The economic impact of the circular economy

A study of the impact of the circular economy on the profitability in the Dutch Graphic and Arts sector

Author:	Emiel van Zoelen
Student number:	2559285 (VU) 10576738 (UvA)
Email:	Emiel_94@live.nl
Program:	Joint VU and UvA MSc in Entrepreneurship
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Supervisor:	Prof. dr. E. Masurel
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Preface

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Abstract

The circular economy is a rising economic system in Europe. The system is introduced by legislation and regulations, which is a top-down strategy. However, this research focuses on the bottom-up transition towards a circular economy. Are there economic advantages of working circular and why should firms be concerned with the circular economy from the point of view of market-driven reasons? More specific this research is looking into the economic contributions of the circular economy on small and medium-sized enterprises in the Dutch Graphic and Arts sector. According to the existing theory, the main reason the circular economy will contribute to the profitability of firms is that there is an increase in the scarcity of raw materials. This increase of scarcity leads to rising prices and unpredictable supply fluctuations. Firms working with the concepts of the circular economy find ways to get around these uncertainties. By using waste as input for new cycles and extending the cycles of products and materials, they will be less dependent on the declining supply of virgin materials. Segments of the circular economy that counteract scarcity and improve resource productivity are cycling, product design, process design and the sharing economy. However, in this research, no significant evidence is found to confirm that the circular economy is helping to improve the economic performance of small and medium-sized enterprises in the Dutch Graphic and Arts sector. The absence of scarcity seems to be the most important reason for this. But even companies that do experience an increasing fluctuation in price and supply of materials show no significant improved economic performance. The traditional input of restorative materials and personalized products in the specific sector of this research might be the reason for this. Another reason is, is that the circular economy is relatively new and it has to develop more before it gets profitable. When there are more working examples of the circular economy, it will be easier to succeed for other businesses.

1. Introduction

Sustainability and the circular economy are a increasingly relevant topic in scientific publications. The circular economy is getting more and more attention from researchers (Merli et al., 2018); (D'Amato et al., 2017). One of the most important pioneers in the context of the circular economy is Kate Raworth. Kate Raworth (2017) describes the current economic model as one that only strives for economic growth. She argues that this cannot be sustainable in the long term and that the economy has to reach a maturity phase (like everything in nature) with economic stagnation. By indefinitely striving for economic growth, the boundaries of the earth will be reached and surpassed, resulting in irreversible degradation of different ecosystems. Important ecosystems that are already on the verge of surpassing or already surpassed critical levels are the nitrogen cycle and biodiversity loss (Rockström et al., 2009).

The most important reasons why the different ecosystems are in danger is the growing world population and the increasing prosperity in several parts of the world (Bastein et al., 2013 p.6). According to the Ellen MacArthur Foundation (2013 p.6), there will be 3 billion additional middle-income consumers by 2030 who will increase and overload the need for natural resources if the system does not change.

The topic of the circular economy is also relevant for scientific reasons. According to Korhonen et al. (2018), the circular economy has been introduced by practitioners like businesses and policymakers, so the scientific background of the subject is mainly unexplored so far. The already existing literature argues that two different strategies have to be combined to implement the circular economy (Lieder & Rachid, 2016). One is the top-down approach where change is introduced by regulations and legislation. The other strategy is bottom-up, where companies get deeper into the circular economy because it increases their competitiveness and their profits. The two approaches are related to each other. If governments for example change regulations or introduce subsidies associated with the circular economy, it will affect the bottom-up implementation. Nevertheless, this research will focus on the bottom-up implementation method.

The European Union makes the Circular economy an critical ambition and goal for the near future (Korhonen et al., 2018);(Bastein et al., 2013 p.4), and the Dutch government is also promoting and betting on the circular economy. While working on this article, the Dutch government introduced new grants for companies that stimulate small and medium-sized

enterprises to create circular collaborations with each other (RVO.nl, 2020). Therefore, it will become a more and more relevant topic in the Graphic and Arts sector in the Netherlands as well, which will be the context of this research.

The Dutch Graphic and Arts sector is a specific sector with a lot of small and medium enterprises (Masurel, 2007). The industry is struggling since the rise of digitalization, and this is one of the main reasons the industry is in decline (Teunen, 2015 p.22). On top of that, the economic crisis of 2008 accelerated this process. In addition to this decline of the Graphic and Arts sector, the industry is in an increasing aging process (Teunen, 2019). Those factors, in combination with the growing introduction of the circular economy, make it relevant for the entrepreneurs in the industry to see what potential there is for the circular economy concerning economic outcomes. This leads to the question for this research:

What is the impact of the circular economy on the economic performance of small and medium enterprises in the Dutch Graphic and Arts sector?

In the next part of this paper, the theoretical framework, the circular economy and its different aspects will be explained. The theoretical relation between the different aspects and their relevance for the economic position of SMEs will be the focus of that section. Thereafter, the method of this research will be elaborated and finally the results and their conclusions will be discussed.

2. Theoretical framework

In this part of the thesis, the circular economy will be explained. The different aspects, like cycling, design thinking and sharing economy and their relation to the competitive position of small and medium-sized enterprises will be shown. According to the theory, there is an increasing scarcity of resources and the circular economy can offer ways to bypass the negative consequences of this increase.

2.1. What is the circular economy?

The base of the circular economy is to change the system of production and consumption from linear to circular. The reuse of materials and product have to be maximized so raw materials can keep their value in a circular economy (Jonker et al., 2018). In the linear economy the materials are disposed at the end of the lifetime of the product which is unsustainable because resources will deplete (Korhonen et al., 2018);(Ellen MacArthur Foundation, 2013). In the linear economy the product is seen as waste and therefore the lifetime of a product is shorter than in the circular economy where the waste is used as new inputs (Fischer & Pascucci, 2017 p.3). Therefore, in a perfect circular system, the lifetime of the materials is indefinite.

The circular economy is considered necessary because the infinite growing economy leads to environmental degradation and running out of environmental resources (Raworth, 2017). Limits of the earth are being reached and surpassed and this can lead to irreversible damage to different ecosystems (Raworth, 2017);(Rockström et al., 2009). The idea that natural resources can be depleted is not from this century. Meadows et al. (1972) already wrote about the depletion of natural resources, degradation of the environment and the limits of growth. The circular economy is seen as the solution for sustainable development (Korhonen et al., 2018);(Merli et al., 2018);(Raworth, 2007);(Leider & Rashid, 2016). The circular economy is an approach which combines the pursuit of economic growth with environmental sustainability and economic development (Korhonen et al., 2018), by decoupling growth or revenues from material input (Ellen MacArthur Foundation, 2013);(Bastein et al., 2013 p.8);(Mendoza et al., 2017 p.526);(Fischer & Pascucci, 2017 p.3).

