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Toward resilient organizations after COVID-19: an analysis of circular and less circular companies

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Abstract

The COVID-19 pandemic had large repercussions for our economy and organizations. Improved resilience can give organizations the ability to withstand crises and build back better and faster. This article assesses resilience of organizations and sole proprietorships in the context of the COVID-19 pandemic with eight circular strategies as explanatory variables. Furthermore, these eight circular strategies are also used to assess the organizations' and sole proprietorships' resilience outside of the COVID-19 pandemic. This analysis is conducted to explain how circular strategies can help companies and sole proprietorships maintain stability. The analysis was performed by means of a survey conducted between May and June 2020 in Flanders (Belgium), using a sample of 542 respondents. After performing a regression analysis combined with expert opinions collected through interviews, we find that companies and sole proprietorships with a higher circularity score have a significantly higher resilience score during crises and during normal times, compared to less circular companies. Furthermore, we find that the size of the company does not matter during a crisis to adapt and react flexibly, while it is important when there is no crisis. Finally, we argue that it is the combination of different circular strategies which yields to the highest results for the organizations' resilience and we provide policy recommendations based on the most asked support measures.

Keywords

Circularity, resilience, COVID-19, regression, companies, crisis

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1. Introduction

The COVID-19 pandemic has uncovered the current problems regarding organizations' sustainability and resilience. EU's total GDP declined by 12.1% in the second quarter of 2020, in Belgium it declined by 19.1% in the second quarter of 2020 (FOD Economie, n.d.; Shan et al., 2021). Besides the growth and the financial situation of businesses, the pandemic and different lockdown policies also influenced people's lifestyles, production activities, energy consumption, and CO₂-emissions.

Already during the pandemic, there are ideas to rethink our economic system. One of the contentions of Sarkis et al. (2020) and the Organisation for Economic Co-operation and Development (2020) is that the macroeconomic system should not be allowed to return to the original status after the pandemic. They believe it is our chance for economic development. On a business level, they posit, as well as Elliott et al. (2020), that the COVID-19 pandemic will lead to shorter and more local supply chains because the global production methods are complex and less diversified. Gregurec et al. (2021) concluded, based on an extensive literature review, that the coronavirus is an incentive for small and medium-sized enterprises (SMEs) to rethink their basic competences, look for new opportunities and intensively use sustainable business models. Their literature review also showed that the core focus of SMEs shifted from technology to social, customers, and organizationally driven changes. FOD Economie (2022), estimated that the number of SMEs in Belgium, of which the region Flanders is the scope for this paper, is higher than the EU average, respectively 68 and 59 SMEs per 1000 inhabitants. Therefore, it is important to keep an eye on these SMEs while analyzing the effects of the COVID-pandemic. According to Ibn-Mohammed et al. (2021), the size of the company has a large impact on its resilience during the COVID-19 pandemic. Based on an extensive literature review, they found that the pandemic caused an increase in e-commerce, which larger companies already implemented. SMEs also have implemented web services, though not as widespread as larger companies. Neligan et al. (2022) confirm, based on an extensive literature review with German firms in the manufacturing and industrial service sector, that large companies (250 employees or more) who implement a product-as-a-service strategy have a higher use of digitalization than smaller companies with the same strategy.

Some authors argue that, besides the size of the company, circularity plays a role in the resiliency during crises, e.g. Wuyts et al. (2020). The circular economy (CE) is a well-contested concept with many definitions. Kirchherr et al. (2017), in their well-cited paper, analyzed 114 definitions to capture the covering of the concept and summarized their findings in one definition, which is adopted in this paper: *"A circular economy describes an economic system that is based on business models which replace the 'end-of-life' concept with reducing, alternatively reusing, recycling and recovering materials in production/distribution and consumption processes, thus operating at the micro level (products, companies, consumers), meso level (eco-industrial parks) and macro level (city, region, nation and beyond), with the aim to accomplish sustainable development, which implies creating environmental quality, economic prosperity and social equity, to the benefit of current and future generations."* Potting et al. (2017) define the 10 R-strategies on which the circular economy is based: refuse, rethink, reduce, reuse, repair, refurbish, remanufacture, repurpose, recycle, and recover. In this paper, we will focus on these circular R-strategies and adapt these to the business (micro) context based on Kishna et al. (2019) to come to eight circular strategies.

Circularity on this micro level faces some challenges. Urbinati et al. (2017) formulate the problem of the practical implementation of the CE principles in business models. The ultimate goal of circular business models (CBMs) is to reduce the dependency on virgin materials, shift from a carbon-based energy system to a renewable one, increase the adoption of sustainable production practices, and adjust their value chain strategies. On the one hand, there are some barriers for companies to see the CE as a possible strategy to implement in their business models, such as the variety in the needs of customers, the technological expertise of companies, the efficiency of the products in terms of the return flow and the economic uncertainty and viability, the limitations of the design of products with regard to their possibility for CE implementation, the lack of supporting regulations

concerning Intellectual Properties and knowledge access, and the lack of incentives for partners to move to circular business models (Linder & Williander, 2017; Urbinati et al., 2021). On the other hand, there are enablers to working circular, such as the development of technologies that facilitate resource optimization, or the improvement of existing technologies, the resource efficiency and reduced dependency on material prices, and the geographical proximity of supply chain partners (Urbinati et al., 2021).

Besides the size of the company as mentioned above, another important distinction in terms of CE implementation is that of established companies versus startups. Henry et al. (2020) define startups as “*new*” (i.e. typically operating for four to six years) and ‘independent’ entrepreneurial ventures designed to effectively develop and validate a scalable, repeatable, and at least break-even business model”. Neligan et al. (2022) illustrate, using an extensive literature review for German firms in the manufacturing and industrial service sector, that companies tend to concentrate first on small incremental changes of their business operations and implementation of circular strategies before they can do more radical changes. This is different for startups who are able to start a business model from scratch.

The implementation of circular strategies in businesses is a part of the implementation of sustainability, where circularity has a focus on the reduction of material use, waste generation, and resource depletion (Henry et al., 2020). Sustainability on the other hand is a broader concept, taking into account economic, environmental and social values with multiple goals (Geissdoerfer et al., 2017). In the existing research on the CE, the social dimension is often limited to the labour market and the focus is put on the economic viability and environmental effects in terms of material use. However, it is important to keep the social dimension in mind when talking about circularity as well, the circularity transition should be a socially just transition. Kirchherr (2021) opens the discussion on what he calls circular justice with a first draft of a definition: “*Recognizing the full breadth of communities impacted by (shifting) to a circular economy – in particular communities of the Global South; fairly incorporating in particular marginalized communities into relevant decision-making processes; equitably distributing the benefits and costs of (shifting towards) a circular economy*”. A study of Repp et al. (2021) confirms that the CE transition could lead to a large decrease in employment in low- and upper-middle-income countries outside the EU while positive effects in the EU are expected. Waste pickers are a large part of the informal circular economy in these low- and middle-income countries, for example 54% in Brazil (UN, 2010). During the pandemic, these jobs are heavily impacted while they do not have a safety net to fall back to (Samson, 2009; ILO, 2020). Estimates of ILO (2020) show that these informal workers will have an increase in relative poverty with 21 percentage points in upper-middle-income countries, 52 points in high-income countries and 56 points in lower- and low-income countries. Hartmann et al. (2022) conducted a survey with 499 waste pickers in three cities (Accra in Ghana, Mexico City, and Lima in Peru) and found that the income of the waste pickers post-COVID (June and July 2020) did not reach the income before COVID (February 2020), indicating a low resilience of the income of these jobs in the circular economy.

Impact assessments of the implementation of circular strategies on resilience levels of businesses are missing in the current body of literature. This paper aims to be the first to empirically assess whether circular companies were more resilient during the first wave of COVID-19 measures between March 2020 and June 2020. This is achieved by means of a survey analysis, covering 542 respondents of different organizations in the region of Flanders (Belgium), probing for the self-assessed resilience levels and a self-assessment of their level of circularity. This analysis provides necessary insights for involved stakeholders, including private sector actors about to take investment decisions on circular strategies. On top of this, the conclusions support policy makers working on the topic of circularity. Flanders is considered as a prosperous small open economy and the set of respondents is representative for other prosperous small open economies.

The resilience in our survey is already rigorously defined in literature, although not all the definitions are applicable for this research. Suitable for this paper, are the definitions of Wuyts et al. (2020) and Fiksel (2015).

