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How digitalization affects elderly care

Is digitalization the holy grail solution to the issue of increasing costs in Sweden's elderly care?

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Abstract

This thesis analyzes how digitalization in elderly care affects cost-efficiency and quality of care. More specifically, digitalization in elderly care is divided into welfare technologies and E-services. The study goes into how well digitalization meets its promises of solving many of our society's future problems regarding elderly care, such as an aging population. In order to analyze this, I have, based on data from Socialstyrelsen, SKR and SCB, created several indexes over how digitalized, how high quality of care and how cost-efficient each Swedish municipality was during 2016 and 2020. The study then takes the differences between these time periods and uses a first difference estimation to calculate the effects of digitalization on quality and efficiency. The theory used in this paper that also forms the basis of the discussion is Dunleavy et al.'s (2005) Digital era governance. The results show that neither digitalization nor its subparts - welfare technology and E-services - have practically any effect on the quality nor the cost-efficiency of elderly care in Sweden. This goes against the hypotheses of this study, that digitalization will affect efficiency and quality positively, but at the same time provides interesting conclusions. Mainly that digitalization on a grand-level does not live up to its "promises" and that more specific measures rather than grand-scale digitalization in every aspect could be the way to go.

Key terms: Elderly care, digitalization, quality, efficiency, first difference estimation
Words: 16 667

1. Introduction

An aging population results in many issues, one of them being the rising costs of elderly care. Rising costs in elderly care are primarily an issue if a country has ambitions of being a welfare state with extensive social protections. An example of such a country is Sweden. The share of the population above 65 is 20 percent: only 14 countries have an older population. The population over 80 is above that predicted to increase by more than 50% by 2030, and the population over 85 is predicted to double by 2050 (The world bank 2019, Socialstyrelsen 2020). Furthermore, the consumption of elderly care increases by 1,3-1.4 % every year, which in today's monetary value equals 1,7-1,9 billion Swedish kronor (Ekholm 2010). The increasing costs of elderly care will undoubtedly lead to severe challenges in the future, challenges which have to be met.

Elderly care, just as many other parts of the public sector, has historically also been characterized by Baumol's cost disease. According to Baumol's cost disease, the public sector cannot become more efficient in the same way as the private sector. Baumol's cost disease claims it is more challenging to make staff-intensive sectors, such as elderly care, more cost-efficient. Furthermore, as a consequence, staff-intensive sectors tend to increase in price relative to other industries and inflation, because why should a person stay in these sectors if other sectors have much higher wage increases (Nordhaus 2006)? To put this in numbers, the Swedish CPI increased by 4,5% between 2013-2018. During the same time, elderly care costs rose by 20,3% (SCB 2021) (Arnek, Melin & Norrlid 2020, s. 29).

According to Baumol's cost disease, if the goal is to lower the cost of elderly care, this will come at the cost of aspects such as quality. It will come at the cost of quality as it is more challenging to make an industry where the product is highly connected to a person, such as elderly care, more efficient. Thus, there is a supposed trade-off between efficiency and quality. If the goal is to make elderly care more cost-efficient, cutting patient-staff time has historically been one of few options, which most likely decreases the quality of care.

There have also been other ways in which governments have met the issue of rising costs within the public sector, mainly by using methods from the private sector such as privatization and result-oriented management. These measures can be summed up into what is called New Public Management (NPM). Lately, although still existing throughout the public sector, western governments, due to inefficient results, have gradually abandoned this approach and focused more on the opportunities that digitalization has to offer. An example of this is the creation of a digitalization agency, which has the purpose of "coordinate and support the administrative-wide digitalization in order to make the public administration more efficient and effective" (DIGG n.d). Additionally, many municipalities, such as Gothenburg (2020), Stockholm (2016) and Malmö (2017), have their own digital plans and agendas. The question thus becomes, can digital technology be the holy

grail solution that both yields increased cost-efficiency and increased quality of care?

While digitalization is often portrayed as a "holy grail" solution, there are examples that have not fulfilled this expectation. There have been very mixed results in one part of the public sector, education. While some students feel that it has increased their ability to seek information, it has also led to increased stress and distractions on social media (Herold, 2018). In health care, web-based doctors can give easier access to medical care, but at the same time, they decrease actual in-person meetings with medical staff, which might decrease the quality of care. The same goes for the object of the study, elderly care. Digital meetings with the elderly instead of meeting in person might decrease costs, but at the same time, the quality might decrease because loneliness could increase. There is thus a division in how digitalization will affect the public sector. This study will look further into this divide, and if digitalization really is a "holy grail" solution regarding the issues of Sweden's elderly care.

1.1 Purpose and research puzzle

This thesis aims to research the effect that digitalization has had on the elderly care of the municipalities of Sweden. More specifically, the thesis will look into if digitalization can make elderly care more cost-efficient and at the same time increase the quality of care. The historical trade-off between efficiency and quality is also the puzzle of the study. Can digitalization be a perfect solution to the problems in our elderly care system and change previously failed projects and instead succeed?

1.2 Research questions

Based on the purpose and the introduction, the research questions are as follows:

1. *How does the degree of digitalization affect the cost-efficiency of elderly care in Sweden?*
2. *How does the degree of digitalization affect the quality of elderly care in Sweden?*

1.3 Contribution and relevance

This paper has great potential in contributing to the academic debate, especially regarding how digitalization affects our public sector. As Peter Larsson (2020), an analyst who wrote a report about welfare technology for the government said: “we do not yet fully know to what degree welfare technology can contribute to our

elderly care". This study can give more information on this issue. To what degree can digitalization make our elderly care more efficient and increase the quality of care? Does it affect the quality and efficiency of the elderly care at all? The municipalities of Sweden can, in turn, use the results in their policies.

Furthermore, it can illuminate the conflict between quality and efficiency gains described above. It can give more information on if digitalization can end this conflict and result in efficiency gains that have no adverse effects on the quality of care.

2. Digital Era Governance

A theory that emphasizes both cost-efficiency and quality as essential aspects and claims that they both can be achieved at the same time is digital-era governance (DEG). DEG is a post-new public management theory based on some of the problems of NPM. DEG was developed in 2005 by Dunleavy et al.'s article "New Public Management Is Dead — Long Live Digital-Era Governance" and has three main components, reintegration of government services, needs-based holism and digitization processes. As the key focus of this thesis is the effects of digitalization, the component which is relevant for the paper will thus be digitization processes. While reintegration of government services and needs-based holism provide aspects that may increase the cost-efficiency and quality of governance, these are not the factors at focus in this study.

