficients of explanatory variables in NOA group are greater than those in AOC group in each model when the significance was passed. The impact of the COVID-19 epidemic on the countries in NOA group was greater than that in AOC group. Therefore, comparing the differences between the import trade data models (3), (5), (7), and (8) and the export trade data models (4), (6), (8), and (10), the absolute values of the coefficients of each explanatory variable in the export data model are higher than those in the import data model. Compared with Table 10, it shows the opposite result: that COVID-19's impact on exports is greater than on imports in NOA group.

From the results of the national development level groups and the total import and export trade volume groups, the study made an obvious discovery. In DEI group, all of the explanatory variables are not significant. And in DEV group, all of the explanatory variables are significant. At the same time, the coefficients' absolute values of all explanatory variables in TVH group are much higher than those of the TVL group. These show, not surprisingly, that

TABLE 15. Model Results of Explanatory Variables After Grouping

Explanatory Variable	Model	Groups								
		EUR	NOA	AOC	DED	DEI	TVH	TVL	PTB	ATB
COV	Model (3)	−4.44E + 08 (−0.37)	−8.52E + 09 (−4.43)***	−3.88E + 09 (−2.62)***	−4.74E + 09 (−5.47)***	−1.11E + 09 (−0.40)	−4.35E + 09 (−2.38)**	−2.87E + 09 (−4.66)***	−2.61E + 09 (−2.33)**	−7.17E + 09 (−4.68)***
	Model (4)	−8.70E + 08 (−0.60)	−1.38E + 10 (−9.98)***	1.10E + 08 (0.06)	−5.79E + 09 (−6.95)***	5.25E + 09 (−1.4)	−4.74E + 09 (−2.16)**	−1.81E + 09 (−3.05)***	−7.50E + 08 (−0.52)	−1.07E + 10 (−9.35)***
LNCASE	Model (5)	−1.92E + 07 (−0.14)	−7.13E + 08 (−4.66) ***	−4.65E + 08 (−3.01)***	−4.44E + 08 (−5.64)***	−1.67E + 08 (−2.61)	−4.63E + 08 (−2.76)***	−2.49E + 08 (−4.24)***	−2.77E + 08 (−2.40)**	−5.53E + 08 (−4.67)***
	Model (6)	−6.06E + 07 (−0.47)	−1.18E + 09 (−11.01)***	−1.63E + 08 (−0.82)	−5.76E + 08 (−7.65)***	1.40E + 08 (0.38)	−6.79E + 08 (−3.39)***	−1.64E + 08 (−2.91)***	−1.69E + E08 (−1.14)	−8.75E + 08 (−9.99)***
LNDEATH	Model (7)	−6.50E + 07 (−0.42)	−1.03E + 09 (−4.72)***	−8.41E + 08 (−3.36)***	−6.61E + 08 (−5.67)***	−4.31E + 08 (−2.14)	−7.91E + 08 (−3.09)***	−3.77E + 08 (−4.35)***	−4.71E + 08 (−2.56)**	−8.02E + 08 (−4.87)***
	Model (8)	−1.08E + 08 (−0.68)	−1.72E + 09 (−11.44)***	−6.80E + 08 (−2.13)**	−9.05E + 08 (−8.15)***	−4.92E + 08 (−0.89)	−1.45E + 09 (−4.78)***	−2.33E + 08 (−2.79)***	−5.43E + 08 (−2.32)**	−1.24E + 09 (−10.17)***
RESSTR	Model (9)	−1.45E + 05 (−0.24)	−4.27E + 06 (−4.53) ***	−1.52E + 06 (−2.04)**	−2.23E + 06 (−5.01) ***	−3.47E + 05 (−0.29)	−1.99E + 06 (−2.02)**	−1.22E + 06 (−4.13) ***	−1.04E + 06 (−1.77)*	−3.11E + 06 (−4.35)***
	Model (10)	−6.15E + 05 (−0.85)	−6.92E + 06 (−10.31) ***	5.68E + 05 (0.60)	−3.01E + 06 (−7.04) ***	2.08E + 06 (1.26)	−2.29E + 06 (−1.94)*	−8.71E + 05 (−3.07)***	−2.71E + 04 (−0.04)	−4.96E + 06 (−9.30)***

The numbers in parentheses represent t-statistics. *, **, and *** represent statistical significance at the 10 percent, 5 percent, and 1 percent level, respectively.

the COVID-19 epidemic had a greater impact on the countries with developed economies and prosperous import and export trade.