The former formulated resilience as *“the ability to adapt, to innovate and be flexible in order to resist the crisis as well as to bounce back to the normal state as soon as possible.”* Fiksel (2015) defined resilience in the business context as *“the capacity for a system to survive, adapt, and flourish in the face of turbulent change and uncertainty”*. Furthermore, they posited that resilience is more of a short-term concept to overcome disruptions when they occur. Being able to anticipate and counteract these short-term disruptions also makes the organization resilient in the long run.

The interplay between circularity and resilience is mainly investigated by means of literature reviews and other qualitative research. Ellen MacArthur Foundation (2013) found that the change from a linear economic system to a circular one could cause an innovation wave and could give the opportunity for economies to grow and remain stable. Furthermore, *“Circular concepts could address challenges such as an intensified cost-price squeeze, shorter product life cycles, geographic and political supply risks, increased commoditisation of products, and decreased customer loyalty.”* Until now, the linear and global system pushed companies to increase their scale levels and adopt global cycles, which diminished their resilience (Ibn-Mohammed et al., 2021). Another way in which circularity leads to stability, is through reducing the dependency on scarce materials, among others, as waste can replace these materials (Fiksel et al., 2021).

Many aspects of the circularity-resilience nexus remain unclear. Coalition Circular Accounting (2021) for example articulated that the economic situation of a business still depends mostly on its financial data while generating circular data can provide additional insights. According to them, it can be expected that circular companies have a lower financial performance because of internalizing externalities. However, the benefits of circularity should also be captured, such as extending the lifespan of materials and products, reducing waste, and the use of renewable energy. Value creation by these strategies is thus overlooked and constraints such as resource depletion or climate change are not reflected in the financial performance of the companies. When these businesses implement circular strategies, they are quickly out-competed due to increased costs for innovation (Bauwens, 2021).

The structure of this paper is the following. First, the method used for this paper will be explained in depth. Next, the results of the analysis will be discussed. The analysis consists of two parts: descriptive statistics and an Ordinary Least Squares regression analysis. Furthermore, we will discuss our results while comparing them to the broader literature and supplementing them with interviews with experts. The discussion section will also stipulate policy recommendations and signal this paper’s limitations .

2. Method

Data on resilience and circularity levels was gathered through a survey. The survey was conducted between May and June 2020 and probed for the experiences of organizations during the COVID-19 pandemic, prospects for the future, and the role of the circular economy in Flanders. Flanders is a small open economy which depends to a large extent upon its service sector. It is strongly integrated in global trade and mainly export-oriented. With a lot of aid programs for SMEs, Flanders mainly derives its power of its economic network from SMEs, with more and more pressure on multinational companies (European Commission, n.d.). Furthermore, Flanders is considered as a rich region, with a higher GDP per capita, a higher R&D intensity, and a lower share of people below the poverty threshold compared to the EU (Statistics Flanders, 2020). This turns Flanders into a representative region for many other regional small open economies within the EU and in other developed countries elsewhere.

This research applied a voluntary sampling process and solicited the participants over the internet. Voluntary sampling typically leads to a set of respondents demonstrating interest in the survey’s topic. To avoid a biased sample composition, the survey is presented via an online template which is made available on the social media

channels of Circular Flanders¹ and research institute VITO. These two organizations are different in nature and consequently appeal to a different pool of participants, resulting in a balanced sample composition. Finally, the respondents' basic characteristics are checked to avoid undercoverage of specific groups. This resulted in a final sample which includes 542 respondents representing 223 private companies, 87 governmental organizations, 59 sole proprietorships, 90 non-profits, 53 knowledge and educational institutions, and 24 from none of the above.

The survey was structured in 4 distinct parts. The first part gathered demographic information, and information which allowed categorization of the organizations the respondents represented. The categorization occurred by means of a couple of parameters, including organizational size (measured in number of employees), sector, the type of organization, and the type of job.

The second unit consists of a self-assessment of the circularity level of the represented organizations, where the respondents indicate to what extent their organization implements eight distinct circular strategies. The circular strategies were based on the R-strategies of the Netherlands Environmental Assessment Agency and consequently adapted (Kishna et al., 2019). These strategies were identified as: 1) using less materials, 2) using renewable energy, 3) recuperate waste and materials, 4) ensuring lifetime extension, 5) sharing production factors, 6) using circular business models (e.g. product-service models), 7) using local chains and 8) offering shared mobility. For each of these strategies, the respondents indicated to what extent their organization implements these strategies on a four point scale: 1) not (yet) implementing 2) limited implementation, 3) good basis, 4) thorough implementation and 'I don't know' (0). Next, a circularity score is calculated based on the answers of the respondents. All zero scores were excluded after which a mean was calculated over all the strategies per organization, attributing equal weights to each of the strategies. Hence, the scale is considered as a continuous scale. That mean score is referred to as the circularity score. The higher the circularity score, the higher the level of implementation of circular strategies. Note that the records of respondents who did not know the answer to the question were omitted out of this analysis, resulting in a smaller sample.

Next, this part questioned a self-assessed overall-resilience. This relates to the general structure of the organization and its surroundings, regardless of the pandemic. The question was "Which can be applied to your organization?". The answer options were the following: We work in a sector where the demand is stable and independent of the business cycle, we have a well-filled order book, we have loyal and solvent clients/members/customers/students/..., we build well resistant capital buffers, we are creative and adapt fast to changing surroundings, we have a robust supply chain, we have local stock, we have loyal and creative employees, we invest strongly in innovations for which a market will certainly be available in the future, and we have a strong long-term vision so that we can handle temporary crises. These options are based on the approach of Erol et al. (2010) and satisfy the previous definition given of resilience. This time, a score from 1 to 5 was calculated; Totally disagree (1), disagree (2), neutral (3), agree (4), totally agree (5). A higher score on the calculated mean score for this category of questions indicates a higher overall-resilience.

Finally, this part also probed for the governmental support they would wish to receive to achieve this circularity: A stronger antidumping policy to prevent unfair competition, fiscal measures which stimulate circular goods and services, better access to circular 'communities of practice', better access to venture capital for circular projects, public procurement for circular goods and services, bank guarantees for investments, removing regulatory barriers, support for innovation and cooperation (subsidies), more education and training for new and more polyvalent skills, better access to information and expertise, liquidity support for subordinated loans, and improving export chances and international knowledge exchange for Flemish frontrunners. The respondents could tick as many answers as they wanted.

¹ Circular Flanders is a partnership of governments, companies, non-profits, and knowledge institutions for the circular economy in Flanders

The third part probes for the respondents' expectations concerning new economic trends on both the production and consumption side of the market in the course of the next five years. The possible future changes range from globalization, the leave or return of industry from Belgium, working from home, limitations to trade, the reduction of CO₂, the focus on digitalization, prices and availability of raw materials, the implementation of new business models, the expenses of consumers and their attention for sustainability, and their preferences toward physical shops or e-commerce.

The fourth and last part directly links to the COVID-19 pandemic and questions the types of problems both the respondents and their organizations encountered during the lockdown, and probes for the seriousness of these problems by means of a likert-scale. Based on the question "Did your organization experience problems during the COVID-19 pandemic?", a self-assessment crisis-resilience score could be calculated. The crisis-resilience factors were problems with resources, materials and parts, labour forces, information, customer demand, stocks, logistics, financing, permission to work, and the possibility to work safely. For each of these problems they could indicate whether they experienced large problems (1), limited problems (2), not really a problem (3), no problem at all (4) or not applicable (0). The crisis-resilience score was then calculated in the same way as the circularity score, a higher crisis-resilience score signifies less problems.

Finally, the respondents are categorized in two groups: the less circular organizations and the circular organizations. The division was based on the circularity score, those with a circularity score lower than three were labelled as less-circular. Thus, a circular organization is defined in this paper as an organization that has, on average, a good basis or very thorough implementation of all the circular strategies while a less circular company is defined as an organization that has, on average, no understanding or a limited understanding of all the circular strategies. The gathered data is then analyzed by means of a two-step procedure. The first step consists of the generation of descriptive statistics on the covered variables. The second step seeks for relationships among the variables. The aim of this second step is to discover to what extent an organization's circularity level impacts the organization's resilience in times of crises or in normal times. This is assessed by an OLS regression analysis while controlling for the size of the organizations.