By digitization changes, Dunleavy et al. (2005) mean the process where we, organizational and cultural wise, use the potential of digitalization. Digitization processes focus more specifically on the gains that can occur with the help of IT and technology. Dunleavy et al. (2005) emphasize that these changes must be all-encompassing, meaning that for digitalization to reach its true potential, there needs to be a transition into a fully digital operation. In other words, as the authors put it, "Instead of electronic channels being seen as supplementary to conventional administrative and business processes, they become genuinely transformative, moving toward a situation where the agency becomes its Web site".

One subcategory of digitization processes that describes this transformation is so-called zero-touch technology. Zero-touch technology is a technology with which we transform entire processes to digital platforms, in some cases creating a new process with the same function in society as before but now entirely digital and without any staff needed. One such example of so-called zero-touch technology that Dunleavy et al. (2005) mention in their article is London's congestion policy's surveillance and control system, which requires almost no staff. DEG argues that changing government policies and agencies like this will result in both increased cost-efficiency and better quality. In the context of elderly care, a zero-touch technology could be welfare technology such as robots that help the elderly with specific basic tasks that they cannot do by themselves anymore. Such welfare technologies have the possibility of taking away the staff that was previously needed to perform these tasks.

Above zero-touch technology digitization emphasizes "radical disintermediation". By radical disintermediation, Dunleavy et al. (2005) refer to the process in which one, by web-based means, creates direct links between citizens, businesses and other civil society actors and state systems. The links, in turn, are of such a character that they allow these actors to connect with state systems without previously needed links, such as agency personnel. In the context of this study, one example of this is E-services. E-services that, for instance, allow the elderly to book a time online can bypass the previously needed agency personnel that needed to book the time for you. Dunleavy et al. (2005) highlight

that this, on the other hand, can only be achieved when consumers of public services change their behavior in line with the new digital channels provided by the government agency. In order to book an appointment on a municipality's website, a customer, in other words, needs to understand how the website works. This, in turn, can be problematic within elderly care as the elderly generally know less about digital technology than the other parts of the population.

The third subcategory of digitization changes relevant to this paper is Electronic service delivery (ESD). By ESD, Dunleavy et al. (2005) refer to converting previously paper-based processes into E-governmental processes. ESD is, like radical disintermediation, also highly connected to E-services, as previously necessary links are not necessary anymore. Unlike radical disintermediation, the focus here is on the first step, the conversion itself, and the efficiency and quality gains that will occur because of it. An example of efficiency gains that occurred due to the creation of E-processes is when the Danish government in 2001 started the digital mailbox E-boks and later made it mandatory. Unlike before, when they received messages from the government by paper, people above 15 were given an account and could thus receive messages from government agencies online (Danish agency for digitization n.d). The conversion to a digital format, in turn, saved the Danish government approximately 1 billion Danish kroner (European Commission, 2015).

3. Earlier research

In this section I will outline some of the previous research that has been done on the subject of my study. I will start by going through the difference between digitization, digitalization and digital transformation according to a number of scientists. This is crucial as they are terms that are often used in the same context when they in fact mean different things, and as digitalization and not digitization and digital transformation is the focus of my study. I will then continue with an outline of what the scientific literature says about how digitalization affects cost-efficiency and quality, and then finally what it says about the conflict between efficiency and quality. What the scientific literature says about digitalization in the context of my study could be discussed through all of this thesis. The purpose of this section is not to do this but to provide an overview of the literature.

3.1 What is digitalization?

According to Bloomberg (2018), digitalization is often confused with two related yet different terms, digitization and digital transformation. Digitization refers to the process of changing from analog to digital form. It could be something as simple as going from handwriting to typewriting. Digitalization is a more complex term with many different definitions in earlier research. Bloomberg (2018) mentions several definitions, one by Brennenn and Kreiss, which defines digitalization as "the way in which many domains of social life are restructured around digital communication and media infrastructures". Another definition of digitalization mentioned by Bloombergs is Gartner's, "Digitalization is the use of digital technologies to change a business model and provide new revenue and value-producing opportunities". In order to have a digital transformation, an organization above the digital technologies implemented by digitalization projects needs cross-cutting organizational change.

Digitalization is thus a broad concept and difficult to measure. One example of a measurement developed by the University of Gothenburg is Dimios, which more specifically measures digital maturity. They define digital maturity as the combination of digital ability and digital legacy. By digital ability, Dimios means the ability to understand and change based on digital opportunities. By digital legacy, they mean the sum of earlier digital initiatives' effect on the organization's ability to maneuver in an increasingly digital environment. By doing this, Dimios creates a scale on digital maturity in which they categorize organizations into four categories: type A (an organization with low digital ability and digital legacy, which leads them to have difficulties in gaining from the digital transformation of our society), type B (an organization that only lacks digital ability which leads to difficulties identifying innovation and bad investments), type C (an organization

which only lacks digital legacy so they can identify innovation but instead have problems with realizing the potentials of a digital innovation), and type D (an organization with both high digital legacy and digital ability, which leads them to have good abilities in gaining from the digital transformation of our society) (SCDI, 2021).

Unlike this study, Dimios focuses on the mechanism within the relationships between digitalization and efficiency and quality. Dimios, in other words, also focuses on the organizational changes needed to gain from digitalization, i.e., digital transformation, while this paper solely focuses on digitalization. The framework created by Dimios can, in turn, be helpful when analyzing why the results turned out the way they did (SCDI, 2021).

3.2 Digitalization and cost-efficiency

Some earlier digitalization projects that resulted in efficiency gains, such as Danish E-boks, have already been mentioned. Another example of a country that has successfully made the public sector more efficient by using digital technology is the Netherlands, which moved contact with the government to online forums, which decreased physical visits to governmental offices significantly (Dilmegani, Korkmaz & Lundqvist 2014). Above nationwide examples such as Denmark and the Netherlands, extensive research has been done on the subject. Studies such as Ekman (2018), Hedman et al. (2013) and Pearl (2014) all indicate that digitalization within the public sector has the potential of increasing cost-efficiency. Ekman (2018) concluded that using digital visits could save 1-10 billion kronor per year, Hedman et al. (2013) that the use of E-treatments for mental illness is positive and cost-effective, and Pearl (2014) researched an E-health system that increased the number of virtual visits significantly. Something which all these studies have in common is that they do not claim that the positive effects of digitalization on efficiency come without conditions; good access and understanding of the new digital technologies is needed to gain from them.