From the results of trade balance groups, in the import trade data models (3), (5), (7), and (8), all of the explanatory variables are significant. All of the absolute values of coefficients in ATB group are much higher than those in PTB. And in the export trade data models (4), (6), (8), and (10), all of the explanatory variables are significant in ATB, but only **LNDEATH**'s coefficient is significant in PTB. It shows that compared with trade surplus countries, the COVID-19 epidemic made more impact on the import and export trade in the countries with trade deficits.

In addition, it is worth noting that the analysis of this study is based on the nine countries selected in this study. Other countries should be included in further studies as well.

CONCLUSION

The COVID-19 epidemic, which continues to this day, has posed a great challenge to the global supply chain system gradually formed over the past 30 years. It revealed the defects of the global supply chain system in the face of global emergencies, which will have a far-reaching impact on the future global industrial pattern. Nevertheless, because the pattern of global industrialization that has formed is hard to replace, it would not change fundamentally in the short term. From the results of data and models, it is obvious that the epidemic has

made a greater impact on the countries with more developed economies and prosperous import and export trade. This epidemic may accelerate the industrial structure adjustment and industrial layout of these countries.

The number of infections, deaths, and the prevention and control policies of governments all had a negative impact on the international trade. Overall, the impact of the number of deaths was greater than the number of infections. The negative effects of prevention and control policies were different in different countries. It is necessary to explore appropriate prevention and control policies to prevent epidemics and reduce their impact on the economy at the same time.

Although the impact of the epidemic continues, according to the data in 2020, its impact on the global supply chain system was declining rapidly. With the popularity of vaccines and other preventive measures in major economies, the epidemic should be gradually controlled. Considering the frequent retaliatory rebounds after major shocks, global import and export trade should become better in 2021.

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Features of the Termination of Their Activities by Entrepreneurs in 2020

Iuliia S. Pinkovetskaia

Abstract

Motivation: Due to the significant impact of the COVID-19 pandemic on the exit of entrepreneurs from their businesses, the study of this problem in different countries is relevant.

Purpose: The aim of the study is to assess the reasons for the exit of entrepreneurs from their businesses in national economies in 2020.

Approach: The assessment of five indicators characterizing the opinions of entrepreneurs who have left their businesses about the positive and negative reasons was considered. In addition, an assessment was made of the share of entrepreneurs who stopped working due to the influence of COVID-19 in the total number of economically active population in 2020. The initial data were the results of a survey of the economically active population in 39 countries during the implementation of the Global Entrepreneurship Monitoring project. Five indicators were evaluated using the density functions of the normal distribution.

Results: It is proved that the share of people who stopped entrepreneurial activity in 2020 amounted to about 6 percent of the total economically active population on average in the countries under consideration. It is shown that 0.7 percent of the total economically active population stopped entrepreneurial activity for positive reasons. It is proved that about five out of every six entrepreneurs who have gone out of business have stopped their activities for negative reasons. It is shown that about one-third of entrepreneurs who left their business in 2020 for negative reasons did so due to the consequences of the coronavirus pandemic.

Conclusion: The results of our research have a certain theoretical and practical significance for governments, entrepreneurs, and the economically active population. The methodological approach presented in the article can be used to assess the impact of the COVID-19 pandemic on the exit of entrepreneurs from their businesses in 2021.

Consistency: The pandemic has significantly increased the risks and uncertainty in the activities of entrepreneurs, so the new knowledge gained is of interest to a wide range of government organizations and entrepreneurs in various countries.

Keywords: COVID-19 pandemic; economically active population; entrepreneurs who have gone out of business; normal distribution functions

JEL Classification Codes: C31, L26, M20

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INTRODUCTION

In this article, the problem of entrepreneurs leaving their businesses is considered, in particular, the share of entrepreneurs who have stopped their activities in the total number of economically active population is estimated. The relevance of this problem is due to the fact that sooner or later every entrepreneur is forced to stop for objective or subjective reasons (DeTienne 2010).

A distinctive feature of entrepreneurial activity in 2020 was the crisis phenomena that arose in the economy in the absolute majority of countries due to coronavirus infection, declared a global pandemic by the World Health Organization (Cucinotta and Vanelli 2020). The pandemic has had a significant impact not only on people's health, but also caused a multifaceted shock in their social and economic lives. The negative consequences of the pandemic are associated with a sharp decline in domestic consumption in most economically developed and developing countries due to limited mobility of the population. In addition, there is a significant decrease in investment, as the pandemic has caused a decrease in optimistic views on the business activity of entrepreneurs in the future. Accordingly, the aggregate demand decreased, which reduced the need for goods produced by entrepreneurs and services provided by them. All this predetermined the violation of industrial and economic relations (Martin et al. 2020; Nosachevskaya 2020).