The constructions of all the scores were checked by the Cronbach Alpha, which is at least 0.83. It can thus be concluded that the internal consistency of our constructs is reliable.

The discussion and interpretation of the survey results is data-based in the first phase. In the second phase, the results are also presented to 8 experts (see Annex B for an overview of the functions and organizations of the interviewed experts). Semi-structured interviews are used to probe their explanation of, and insights into the observed trends. Recordings of the interviews are used to complement the analysis and transcribe certain passages.

3. Results

3.1. Descriptive statistics

Circularity

The circularity score is calculated based on the question "Which circular strategies does your organization implement?". The mean circularity score over all organizations is 2.59 and the median 2.63. In what follows, we continue to work with only companies and sole proprietorships. The reason for this is the following assumption: The financial structure of governmental organizations, knowledge institutions, and non-profit organizations depends less on the value chain with the market of demand and supply and is thus less impacted by the crisis. Including these other types of organizations could distort the analysis.

The mean circularity score over all companies and sole proprietorships is 2.58 and the median 2.63, which is comparable to before. The number of companies which are defined as circular (those the circular strategies on at least a good basis) is 71, with a mean circular score of 3.38, while 150 companies were labelled as less circular with a mean circularity score of 2.21.

Table 1 gives a distribution of different types of circular strategies and their circularity score. As a result, using less materials, using renewable energy, recuperation of waste and materials, ensuring lifetime extension and using local chains all have a median of 3, while sharing production resources, using circular business models and offering shared mobility have a lower median of two. The measure with the highest mean circularity score is using renewable energy followed by using less materials and the recuperation of waste and materials. The standard deviation for all the strategies fluctuates between 0.94 for using less materials and 1.14 for adopting circular business models.

| | Min | Q1 | Median | Mean | Q3 | Max | St dev |
|------------------------------|-----|----|--------|------|----|-----|--------|
| Less materials | 1 | 2 | 3 | 2.84 | 4 | 4 | 0.94 |
| Renewable energy | 1 | 2 | 3 | 2.92 | 4 | 4 | 0.99 |
| Recuperation waste/materials | 1 | 2 | 3 | 2.82 | 4 | 4 | 1.05 |
| Lifetime extension | 1 | 2 | 3 | 2.76 | 4 | 4 | 1.01 |
| Sharing production resources | 1 | 1 | 2 | 2.26 | 3 | 4 | 1.06 |
| Circular business models | 1 | 1 | 2 | 2.29 | 3 | 4 | 1.14 |
| Local chains | 1 | 2 | 3 | 2.69 | 4 | 4 | 1.01 |
| Mobility | 1 | 1 | 2 | 2.30 | 3 | 4 | 1.09 |

Table 1: Summary and statistics of the different types of circular strategies and their circular score

Crisis-resilience

The survey probed for resilience in times of crisis by means of the following question: "Did the production, service, or supply of your organization change due to the pandemic?". Multiple answers were possible, and 43% of the respondents working in companies and sole proprietorships indicate that their production, service or supply did not change. 8% of the respondents say that there was more production, service or supply, while 22% say there was less. Also 22% believe that new supply was developed.

The results for the circular and less circular companies and sole proprietorships for the question "Did your company experience problems during the COVID-19 pandemic?", of which the answer options were called the crisis-resilient factors, are reported in Table 2. After compiling a t-test, we found that only the access to enough information and having enough labor forces is significantly higher for the circular companies than for the less circular companies.

| | Circular | Less circular |
|------------------------|----------|---------------|
| Resources | 32% | 35% |
| Materials/parts | 45% | 43% |
| Labor forces | 13% | 29% |
| Information | 8% | 15% |
| Customer demand | 52% | 46% |
| Stock | 29% | 29% |
| Logistics | 21% | 27% |
| Financing | 20% | 30% |
| Permission to work | 27% | 38% |
| Ability to work safely | 17% | 24% |

Table 2: The share of circular and less circular companies which experience the problems in the rows

Furthermore, the answer to the previous question can also be used to calculate a crisis-resilience score. As explained before, this is the mean score over all the respondents and all the problems they may encounter. The mean crisis-resilience score for all the companies and sole proprietorships is 2.70, while the mean for less circular companies and sole proprietorships is 2.69 and the mean for circular companies and sole proprietorships is 2.87. After compiling a t-test, we found that these differences in crisis-resilience are statistically significant on a 5% significance level.

Support measures

In the survey, we questioned the need for support measures from organizations. Figure 1 shows some possible support measures and the number of respondents who indicated that they could use these measures to become more circular. It is clear that the most asked support measure is fiscal measures to stimulate circular goods and services, followed by support for innovation and collaboration. The measures that are asked least are liquidation support or subordinated loans, followed by bank guarantees for investments. These measures are specifically for Flanders, however, the results can also be applied on other prosperous small open economies.

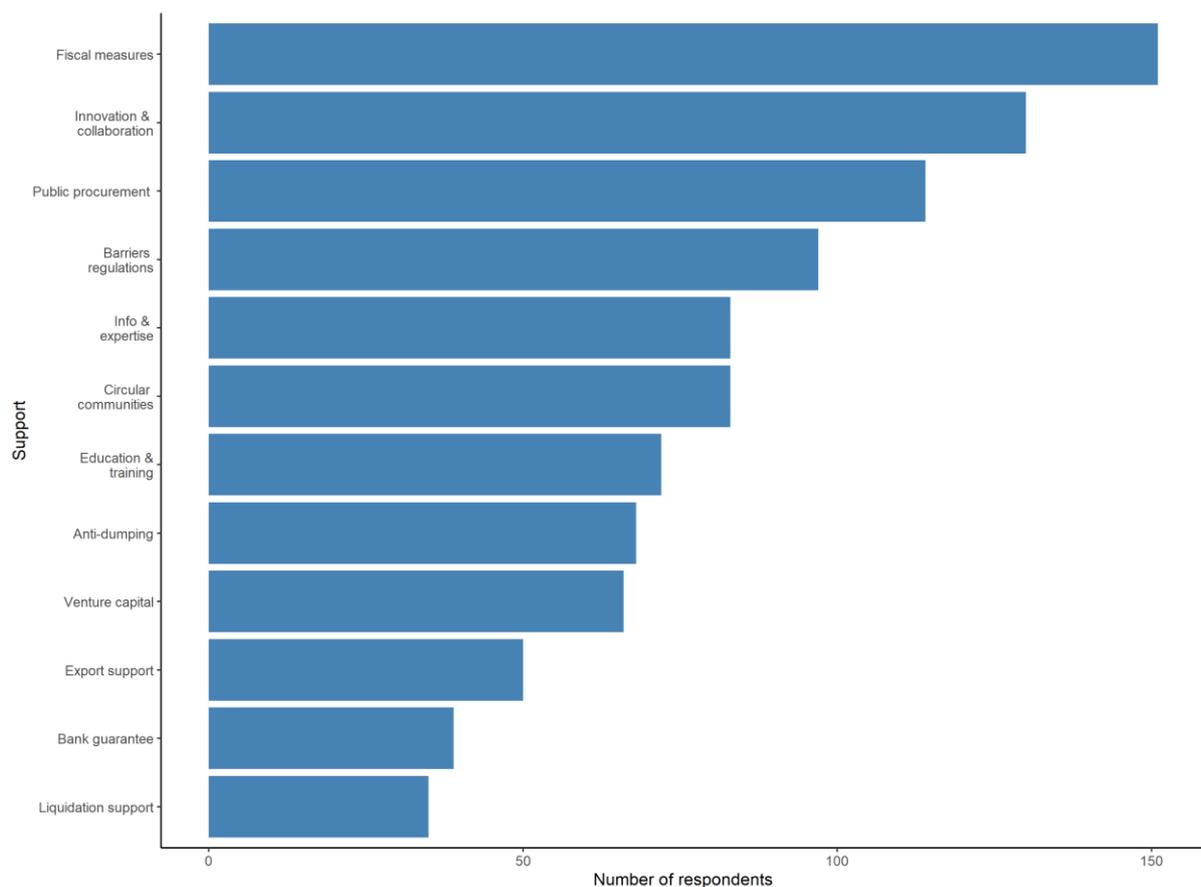


Figure 1: Frequency of requested support measures

3.2. Regression analysis

Circularity and crisis-resilience

It is interesting to estimate a regression model on the possible link between circularity and crisis-resilience. More in particular, this research estimates an OLS regression model with the following specification:

$$CR_i = \beta_0 + \beta_1 CS_i + \beta_2 S_i + e_i \quad (1)$$

Where i refers the company; CR_i refers to the crisis-related resilience level of company i ; CS_i refers to the circularity score; and S_i refers to the company size. The error term is presented by e_i . In this set-up, the resilience level is modelled as a function of company size and circularity. The company size serves as a control variable, hence the impact of that variable is controlled for when assessing the impact of the explanatory variable on circularity.