There is also research which indicates that digitalization is not always so successful in increasing cost-efficiency. One such study is Bailey et al. (2013), which showed that the use of electronic data regarding health information did not result in any lowering of costs. Thus the question if digitalization increases cost-efficiency is not clear-cut, which indicates that there is a chance that the results might show different conclusions than expected.

3.3 Digitalization and quality

How quality is affected by digitalization is also a subject that has been researched before. In the context of this study, this is also the case regarding how it affects the quality of elderly care. One such study is Stewart et al. (2013), which concludes that the use of integrated care in the so-called PRISMA project in Quebec resulted in a significantly positive effect on the quality of their elderly

care. In other parts of the public sector, Donker et al. (2013) found similar results regarding how digital technologies affect the treatment of mental illness and Paré et al. (2014) regarding how the introduction of E-reminders increased the perceived quality of care.

On the other hand, Free et al. (2013) conclude that using distance assessment within healthcare decreased the number of correct diagnoses. Thus, digitalization's effect on quality, just like cost-efficiency, is not clear-cut.

3.4 The conflict between efficiency and quality

Earlier research on the potential of making the public sector more efficient is also divided. Despite the cost increases connected to the Baumoleffect, government agencies such as ESO, on the one hand, claim that there is a potential to make the public sector 15% more efficient (Arnek, Melin & Norrlid 2016). Furthermore, studies show that the relationship between spending on elderly care and quality is weak (Sanandaji & Morin, 2018). On the other hand, Olsson & Ingvad (2006) conclude a conflict between quality and gaining efficiency, at least during Sweden's elderly care reforms during the 1990s. Similarly, Kirpal (2004), which focuses on healthcare, concludes that nurses have conflicted interests because of demands for both efficiency gains and good quality, e.g., social interactions with the patients. Setting time constraints with patients might result in cost-efficiency gains but at the same time more responsibility on the patients, which in turn might lead to worse quality of care. As with digitalization's effect on efficiency and quality, the question of whether there is a conflict between efficiency and quality within the public sector is not clear-cut.

There is also research which indicates that digitalization is not always so successful in increasing cost-efficiency. One such study is the above-mentioned Bailey et al. (2013) which also concluded that the use of electronic data did decrease the need for diagnostic tests and improved the adherence to guidelines in emergency care. Thus, while more digitalization did not lower the costs, it increased the quality.

4. Hypothesis

I have constructed six hypotheses based on the research questions and the above-outlined theory. The hypotheses directed towards the first research question about how digitalization affects cost-efficiency within elderly care say that it affects elderly care in a way that makes it more cost-efficient. The hypotheses directed towards the second research question are instead about how digitalization increases the quality of care.

To concretize this, I have formulated six null and alternative hypotheses outlined below.

H0: *Increased digitalization within elderly care does not affect how cost-efficient a municipality is regarding its elderly care.*
H1: *Increased digitalization within elderly care positively affects how cost-efficient a municipality is regarding its elderly care.*

H0: *A higher usage of welfare technology within elderly care does not affect how cost-efficient a municipality is regarding its elderly care.*
H1: *A higher usage of welfare technology within elderly care positively affects how cost-efficient a municipality is regarding its elderly care.*

H0: *A higher usage of e-services within elderly care does not affect how cost-efficient a municipality is regarding its elderly care.*
H1: *A higher usage of e-services within elderly care positively affects how cost-efficient a municipality is regarding its elderly care.*

H0: *Increased digitalization does not affect the quality of elderly care.*
H1: *Increased digitalization positively impacts the quality of elderly care.*

H0: *A higher usage of welfare technology does not affect the quality of elderly care.*
H1: *A higher usage of welfare technology positively impacts the quality of elderly care.*

H0: *A higher usage of E-services does not affect the quality of elderly care*.
H1: *A higher usage of E-services positively impacts the quality of elderly care.*

All hypotheses are substantiated similarly, using earlier research and the theoretical framework of digital era governance. That welfare technology and E-services, which together represent digitalization in elderly care, can result in a more cost-efficient elderly care is based on different aspects of digital era governance. One such aspect is the previously mentioned emphasis on zero-touch technology. The introduction of digital technology into the public sector can, according to DEG, achieve this goal because it can replace much workforce with technology. As digital technology is characterizing our society more and more, I

believe it will increase the cost-efficiency of Sweden's elderly care. In the case of zero-touch technology, it can replace all the workforce within a process. Furthermore, by following the logic of another part of DEG, Electronic delivery services, previously paper-based services will be converted to a digital format. This conversion could, like zero-touch technology, delete unnecessary steps and thus make the process more efficient.

Similarly, the three hypotheses connected to the first research question can also be motivated by the reasoning of radical disintermediation. E-services have the possibility of cutting away parts of the process in which the elderly and staff are linked. Suppose a municipality has an automatic chat, which based on the information that exists on the municipality's website, can guide a person to their answers. In that case, the municipality no longer needs staff to the same degree, which would likely result in greater cost-efficiency.

The three last hypotheses are all connected to the second research question. As with the first and second hypotheses, the alternative hypotheses can also be motivated by the reasoning of DEG. That unnecessary steps in the delivery of elderly care should be taken away can also increase quality. An elderly might, for example, get easier access to a doctor as unnecessary forms will not be used anymore. Another example might be that it will become easier to put forward complaints and views to the staff as unnecessary forms that previously existed might have been taken away from the process.

Furthermore, before welfare technology and E-services were available, the primary way to make elderly care more cost-efficient was to increase the staff's workload and decrease time with patients. This, in turn, most likely affects the quality of care, as a more stressful staff and less staff-patient time assumably will decrease the quality of care. Welfare technology and E-services can change this by instead decreasing the workload and helping patients with tasks that before needed the staff involved. Thus, if this study shows that cost-efficiency has increased, I do not believe the quality of care will decrease.

That digitalization increases the quality of care can also be backed up by earlier research as shown in *3.3 Digitalization and quality*. Stewart et al. (2013), Donker et al. (2013), and Paré et al. (2014) all indicate this. At the same time, specific studies such as Free et al. (2013) do not conclude that digitalization has potential, at least not within healthcare, so there is not a complete consensus within the scientific community.