According to the scientific research, entrepreneurs working in industries related to personal contacts, as well as complex logistics, were most severely affected by the consequences of the pandemic (Golovnin and Nikitina 2020; Nicola et al. 2020). This includes sectors related to retail trade, transport, tourism, public catering, personal services, and recreation. Entrepreneurs specializing in these types of activities found a sharp drop in income while maintaining most expenses, which led to a significant deterioration in their financial situation (Adam and Alarifi 2021). It should be noted that the negative consequences also affected the suppliers and customers of most affected entrepreneurs. That is, there were serious failures in the production and distribution chains. This was especially evident in the globalized sectors of the economy, which were impacted by a decrease in the level of accessibility in a number of countries and regions due to the restrictions imposed.

There is currently limited information on how the pandemic and related policy decisions affect the termination of the activities of entrepreneurs and their exit from their businesses. Taking this into account, this article considers indicators describing both the share of entrepreneurs who stopped their activities in 2020 in the total number of economically active population, and the exit of entrepreneurs from their businesses under the influence of the COVID-19 pandemic. At the same time, this article responds to calls expressed by a number of authors (Amankwah-Amoah 2021; Leland et al. 2021) to reduce the existing uncertainty and obtain objective and reliable information on various countries. The availability of such information is necessary for the development of measures to reduce the negative consequences of the pandemic. That is why the problem of studying the impact of COVID-19 on the exit of entrepreneurs from businesses is relevant.

The purpose of the study is to assess the reasons for the exit of entrepreneurs from their businesses in national economies in 2020.

This article makes the following contributions to scientific publications. The article provides an assessment of three main groups of reasons for entrepreneurs to stop their activities by country. The share of people who have stopped entrepreneurial activity in the whole economically active population, as well as the corresponding indicators for positive and negative reasons, both related and unrelated to the coronavirus pandemic, are estimated. Thus, along with the study of the traditional reasons for the termination of entrepreneurs' activities, the article provides fundamentally new information about the impact of the pandemic on the exit of entrepreneurs from their businesses in 39 countries located in Europe, Asia, Africa, Latin America, and North America.

The article is organized as follows. Literature Review provides an overview of scientific publications on the reasons for entrepreneurs leaving their businesses in different countries. Methodology and Data presents the methodology, initial data, and design of the study. Research Results and Discussion presents the results of a computational experiment and the characteristics of indicators that assess the level of termination of entrepreneurial activity for various reasons. Next, the countries with the maximum and minimum values of indicators were identified and an ANOVA analysis was given. Conclusion presents the findings of the study.

LITERATURE REVIEW

At the end of the twentieth and the beginning of the twenty-first centuries, much attention was paid to the theoretical and practical foundations of entrepreneurial activity. It should be noted that when developing the principles and concepts of the role of entrepreneurship in modern national economies, most researchers paid little attention to the termination of activities by entrepreneurs, as was noted, for example, by Peters (2009) and DeTienne (2010). At the same time, the exit of an entrepreneur from business is understood as a process in which an entrepreneur completely leaves the previously created business. In the last decade, interest in such processes has grown significantly in scientific publications (Mantere et al. 2013; Hsu et al. 2015; Wolfe and Shepherd 2015; Jenkins and McKelvie 2016). Some aspects of the problem of entrepreneurs exiting their businesses are considered in the following studies.

In Khelil (2016), exit from the business is multifaceted and should be considered from various sides, in particular, whether entrepreneurs had difficulties in the implementation of their goals and whether entrepreneurs were disappointed with their activities.

Cefis and Marsili (2011) studied the exit of entrepreneurs from their businesses by selling, that is, receiving money. Often, this method is used by entrepreneurs working in niche markets, in which competing firms try to acquire a business even at a significant premium. The sale of businesses is especially relevant for entrepreneurs who want to minimize their risk in the future. Such sales allow entrepreneurs to turn their labor and intelligence into specific income (Wennberg and DeTienne 2014). Marjanski and Sulkowski (2019) examine a variant of entrepreneurs' exit from their businesses—transferring them to family members (often children). Both the sale of their business and the transfer to family members are associated with the positive reasons that entrepreneurs stop

their activities (DeTienne and Sieger 2015). The retirement of entrepreneurs can also be attributed as a positive reason to sell (Morris et al. 2020).