Table 3 presents the results of this analysis. The circularity score has a positive significant effect on the crisis-resilience on a 5% significance level. This indicates that firms with higher levels of circularity also have higher resilience scores in times of crisis. The lower number of observations is due to the calculation of the crisis-resilience and circularity scores, as mentioned before. The people who indicated that they do not know which circular strategies are applied, or that some crisis-resilience factors cannot be applied to their organization, are not included in the calculation.

| Crisis-resilience score | |
|-------------------------|----------------------|
| Circularity score | 0.175*** (0.059) |
| Size | -0.010 (0.027) |
| Constant | 2.327*** (0.192) |
| Observations | 92 |
| R ² | 0.094 |
| Adjusted R ² | 0.074 |
| Residual Std. Error | 0.375 (df = 89) |
| F statistic | 4.622** (df = 2; 89) |

Table 3: OLS regression of the circularity score on the crisis-resilience score

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

When this is broken down into the different circular strategies and crisis-resilience factors, it can be seen which circular strategies contribute to which crisis-resilience factors. This more detailed analysis is specified in the following OLS regression model:

$$CR_{i,f} = \beta_0 + \beta_1 LR_i + \beta_2 RE_i + \beta_3 WM_i + \beta_4 LTE_i + \beta_5 SH_i + \beta_6 CBM_i + \beta_7 LC_i + \beta_8 SM_i + \beta_9 S_i + e_i \quad (2)$$

Where f stands for one of the included crisis-resilience factors, i.e.: access to resources, parts & materials, labor forces, information, demand, stocks, logistics, financing, permission to work and the ability to work safely. In addition, LR_i represents company i 's efforts to use less resources; RE_i refers to the use of renewable energy and materials; WM_i refers to waste management; LTE_i and SH_i refer to application of lifetime extension, respectively sharing strategies; CBM_i refers to Circular Business Models; LC_i refers to the use of local value chains; SM_i refers to shared mobility. Again, company size S_i is introduced to filter out that impact, and focus on the circular strategies' impact instead.

Table 4 presents the results of this analysis and demonstrates that the size of the company has a negative significant effect on the 10% significance level (s.l.) on the abundancy of resources. Using renewable energy or materials has a positive significant effect on having enough parts or materials on the 10% s.l. Sharing production resources has a positive significant effect on having enough labour force on the 1% s.l. Using renewable energy/materials and expanding the lifetime of its products has a positive significant effect on the availability of information during the pandemic on the 5% s.l. Using renewable energy, sharing production resources and the size of the company has a positive significant effect on the customer demand during the pandemic, all on the 5% s.l. Having a sufficient waste management has a positive significant effect on having enough stocks on the 1% s.l. The size of the company has a positive significant effect on financing and the permission to work, on the

1% and 10% s.l., respectively. Finally, using renewable energy has a positive significant effect on the ability to work safely on the 5% s.l.

To check the robustness of the results, we deleted the circular strategy of renewable energy, and found that no other results changed.

| | Resources | Parts/materials | Labor forces | Information | Demand | Stocks | Logistics | Financing | Permission | Work safely |
|-------------------------|---------------------|----------------------|---------------------|-----------------------|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Less resources | 0.070 (0.091) | 0.062 (0.091) | -0.074 (0.086) | -0.054 (0.077) | -0.062 (0.099) | 0.032 (0.097) | 0.027 (0.081) | -0.032 (0.082) | -0.119 (0.085) | 0.050 (0.077) |
| Renewable energy | 0.002 (0.079) | 0.150* (0.077) | 0.041 (0.078) | 0.151** (0.069) | 0.188** (0.088) | -0.121 (0.087) | 0.020 (0.076) | 0.091 (0.071) | 0.026 (0.077) | 0.145** (0.069) |
| Waste management | 0.002 (0.071) | 0.080 (0.070) | 0.072 (0.070) | 0.027 (0.062) | -0.062 (0.080) | 0.163** (0.078) | 0.028 (0.068) | 0.044 (0.064) | 0.102 (0.068) | 0.007 (0.062) |
| Lifetime extension | 0.030 (0.072) | -0.035 (0.071) | -0.066 (0.068) | -0.099 (0.064) | -0.005 (0.079) | -0.040 (0.078) | -0.001 (0.067) | -0.028 (0.066) | 0.087 (0.071) | 0.037 (0.063) |
| Sharing | 0.031 (0.075) | 0.064 (0.075) | 0.194** (0.076) | 0.062 (0.066) | 0.198** (0.085) | 0.044 (0.083) | 0.006 (0.068) | 0.050 (0.067) | -0.077 (0.073) | -0.082 (0.066) |
| CBM | -0.005 (0.064) | -0.047 (0.060) | 0.030 (0.057) | -0.021 (0.053) | -0.104 (0.066) | 0.045 (0.071) | 0.031 (0.059) | -0.006 (0.054) | -0.016 (0.060) | 0.48 (0.053) |
| Local chain | 0.008 (0.069) | -0.025 (0.067) | 0.038 (0.065) | 0.088 (0.062) | 0.007 (0.079) | -0.052 (0.076) | 0.010 (0.066) | 0.013 (0.062) | 0.022 (0.068) | -0.020 (0.062) |
| Shared mobility | 0.010 (0.069) | -0.084 (0.066) | -0.029 (0.065) | 0.049 (0.059) | -0.037 (0.075) | 0.015 (0.075) | -0.061 (0.061) | 0.017 (0.062) | 0.090 (0.064) | 0.046 (0.057) |
| Size | -0.074* (0.041) | -0.055 (0.040) | -0.021 (0.040) | -0.039 (0.034) | 0.111** (0.044) | -0.010 (0.044) | 0.019 (0.037) | 0.093*** (0.035) | 0.069* (0.039) | 0.045 (0.034) |
| Constant | 2.564*** (0.275) | 2.190*** (0.267) | 2.488*** (0.248) | 2.689*** (0.223) | 1.853*** (0.287) | 2.706*** (0.283) | 2.572*** (0.246) | 2.052*** (0.233) | 2.130*** (0.271) | 2.403*** (0.221) |
| Observations | 117 | 128 | 163 | 190 | 208 | 125 | 143 | 168 | 184 | 191 |
| R ² | 0.072 | 0.121 | 0.083 | 0.094 | 0.083 | 0.065 | 0.024 | 0.078 | 0.064 | 0.064 |
| Adjusted R ² | -0.006 | 0.054 | 0.029 | 0.048 | 0.041 | -0.008 | -0.042 | 0.025 | 0.016 | 0.018 |
| Residual Std. Error | 0.590 (df = 107) | 0.608 (df = 118) | 0.695 (df = 153) | 0.695 (df = 180) | 0.928 (df = 198) | 0.668 (df = 115) | 0.621 (df = 133) | 0.658 (df = 158) | 0.754 (df = 174) | 0.683 (df = 181) |
| F Statistic | 0.920 (df = 9; 107) | 1.807* (df = 9; 118) | 1.546 (df = 9; 153) | 2.070** (df = 9; 180) | 1.983** (df = 9; 198) | 0.885 (df = 9; 115) | 0.363 (df = 9; 133) | 1.458 (df = 9; 158) | 1.322 (df = 9; 174) | 1.328 (df = 9; 181) |

Table 4: OLS regression of the circular strategies on the crisis-resilience factors

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Circularity and overall-resilience

Similar to the circularity score and the crisis-resilience score, an overall-resilience score can be calculated based on the resilience levels of the companies and sole proprietorships regardless of the pandemic. This model is specified as:

$$OR_i = \beta_0 + \beta_1 CS_i + \beta_2 S_i + e_i \quad (3)$$

Where OR_i refers to overall-resilience of company i . The results of this overall-resilience can be found in Table 5. Both the size and the circularity score have a significant positive effect on the overall-resilience on the 1% significance level. The number of observations is higher, because all the respondents were obliged to answer the questions of the overall-resilience since they did not have the possibility to indicate that they do not know the answer. When the companies and sole proprietorships were divided into two groups, the circular and less circular companies, we see that there is a significant difference in the means of the overall-resilience on a 5% significance level (respectively 3.54 and 3.26).