5. Research design

In this section I will outline the methodological choices of the study. I will start by discussing the benefits and limitations of using a quantitative approach, and how I have taken these limitations into account. I will continue by discussing how a first difference estimation will be applied to the study, data and case selection, how the indexes will be constructed and finally which control variables will be used.

5.1 Why a quantitative method?

In order to test the research questions, a quantitative method will be applied, which has certain consequences for the study. I will start by discussing why a quantitative method is best fitted to answer the research questions and then discuss some of the critiques against using a quantitative approach and which measures will be used to take this into account.

As will be discussed later in *5.4 Case selection*, the municipalities included in this thesis are not every Swedish municipality. Instead, they are based partly on Socialstyrelsen's study and partly on how much privately bought elderly care they have. At the same time, the aim to generalize the conclusions to other municipalities that are not included in the sample. For this, a qualitative method is not appropriate. A qualitative method can go in-depth into the effects of digitalization in a way that a quantitative method cannot. Furthermore, it can generalize its results to the theory I am using in this study, digital era governance (Vromen 2010, 255-256). What is very difficult, if not impossible, to do properly with a purely qualitative method is to generalize the results to the broader population, i.e., the other municipalities in Sweden. Because what is to say that Lund, for example, is representative of all Swedish municipalities? A quantitative method's ability to generalize the effects of digitalization on quality of care and cost-efficiency is the main reason it is used in this study.

One critique against quantitative methods is that they are too positivistic. Too positivistic, in other words, means that by focusing on quantifying observations, one ignores the complexity of the world and the political context surrounding it (John 2010, 267). In this thesis, I am not unaware of this critique. The aim is not to create an all-explanatory study that has the answers to everything about digitalization connected to elderly care. On the contrary, I encourage further, more detailed research on how digitalization affects quality and efficiency in elderly care, which can complement the broader explanatory and generalizing research that a quantitative method provides.

Above that, a quantitative method implies a foundationalist ontological perspective, meaning that a real-world exists independent of our knowledge of it. Consequently, as a researcher, one can make conclusions about the consequences of digitalization that are not affected by their own views. That one is not affected

by their own beliefs might sound simplistic, which is why I take the epistemological standpoint - ontology and epistemology are connected according to Marsh & Furlong (2010, 186) - of realism instead of positivism. Epistemological realism, like positivism, believes that there is a real, measurable world in which causal relations can be identified. However, unlike positivism, it emphasizes the importance of theory in interpreting those causal relationships (Marsh & Furlong 2010, 190). The role of theory in epistemological realism softens and takes into account some of the critique brought up by qualitative research as epistemological realism to some degree by its use of theory interprets the results. In the context of this study, this means that the interpretation of the results will be connected to Digital era governance theory.

5.2 Linear regression analysis

In this study, an ordinary least square (OLS) linear regression model will be used to answer how the degree of digitalization affects the quality and efficiency of a municipality's elderly care. A general advantage of OLS is that it gives a clearcut model of the statistical power of the relationship investigated and how secure that relationship is. The former is measured by R-squared and the latter by significance levels, which will also be used in this study. The significance levels will be at 90%, meaning that if the significance level is below 0,1, there is a lower than 10 percent chance that I accept the alternative hypotheses when they, in reality, are incorrect (John 2010, 276).

In the context of this study, an OLS model fits well as all the indexes I will create, the quality index, and the digitalization indexes (see *6. Operationalization and theoretical definitions*), are on a ratio scale. Being on a ratio scale means that they have a natural zero-point and that, unlike an ordinal scale, the distance between each unit is the same (John 2010, 272). As a result, I avoid the problems of using an ordinal scale in an OLS regression, such as difficulty interpreting the b-coefficient. Because if the distance between each score in my indexes is different, then the interpretation of the b-coefficient becomes more difficult.

5.2.1 First differences estimation

First difference regression is the method I will use as the estimation strategy for this study. A first difference estimation is a special kind of linear regression model. Unlike a regular linear regression, a first difference regression measures the differences of the dependent and independent variables and how the differences themselves relate to each other. One of the main benefits of using a first difference estimation is that it automatically removes unobserved heterogeneity that does not vary between the two time periods and which might impact the independent and dependent variables. A first difference regression removes unobserved heterogeneity as it only looks at the differences between period 1, 2016, and period 2, 2020. Thus, the stable effects between 2016 and 2020 will not impact the study (Roberts 2009).

Another method that could be applicable to the study is a difference-in-differences analysis. Like a first difference estimation, a difference-in-differences analysis controls for unobserved effects that do not vary over time. Above this, effects that vary over time but are common to both the treatment and control group are also taken into account. The fact that a difference-in-differences approach takes more unobserved aspects into account could make it a better-suited method than a first difference regression. In order for this to be the case, there, on the other hand, needs to be two distinct groups. That there need to be two distinct groups is problematic as almost all municipalities to some degree have become digitalized. Thus, to get a counterfactual scenario, many cases would have to be dropped, which would result in a significant loss of variance, and as a consequence, the study will lose strength. While a difference-in-differences takes more aspects into account, this thesis does not meet the criteria to be suited for such a study. Thus, a first difference estimator with similar advantages will be best suited (Angrist & Pischke 2015, p. 459-467).

The equation for a linear regression model is $Y = a + bX + E$. For a first difference estimation this equation is equal to $(Yt - Yt\text{-}1) = b(Xt - Xt\text{-}1) + (Et - Et\text{-}1)$. The term a is a time-constant variable that, due to its time-constant characteristic, is eliminated from the model by doing a first difference estimation. Time-constant variables are removed as a first difference estimation only includes the differences from one time period to another; regarding this study, how digitalization, quality, and cost-efficiency have changed from 2016 to 2020. As mentioned earlier, that a gets removed is one of the main benefits of using a first difference estimation. The first difference regressions I will test in this study are listed in Table 1 below, where Ydiff stands for the difference of the dependent variables (cost-efficiency and quality of care) between 2016 and 2020 and X for the difference of the independent variables (digitalization, welfare technology, and E-services) between 2016 and 2020. B, on the other hand, represents the slope and Ediff for the difference of the error term between 2016 and 2020. A more detailed discussion about the consequences of this time span will be held in *5.4 Case selection*. Above the key variables in the first difference regression, four control variables will be used to account for omitted variable bias, which will be discussed more thoroughly in *5.6 Control variables*. In the equations below, the four control variables are represented by Controldiff.