There are a significant number of entrepreneurs who leave their businesses for negative reasons. These reasons are divided into external and internal. External causes are caused by global and local crisis phenomena in the economies, changes in the institutional sphere, as well as problems in the markets of goods and services produced by entrepreneurs (Wennberg and DeTienne 2014; Aldrich 2015). The main internal reasons for the exit of entrepreneurs from their businesses, according to researchers, are the difficulties of implementing the goals set, the complexity of managing production processes, lack of financial resources, as well as low production efficiency (Parastuty et al. 2016).

METHODOLOGY AND DATA

In this paper, entrepreneurs who have ceased their activities were divided into three groups, depending on the reasons that led to the exit from business. The first group included entrepreneurs who stopped their activities for positive reasons. That is, those who sold their business, transferred it to relatives, or retired. The second group included entrepreneurs who stopped their activities for negative reasons unrelated to the COVID-19 pandemic. Both external and internal production and management reasons were taken into account. The third group included entrepreneurs who attribute their exit from business to the negative consequences of the COVID-19 pandemic.

This study considered indicators that characterize the share of people who have stopped their business activities within the economically active population in the countries under consideration. In addition, it identified appropriate indicators on the share of people who indicated one of the three groups of reasons for leaving their businesses during the survey. The study was based on the assessment of the following indicators:

- The share of people who stopped entrepreneurial activity in 2020 from the total economically active population (indicator 1)
- The share of people who left their businesses for positive reasons from the total economically active population (indicator 2)
- The share of people who left their businesses for negative reasons unrelated to the pandemic from the total economically active population (indicator 3)
- The share of people who left their businesses due to negative reasons caused by the COVID-19 pandemic from the total economically active population (indicator 4)
- The ratio of the shares of entrepreneurs who stopped their activities due to negative reasons, unrelated or caused by COVID-19 pandemic (indicator 5)

As the initial information, the study used the results of a survey of the economically active population (adults aged 18 to 64), conducted by national research teams and experts in 39 countries, during the implementation of the Global Entrepreneurship Monitoring Project (2021). In total, almost 140,000 people were interviewed, and at least 2,000 respondents answered in each of the countries. During the monitoring process, it was possible to collect data on

a limited number of countries due to difficulties in conducting surveys in the context of the ongoing pandemic. For each of the countries in the Global Entrepreneurship Monitoring Project (2021), the percentage of entrepreneurs who left their businesses from the total number of economically active population were given. In addition to the general data, their distribution was given for each of the three groups of reasons for entrepreneurs leaving their businesses. The data was collected from Cyprus, Germany, Greece, Italy, Latvia, Luxembourg, Netherlands, Norway, Poland, Russian Federation, Slovak, Slovenia, Spain, Sweden, Switzerland, United Kingdom (Europe), India, Iran, Israel, Kazakhstan, Kuwait, Oman, Qatar, Republic of Korea, Saudi Arabia, Taiwan, United Arab Emirates (Asia), Angola, Burkina Faso, Morocco, Togo (Africa), Brazil, Chile, Colombia, Guatemala, Panama, Uruguay (Latin America), Canada, United States of America (North America). The former entrepreneurs expressed their opinions about the reasons for exit from business. The limited number of countries in the monitoring process was due to the significant limitations of conducting surveys in the context of the ongoing pandemic. For each of the countries in the Global Entrepreneurship Monitoring Project (2021), the percentage of entrepreneurs who left their businesses were given for each of the three groups of reasons in the total number of economically active population.

The study consisted of five stages. The first stage was associated with the formation of empirical data describing the opinion of former entrepreneurs about the reasons for leaving their businesses. At the second stage, the values of the five above-mentioned indicators were evaluated. The third stage was aimed at determining the average values for the countries under consideration for each of the indicators. The fourth stage was associated with a comparative analysis, which made it possible to identify countries with minimum and maximum values of indicators. At the fifth stage, indicators were compared for groups of countries with their minimum and maximum values on the base of ANOVA method.

The conducted research included testing of three hypotheses:

- The first hypothesis is that the consequences of the coronavirus pandemic were one of the basic reasons for the exit of entrepreneurs from their businesses.
- The second hypothesis is that there are significant differences in the values of each of the five indicators under consideration for different countries.
- The third hypothesis is that the geographical location of states and the income of the population in them do not significantly affect the maximum and minimum values of indicators.