| Overall-resilience score | |
|--------------------------|-------------------------|
| Circularity score | 0.257*** (0.053) |
| Size | 0.091*** (0.025) |
| Constant | 2.426*** (0.163) |
| <hr/> | |
| Observations | 217 |
| R2 | 0.139 |
| Adjusted R2 | 0.131 |
| Residual Std. Error | 0.557 (df = 214) |
| F statistic | 17.323*** (df = 2; 214) |

Table 5: OLS regression of the circularity score on the overall-resilience score

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Also the overall-resilience can be assessed in more detail, leading to the specification of the following OLS regression model:

$$OR_{i,f} = \beta_0 + \beta_1 LR_i + \beta_2 RE_i + \beta_3 WM_i + \beta_4 LTE_i + \beta_5 SH_i + \beta_6 CBM_i + \beta_7 LC_i + \beta_8 SM_i + \beta_9 S_i + e_i \quad (4)$$

Table 6 presents the results of this analysis. It can be seen that having a local supply chain has a positive significant effect on being creative and the ability to adapt fast, and on a robust supply chain on the 5% s.l. Having a circular business model has a significant effect on the innovations in future markets on the 1% s.l. Next, the lifetime extension of products, installations and buildings has a significant positive effect on having a stable demand for that company on the 10% s.l. The size of the company has a significant positive effect on both having loyal and solvent customers on the 5% s.l. and on having built sufficient capital buffers on the 1% s.l. Furthermore, both using renewable energy or renewable materials and the size of the company have a significant effect on having a well-filled order book (respectively on the 5% and 1% s.l.). Also renewable energy/materials and having a local production or local supply chain both have a positive significant effect on a 5% s.l. on having enough stock. Furthermore, offering shared mobility and the size of the company both have a positive significant effect on having loyal and creative employees (respectively on the 10% and on the 1% s.l.). Finally, using renewable energy or renewable materials, having circular business models, having a local production or local supply chain and the size of the company all have a positive significant effect on the long-term vision. This is on, respectively, a 10%, 1%, 1% and 5% s.l. After compiling a t-test, we see that the mean score for investing in innovations, having loyal and creative employees, having a robust supply chain, and being creative and being able to adapt fast to counter possible crisis is significantly higher for circular than for less circular companies.

It is clear that some of the circular strategies are more or less important during times of crisis compared to an overall-resilience. For example, having a local chain and implementing circular business models did not seem to be important during the corona-crisis, while it is overall important for several resilient factors. This is surprising but can be explained by the small open economy of Flanders with central location in Europe. Having a good waste management, implementing lifetime extension, and sharing production resources however, seemed more important during the crisis.

| | Stable demand | Well-filled book | order | Loyal customers | Capital buffers | Creative and adaptive | Robust supply chain | Local stocks | Loyal employees | Investments in innovations | Long-term vision |
|--------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|-----------------------|---------------------|---------------------|---------------------|----------------------------|------------------|
| Less resources | 0.024 (0.114) | -0.137 (0.108) | -0.032 (0.104) | -0.080 (0.112) | 0.101 (0.093) | -0.048 (0.088) | -0.096 (0.090) | 0.067 (0.091) | -0.014 (0.098) | 0.097 (0.097) | |
| Renewable energy | 0.070 (0.101) | 0.202** (0.096) | 0.087 (0.092) | 0.057 (0.099) | 0.036 (0.082) | 0.029 (0.078) | 0.203** (0.080) | 0.124 (0.081) | 0.099 (0.087) | 0.150* (0.086) | |
| Waste management | -0.057 (0.092) | 0.099 (0.087) | 0.034 (0.084) | -0.052 (0.090) | 0.046 (0.075) | 0.049 (0.071) | -0.026 (0.073) | -0.087 (0.074) | -0.012 (0.079) | -0.109 (0.078) | |
| Lifetime extension | -0.159* (0.093) | -0.089 (0.088) | 0.004 (0.085) | 0.110 (0.091) | -0.003 (0.075) | 0.083 (0.071) | -0.088 (0.073) | -0.023 (0.074) | 0.115 (0.080) | 0.092 (0.079) | |
| Sharing | 0.134 (0.099) | 0.009 (0.094) | -0.069 (0.090) | -0.097 (0.097) | 0.031 (0.080) | -0.077 (0.076) | 0.045 (0.078) | -0.099 (0.069) | -0.037 (0.085) | -0.069 (0.084) | |
| CBM | 0.056 (0.077) | -0.055 (0.073) | 0.041 (0.070) | 0.070 (0.075) | 0.027 (0.062) | 0.026 (0.059) | 0.079 (0.060) | 0.072 (0.061) | 0.254*** (0.066) | 0.187*** (0.065) | |
| Local chain | 0.034 (0.091) | 0.028 (0.086) | 0.062 (0.083) | 0.001 (0.089) | 0.148** (0.074) | 0.158** (0.070) | 0.155** (0.072) | 0.069 (0.073) | 0.051 (0.078) | 0.208*** (0.077) | |
| Shared mobility | 0.006 (0.086) | 0.100 (0.081) | 0.097 (0.078) | 0.044 (0.084) | -0.066 (0.070) | -0.003 (0.066) | -0.098 (0.068) | 0.133* (0.069) | 0.108 (0.043) | 0.008 (0.073) | |
| Size | 0.049 (0.050) | 0.211*** (0.047) | 0.105** (0.056) | 0.266*** (0.049) | -0.064 (0.041) | 0.055 (0.039) | 0.032 (0.039) | 0.127*** (0.040) | 0.018 (0.043) | 0.109** (0.043) | |
| Constant | 2.290*** (0.325) | 2.034*** (0.308) | 2.501*** (0.297) | 2.174*** (0.319) | 3.118*** (0.264) | 2.425*** (0.251) | 2.518*** (0.256) | 2.899*** (0.260) | 2.310*** (0.280) | 1.780*** (0.277) | |
| Observations | 217 | 217 | 217 | 217 | 217 | 217 | 217 | 217 | 217 | 217 | |
| R ² | 0.032 | 0.143 | 0.061 | 0.149 | 0.106 | 0.070 | 0.086 | 0.116 | 0.190 | 0.223 | |
| Adjusted R ² | -0.010 | 0.106 | 0.020 | 0.112 | 0.067 | 0.030 | 0.047 | 0.078 | 0.154 | 0.189 | |
| Residual Std. Error (df = 207) | 1.090 | 1.035 | 0.995 | 1.070 | 0.886 | 0.842 | 0.859 | 0.873 | 0.939 | 0.929 | |
| F Statistic (df = 9; 207) | 0.762 | 3.838*** | 1.498 | 4.013*** | 2.731*** | 1.730* | 2.173** | 3.030*** | 5.379*** | 6.594*** | |

Table 6: OLS regression of circular strategies on overall-resilience factors

Note: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

4. Discussion

4.1. Circularity and resilience

Besides the human health crisis, the COVID-19 pandemic had and still has large repercussions for both the economy and organizations. To endure the crisis, it is important for these organizations to build resilience on the short-term and the long-term. Since the outbreak, numerous studies have been conducted to help firms to “build back better”. However, few studies have estimated the empirical link between implementing circular strategies and resilience of the firms.

In our empirical analysis, the companies and sole proprietorships were split into two groups: the circular and less circular ones. We found that the mean crisis-resilience score and overall-resilience score is significantly higher for the circular than for the less circular companies. These results confirm those of Zhongming et al. (2020), who posited that the decrease of reliance on scarce resources in a circular economy increases the resilience.

Furthermore, we found that the circularity score has a positive significant effect on the crisis-resilience score, while both the circularity score and the size of the company have a positive significant effect on the overall-resilience score. It seems that the size of the company is not important during a crisis in terms of its resilience against the lockdown measures while it is important overall. This is contradictory with the results of Ibn-Mohammed et al. (2021), who found in their extensive literature review that the size of the company is important for the resilience during a crisis. Expert 5 argues that the size of the companies is indeed not important to assess the resilience of the companies during a crisis, but the resilience is dependent on the ability to switch production processes quickly. Experts 3 and 4 on the other hand confirm the results of the existing literature and both argue that large companies are less flexible to change their production processes compared to smaller companies. Expert 3 furthermore confirmed the literature from the introduction that Belgium is an SME-country, and that even though smaller companies are more flexible to change their production processes during a crisis, smaller companies were more concerned with surviving in the first place, making their resilience dependent on other factors such as circularity.