Furthermore, the differences can be calculated either in absolute terms, i.e., one to 5 equals an increase of 4, or in relative terms, as in 1 to 5 equals an increase of 400%. In this study, I will perform both to ensure one of the two methods does not show a significantly different result than the other (Roberts 2009). The results can differ depending on whether absolute or relative differences are used as relative differences account for which level a municipality is starting on. If a municipality gets a high score on the digitalization index in 2016 and raises this with one score to 2020, the relative difference is negligible. On the other hand, if a municipality gets a very low score on the digitalization index in 2016 and raises this with one score, the relative difference is more significant. On the other hand, the absolute difference in both these scenarios is the same. Thus, by including both ways of calculating differences, I take into account that the different methods might yield different results. Consequently, the strength of my results increases as they are not dependent on a certain method of calculating differences.

Table 1 - First-difference equations

Equations
$Y_{diff} = bX_{diff} + E_{diff}$
$Cost\text{-}efficiency_{diff} = bDegree\_of\_digitalization_{diff} + Control_{diff} + E_{diff}$
$Cost\text{-}efficiency_{diff} = bDegree\_of\_welfare\_technology_{diff} + Control_{diff} + E_{diff}$
$Cost\text{-}efficiency_{diff} = bDegree\_of\_E\text{-}services_{diff} + Control_{diff} + E_{diff}$
$Quality\_of\_care_{diff} = bDegree\_of\_digitalization_{diff} + Control_{diff} + E_{diff}$
$Quality\_of\_care_{diff} = bDegree\_of\_welfare\_technology_{diff} + Control_{diff} + E_{diff}$
$Quality\_of\_care_{diff} = bDegree\_of\_E\text{-}services_{diff} + Control_{diff} + E_{diff}$

5.2.2 Assumptions of OLS regression and First difference estimation

Five assumptions should be met in an OLS linear regression, which a first difference regression is a version of. If these assumptions are not fulfilled, the study's results will be biased. The first assumption is that the relationship between the dependent and independent variables needs to be linear. If the linear assumption fails, the results will be skewed, and digitalization's actual effect on quality and cost-efficiency thus cannot be correctly interpreted. To test the linear assumption, I will visualize the relationship between the dependent and independent variables. The second assumption says that the residuals need to be normally distributed. This is crucial as hypothesis testing is a central part of the study, and if the residuals are not normally distributed, the p-values will be incorrect (University of Utah, n.d.). To control for non-normality, I will bootstrap the data. The third assumption, multicollinearity, will not be an issue in this study as the regressions only include one independent variable. The fourth assumption says that there should not be any auto-correlation, i.e., residuals should be independent of each other. If the residuals are auto-correlated, then the standard errors will not be reliable, and the effects of digitalization on the dependent variables would not be interpreted correctly. In order to control for this, robust standard errors will be applied. Finally, the last assumption of OLS linear regression says that the data should be homoscedastic, meaning that the residuals are equal across the regression line. If the data is not homoscedastic, the standard errors of the regression will be biased. Robust standard errors will be used to control for this (Samaha 2020).

Above these assumptions, two other aspects that should be controlled for to run a proper first difference estimation are that the variables must have some variance across cases and time. In other words, if all municipalities have the same increase/decrease in the digitalization index, then there is no variance between municipalities, and if there is no change across time, the time-varying assumption is not fulfilled. The statistical tests I will perform to ensure these assumptions are fulfilled can be seen in the Appendix (see Table 11 and Table 12).

Another vital aspect to consider, especially when the sample size is small, is influential outliers. Deciding to delete outliers should, at the same time, be done with caution. For example, suppose a municipality is an outlier to the degree that it by being included completely changes the relationship. In that case, it should probably be dropped as the relationship is entirely dependent on that one observation. On the other hand, as I am calculating differences both in absolute and relative terms, the risk of this scenario happening decreases. Furthermore, as shown in Graph 1-12 (see Appendix), there does not seem to be any significant outlier, which, if not included, completely changes the relationship between the independent and dependent variables in my study. Consequently, the downsides of deleting outliers, such as less generalizability, are more significant than the upsides, which is why I will not delete any potential outliers (Humans of data, 2018).

5.3 Data

In this thesis, I will have to measure three things to answer my research questions: efficiency, quality, and degree of digitalization (represented by the welfare technology index and the E-service index). The data I will use to measure efficiency will be collected from Kolada, a database created by the organization of regions and municipalities in Sweden (SKR). By efficiency, I mean cost-efficiency, i.e., how efficiently a municipality spends its resources regarding elderly care. Only using cost per elderly will simultaneously lead to skewed results as how much a person spends is affected by variables such as educational level, how densely populated the municipality is and age demographics. To compensate for this, net-cost deviation, which is based on the communal cost-equalization system (where these factors are taken into account.), will be used. Net-cost deviation, in other words, is a measurement of how much a municipality should spend when all these factors have been taken into account. If a municipality spends more than the index shows, it is thus less efficient.

In order to measure the quality of care, I will use data from the same database, Kolada. On the other hand, this data initially came from Socialstyrelsen and is only stored at Kolada. While I do not collect this data myself, it comes from a very credible source, which raises the credibility of the data (Kolada, n.d).

The data I use to measure the degree of digitalization in elderly care also comes from Socialstyrelsen. Here I divide digitalization within elderly care into two groups, use of welfare technology and E-services. By welfare technology in elderly care, I mean things such as night cameras, passive alarms and digital support for training. E-services, on the other hand, refers to the more administrative part. Some of the data from Socialstyrelsen, for example, measures if a municipality has an E-service directed to elderly care, if a person can book a time online, if an individual can make a digital application for assistance, and more (Socialstyrelsen, 2021a). A more detailed discussion of the theoretical definition and operationalization I will use will be done later in *6. Operationalization and theoretical definition*.

Regarding the control variables: median income, share in a municipality that is foreign-born, age demographics and violent crime rate, the data comes from

similar sources. Except for median income, which was directly taken from SCB, the other three control variables were collected from Kolada. The data behind the three variables were, on the other hand, not created by Kolada. The data representing age demographics were collected from SCB, while the data measuring violent crime rates were collected from SCB and BRÅ. The data measuring the share that is foreign-born were finally collected by Skatteverket. That all these sources are well established governmental agencies increases the credibility of the data and thus also the credibility of the study (Kolada, 2020a), (SCB, n.d).