Our hypotheses are based on the assumptions indicated in the literature review, as well as the studies by Bartik et al. (2020), Lattacher and Wdowiak (2020), Jeng and Hung (2019), Rahyuda et al. (2017), Byrne and Shepard (2015), and Shepard et al. (2009).

These estimates for the five indicators under consideration are based on developing density functions of the normal distribution (Pinkovetskaia, Slepova 2018; Pinkovetskaia et al. 2021). The number of respondents for each of the countries is quite large. This, as well as the presence of various factors influencing their opinion, suggests the probabilistic (stochastic) nature of the values of

indicators describing the reasons of exit of entrepreneurs from their businesses. The study of phenomena and processes whose parameters are formed as a result of the combined influence of many factors acting additively and independently of each other can be carried out using the law of normal distribution.

The probability density is non-negative over the entire range of variation, since it is the derivative of a non-decreasing function. The density distribution function describes as all the information about a random variable. The main information that characterizes a certain random variable is:

- The parameters of a random variable, that is, the average value, median, mathematical expectation, which for the density functions of the normal distribution are equal to
- The standard deviation of the random variable, i.e., the spread of a random variable near the average value
- The coefficient of skewness is equal to zero for normal distribution

The development of mathematical models describing the distribution of indicators using the density functions of the normal distribution is based on the construction of histograms. With a large amount of empirical input data (35 or more), we can group this information into intervals to make working with the data more comfortable. To do this, the source data is divided into a certain number of intervals.

The general form of the density function of the normal distribution is:

$$y(x) = \frac{A}{\sigma \times \sqrt{2\pi}} \cdot e^{\frac{-(x-m)^2}{2\times\sigma\times\sigma}}$$

Where

x is the indicator whose distribution we are studying

m is the average value of the indicator for all observed objects

σ is the standard deviation

The obtained functions allow us to estimate the average values of each of the five indicators in the countries under consideration, as well as their variations typical for most countries. In addition, the study identifies countries where the indicators considered are above the maximum and below the minimum ranges. The limits of the indicator ranges for the majority (68 percent) of states are calculated based on the average values and the corresponding standard deviations. The lower bound of the range is equal to the difference between the mean and the standard deviation, and their sum corresponds to the upper bound of the range.

RESEARCH RESULTS AND DISCUSSION

In the process of economic and mathematical modeling, based on empirical data, functions (y_1, y_2, y_3, y_4, y_5) were constructed that describe the densities of the normal distribution of each of the five considered indicators (x_1 percent, x_2 percent, x_3 percent, x_4 percent, x_5 percent):

- The share of people who stopped entrepreneurial activity in 2020 from the total economically active population

$$y_1(x_1) = \frac{129.05}{3.94 \times \sqrt{2\pi}} \cdot e^{\frac{-(x_1-6.03)^2}{2\times 3.94\times 3.94}} \quad (1)$$

- The share of people who left their businesses for positive reasons from the total economically active population

$$y_2(x_2) = \frac{10.03}{0.35 \times \sqrt{2\pi}} \cdot e^{\frac{-(x_2-0.70)^2}{2\times 0.35\times 0.35}} \quad (2)$$

- The share of people who left their businesses for negative reasons unrelated to the pandemic from the total economically active population

$$y_3(x_3) = \frac{50.14}{1.86 \times \sqrt{2\pi}} \cdot e^{\frac{-(x_3-3.08)^2}{2\times 1.86\times 1.86}} \quad (3)$$

- The share of people who left their businesses for negative reasons caused by the COVID-19 pandemic from the total economically active population

$$y_4(x_4) = \frac{45.52}{1.56 \times \sqrt{2\pi}} \cdot e^{\frac{-(x_4-1.77)^2}{2\times 1.56\times 1.56}} \quad (4)$$

- The ratio of the shares of entrepreneurs who stopped their activities due to negative reasons, which belong respectively to the third and second groups of reasons

$$y_5(x_5) = \frac{13.65}{0.41 \times \sqrt{2\pi}} \cdot e^{\frac{-(x_5-0.51)^2}{2\times 0.41\times 0.41}} \quad (5)$$

The quality of functions (1) through (5) were tested using the Kolmogorov–Smirnov test, the Pearson chi-squared test, and the Shapiro–Wilk test. Calculated values of criteria are given in Table 1.