When we looked at the different crisis-resilience factors separately, we did find that the size of the company has on the one hand a negative significant effect on the abundance of resources, and on the availability of information, and a positive significant effect on the other hand on the customer demand, on the access to financing, and on the permission to work. During the crisis, there were often problems with resources, and the negative effect of the size of the company can be explained by the larger production volumes and larger need for these resources by larger companies than smaller companies, the reliance upon lean management techniques (with accompanying low stocks) and the reliance upon international instead of more local value chains (Golgeci et al., 2020; Ivanov, 2021). Expert 6 explains that younger and smaller companies often had the audacity to look for alternative supply chains and production processes, and they often made more use of digital sources to build a community and their storytelling, leading them to experience less problems with resources and the availability of information. Larger and more traditional companies on the other hand were often stuck in their supply chain, dependent on the supply of materials and increasing material prices. However, expert 7 notes that larger companies are often less transparent about their challenges and problems, which makes it more difficult to get a good grip on their effects, making it impossible to draw correct conclusions.

The positive effect of the size on the customer demand can be explained by the trustworthiness and brand awareness of larger companies. Several traditional companies, such as DIY stores, thrived during the lockdown as a consequence of working from home en masse (confirmed by expert 6). The positive significant effect on the access to financing can be explained by the upcoming trend for futureproof innovation for large companies

according to expert 3 and by the financial buffers of larger companies according to expert 7. According to expert 8, the problem for smaller companies is that a complete business plan is required in order to receive funding, while this is less difficult for larger linear companies who want to start a circular side activity. However, experts 2 and 4 disagree and argue that there are increasingly more impact investors for startups who look at the content of the business plan and not at the trustworthiness of the companies. Finally, the positive effect on the permission to work is ambiguously explained by the experts: expert 4 noticed that large companies always found a way to continue their business operations while expert 1 argues that larger companies were monitored more closely by labour unions compared to smaller companies.

A more detailed analysis of the different circular strategies showed that using renewable energy and the sharing of production resources had a positive significant effect on having a stable demand during crisis. This positive effect of using renewable energy and materials and the sharing of production resources on the stable demand can be explained by the focus of these companies on different types of consumers (argued by experts 2, 6, and 8). A crisis disrupts the supply chains and the material prices, which pushes consumers to make different choices. The consumers convinced of the company's value proposition will stay loyal and will pay the demanded price. Often companies with more circular activities focus more on these value propositions since they are not in the position to compete with market prices. Michaud en Llerena (2011) also illustrate that the willingness to pay is not necessarily lower for more expensive sustainable products when the environmental impact is given.

Furthermore, the COVID-19 crisis has increased the importance of digital tools in supply chains to connect to customers (e.g. online shopping, traceability of materials). These digital tools thrive especially well in a circular value chain because circular companies find it more easy to connect to customers by means of digital tools in times of crisis (Nandi et al., 2021; Ranta et al., 2021). Experts 4, 7, and 8 confirm this finding from practice where they see that companies that are engaged in circular strategies often think of digitalization in the first step of developing the business plan. These companies want to stay in touch with the customers during the life cycle of the product or with other companies with who they share resources and they want to facilitate take-back systems. As a result, they often have a well-developed track & trace system and data captation. In the scientific literature, Del Vecchio et al. (2022) illustrated the same principle based on a single case study with a small company that digitalization is needed to support its business operation in terms of communication with their stakeholders and supply chain.

When there is no crisis, it is the use of lifetime extension of products, buildings, and installations which has a positive significant effect on having a stable demand. Only the size of the company has a positive significant effect on having loyal customers. The results of the overall-resilience are in line with Ellen MacArthur Foundation (2013), who claimed that the tackling of circular concepts could help dealing with decreased consumer loyalty due to a "life-time service". A possible explanation might be that these companies and sole proprietorships are more concerned with their long-term vision and are investing to be less energy-dependent, and engage on the long term with other companies and sole proprietorships to share production resources. This is in line with the need for a long-term vision in management.

Using renewable energy/materials during a crisis has a positive significant effect on having enough parts or materials, on the customer demand, on the availability of information, and on the ability to work safely. The first one is intuitively logical: using renewable energy/materials decreases the need for new materials and in addition adheres the circular principle of building more resilient supply chains. Pagliaro (2019) for example describes how renewable energy systems decrease supply chain dependency (or increase resilience) at lower costs (also confirmed by experts 4, 5, and 8). This way, the company becomes more self-sufficient in terms of parts and materials, and energy. The same explanation can be used for the positive significant effect of a sufficient waste management on having enough stocks, also illustrated by Park et al. (2010), who say that the ability to recycle

can improve the availability of materials. However, expert 8 notes the disadvantage of this increased self-sufficiency, namely that the increased self-sufficiency in terms of the upstream supply chain is swapped by less self-sufficiency in terms of new types of collaboration. The company becomes more dependent on logistical partners and financiers, among others. Bocken et al. (2018) also argue that CE companies need to involve multiple stakeholders which are different than those from the conventional value chain.

Next, sharing of production resources has a positive significant effect on having enough labor force and on the customer demand. This can be induced by brand awareness, focusing on the right customers (confirmed by experts 2 and 4), and employees (confirmed by all experts). It is believed by all experts that the younger generation values sustainability in their work place and will take this into account when applying for a job. At the same time, sharing of production resources requires less new skills, so that the existing labour force is ready to take up these types of jobs on a short term during a crisis. Finally, expanding the lifetime of its products has a positive significant effect on the availability of information during the pandemic.

When we grouped the companies and sole proprietorships in two groups: the circular and less circular companies, we found that the mean score for having enough labor forces and access to information is significantly higher for the circular companies than for the less circular companies.

In a detailed analysis of normal times, the size of the company has a positive significant effect on having loyal and solvent customers, on having built sufficient capital buffers, on having a well-filled order book, on having loyal and creative employees and on having a long-term vision. This can be explained by the trustworthiness and brand awareness of larger companies to attract investors, employees and orders. Expert 4 agrees with the notion that larger companies have sufficient capital buffers but disagrees with larger companies having significantly more loyal customers and having a well-filled order book by arguing that customers do not always see the efforts that larger companies make for transforming a small part of their linear production process to a circular process.

Having a local supply chain has a positive significant effect on being creative and the ability to adapt fast, on a robust supply chain, on having enough stock, and on having a long-term vision. This can be explained by the stability of local chains and the lower dependency on international supply chains. Expert 7 argues that a local supply chain does not necessarily increase the resilience by a decreased dependency on materials, but it increases the resilience by being in a closer proximity to the customers, and offering a certain value and service, which leads to more robust supply chains. Keeping in mind the notion of circular justice from the literature review, we argue that the social impact of the decreasing global supply chains should be kept in mind.

Next, having circular business models has a positive significant effect on the innovations in future markets, and on having a long-term vision. Since circular business models (CBMs, e.g. product-service systems) are not yet widely implemented, this can be seen as an inherent innovation and a long-term vision. Expert 3 argues that the cashflow of a company with a CBM is different than the cashflow of a linear company, namely, there is a return flow from the consumer to the producer. This is also illustrated by Linder and Williander (2017) who followed a startup for electrical bicycles with a monthly subscription and found that there is a lower customer demand for long-term subscription, consumers prefer short-term subscriptions although it renders the firm a less stable income. This cost and revenue structure requires businesses with CBMs to have a wider horizon as the calculation of the economic remaining value of a product is foreseen for a point further in time. On top of this, the recirculation of the product after the end-of-life requires a wider time horizon. Furthermore, producers benefit when their products have a longer lifetime and when they know when they have to do maintenance. This stimulates long-term vision and investments in future markets. Expert 4 notes that most companies engaging in as-a-service models often do so as a side activity first and have a main linear activity at the same time, because they need the revenues from their linear business operations to invest in the CBMs, which takes time and a long-term vision. Michaud and Llerena (2011) argue that CBMs need a long-term vision because

products developed in a servitization system require a way to upgrade them to the latest fashion developments and timelessness.