That all the data mentioned above are based on secondary sources could be seen as a downside for the study as the reliability of the sources might change. On the other hand, that the sources are primary sources in the sense that they have not been interpreted in any way and that they originally were collected by well-established governmental agencies raises the credibility of the data. Despite being secondary sources, the data is reasonably more reliable than if I had collected the data as Kolada does not interpret the data, and the data originally come from credible governmental agencies.

5.4 Case selection

As mentioned earlier, the time span of this study will be 2016-2020. During a time span of 5 years, the effects of digitalization have to a larger degree been realized than if the time span would be two years, for example. Thus, a five-year time span results in the possible conclusions being more secure as the actual effects of digital policies have had their effect regarding costs to a larger degree. It would have been even more beneficial with a longer time span. However, unfortunately, Socialstyrelsen only started with its questionnaire on welfare technology and E-services in 2016, and data from earlier years thus do not exist. As a consequence of this lack of data before 2016, the quality and efficiency measurements will naturally also be from 2016-2020 as they are measured in a regression with digitalization.

The cases included in the sample can be seen in table 10 (Appendix) and will as much as possible be a total sample, i.e., the whole population. One criterion has been taken into account to strengthen the study's validity. This criterion is that only 10 percent of the elderly in a municipality can buy their elderly care from private sources. This rule was included because most of the questions that Socialstyrelsen uses in its questionnaire are directed only towards elderly care homes that are publicly owned. If municipalities like Danderyd, where more than 10 percent of the elderly care is bought from private sources, would have been included, the results would have become biased as cost-efficiency measures all elderly care. In contrast, the questions asked by Socialstyrelsen are mainly directed towards publicly owned elderly care. Consequently, I would not measure what I actually intend to measure, and construct validity would thus be worsened (Esaiasson et al., 59). In the perfect situation, the limit of 10 percent of elderly care bought from private sources would be decreased to 0 percent, but this would result in the sample being very small and possible conclusions as a consequence challenging to make. At the same time, allowing for some privately bought

elderly care to be included in the sample will worsen the external validity to some degree (Esaiasson et al., 59). Furthermore, the sample was also limited by Socialstyrelsens sample in their study about welfare technology and E-services, which the study's data is based on.

Because all possible cases based on the one sampling criterion were included, there was no random sampling strategy. As the sampling strategy is not random, the possibility of making statistical inferences should be more difficult. However, as the sample represents such a large part of the total population and is random to the degree that I did not actively choose certain cases but chose every case based on the 10 percent criterion and Socialstyrelsens study, this will not be the case. Only including countries with less than 10 percent of elderly care bought from private sources will increase the ability to generalize the results as it increases the study's validity. To not include privately bought elderly care, at the same time, means that the possible results cannot be generalized to privately controlled elderly care to the same degree as it is different from publicly owned care. Instead, the results will only be generalized towards publicly controlled care.

5.5 Index

In the questions asked by Socialstyrelsen to the municipalities, most of them were framed as binary yes/no questions, but some were not. One example is "*If municipal mobile health care staff have access to equipment to document online in national systems like NPÖ and Pascal?*", in which the possible answers were *none, less than half, about half, more than half* and *all*. If the indexes include non-binary variables as the one above, it will result in different scales being used, which will skew the results. Thus I recoded the non-binary variables into binary variables. In the case of the example above, every answer that was not all was coded as 0 and all as 1.

In order to avoid getting a skewed result, I have to take into account how much of the cost of elderly care that goes to special care homes and how much that goes to ordinary care homes, and what share of the elderly that live in each type of home. I focus on the costs in the first research question as the independent variable is cost-efficiency. It is thus irrelevant how many people that live in each home, but instead how the costs differ. In 2018, according to Socialstyrelsen (2020), special care homes and ordinary care homes represented 57 percent and 42 percent of the costs, respectively. The index used for the first research question will thus take this into account and give extra weight to the variables connected to special care homes. I will use two variables from Kolada called *net-cost ordinary care, elderly care kr/inhabitant* and *net-cost special care, elderly care kr/inhabitant*, to calculate what share of the cost each home represents in each municipality. Suppose special care homes represent 60 percent of the total cost of elderly care in a municipality. In that case, variables related explicitly to special care homes will be multiplied by 0,6.

Consequently, the study's internal validity will improve as the results represent reality to a higher degree (Esaiasson et al. s., 59). The variables included in the digitalization index - which will be discussed more thoroughly in *6. Operationalizations and theoretical definition* - are either related to all homes or

specifically to ordinary or special care homes. As other forms of elderly care are not included, such as day-activity homes, this might affect the study's internal validity as the measurement of cost-efficiency includes all types of elderly care homes. On the other hand, I reckon that this will have a minimal effect on the study's validity as ordinary care homes and special care homes together represent 99 percent of the costs of elderly care (Socialstyrelsen 2020).

The same goes for the second research question, but it instead becomes relevant to give extra weight to certain variables depending on the proportion of the elderly in each home. That the focus instead is on the proportion which lives in each home is the case as the independent variable here is quality of care and not cost-efficiency. According to Socialstyrelsen (2021b), in 2020, there were 236 000 (72,5%) older adults living in ordinary care homes with home-care services and 84 000 (25,8%) living in special care homes. Above this, 5500 (1,7%) of the elderly lived in so-called temporary homes. Again, none of the variables I use for quality or digitalization take temporary homes into account. However, as 5500 only represents about 1,7 percent out of the total population in these categories, it will not affect the study in any significant way. Like in the digitalization index in the first research question, the index for quality and the index for digitalization in this research question will be weighted depending on which home the variable is measuring. The data I will use to control for this is *people 65+ in special care homes, share (%)* and *people 65+ in ordinary care homes with home-care service, share (%)*. Due to a lack of data in 2020 on one of the variables, 2019 will be used instead. That one of the variables will use 2019 is a downside, as each home's share might have changed in 2020. However, it is still a better choice than not to weigh the index, as that would be less close to reality. Thus, three different indexes will be created, one for quality and two for digitalization, weighted differently in the first and second research questions.