Two main concepts in the circular economy are resource efficiency and eco-innovation or design thinking. In Eco-innovation environmental aspects are considered in the product design and the development phase by creating a product in a way that it can be reused or

recycled at the end of the product life cycle (Sauve et al., 2016). According to the Ellen MacArthur Foundation (2013 p.6) and Bastein et al. (2013 p.8) companies increased their attention on resource efficiency by increasing recycling, reparation and reuse of products, but is the design thinking concept lacking behind in the transition to a more circular economy. According to the Ellen MacArthur Foundation (2013) the circular economy is an industrial concept that is regenerative by intention and design. In the circular economy more attention has to be paid to systematically design out material leakages and disposal (Bastein et al., 2013 p.8). In a perfect circular economy waste is eliminated (Ellen MacArthur Foundation, 2013);(Lewandowski, 2016). In the real world the goal is to use the economic value of materials for as long as possible (Korhonen et al., 2018). Products are designed to be reassembled and reused at the end of the lifetime. This has to be the central point in all parts of the supply chain (Bastein et al., 2013 p.4). The only resources that can be 'consumed' in the circular economy are biological ingredients that cannot harm or even benefit the environment and biosphere (Ellen MacArthur Foundation, 2013). Those ingredients will automatically be cycled back into nature.

According to Korhonen et al. (2018) the circular economy is being promoted by many different countries and institutions, including the Dutch government and the European Union. Even though creating a circular economy is an European ambition, the Dutch economy does not have to wait for European regulations to start a transition to a new economy (Bastein et al., 2013). The Ellen MacArthur Foundation (2013 p.9) agrees, they state that businesses could already make profits from the opportunities of the circular economy back in 2013. Even with unchanged customer behaviors, supply chains or regulatory incentives.

2.2. Small and medium-sized enterprises and the circular economy

Small businesses are different from large businesses in more than just size (Masurel, 2019 p.31). They are not only different in a quantitative way, but they also behave in a different way than large businesses. Quantitatively there are clear rules or boundaries where small enterprises change to large enterprises. In the European Union small and medium businesses have less than 250 employees, an annual turnover below fifty million euros a year, or a balance sheet of 43 million euros. 99% of all businesses in Europe are small or medium enterprises (Europa.eu, 2003), which makes it extremely important to see which impact the circular economy has on these enterprises. But in what way are small and medium enterprises

different from large enterprises in a qualitative way? Masurel (2019 p.35) came up with eight qualitative differences between small and large businesses: the prominent role of the entrepreneur, the focus on the short-term, the strong regional/local focus, the complicated performance measurement, the high presence of family businesses, the simple formal organograms, the low degree of formalization and the importance of umbrella organizations.

The European Union started a new policy to make European enterprises work more circular (Rizos et al., 2015 p.6). The aim of the plan is to maximize resource efficiency in the circular economy for European firms. For small and medium enterprises there was a particular plan named the Green Action Plan (GAP) to "enable SMEs to turn environmental challenges into business opportunities."

The shift from the linear to a circular economy has an impact on the business models of firms, on larger corporates, but also on smaller firms (Lewendowski, 2016). According to Masurel (2007) small and medium enterprises are slower than larger companies in implementing sustainability measures. According to Shields and Shelleman (2015) the main reasons for this are constraints in time, financial resources, knowledge and organization structure. Nevertheless, Rizos et al. (2015) state that small and medium-sized enterprises are increasingly aware of possible benefits from a circular working approach. The authors show that working circular can contribute to cost savings in the use of materials and warranty cost because of longer-lasting products. They also state that closing the waste loop and increasing the reuse of waste gives firms more security about the swings in the supply and demand of raw/virgin materials. Furthermore, the sustainable method can bring small and medium sized enterprises a competitive advantage and bring them to new markets.

A crucial factor of the presence of a circular mindset in a business is the role of the manager (Masurel, 2019 p.36);(Rizos et al., 2015 p.3). The manager is often the owner of a small enterprise and has almost all decision power in the company. The view of the manager towards sustainable operations has a considerable influence on the performance of the company. However, quantitative studies in the past have not found relations between the values of the management of firms and sustainability orientated entrepreneurship (Zafir et al., 2017).

2.3. The economic impact of the circular economy

Korhonen et al. (2018) and Lewandowski (2016) suggest that the circular economy, when done correctly, can contribute to social, environmental and economic development and welfare. However, it is challenging for companies to change their business model from a linear one to a circular one (Lewandowski, 2016).

The scope of this thesis will be limited to the impact of the circular economy on the economic performance of small and medium enterprises in the Dutch Graphic and Arts sector. This research will focus on opportunities for the entrepreneurs and firms to improve their economic situation. What the impact of the circular economy is, is very relevant to know for entrepreneurs and companies in the Graphic and Art sector in the Netherlands. According to Bastein et al. (2013 p.3) there is a vast potential for the circular economy in the Netherlands and the Dutch consumers are very willing to come along with the transition.

In the circular economy materials are used multiple times instead of the usual single usage and the value is kept as long as possible. This leads to business, market and employment opportunities (Korhonen et al., 2018), not only the environmental aspects, but also the economic opportunities are an integral part of the circular economy (Bastein et al., 2013 p.8). Korhonen et al. (2018) and Lewandowski (2016) argue that the circular economy brings economic potential. They state that the European Commission estimated that the circular economy could bring a potential financial benefit of billions of euros per year to the European industry.
In the next chapters different opportunities of the circular economy will be discussed.

2.3.1. Resource Scarcity

The population of the world has grown enormously and will keep growing during this century. According to the United Nations (2017 p.1) the world population will grow till over nine and a half billion people in 2050 and till over eleven billion people in 2100. In addition the average prosperity will increase and lead to an additional 3 billion consumers with middle incomes by 2030 (Allen MacArthur Foundation, 2013 p.6). In the past there was little scarcity for materials which led to low material prices. These low prices made it relatively irrelevant for companies to become more resource-efficient (Stuchtey, 2013). Due to the growing world population, growing prosperity and inefficient use of materials, the usage of materials has multiplied 34 times since the beginning of the 20th century (Bastein et al, 2013 p.6).