Next, the lifetime extension of products, installations and buildings has a significant positive effect on a stable demand for that company. This can be explained by the trustworthiness in the quality of their products and the removal of planned obsolescence. Using renewable energy/materials has a positive significant effect on having a well-filled order book, on having enough stock, and on having a long-term vision. Finally, offering shared mobility has a positive significant effect on having loyal and creative employees. This signifies that offering shared mobility is an extra benefit employees find important. Experts 4, 7, and 8 note that this is the effect of a younger generation and of smaller companies where flexibility is appreciated.

When we grouped the companies and sole proprietorships in two groups: the circular and less circular companies, we saw that the mean score for investing in innovations, having loyal and creative employees, have a robust supply chain, and being creative and being able to adapt fast to counter possible crisis is significantly higher for circular than for less circular companies.

We argue, while looking at the more detailed results of the regression analysis, that it is the combination of different circular strategies which leads to an optimal resilience against the COVID-19 crisis and an optimal resilience after the crisis. This confirms the findings by Katz-Gerro and López Sintas (2019), who also found strong interdependence of different circular strategies. This optimal combination, however, depends on the needs of the firm and the context in which the firm operates. Due to the scarcity of the existing literature, some of the significant results of our regressions could not confirm or counter other literature. Therefore, further research is needed to confirm or counter our results and to provide guidance for organizations and policy makers. Below we explain the detailed results of the regressions.

4.2. Policy recommendations

Our results showed that a combination of different circular strategies could have a higher impact on the resilience than the separate strategies. Companies and sole proprietorships thus benefit from adapting their business models and strategies in order to accelerate the implementation of multiple circular strategies. In order to achieve this, they need a holistic public policy plan in support of the circular economy. In our survey, the respondents indicated which support measures they would need. We saw in figure 1 that the most asked measures are fiscal measures which stimulate circular goods and services. This is followed by support (subsidies) for innovation and collaboration and public procurement for circular goods and services. Other support measures are (from most asked to least asked): removing regulatory barriers, better access to information and expertise, better access to circular “communities of practice”, more education and training for new and more polyvalent skills, a stronger antidumping policy to prevent unfair competition, better access to venture capital for circular projects, improving export chances and international knowledge exchange for Flemish frontrunners, bank guarantees for investments, and liquidity support for subordinated loans.

Some of these support measures were already mentioned in the existing literature. For example, Lordachi et al. (2020) also strived for stimulation of innovation to apply circular practices, as well as regulations. Zhongming et al. (2020) on the other hand promotes investments through funds to encourage circularity. They posit this can be realized by providing loan guarantees to start-ups with circular activities which are frontrunners. They also mention fiscal measures such as subsidies for re-use and recycling, and taxes on waste. Other regulations which they mention is the banishment of single-use plastics. Hartley et al. (2020) performed interviews with 47 experts in the public and private sector in the EU to probe for ways to promote CE, and defined eight policy recommendations, capturing our top 3. The other five policy recommendations were: further adoption of circular design standards and norms at the EU level, liberalization of waste trading, facilitate development of

circular trading platforms, creation of eco-industrial parks, circular economy marketing and promotion campaign, and a global material flow accounting database.

We strive for a combination of different policy measures, as they all target a different aspect of the implementation of circularity. That way, an optimal number of circular strategies can be combined in order to achieve optimal resilience. The effect on other benefits, such as resilience to climate change, decreased biodiversity loss, reduced inequality, and emission reduction goals should be accounted for in further research. As established in the beginning of the paper, few previous studies exist depicting the negative effects for low- and upper-middle-income countries (Repp et al., 2021). We argue that policy measures should be targeted as such to not only benefit economic and environmental values, but also social values. One way in which this can be accounted for is by integrating these policies in a complete recovery package, as many see an opportunity to build back more circular after the pandemic (Ellen MacArthur Foundation, 2021; UNEP, 2021).

4.3. Limitations and further research

Our research faced some limitations. The first one being the lack of more control variables. In our analysis, we controlled for the size of the company, while there are possibly a few confounding variables. For example, the age of the company or sole proprietorship might have an influence on its financial stability, loyal customers and employees, and trustworthiness from stakeholders. This could enforce the resilience of the company or sole proprietorship during a crisis. However, the age of the company was not asked in the survey. Next, digitalization can be an interesting control variable. “Digitalization has the potential, through processes, to mitigate the magnitude and reach of change by, at the same time, increasing the proactive stance and agility of business processes and the resilience of the organization.” (Miceli et al., 2021). Other interesting control variables are, among others, technological capability, agile leadership, knowledge, innovation ambidexterity, recovery financing, and collaboration (Aldianto et al., 2021; Kechichian & Mahmoud, 2020). Including these kind of parameters in future research can assess the validity of this paper’s conclusions.

Another limitation is the bias in our respondents. The question “How familiar are you with the concept of circular economy” was asked with four response options: I had never heard of it, I had heard of it but never considered it, I am familiar with the concept, and I know the concept in-depth. 60% of the respondents indicated that they know the concept of the circular economy rather detailed and 32% indicate that they are familiar with the concept. Moreover, 5% of the respondents indicate that they had heard of it but had never considered it. Only 2% had never heard of it. A possible explanation is that the survey was spread through the network of Circular Flanders. However, analysis of the overall sample of companies and sole proprietorships demonstrates that both the circular and non-circular organizations are sufficiently represented: there were 71 circular companies and sole proprietorships in our sample and 150 less circular companies and sole proprietorships. A last bias in our respondents is the use of self-assessments for circularity and resilience. It is possible that respondents guessed the link between circularity and resilience and answered accordingly to satisfy the researchers. Also, it is possible that the respondents wanted to “look good” by indicating a higher level of circularity.

A third limitation is our use of cross-sectional data and not panel data. The survey was spread during the first wave of lockdown measures. At that time, it was unclear how long the pandemic would last. We expect that the resilience is further endangered once the duration of the lockdown measures is extended, as was the case for the COVID-19 crisis. Future research can further investigate this paper’s limitation, accounting for the prolonged duration of the pandemic.

Next, this paper is built on survey data gathered in Belgium. On the one hand, this limited geographical scope may limit the generalizability of the research findings. However, Belgium is also a very relevant region to investigate. First, as a small-open economy, it corresponds to many other regions’ situations, both within and outside Europe. Second, the concept of circular economy is increasingly well-established in Belgium. This is due

to governmental incentives at both national and European level. That familiarity with circular practices is required to assess the practices' impact. The case of Belgium and the research findings of this paper can therefore serve as an example for many other comparable regions. Future research can mimic this paper's approach to further assess the robustness of the drawn conclusions. On top of this, the effect of increased circular implementation and increased local supply chains in Belgium on the resilience of low-income countries can be further explored, as well as potential increasing or decreasing inequalities in Belgium.

Finally, as this research was performed between March and June 2020, we argue that the results of this research are best considered as results of a short-term crisis. A follow-up study could show the results of a longer, more intensified crisis as the pandemic continued to have consequences during 2021 and 2022.

5. Conclusion

The COVID-19 virus has grown since the beginning of 2020 into a worldwide pandemic, of which numerous actors such as organizations, health care institutions, and educational institutions felt the consequences. Despite the growing attention on "building back better", none of the recent studies have focused on the empirical link between circularity and resilience of organizations. Circular strategies have not yet been empirically assessed to improve the ability of these organizations to withstand the crisis.

To our knowledge, our work is the first survey on circularity and resilience with a large sample (542 respondents). We find that circular companies and sole proprietorships score significantly higher than less circular companies and sole proprietorships with regard to their resilience against the crisis and their resilience in normal times. Furthermore, we find that the size of the company is unimportant during the crisis for the average resilience score, while it is important when there is no crisis. In general, we conclude that it is the combination of several circular strategies which will help companies and sole proprietorships become more resilient against future shocks. Finally, we probed for which support measures the companies and sole proprietorships would like to receive as incentives to become more circular. The top three most asked measures were fiscal measures, support (subsidies) for innovation and collaboration, and public procurement for circular goods and services.

Our work offers the necessary insight for companies and sole proprietorships, governments, and other researchers to step up and research the possibility to build back better after this pandemic. Furthermore, this could help other researchers to guide governments in their ambitions toward a circular economy and their strives for net zero carbon by diminishing the use of resources, increasing the use of renewable energy and optimizing the waste management, among others.