TABLE 1. Calculated Values of Criteria

Indicators	Criteria		
	Kolmogorov–Smirnov Test	Pearson Test	Shapiro–Wilk Test
The share of people who stopped entrepreneurial activity in 2020 from the total economically active population	0.09	2.01	0.97
The share of people who left their businesses for positive reasons in the total economically active population	0.05	1.01	0.98
The share of people who left their businesses for negative reasons unrelated to the pandemic in the total economically active population	0.08	0.85	0.98
The share of people who left their businesses for negative reasons caused by the COVID-19 pandemic in the total economically active population	0.09	1.95	0.97
The ratio of the shares of entrepreneurs who stopped their activities due to negative reasons, which belong respectively to the third and second groups of reasons	0.08	4.10	0.95

Source: The data in the table are based on the results of calculated functions.

Information given in column 2 of Table 1 showed that all calculated values are less than the critical value of the Kolmogorov–Smirnov test (0.174) at significance level of 0.01. Data in column 3 are less than the critical value of the Pearson criterion (9.49) at significance level of 0.01. Data in column 4 exceed the critical value of the Shapiro–Wilk test (0.93) with significance level of 0.01. Thus, the computational experiment showed that two developed functions have high quality.

The constructed functions allowed us to determine the values of indicators describing various options for entrepreneurs to exit their businesses in 39 countries. These indicators are summarized in Table 2. Its second column shows the average values for countries, and the third column shows the ranges in which the values of indicators for most countries are located.

The data presented in Table 3 show that a significant number of the economically active population, on average about 6 percent in the countries under consideration, stopped their business activities in 2020. That is, almost every sixteenth adult resident who was previously an entrepreneur left the business. At the same time, only 0.7 percent of the economically active population did this for positive reasons. Accordingly, every eighth entrepreneur has stopped activity in connection with the sale of the business, its transfer to family members, or retirement. On average, 4.85 percent of the economically active population left their businesses for negative reasons. It should be noted that of the entrepreneurs who stopped their activities for negative reasons, the relative majority 3.1 percent (i.e., two-thirds) did so without direct connection with the consequences of the pandemic. From the entrepreneurs who left the business for negative reasons, about one-third indicated the consequences of the COVID-19 pandemic as a motive. Such people are 1.8 percent of the total economically active population. The average ratio of the shares of entrepreneurs who stopped their activities due to negative reasons caused by the COVID-19 pandemic and not related to this pandemic was 0.51 for the countries under consideration. Thus, the first hypothesis stating that the consequences of the pandemic were one of the basic reasons for the exit of entrepreneurs from their businesses has been confirmed.

The sum of the values of the indicators given in rows 2, 3, and 4 of the second column of the Table 2 is less than the value given in row 1. In our opinion,

TABLE 2. The Values of Indicators That Characterize the Reasons for the Termination of Their Activities by Entrepreneurs

Indicators	Average Values	Values for Most Countries
The share of people who stopped entrepreneurial activity in 2020 from the total economically active population, in percent	6.03	2.09 to 9.97
The share of people who left their businesses for positive reasons from the total economically active population, in percent	0.70	0.35 to 1.05
The share of people who left their businesses for negative reasons unrelated to the pandemic from the total economically active population, in percent	3.08	1.22 to 4.94
The share of people who left their businesses for negative reasons caused by the COVID-19 pandemic from the total economically active population, in percent	1.77	0.21 to 3.33
The ratio of the shares of entrepreneurs who stopped their activities due to negative reasons, which belong respectively to the third and second groups of reasons in percent	0.51	0.10 to 0.92

Source: Calculated by the author using functions (1) through (5).

this is due to the fact that not all former entrepreneurs were able to accurately identify the reason that determined the termination of their activities.

To test the second hypothesis about the differentiation of indicators by state, an analysis of the scope of variation of each of the indicators presented in Table 2 was carried out. The variation indices for each of the indicators are given below:

- The share of people who stopped entrepreneurial activity in 2020 from the total economically active population was 65 percent.
- The share of people who left their businesses for positive reasons from the total economically active population was 50 percent.
- The share of people who left their businesses for negative reasons unrelated to the pandemic from the total economically active population was 60 percent.
- The share of people who left their businesses for negative reasons caused by the COVID-19 pandemic from the total economically active population was 88 percent.
- The ratio of the shares of entrepreneurs who stopped their activities due to negative reasons, which belong respectively to the third and second groups of reasons was 80 percent.

The values of the variation indices showed a significant differentiation across the countries of all five indicators. Therefore, the second hypothesis was confirmed.