Nowadays materials will become more and more scarce (Wouters & Bol, 2009);(Tukker, 2015 p.2) and therefore the European Union is making resource efficiency as one of their most important strategic targets to counter the scarcity of materials (Tukker, 2015 p.2). The scarcity of materials will lead to resources being more costly and increased volatility of the prices and supply of materials. An increasing number of companies is facing the risk of these increasing costs and supply chain uncertainties (Ellen MacArthur foundation, 2013 p.6). Since 2000 the prices and volatility of natural resources started to increase. The circular economy can protect businesses from such threats (Rizos et al., 2015);(Wouters & Bol, 2009);(Bastein et al., 2013 p.8). By using rest products like waste and emissions are used for value creation in a new cycle, the demand for virgin materials decreases. According to Bastein et al. (2013 p.8) these rest streams are essential for creating higher competitiveness and new business forms. Another way to work around the scarcity is to use materials that nature can recover. A good example of this is the use of energy. Because we are running out of fossil fuels like oil (Höök & Tang, 2013), we need to find to find other sources of energy. To decrease dependency on resources companies should use energy from renewable sources (Ellen MacArthur Foundation, 2013 p.7).

2.3.2. Product and material cycling

To increase the efficiency of resources the goal of the circular economy is to use resources multiple times (Bastein et al., 2015 p.10). By sending or cycling materials or products back into the supply chain, the life cycle of a good can be extended time after time (Fischer & Pascucci, 2017 p.3). The Ellen MacArthur Foundation (2013 p.7) came up with a couple of aspects that are related to the cycles of the resources and materials and contribute to the productivity of materials, starting with the most desirable to implement because they require less energy (Fischer & Pascucci, 2017 p.3). The first and most logical gains in the value retention of resources are in the maintenance of products. When keeping products longer in a cycle there are fewer materials needed for new products. The second way to increase the productivity of materials is to improve and maximize the number of cycles per product. By means of reusing and redistributing goods, less new products are needed. Some products can be used in different ways before they lose their value. One example of this is the second-hand market. Thirdly, remanufacturing and refurbishing important parts of products increases the value of the products with relatively low inputs. Finally recycling products, getting back the materials and nutrients in goods and products makes them available for new products and

decreases the need for virgin materials. By making the product as easy as possible to reuse, remanufacture and recycle the higher the productivity of the product. If it takes less time to get the materials back into value, fewer products and materials are needed. Therefore, firms and manufacturers have to take these ways of increasing the productivity of materials and products into account at the design of the product and supply chain (Fischer & Pascucci, 2017 p.3).

2.3.3. Design thinking

In design thinking, aspects of the circular economy are central in the design of the product. Products should be designed in a way that they can easily be reused or recycled at the end of the lifetime (Sauve et al., 2016). This includes the choice of material that is used (Ellen MacArthur Foundation, 2013 p.9). A circular product design brings challenges for designers. Products have to be designed so they can be used multiple lifecycles while staying marketable (De Los Rios & Charnley, 2017 p.18). In addition the designers are also constrained in using specific materials or components. For example, the use of toxic materials should be omitted (Fischer & Pascucci, 2017 p.3). De Los Rios and Charnley (2017 p.19) state that this implies that companies might have to distinguish by creating symbolic value or excellent service and user experience.

Design thinking does not stop by the design of the product, but should cover the whole supply and value chain of the product (Mendoza et al., 2017 p.526). By designing and redesigning the supply chain, companies can get value in other ways than just improving resource efficiency (Murray et al., 2017 P.14). The design thinking of the supply chain includes for example the implementation of efficient reverse logistics or changing the business model towards the Sharing Economy in the next section (Ellen MacArthur Foundation, 2013 p.8). In the same article, the Ellen MacArthur Foundation (2013 p.9) states that the more included the circular design of the value chain is, the higher the economic impact is. A circular supply chain is more complicated than a linear supply chain because it needs more collaboration between firms (Fischer & Pascucci, 2017 p.2). There is more required collaboration because materials might need to be jointly managed, skills and resources might need to be shared or because the waste of one company could be used by another firm.

For the change of the value chain, the Ellen MacArthur Foundation (2013 p.9) came up with some enablers to improve cross-cycle and cross-sector performance. Those enablers include

improved transparency, the alignment of incentives, the initiation of industry standards for collaboration, and education for awareness and circular innovation.

The mobile phone industry is an industry that is working in a traditional linear way. If they would decide to design phones in a way that they would become easier to reassemble phones, change parts and return used phones, the energy usage per phone could be 50% lower (Ellen MacArthur Foundation, 2013).

2.3.4. Sharing economy

In the business reports describing the circular economy, an essential topic is the improvement to more intensive use of products and materials. Changes of businesses and customers are needed to make the circular economy work (Bastein et al., 2013 p.13);(Korhonen et al., 2018 p.41);(Mendoza et al., 2017 p.527). One clear example that shows the change of behavior is the example of car-sharing programs. Most cars are parked for 95% of their lifetime, and in the other 5% of the time they are barely used to their full capacity (Knol & Groag, 2017). Still we generally buy cars because of status or individuality while we can think of way more efficient systems (Bastein et al. 2013 p.14). However, Bastein et al. (2013 p.3) does think the Dutch consumers are ready for change of this attitude.

One frequently mentioned way to achieve more intensive use of products and materials is the sharing economy. The sharing economy means that access to resources is preferred over the ownership of resources and this increases the resource efficiency (Tukker, 2015);(Korhonen et al., 2018);(Ellen MacArthur Foundation, 2013 p.7);(De Los Rios & Charnley, 2016 p.22). We already know multiple examples of this in the Netherlands. Those examples include the OV-fiets or Car2go, where the user only pays for the product when the product is in use. One other eminent example is the Light-as-a-service collaboration between Philips and Schiphol. Instead of buying light bulbs, Schiphol pays for the light-as-a-service they use but Phillips remains the owner of the light bulbs. Instead of trying to sell as many light bulbs as possible (by making them last shortly and inefficient) Phillips got an incentive to make their lightbulbs work as long as possible. This resulted in a 50% efficiency improvement of the energy of the light bulbs (Laubscher, 2015). It is easier to come up with systems to maximize the fulfillment of the customer needs with lower impacts when focusing on these needs instead on a product (Tukker, 2015 p.1). In the traditional product-oriented business models, firms aim to sell as many products as possible to maximize their income. In the product-as-a-service model, the products they use become costs instead of income and this makes it more relevant to use

products with longer lifetimes, use them as intensive as possible and make them as efficient as possible (Tukker, 2015 p.1);(Ellen MacArthur Foundation, 2013 p.7).