As seen in *6. Operationalization and theoretical definition* in some of the indexes, the variables specifically relate to either special care homes or ordinary care homes. Furthermore, the amount of variables relating to each home is different; in the case of the quality of care index, 14 variables related to ordinary care homes and 21 variables related to special care homes are included. If I only add the scores, the final index result of a municipality will, as a result, be biased towards special care homes. It will be biased as more variables are related to special than ordinary care homes. To control for this, I divide the index score for special care homes and ordinary care homes, respectively, with the number of variables in an index that is specifically related to them. So for the quality of care index, I divide the total score of the variables measuring special care homes with 21 and the variables measuring ordinary care homes with 14. Consequently, the study's validity increases as there is no bias towards a certain kind of elderly home. On the other hand, the variables not related to any specific elderly home, such as if a municipality got an E-service for time-booking, will not be multiplied by anything as they range over both ordinary care homes and special care homes.

For variables to be appropriate for an index, they need to measure the same underlying phenomena. A statistical test for this is the Cronbach alpha. This reliability test measures the internal consistency of an index, i.e., how well the variables measure the underlying concept, in this case, digitalization, welfare technology, E-services and quality of elderly care. The Cronbach alpha will be used as a way of testing if the variables representing the indexes are good enough. The limit for this is usually set at 0,7 (a Cronbach alpha can have a score between

0-1, where 1 equals perfect internal consistency), which is what I will use for my indexes as well (Esaiasson et al., 399).

5.6 Control variables

An important concept to consider when doing a first difference estimation is omitted variable bias (OVB). OVB, or so-called confounding bias, occurs when a variable is associated both with the outcome and treatment variables. As is mentioned in *4.3 First difference estimation*, one of the main benefits of a first difference estimation is that it automatically removes unobserved and fixed biases that change between the two time periods. As a result, the control variables that needs to be taken into account are time-varying variables. Variables that do not vary over time, at least not to any significant extent over five years, such as educational level, are thus automatically taken into account by the first difference model.

Another variable that otherwise needs to be controlled for but now does not is if a municipality is an urban or countryside municipality. This is not time-varying to any significant rate during five years. Urbanization has slowed down massively, and between 1970-2010, the share of people living in urban areas only increased from 81% to 85%. The amount of people living in the countryside is not decreasing in absolute numbers anymore (SCB, 2015). Thus, the study does not need to account for it as the model does it automatically. Keep in mind that the benefits of using a first difference estimation that was mentioned above only hold if its assumptions are fulfilled.

One time-varying variable that could result in OVB is age demographics. According to George, Jell & Todd (2006), age demographic had a significant effect on the efficiency of the UK's emergency department; an older population resulted in lower efficiency and worse care. Similarly, age demographics can affect cost-efficiency in elderly care as it is more expensive to take care of older patients. They have an increased risk of getting diseases, need care more hours of the day, and so on. As a consequence, a municipality might prioritize using resources more efficiently. Furthermore, it can affect the quality of care as it is reasonably more challenging to keep up a high quality of care when the population is getting older. Lastly, digitalization can be affected as those in most need of welfare technology are the oldest of the elderly. This is partly due to the reasons mentioned above, that they have an increased risk of hurting themselves. Usually, it takes more than five years for age demographics to become a significant time-varying factor. However, as it is combined with the effect of younger people moving out of municipalities with an already high amount of older people, I argue that this, on a municipal level, is time-varying even during a 5-year time span. Consequently, this will be something that is taken into account in the study. In order to control for age demographics, I will use a variable from Kolada with data on the share of each municipality's population that are above 80 years old, *people 80+, share (%)* (Kolada, 2020b).

Another variable that between 2016 and 2020 has been time-varying, and thus could result in OVB, is the share of a municipality's population that is foreign-born. Regarding the first research question, it can affect cost-efficiency as

communication might be more difficult for a foreign-born person, and good communication, in turn, increases cost-efficiency. Studies have, for example, found that most multinational corporations demand that a person know Swedish even to have the possibility of getting employed (Gunnarsson, 2019). In the same way, it can affect the quality of care as good communication increases the quality of elderly care. The connection is not as clear-cut regarding digitalization, but I would argue that it still might exist and thus need to be accounted for. An indication of this is that Sweden is a country that has come further regarding digitalization and technological changes than the countries where most of the current migrants come from (Liu, 2021). The variable I will use to control for this is called *Foreign-born, share (%)* (Kolada, 2020c).

A third variable that might result in OVB is the crime rate in a municipality. As Sweden has seen an uptick in violent crimes during recent years, this variable becomes time-varying (BRÅ, 2021). It also affects all variables in the two research questions. Cost-efficiency and quality of care are affected as increased crime takes resources and is likely to be prioritized above elderly care. That law and order is prioritized above elderly care has also been shown to be the case. According to a Swedish opinion poll on which political areas the voters think are most important, law and order get a 15 percentage point higher score than elderly care (Öbrink, 2020). As a consequence, cost-efficiency and quality of care might be affected. While not so obvious, digitalization might be affected by similar reasoning as resources are needed to prioritize it. This control variable will be represented by *The number of reported violent crimes per 100 000 inhabitants*. The data was collected from Kolada (2020a), which got the statistics from SCB and BRÅ.

A fourth control variable that I will consider is the economic development in each municipality. The economic development will be represented by the average median income in every municipality. The median income is time-varying as much economic development can occur even during a single year. An illustration of this is municipalities such as Stockholm and Gothenburg, who benefit significantly from the constant flow of high-skilled workers. In combination with other municipalities having the opposite pattern of highly educated people leaving, this flow makes it a time-varying factor. Due to missing data during 2020 in SCB (n.d), the median income difference will instead be counted from 2016 to 2019.

As mentioned, a control variable needs to be time-varying and vary between municipalities to be relevant for a first difference regression. To make sure that this is the case and that the control variables as a consequence are valuable to the study, I will perform a regression to see if the variation over time and between municipalities is significant, see Appendix (Table 11 and Table 12)

6. Operationalization and theoretical definition

In this section, I will define what I mean by the three central terms of the study: digitalization, quality of care and efficiency, and then create operational definitions for them, and discuss how well these definitions fit with the theoretical definition of the terms.

6.1 Degree of digitalization within elderly care

Digitalization is a relatively new scientific term and thus also a relatively unresearched one that, as a consequence, lacks a common theoretical definition. As a theoretical definition, I will use Rachinger et al.'s definition of digitalization: "the exploitation of digital opportunities". This definition is concise, which could be seen as a downside, but at the same time, it applies to all sectors of society, private and public, and to be more specific elderly care. Within elderly care, I use the division created by Socialstyrelsen of welfare technology and E-services, which together represent digitalization. The operationalization I use for digitalization goes back to *3.1 What is digitalization?* where I discuss the difference between digitization, digitalization and digital transformation. As digitalization is at focus in the study, digital transformation, i.e., the organizational changes and the use of digital technologies are not included in the definition of digitalization that I am applying to the study.