The fourth stage was associated with the identification of groups of countries that were characterized by the minimum and maximum values of each of the indicators. At the same time, the maximum and minimum values are values that respectively exceed the upper limits of the ranges shown in the third column (Table 2) and are smaller than the lower limits of the ranges. The results of this analysis are shown in Table 3. Along with the lists of countries, Table 3 also presents a division of the identified countries by their geographical location and income level of the population. Data on level of income for the countries discussed are from the Global Entrepreneurship Monitoring Project (2021).

Table 3 provides information on the territorial location of countries with the maximum (column 2) and minimum (column 3) values of each of the five indicators evaluated in this study. The analysis of this information showed that according to most indicators, the countries with the maximum and minimum values of indicators are located in different parts of the world and are characterized by different values of the population's income. This provision is not fulfilled only for countries where the shares of the number of people who left their businesses for negative reasons unrelated to the pandemic have minimal values. All these states are located in Europe and are characterized by high incomes of the population. Thus, we can conclude that the third hypothesis is partially confirmed.

Then the ANOVA analysis was carried out. At the same time, for each of the five indicators under consideration, values of indicators on two groups of countries were compared, respectively, with the maximum and minimum values of the indicators, the lists of which were given in Table 2. The results of the

TABLE 3. Characteristics of the Countries with Maximum and Minimum Indicators

Indicators	Countries	Geographical Location	Income of the Population
1	2	3	4
The share of people who stopped entrepreneurial activity in 2020 from the total economically active population	**With Maximum Values of Indicators**		
	Oman	Asia	High
	Egypt	Africa	Low
	Brazil	Latin America	Medium
	Kuwait	Asia	High
	Panama	Latin America	High
	Kazakhstan	Asia	Medium
	Angola	Africa	Low
	With Minimum Values of Indicators		
	Italy	Europe	High
	Spain	Europe	High
	Switzerland	Europe	High
	Slovenia	Europe	High
	Germany	Europe	High
	Norway	Europe	High
The share of people who left their businesses for positive reasons from the total economically active population	**With Maximum Values of Indicators**		
	Sweden	Europe	High
	United Arab Emirates	Asia	High
	Saudi Arabia	Asia	High
	Luxembourg	Europe	High
	Oman	Asia	High
	Colombia	Latin America	Medium
	Netherlands	Europe	High
	Canada	North America	High
	Angola	Africa	Low
	With Minimum Values of Indicators		
	Italy	Europe	High
	India	Asia	Low
	Spain	Europe	High
	Burkina Faso	Africa	Low
	Morocco	Africa	Low
	Republic of Korea	Asia	High
	Switzerland	Europe	High
The share of people who left their businesses for negative reasons unrelated to the pandemic from the total economically active population	**With Maximum Values of Indicators**		
	United Arab Emirates	Asia	High
	Brazil	Latin America	Medium
	Oman	Asia	High
	Kazakhstan	Asia	Medium
	Angola	Africa	Low
	With Minimum Values of Indicators		
	Italy	Europe	High
	Slovenia	Europe	High
	Spain	Europe	High
	Switzerland	Europe	High
	Luxembourg	Europe	High
	Poland	Europe	High

(continued)

TABLE 3. Characteristics of the Countries with Maximum and Minimum Indicators *(continued)*

Indicators	Countries	Geographical Location	Income of the Population
1	2	3	4
The share of people who left their businesses for negative reasons caused by the COVID-19 pandemic from the total economically active population	**With Maximum Values of Indicators**		
	Colombia	Latin America	Medium
	Brazil	Latin America	Medium
	Togo	Africa	Low
	Chile	Latin America	High
	Saudi Arabia	Asia	High
	Kuwait	Asia	High
	Panama	Latin America	High
	Angola	Africa	Low
	With Minimum Values of Indicators		
	Iran	Asia	Low
	Italy	Europe	High
	Norway	Europe	High
	Germany	Europe	High
	Israel	Asia	High
	Slovenia	Europe	High
The ratio of the shares of entrepreneurs who stopped their activities due to negative reasons, which belong respectively to the third and second groups of reasons	**With Maximum Values of Indicators**		
	Togo	Africa	Low
	Cyprus	Europe	High
	Colombia	Latin America	Medium
	Chile	Latin America	High
	Poland	Europe	High
	India	Asia	Low
	Kuwait	Asia	High
	Panama	Latin America	High
	Saudi Arabia	Asia	High
	With Minimum Values of Indicators		
	Iran	Asia	Low
	Israel	Asia	High
	Norway	Europe	High
	Taiwan	Asia	High
	Republic of Korea	Asia	High

Source: Generated by the author using the data in Table 2.