The sharing economy is linked to the circular economy because it contributes to the objective of maximizing value at each point in the resources life (Stahel, 2016);(Sauve et al., 2016). The sharing economy will not only lead to more intensive use of resources, but it will also reduce the need for maintenance and space for storage. All by all, this will have a positive effect on the resource efficiency (Sauve et al., 2016). Not only the previously named examples show that there are working business models based on the sharing economy. The Ellen MacArthur Foundation (2013 p.8) calculated that the leasing of washing machines would make them affordable for more households. The manufacturer of the machines could increase his profits by one third while saving materials and energy. This leads to the third hypothesis.

2.4. Hypotheses

There are two ways to achieve a economy that is circular (Lieder & Rashid, 2016). One way is by pushing towards a circular economy by changing legislation and regulations by governments and other policymakers. This paper does not focus on this top-down strategy but on the bottom-up strategy. Are there incentives from the market that makes entrepreneurs and firms move towards more circular operations voluntarily? In other words, can firms benefit economically from making a move towards the circular economy? According to the existing literature, the circular economy can contribute to the economic performance of businesses, mainly because resources are getting more scarce. Therefore, companies that can improve the efficiency of their resources can create a defense against increasing material prices and fluctuating supply. To test this, the central hypothesis of this research will be:
Hypothesis 1: Applying the concepts of the Circular Economy leads to a better economic performance of SMEs.

To get to a better economic performance, there are several sections where the firms can improve their economic outcomes. The first this research is testing is the section of product and material cycling. According to the theory, firms can improve their economic performance by increasing or extending the number of cycles a product or material is used. For example by repairing products instead of buying new ones, the cycle can be extended and fewer new materials are needed. By reusing (parts of) old products the efficiency of the materials

increases as well, which can be a solution to the increasing resource scarcity. Therefore the following hypothesis is formulated:

Hypothesis 1.1: Applying the concepts of the product and material cycling leads to a better economic performance of SMEs.

The second section is in the design of the products the firms create. By creating the product in a way that it can more easily be maintained, reused, reassembled or recycled at the end of the lifetime, companies can create value from materials and products that are considered waste in the current linear system. By choosing sustainable materials, products can last longer and this will reduce material and warranty costs (Rizos et al., 2015).

Hypothesis 1.2: Applying the concepts of design thinking in product design leads to a better economic performance of SMEs.

Another section is in the design of the value chain of the firm. By cooperating with firms in the supply chain, businesses can increase their resource efficiency. By improving reverse logistics, materials at the end of the lifetime can be brought back into the supply chain to a point where they can be of value again. By collaboration industry standards could be changed and investments can be earned back. All in all this leads to the next hypothesis:

Hypothesis 1.3: Applying the concepts of design thinking in value chain design leads to a better economic performance of SMEs.

The final section, and arguably the most radical section for changing businesses, is the sharing economy. By changing business models firms change the fundamental way they operate. By changing the concept of a customer to an user of a product businesses have an increased incentive to create products that last longer and are more efficient. Companies that manage to increase the intensity of usage of products, will have lower average maintenance costs and storage space. Therefore the final hypothesis is formulated as follows:

Hypothesis 1.4: Applying the concepts of the sharing economy leads to better economic performance of SMEs.

In figure 1.1 on the next page, a visualization of the conceptual model is shown. The different variables of the circular economy have an expected positive relation to the economic performance of small and medium-sized enterprises.

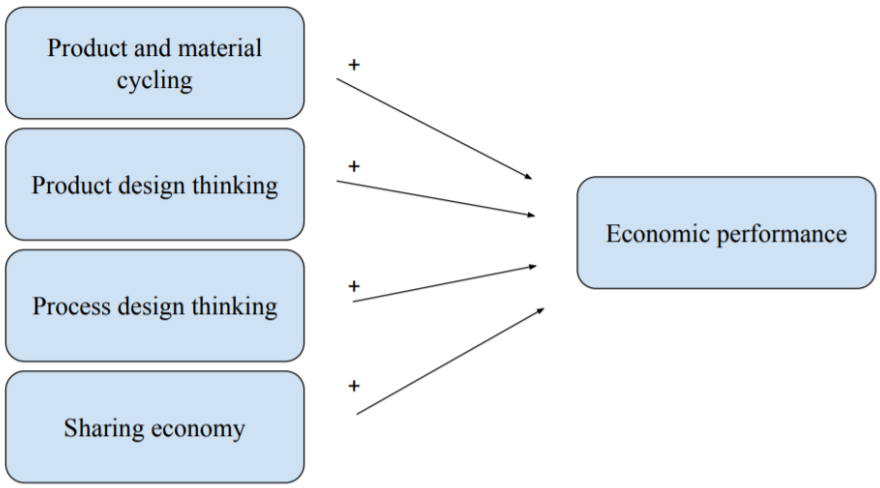

Figure 1.1: Conceptual model of the relation between the circular economy and the economic performance

3. Methods

For this research data is collected in the Dutch Graphic and Arts sector with the help of Dienstencentrum, the service center of this sector. The data will be collected and analyzed in a quantitative way. In 2013 the Ellen MacArthur Foundation wrote an elaborate paper about opportunities of the circular economy for businesses, this paper is the basis for a lot of scientific research since. This research is testing to what extend the opportunities in the circular economy are seized by entrepreneurs in the Graphic and Arts sector in the Netherlands.

3.1. Context

The context and setting of my research will be small and medium enterprises in the Graphic and Arts sector. As stated above, the data is collected in collaboration with Dienstencentrum. They help entrepreneurs and businesses in the Graphic and Arts sector with advice and support (Dienstencentrum.com, 2020). This sector is a fragmentated sector with a large number of different small enterprises (Masurel, 2007). The sector struggled last decennium because of the economic downturn, but more importantly because of the development of digitalization of the media (Teunen, 2015).