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Annex A – The survey

A. Personal information

1. Gender
 - a. Male
 - b. Female
 - c. X

2. Year of birth (fill in)

3. I work as
 - a. A civil servant
 - b. Self-employed
 - c. CEO
 - d. Consultant
 - e. Servant
 - f. Other
 - g. Lecturer
 - h. Teacher
 - i. Environmental expert
 - j. Retired
 - k. Senior management
 - l. Middle management
 - m. Researcher
 - n. Political mandate holder
 - o. Not active on the labor market
 - p. Technical trainer
 - q. Liberal profession
 - r. Self-employed consultant
 - s. Socially engaged artist

4. I work for a
 - a. Company
 - b. Non-profit
 - c. Sole proprietorship
 - d. Local government
 - e. Supralocal government
 - f. Knowledge or educational institution
 - g. Other

5. My organization is mainly active in the following sector:
 - a. Accommodation and meals
 - b. Administrative and support services
 - c. Construction
 - d. Financial activities and insurances
 - e. Health and social services
 - f. Wholesale and retail and reparation of vehicles
 - g. Industry
 - h. Information and communication

- i. Art and recreation
 - j. Agriculture, forestry and fishery
 - k. Education
 - l. Public administration, defense and social security
 - m. Logistics and storage
 - n. Liberal professions, scientific and technical activities
 - o. Other services
 - p. Other sectors
6. My organization has
- a. 1 employee
 - b. 2-9 employees
 - c. 10-49 employees
 - d. 50-249 employees
 - e. 250 or more employees
 - f. I don't know
7. What is the main activity of your company?
- a. Supplier of services
 - b. Production
 - c. Consultancy
 - d. Wholesale
 - e. Retail
 - f. Finances
 - g. Other

B. Circular economy

Definition: In a circular economy, numerous strategies are implemented to keep materials and products in the economy at the highest level of quality as possible. The products are repaired, have a high second-hand-value, can be upgraded, the materials can be separated to be remanufactured into new products. The chosen materials are being recycled, biobased and recyclable or biodegradable at the end of its lifetime. The circular economy wants to valorize everything valuable. Nothing can be wasted.

1. How familiar are you with the concept of circular economy?
- a. I had never heard of it
 - b. I had heard of it but had never considered it
 - c. I know what it's about broadly speaking
 - d. I know the concept in-depth
2. Which circular strategies does your organization implement? ((not) yet – limited – good basis – very thorough – I don't know)
- a. Using less materials
 - b. Use renewable energy/materials
 - c. Recuperation of waste, residuals, and by-products
 - d. Lifetime extension of products/installations/buildings
 - e. Sharing products means
 - f. Circular business models (e.g. as-a-service models)
 - g. Local production chain or local supply chain
 - h. Use of shared mobility or public transportation

3. Of which circular strategies do you think they can make your organization more resilience (= better adaptable against unforeseen circumstances?) (No potential – limited potential – large potential – very large potential – I don't know)
 - a. Using less materials
 - b. Use renewable energy/materials
 - c. Recuperation of waste, residuals, and by-products
 - d. Lifetime extension of products/installations/buildings
 - e. Sharing product means
 - f. Circular business models (e.g. as-a-service models)
 - g. Local production chain or local supply chain
 - h. Use of shared mobility or public transportation

4. Do you think your organization should become more circular to be able to be more resilient?
 - a. Yes
 - b. No
 - c. I don't know

5. Of which support measures could your organization benefit from to become more circular?
 - a. A stronger antidumping policy to prevent unfair competition
 - b. Fiscal measures which stimulate circular goods and services
 - c. Better access to circular 'communities of practice'
 - d. Better access to venture capital for circular projects
 - e. Public procurement for circular goods and services
 - f. Bank guarantees for investments
 - g. Removing regulatory barriers
 - h. Support for innovation and cooperation (subsidies)
 - i. More education and training for new and more polyvalent skills
 - j. Better access to information and expertise
 - k. Liquidity support for subordinated loans
 - l. Improving export chances and international knowledge exchange for Flemish frontrunners
 - m. Other: fill in

6. To which extent do you consider the following statements likely? A more circular economy in Flanders... (Very unlikely – unlikely – Neutral – likely -very likely)
 - a. Creates opportunities voor innovations and Flemish frontrunners
 - b. Makes our economy less dependent on the (uncertain) import of resources
 - c. Leads to more cooperation between companies
 - d. Has benefits for the environment and the climate
 - e. Solves a part of our waste problem
 - f. Makes our economy more local by improving cycles and shorter chains
 - g. Creates new opportunities for employment (in repair, recycling, reuse,...)

C. The future

1. Which economic changes do you expect at the production side for the following five years? (Will decrease – will stay the same – will increase – I don't know)
 - a. Globalization and international connections for our economy
 - b. Depart of industry from Belgium
 - c. Working from home and flexible labor organization

- d. Restrictions for trade
 - e. Further efforts to reduce our CO2-emissions
 - f. The focus on digitalization and automation
 - g. Prices of primary resources
 - h. The execution of new business models (e.g. as-a-service)
 - i. Accessibility of primary resources for our economy
 - j. Return of industry to Belgium
2. Which economic changes do you expect at the consumption side for the following five years? (Will decrease – will stay the same – will increase – I don't know)
- a. Unexpected peaks and downfalls in the expenses of consumers
 - b. The popularity of home deliveries and e-commerce for consumers
 - c. The attention for sustainability for consumers
 - d. The readiness of consumers to visit real shops

D. Today

About you as an employee

1. How do you experience this coronacrisis professionally?
- a. I lost my job
 - b. I am in full temporary unemployment
 - c. I am in partly temporary unemployment
 - d. I continue to work, but there is less to do
 - e. I continue to work (from home)
 - f. I have more work than before the crisis
 - g. I was not (yet) active on the labor market
2. Did the content of your job change due to the crisis?
- a. No
 - b. Yes, a little bit
 - c. Yes, partly
 - d. Yes, a lot

About your organization

1. Did the production, service or the supply of your organization change due to the crisis?
- a. No, nothing has changes
 - b. Yes, we limited the existing production/services/supply
 - c. Yes, we increased the existing production/services/supply
 - d. Yes, we developed new supply
2. Which statements can be applied to your organization (Totally disagree – disagree – neutral – agree - totally agree)
- a. We work in a sector where the demand is stable (independent of the business cycle)
 - b. We have a well-filled order book
 - c. We have loyal, solvent clients/members/customers/Student
 - d. We built strong capital buffers in the past
 - e. We are creative and adapt fast to new circumstances
 - f. We have a robust supply chain
 - g. We have good, local stocks
 - h. We have loyal and creative employees

- i. We invest heavily in innovations for which there will certainly be a market available in the future
 - j. We have a good long-term vision so that we are able to counter temporary crises.
3. Does your organization experience the following problems during the corona crisis? (Large problem – limited problem – not really a problem – not a problem at all – not applicable)
- a. Resources
 - b. Components/materials
 - c. Labor forces
 - d. Information
 - e. Demand from customers
 - f. Stocks
 - g. Logistical support
 - h. Financing
 - i. Permission to work
 - j. The ability to work safely

E. To complete

1. How do you see the future and how do you see the role of circular economy? (fill in)
2. Can we use the answer to the previous question in our communication?
 - a. No
 - b. Yes, but anonymously
 - c. Yes, in my personal name
 - d. Yes, in my professional capacity
3. I would like to receive the following newsletters:
 - a. Vlaanderen Circulair (monthly)
 - b. VITO
 - c. Steunpunt Circulaire Economie (Policy research)

Annex B – Interviews

| INTERVIEWEE NUMBER | EXPERTISE | ORGANIZATION |
|---------------------------|---|--|
| EXPERT 1 | Coordinator | Network association concerning a just transition in Flanders |
| EXPERT 2 | Business coach for startups | Organization for guiding startups in Flanders |
| EXPERT 3 | Expert sustainability and CE | Multisectorfederation for manufacturing companies |
| EXPERT 4 | Projectmanager sustainable entrepreneurship | Intersectoral employer federation 1 |
| EXPERT 5 | Business advisor CE | Public administration for businesses for innovation and growth |
| EXPERT 6 | Entrepreneurial counselor | Intersectoral employer federation 2 |
| EXPERT 7 | Project leader circular economy | Support for businesses and their technological innovation |
| EXPERT 8 | Sustainability & CE consultant | Consultancy firm on CE and other sustainability topics |