ANOVA analysis are shown in Table 4. It contains statistical estimates for each of these groups of countries, which are described below. At the same time, the first and second rows of the Table 4 show, respectively, the average values of the indicators for the groups of countries with the maximum and minimum values. The third and fourth lines show the variances for each of the groups of countries with the maximum and minimum values of the indicators. The following lines show the cross-group estimates for the groups of countries with the maximum and minimum values of the indicators.

TABLE 4. Statistical Characteristics Describing Groups of Countries with Maximum and Minimum Values of Indicators

No.	Statistical Characteristics	Indicator 1	Indicator 2	Indicator 3	Indicator 4	Indicator 5
1	Average for countries with maximum values of indicators, percent	16.31	1.69	8.41	5.89	1.63
2	Average for countries with minimum values of indicators, percent	1.48	0.24	0.86	0.15	0.07
3	Variance for countries with maximum values	101.33	0.53	48.50	4.67	0.19
4	Variance by country with minimum values	1.31	0.01	0.07	0.01	0.01
5	Variance between groups of countries with maximum and minimum values	710.63	8.23	224.68	139.49	7.76
6	Fisher criterion	12.82	26.89	8.10	55.96	60.11
7	Critical value according to the Fisher criterion	4.84	4.60	4.60	4.54	4.74
8	Significance level	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Source: Calculated by the author on the basis of household income indicators.

An analysis of the data presented in Table 4 shows that for all groups of countries characterized by maximum and minimum values of indicators, there are relatively small variances within each group. This indicates that each of these groups includes countries with small differences in values of indicators.

The average values for groups of countries with maximum values of indicators differ significantly from the average values for groups of countries with minimum values. The variance between the groups of countries with the maximum and minimum values is much greater than the variance typical for each of the groups for all five indicators considered. The data shown in Table 3 show that for each of the five indicators considered in the article, there are significant differences between the groups of countries with maximum values and minimum values.

The statistical characteristics of the ANOVA analysis based on inter-group differences, namely, on the Fisher criteria and the level of significance, showed a high quality of the obtained estimates.

CONCLUSION

The article presents the results of a study of the reasons for the exit of entrepreneurs from their businesses in 39 countries in 2020. The purpose of the study, which was to assess the proportion of the number of adults who stopped their business activities for various reasons, in the total number of economically active population in modern national economies, was achieved. The author's contribution, which has scientific novelty and originality, is as follows:

1. A methodological approach is proposed and implemented to assess the distribution of the values of five indicators across countries that characterize the level and various reasons for entrepreneurs leaving their businesses using the density functions of the normal distribution.
2. It is proved that the share of people who stopped entrepreneurial activity in 2020 amounted to about 6 percent of the total economically active population on average in the countries under consideration.

3. It is shown that 0.7 percent of the total economically active population stopped entrepreneurial activity for positive reasons.
4. It is proved that about five out of every six entrepreneurs who left their business stopped their entrepreneurial activity for negative reasons.
5. It is shown that about one-third of the entrepreneurs who left their business in 2020 did so due to the consequences of the coronavirus pandemic.
6. It is proved that the values of each of the five indicators under consideration had a significant differentiation by country.
7. For each of the indicators, countries with maximum and minimum values are identified.
8. ANOVA analysis showed significant differences in the groups that correspond to the maximum and minimum values of all five indicators.

The results of our research have a certain theoretical and practical significance for governments, entrepreneurs, and the economically active population. In most of the countries under consideration, the results showed that in 2020 there was a significant negative impact of the COVID-19 pandemic on business activity. Almost 30 percent of entrepreneurs who left their businesses did so due to the negative economic results caused by the consequences of the pandemic. Therefore, in the future, governments should take preventive measures to reduce the impact on entrepreneurship in cases of the threat of large-scale epidemics or catastrophes. Entrepreneurs should take into account the possibility of negative business conditions in the future. They should provide for remote work activities in advance, plan backup supply chains of necessary goods, and ensure interaction with consumers of products in such conditions.

The methodological approach presented in the article can be used to assess the impact of the coronavirus pandemic on the indicators of entrepreneurs' termination of their activities in 2021. The study had limitations on empirical data due to the fact that only 39 countries were considered. Further research may be related to the assessment of the consequences of the pandemic in 2021.

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