The KVGO is the union of the sector. This union represented 775 enterprises in 2019, which is significantly less than the 2045 enterprises in 2009. In 2009 the union represented around 32.000 Graphic and Arts employees, this number was reduced to around 12.000 employees in 2019. The sector consisted of 2970 active firms in 2019, which is significantly less than the 3835 active firms in 2010 (Teunen, 2019 p.7). The number of companies with over 100 employees has been declining by 50% during this period. The average turnover of the companies declined by 25% between 2010 and 2018 (Teunen, 2019 p.12). These figures show that the sector is going through a though period. 2018 has been a more positive year for the sector. There were fewer bankruptcies than the years before, and the firms had the opportunity to increase prices for the first time in years. The unemployment rate also declined from 9.8% to 7.1% in 2018. This was an improvement, but still the unemployment rate was far above the Dutch average (Teunen, 2019). All these figures are from before the Covid-19 crisis, it is at this point not clear what the impact of this crisis will be on the sector and its firms.

That the research is conducted in this specific sector could have consequences for the generalizability of the results. It could be possible that this sector suffers more constraints towards the circular goals due to the use of toxic or harmful substances in the ink. Another possibility why the firms in this sector might differ from firms in other industries could be that due to the economic environment the circular economy has no priority.

3.2. Research method

The data for this research is collected by means of a survey in Dutch. The population that is the target for this research will be small and medium enterprises in the Dutch Graphic and Arts sector. My supervisor, prof. E. Masurel has good connections with Dienstencentrum and conducted research himself in this sector before. With his help relevant people in Dienstencentrum were contacted. They were willing to cooperate in the data collection process and helped with relevant feedback on the survey.

Data collected via a survey is appropriate to suggest relations between variables, which has been done for different aspects of the circular economy and firm performance in this study. Therefore, data collection by means of a survey has been suitable for this research (Saunders et al., 2009 p.144). The questions in the survey will be directly linked to the theory explained in the theoretical framework section of the thesis. A disadvantage in collecting data through a survey is that it is hard to ask additional questions after the survey is filled in (Saunders et al., 2009 p.362). Therefore the survey has to ask the appropriate questions to answer all the research questions. To do this the literature has been reviewed critically before the survey was discussed with fellow students, my supervisor, and the expertized employees of Dienstencentrum. This process also improved the content validity of the survey (Saunders et al., 2009). Furthermore, the Dutch Sign and Print Festival in March 2020 was visited to get a better insight in the variety of firms in the sector.

The survey has been distributed in combination with the survey of a co-student who was doing research in the same sector at the same time. This made it more convenient for the respondents to participate. To make it more appealing for the business owners to cooperate, there will be two workshops planned around the topics of the circular economy and the lifecycle of the firm later this year. Free participation for these workshop was announced to the respondents of the survey. Because the survey was used for the purpose of two researches, the length of the survey increased. Therefore, we had to limit the number of questions. The

final survey contained 50 questions, of which 23 were dedicated to the topic of circular economy. The survey started with some general questions about the firm, followed by the section of the fellow student about the life-cycle of the firm. The third section of the survey was about the circular economy. This started with one question about the attitude of the responding firm in progress to circularity followed by 21 yes or no statements about the other subjects of circular economy. Finally, there was a scale-question about the profits of the firm in relation to the circular economy. For the full translated survey, see the appendix.

One important implication of the research was the timing. The collection of the data took place during May 2020. This month was during the critical period of the Covid-19 crisis. In the Netherlands people were obliged to work from home if possible and many sectors showed economic decline. Therefore, we have asked the respondents of the survey to answer the questions based on the figures and circumstances of 2019. This could have had an influence on the answers of the respondents.

The survey was created with the software of google forms. The full responses of the software were via the google forms software converted to an Excel CSV-file. Subsequently, the data was uploaded to SPSS where analysis have been conducted. In SPSS the data has been checked for outliers and cleaned by deleting incomplete responses. The goal of the research is to get an insight in the extent of how the principles of the circular economy are implemented among SMEs in the Dutch Graphic and Arts sector and what the impact of this is on the economic performance of the firms in the sector. Therefore the research is descriptive and explanatory (Saunders et al., 2009 p.140). Different aspects of the circular economy are explained in the research and managers of the Dutch Graphic and Arts industry were asked whether they perform the different aspects in their normal business operations in 2019. In advance, the business managers are asked whether their profit is increased, decreased or remained the same by working circular. The regression coefficient between the different aspects of the circular economy and their impact on their economic performance are used to see whether some aspect are more profitable than others. This is done by the a linear regression between the influence of the circular economy on the economic performance as the dependent variable and the constructs of the variables per activity as independent variable. Finally, the main hypothesis is tested with a multiple regression model. Again, the economic performance was the dependent variable and the other constructs were used as independent variables.

The assumptions of regression are tested on normality, linearity and outliers (Pallant, 2013). The normality tested by Shapiro-Wilk has an significance of 0 which implies the results are not normally distributed but the results are linear. As Table 4.1 shows there are a lot of missing values for the economic response measurement. Furthermore there was no substantial collinearity of the independent variables. Only product design and process design had an significant correlation but it is below the boundary of 0.9 (Saunders et al., 2006 p.463). Cronbach's alphas are not relevant for the reliability because the question that are bundled into constructs are dichotomous and not measured on scale.

3.3. The respondents

For the study, 1222 business owners have been approached to conduct the survey, 87 of them responded. Therefore, the response rate reached 7%. They were approached by mail via Dienstencentrum who already had all the contacts of the target audience.

Most of the responding businesses counted few employees. As expected of the typical small and medium-sized industry over 50% of the responses came from businesses with less than ten employees. Nevertheless, the mean of the employees of the respondents was 27 employees due to some high outliers (e.g. one firm had 275 employees). The final sample shows an over-presentation of large firms in relation to the whole industry (Teunen, 2019 p.7). Table 3.1 illustrates the number of employees of the companies who responded. As table 3.2 shows, the founding year of the companies who responded on the survey was 59 years ago. The corresponding standard deviation was 41 years. This shows that there was a great difference between companies in this part. The average time the current management is active was 14 years. Table 3.3 shows that 54% of the companies focused on the sale of products, 8% was focusing on the delivery of services, and the others (38%) had a focus on both at the same time. Furthermore, there were five important segments the companies were active in. Most companies were active in offset (60.9%), digital productions (47.1%), prepress (46%), post-processing (43.7%) and design (36.8%).

NUMBER OF EMPLOYEES	FREQUENCY	PERCENTAGE
1 to 5	27	32%
5 to 10	17	20%
10 to 25	17	20%
25 to 50	10	12%
50 to 100	7	8%
Over 100	7	8%
Total	85	100%

Table 3.1: Number of employees

	N	MEAN	MINIMUM	MAXIMUM	SD
Age of the company	54	1961.2	1857	2016	41.5
Last change of management	84	2006.6	1978	2020	10.7

Table 3.2: Information about the company

FOCUS OF THE COMPANY	FREQUENCY	PERCENTAGE
Services	7	8%
Products	47	54%
Both	33	38%
Total	87	100%

Table 3.3: Focus of the company

4. Results

The economic performance is measured by a scale question about whether the economic performance of the firms is declined, remained the same or increased due to the circular economic activities of the firms. The answers on this question are shown in Table 4.1:

	FREQUENCY	PERCENTAGE	VALID PERCENTAGE
Economic performance declined	9	10.3%	25.7%
Economic performance remained the same	22	25.3%	62.9%
Economic performance Increased	4	4.6%	11.4%
Missing	52	59.8%	
Total	87	100%	

Table 4.1: Economic impact of the circular economy

The first hypothesis that is elaborated is about the cycling of products and materials:

Hypothesis 1.1: Applying the concepts of the product and material cycling leads to a better economic performance of SMEs.

To test this hypothesis different questions about cycling activities were asked in the survey, Table 4.2 shows how the responded firms are engaged in cycling activities.

PRODUCT AND MATERIAL CYCLING	PERCENTAGE
I Repaired materials and products instead of buying new ones	52.9%
I made sure materials and products could be reused as much as possible	84.2%
I made use of recycled materials and products	81.8%
I made use of renewable energy	27.4%
Average	61.6%

Table 4.2: Product and material cycling

The cycling activities are clustered into a construct and correlated by regression with the economic performance with a sample size of 21. A regression coefficient of 0.097 means that there is a positive relation and about 9.7% of the economic performance can be explained by the cycling activities. The R-Square was 0.009. However, the p-value of 0.338 tells that this regression coefficient is not significant in the regression model. Therefor the hypothesis is rejected.

The next hypothesis that is tested in this study is:

Hypothesis 1.2: Applying the concepts of design thinking in product design leads to a better economic performance of SMEs.

To test whether design thinking contributes to economic performance the respondents were asked whether they make use of the concepts of design thinking like if they keep in mind the sustainability of the materials and products they use, how these materials and products can be used as effective as possible and how the materials can keep their value at the end of their lifetime. The outcomes of these questions are represented in Table 4.3.

PRODUCT DESIGN	PERCENTAGE
I considered the sustainability of materials in the product design	68.8%
I considered the efficiency of the materials in the product design	86.4%
I took in account what happened after the life cycle during product design	61.1%
I did not make use of harmful substances	70.1%
Average	71.6%

Table 4.3: Product design

The different questions are merged into one construct again, with a N of 24 and a R-Square of 0.047. A linear regression between the product design construct and the economic performance gave a regression coefficient of 0.218 with a p-value of 0.154. This means that hypothesis 1.2 is rejected.

The third hypothesis is about design thinking in the value chain of the company:

Hypothesis 1.3: Applying the concepts of design thinking in value chain design leads to better economic performance of SMEs.

As Table 4.4 shows the firms in the Graphic and Arts industry were less involved in value chain design measures of the circular economy. Again, the questions are merged into a construct and tested with a linear regression with a N of 24. This time there was a positive regression coefficient of 0.090 and a R-Square value of 0.008. The corresponding p-value was 0.337 and therefore also hypothesis 1.3 is rejected.

VALUE CHAIN DESIGN	PERCENTAGE
I made sure my partners took the reuse of products and materials in account	50.9%
I had a system to get used goods back in the value chain	47.6%
I was proactive in giving a second life to products and materials	40.7%
Average	46.4%

Table 4.4: Value chain design

In relation to the sharing economy the final hypothesis was formulated:
Hypothesis 1.4: Applying the concepts of the sharing economy leads to a better economic performance of SMEs.

Related to the sharing economy the respondents were asked whether they have adjusted their business model in the change to a more circular way of working. As Table 4.5 shows, half of the respondents did change their business model according to their responses but did not start leasing their products in great numbers. With a sample size of 30 the regression coefficient of this construct is -0.158, the R-Square 0.025 and the p-value 0.202. Hypothesis 1.4 is also rejected.

BUSINESS MODEL DESIGN	PERCENTAGE
I adjusted my business model to increase material efficiency.	50.7%
Instead of selling products, I leased them.	9.2%
Average	30%

Table 4.5: Business model design

After rejecting all the sub hypothesis the main hypothesis remains:
Hypothesis 1: Applying the concepts of the Circular Economy leads to a better economic performance of SMEs.

This hypothesis is tested in a multiple regression model with all the constructs as independent variables and the economic performance of Table 4.1 as dependent variable. The sample size of this test was 11. The R-Square of the test was 0.303 which means that 30.3% of the economic performance variance is explained by the model. However, the significance of the model is 0.647 which means the model cannot explain a statistical significance.

This research gave no evidence that the circular economy has an positive impact on the economic performance of small and medium enterprises in the Dutch Graphic and Arts sector, but to get a deeper understanding in the circular decisions of the firms additional questions about scarcity and the progress to circularity were asked. Even though no hypotheses are related to these subjects, the results can be of explanatory interest for this study. Table 4.6 gives an overview of the questions and the responses from the managers in relation to the subject of scarcity.

SCARCITY	PERCENTAGE
I noticed that raw materials became increasingly scarce.	19.5%
I noticed that the prices of raw materials fluctuated more and more.	50.6%
I noticed that raw materials increasingly could not be supplied.	25.9%
Average	32%

Table 4.6: Scarcity

The scarcity answers are again aggregated into a construct and run in a regression model with a N of 30. This gave a regression coefficient of -0.213, a R-squared of 0.045 and a p-value of 0.130.

Another variable that is used for the explanation of the insignificance is the question about the position of the firms in their development towards circularity. The respondents were asked whether they see their firms as not active, a starter, follower, prosecutor or leader in the circular economy. The outcomes of this question are shown in Table 4.7. In the linear regression analysis between this independent variable and the economic performance as dependent variable again no significant relation is found. The test with a sample of 34 shows a positive regression coefficient of 0.226 but the p-value is 0.1. The corresponding R-Square was 0.021.

I AM … IN THE CIRCULAR ECONOMY	FREQUENCY	PERCENTAGE	CUMULATIVE PERCENTAGE
Not active	19	25%	25%
A starter	7	9.2%	34.2%
A follower	33	43.4%	77.6%
A precursor	14	18.4%	96.1%
A leader	3	3.9%	100%
Total	76	100%	

Table 4.7: Position in the progress of circular development

5. Discussion

Hypothesis 1.1 is rejected. In theory the cycling of materials should help businesses to increase efficiency and this should contribute to the economic performance. However, this study did not find significant statistical evidence that the cycling of products and materials has an influence on the economic performance of small and medium-sized enterprises in the Dutch Graphic and Arts sector. The data used for the regression model differs significantly from a normal distribution which is of influence on the reliability the results. The p-value gives no statistical evidence for the approvement of the hypothesis. A possible theoretical explanation is that the sector does not suffer from the negative consequences of scarcity. Only 19% of the firms see an increase in scarcity. Even though half of the firms experiences an increase in price fluctuations, it could be the case that it is still more advantageous to replace products than to extend the life cycle of their materials. This result could be specific for the context of this research. Traditionally the most important input material for the Graphic and Arts sector is paper. This is a restorative material and therefore this material is not as sensitive for the increasing scarcity. Other industries might therefore show other results.

Hypothesis 1.2 is also rejected. The product design should help firms to be more efficient in the use of materials. There is no significant statistical evidence that the product design activities of small and medium-sized enterprises contribute to a better economic performance. Again the absence of normality can be a statistical reason for this. A theoretical explanation is that the sector traditionally made use of sustainable materials and that therefore the respondents score high on the product design questions. Because this could always have been the case, this is not of influence on the circular development of the firms. Again this explanation is sector specific and could be different in other industries.

Hypothesis 1.3 is rejected as well. There is no significant statistical evidence that the process design activities improve the economic position of small and medium-sized enterprises, even though the process design should bring materials to the place where they could be of value again. Also here the absence of normality is a statistical factor in this rejection. A possible argument why the process design activities are not effective is because it is difficult or costly to accomplish collaborations within the value chain. As explained in the theoretical framework, the Ellen MacArthur Foundation (2013 p.6) and Bastein et al. (2013 p.8) state that in general the design thinking is not getting as much attention as resource efficiency from firms. There are less good examples of working corporations and therefor it might be harder to make it work efficiently. Starting collaborations might be especially hard for the Graphic

and Arts sector because of the large number of small enterprises. Scale advantages might therefore miss out. The recent introductions of subsidies from the Dutch government in this theme substantiate these reasonings and might change these outcomes in the near future.

Also hypothesis 1.4 is rejected. There is no significant statistical evidence that working according to the concepts of the sharing economy has a positive influence on the economic performance of small and medium-sized firms. Also here there was an significant abnormality. As in the previous hypothesis, the sharing economy is an emergent concept and there are little working examples. Therefore it might be harder for companies to exploit the possible benefits the sharing economy brings to the firms. In addition the examples of sharing business models are from capital intensive sectors. It might be harder to achieve the advantages of the sharing economy for less capital intensive products. Another argument is the demand for sharing the products from this industry is very questionable. A lot of the products from the Graphic and Arts sector are adjusted for the customer and therefore not suitable to share. The low number of firms that is leasing out products might be a consequence of this.

Finally, the central hypothesis is also rejected. In contradiction to the theory about the circular economy, this study did not find evidence that the circular economy is contributing to a better economic performance for small and medium-sized enterprises. To test this a multiple regression model has been made but the right conditions for this were not met. The sample size for this test was only 11 which is not enough to come to a reliable conclusion. However, counting up all the arguments of the other hypotheses, it can be said that the circular economy not significantly improves the economic position of the firms in the Dutch Graphic and Arts sector. The circular economy is a relatively new concept and it is in development. The subsidies from the different governments show that the development of the circular economy needs support to be effective. At this point of time, it could be to soon for this sector to significant improve the economic performance by working circular because of market reasons. In the future this might change.

One factor that is not taken into account in this study is the image of companies by reason of the circular economy. This factor could affect the economic performance of firms, but it is not an integral part of the circular economy. The profits due to the image of the circular economy is more related to marketing activities and in an extreme example some firm that does not work circular at all could make money of promoting circular marketing. Nevertheless, there is

demand for sustainable products (Ginsberg and Bloom, 2014) and the circular economy could contribute to a competitive advantage (Matthews & Tan, 2011).

One final side note is that the research has taken place during the peak of the Covid-19 crisis. During this crisis a lot of enterprises had to close. Working from home was highly stimulated or even obligatory in a lot of companies. It is hard to say precisely what the effect of this timing was on the responses and the outcomes of the research. One important consequence of this is that the answers on the questions were not about the current circumstances but about the ‘normal’ conditions of the past. Therefore the respondents had to recall their perception of those ‘normal’ circumstances, which potentially can result in less reliable answers.

6. Conclusion

The main conclusion of this study is that there is no significant evidence that working circular has a positive relation to the economic performance of small and medium size enterprises. The other hypotheses about cycling, product design, process design and the sharing economy are rejected as well. The most important reason seems to be the absence of scarcity for most of the businesses in the Dutch Graphic and Arts sector. On average only 32% of the respondents state they make mention of an increase in scarcity. According to the theory this scarcity is the most important factor why working circular should be economically attractive. However, even for the businesses that experience an increase in scarcity there is no evidence that the circular economy is contributing to an improved economic position. Another reason of the rejections seems to be the specific sector that this research has studied. There are a few characteristics that seem to be counteracting the value of the circular economy, such as the traditional input of restorative materials and the personalized producing in the sector.

Furthermore, this research shows that there is a lot of room left for further development of the circular economy in this sector. Most of the companies are only following others or are not even active in the circular economy (Table 4.7). In line with theory the most performed circular activities in the industry are related to cycling and product design. The process design related to the circular economy is lacking behind. The circular economy is a rising concept and it might just be too early for this sector to benefit economically from the circular activities.

These outcomes are important for the strategy of implementing the circular economy. According to Lieder & Rachid (2016) this can be done by a bottom-up or a top-down approach. In this study the bottom up approach is tested but no evidence was found that this works. Therefore the top-down approach might remain more important at the moment. The top down approach is already a hot topic in Europe and also in the Netherlands there is development in this approach. During this study new subsidies are introduced by the Dutch government to foster new circular collaboration among Dutch small and medium sized enterprises (RVO.nl, 2020).

The announced introduction of new subsidies and the European and Dutch governmental circular economic goals point towards an important role of the circular economy in the near future. Even though it might not be economically beneficial for the firms in the sector right away, it seems that the circular economy is going to play a role in the future. Therefore, it is

advisable for the firms in the industry to gradually develop their circular activities so they do not lag behind in the future. A perfect role for Dienstencentrum, the service center of the industry, is to communicate this to the firms in the sector and to keep track of the subsidies of the governments. Subsidies might compensate for the lack of profitability of the circular economy in the sector. In addition, it might be the task of the service center of the industry to lobby for more economic incentives from governments to make the circular economy more interesting for the firms in the sector.

One of the biggest limitations of this research was the sample size. Due to low response rates for important questions the sample size for the economic performance question was only 11. The other hypotheses were tested with slightly larger samples, but those were also on the low side. This is one factor that influenced the normal distribution of the answers and is a part of the reason the hypotheses are rejected. It is advised to conduct additional research with a larger sample to confirm these claims. Another limitation is the timing of the research. Due to the Covid-19 crisis the answers were predicated upon a former period and respondents had to recall those times and numbers. This might have been of influence on the results.

For future research it could be interesting to do a longitudinal study about the circular economy. Longitudinal studies are suitable to investigate development and this might be a valuable addition in the research of the circular economy (Saunders et al., 2009 p.155). It is hard to measure the impact of the circular economy on the performance of firms because it is difficult to isolate the circular development as a variable. However, a longitudinal study could accomplish this by testing whether firms that developed more towards circular working show significantly different economic performances. The longitudinal study would also be interesting because this study expects an rising industrial relevance related to the circular economy. A new research in a few years could shed a new light on this.

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8. Appendix

We would like to ask you to fill in the questionnaire regarding 'normal' business operations in 2019. The Covid-19 crisis naturally has an impact on how things are going at the moment, but in this survey we are particularly curious about how it went last year.

1	General	In which year was your company founded?	*Open*
2	General	In what year did the last significant change in the management of the company occur? (if not applicable, you can leave this question open)	*Open*
3	General	In which sector (s) was your company active in 2019? (multiple answers are allowed)	• Media company • Designer / studio • Corporate Publisher • Logistic handling • Silkscreen • Post-processing • Publicity agency • ICT Company • Packaging pressure • Prepress • Sign • Publisher • DM Company • Digital productions • Offset • Printer other
4	General	Where was the focus of your company in 2019? On sale of services or products?	• Products • Services • Both
5	General	What are the 4 digits of the postcode of your company? If your company has several branches, please include the 4 digits of the zip code of the main branch.	*Open*
6	General	What was the number of employees (active owners and employees) of your company on 1/1/2020?	*Open*
7	General	What different services or products did your company offer in 2019? (multiple answers allowed)	• Books • Other printed matter • Newspapers and magazines • Advertising printing • Trade catalogs • Picture postcards etc. • Prints, engravings, photos

			• Picture albums / books • Cartography • Printed music • Calendars • Sealed paper; checks • Websites • Order portals • Apps • DTP • To design • Marketing • Communication advice • Packaging • Labels • Stickers • Sign & display materials • commercial printing • pos materials • promotional gift • finishing, punching / creasing / • perforate / p ... • photography and texts • food-safe printing • seals, covers, RFIDs • printed bags • clothes • mailings and • display material • Advertising displays, instore • POS materials • story telling pillows
8		How much was your turnover approximately in 2019? (if you don't want to share this, you can leave this question open)	*Open*

In the circular economy, the aim is to reuse products (and parts of products) that are at the end of their lifespan.

	Topic	Question	Answer
1	General CE	I am _____ in the circular economy	• Not active • A starter • A follower • A precursor

			• A leader • No answer
2	General CE	I am guided by legislation in the development towards circular management.	• Yes • No • No answer
3	General CE	I am guided by economic opportunities in the development towards circular management.	• Yes • No • No answer
4	General CE	I am guided by cooperation partners in the development towards circular management.	• Yes • No • No answer
5	General CE	I am guided by external stakeholders in the development towards circular management.	• Yes • No • No answer
6	Scarcity	I noticed that raw materials became increasingly scarce.	• Yes • No • No answer
7	Scarcity	I noticed that the prices of raw materials fluctuated more and more.	• Yes • No • No answer
8	Scarcity	I noticed that raw materials increasingly could not be supplied.	• Yes • No • No answer
9	Scarcity	My company looked at how raw materials could be used more efficiently.	• Yes • No • No answer
10	Cycling	I repaired materials or products instead of buying new ones.	• Yes • No • No answer
11	Cycling	I made sure that materials and products could be reused as much as possible.	• Yes • No • No answer
12	Cycling	I used materials and products that were recycled.	• Yes • No • No answer
13	Cycling	I used renewable energy.	• Yes • No • No answer
14	Product design	When designing my products, I considered the sustainability of materials I use.	• Yes • No • No answer
15	Product design	When designing my products, I considered the efficiency of materials I use.	• Yes • No • No answer
16	Product design	When designing my products, I took into account what happens to the product after the life cycle.	• Yes • No • No answer

17	Product design	I did not use toxic or environmentally harmful substances.	• Yes • No • No answer
18	Process design	I made sure that my partners took the reuse of products and materials into account.	• Yes • No • No answer
19	Process design	I had a system to get used goods back into the value chain.	• Yes • No • No answer
20	Process design	I was proactive in giving products a second life at the end of their life cycle.	• Yes • No • No answer
21	Business model	I adjusted my business model to produce more efficiently.	• Yes • No • No answer
22	Business model	Instead of selling products, I leased them.	• Yes • No • No answer
23	Economic performance	By working circularly, my profit increased in 2019.	• No, circular work was very loss-making • No, circular work was somewhat loss-making • Circular working was neither profitable nor loss-making • Yes, circular work was somewhat profitable • Yes, circular work was very profitable • I don't know / no answer