6.1.1 E-services

Socialstyrelsen defines an E-service as an interactive digital service where the elderly can contact social services. This definition is, in my opinion, too narrow as it excludes digital services between staff only, such as a register over patients' health status. Thus the theoretical definition for E-services that I will use will instead be: E-service is a digital service in which the elderly and the staff can interact and share information. Thus, variables such as if a municipality is connected to the International Classification of Functioning, Disability and Health (ICF) system are also considered an E-service. The purpose of ICF is to create a uniform way of describing how health-related status affects one's functioning and disabilities.

The seven variables in Table 2 will represent the operationalization of E-services in elderly care. Due to the study's time span, 2016-2020, I could not use certain E-services variables as Socialstyrelsen only measured those variables during one of the years in the time span. Two such variables were if an E-service

exists to have an anonymous chat or a secure conversation. The lack of variables in the index for E-services is an obvious downside as the variables might not represent E-services as a whole. As a consequence, the conclusions from this index should be drawn with caution. In order to make sure that the index is not flawed, an internal consistency test will be performed by using Cronbach's alpha. The same test will also be done on all the other indexes.

By looking at Table 2, it might seem that if a municipality uses ICF gets an unproportionate size in the index, but this is not the case. As mentioned in *5.5 Index*, the variables connected to both ordinary and special care homes have a greater value in the index to avoid skewing it so that either ordinary or special care homes are valued more. Thus the first two variables in Table 2, which are not related to ICF, are not multiplied by the share each home represents, such as 0,6 (60%). They are not multiplied by how big of a share each home represents as they span over both types of homes. In other words, while there are only two variables in the E-service index that are not related to ICF, they, in reality, represent a large share of the index. That these two variables represent a larger share of the index, in turn, increases the validity of the study as the index otherwise would be biased towards if a municipality uses ICF.

Table 2 - Operationalization of E-services

Variable	**Degree of digitalization**
	E-services
1.	If the municipality has an e-service where the elderly and more can put forward complaints and opinions?
2.	If the municipality have an e-service regarding time-booking
3.	If administrators in the social service uses ICF (International Classification of Functioning, Disability and Health) within elderly care
4.	If ICF is used in the documentation within communal healthcare in special care homes?
5.	If ICF is used in the documentation in homecare in ordinary care homes?
6.	If the staff uses ICF in the documentation in ordinary care homes?
7.	If the staff uses ICF in the documentation in special care homes?

6.1.2 Welfare technology

The theoretical definition of welfare technology which will be used in this study is the one that Socialstyrelsen uses: "digital technology that aims to maintain or increase security, activity, participation or independence for a person who has or is at increased risk of getting a disability". As I am using an established definition from a government agency that is well acquainted with the subject at hand, the study's validity increases. The validity increases as the risk of measuring what I actually intend to measure increases. Furthermore, the definition not only includes digital measures aimed at the elderly but also the staff taking care of them. It also includes staff as what will help the staff will usually also help the elderly.

The operationalization of this theoretical definition will also largely be taken from Socialstyrelsen, specifically their E-health and welfare technology report. The operationalizations I will use are those listed in Table 3.

Some variables in the index are of different sizes; this is especially the case regarding *If a municipality uses passive alarms*. The variable passive alarms are of a different size as there are many kinds of passive alarms, such as the ones mentioned in the parenthesis in Table 3. In Socialstyrelsen's studies on welfare technology and E-services later than 2016, they also divide this variable into many variables, which indicates that this should not be valued the same in the index as the other variables. Consequently, instead of 1, the two variables (one for ordinary care and one for special care homes) regarding passive alarms are valued at 5 in my welfare technology and digitalization index. As with all variables connected to a specific type of elderly home, it is multiplied by the share of elderly care which that type of home represents. Valuing it higher increases the study's validity as valuing it the same and thus treating it as one variable would downplay its actual value.

Table 3 - Operationalization of welfare technology

Variable	**Degree of digitalization**
	Welfare technology
1.	If a municipality uses night surveillance with digital technology (Security camera, night-to-night vision / remote control with camera) in ordinary care homes?
2.	If a municipality uses GPS-alarms/positioning alarms in ordinary care homes?
3.	If a municipality uses passive alarms/sensors (alarm mats, door sensors, movements sensors, fall alarms etc) in ordinary care?
4.	If a municipality uses night surveillance with digital technology (Security camera, night-to-night vision / remote control with camera) in special care homes?
5.	If a municipality uses GPS-alarms/positioning alarms in special care homes?
6.	If a municipality uses passive alarms/sensors (alarm mats, door sensors, movements sensors, fall alarms etc) in special care homes?
7.	If the elderly are able to connect to wifi in special care homes?
8.	If all municipal mobile social service staff have access to equipment to read online in the municipal digital operating system, when visiting patients for example?
9.	If all municipal mobile social service staff have access to equipment to document online in the municipal digital operating system, when visiting patients for example?
10.	If all municipal mobile health care staff have access to equipment to read online in the municipality´s digital operating system?
11.	If all municipal mobile health care staff have access to equipment to read online in national systems like NPÖ and Pascal?
12.	If all municipal mobile health care staff have access to equipment to document online in the municipality´s digital operating system?
13.	If all municipal mobile health care staff have access to equipment to document online in national systems like NPÖ and Pascal?
14.	If a municipality uses digital locks/key free locks

6.2 Quality within elderly care

Quality is complex to measure and does not have a unanimous definition within academics. This paper is directed towards the elderly; thus, it is the view of the elderly I am interested in. According to researchers such as (Elwyn et al. 2007) (Steptoe, Deaton & Stone 2015) (Kaplan, Barell & Lusky 1988), quality of care is very subjective. Thus, the first step to recognize the complexity of quality will then be to recognize the inherent subjectivity in it. Thus, the variables I will use to measure quality will be subjective. What I mean by this is that the variables will primarily consist of how the elderly themselves feel about their elderly care. The variables will measure things such as how the elderly feel about safety, confidence in the staff, if their opinions are taken into account, if they have enough time with the staff, if they feel lonely, if they are happy with the social activities, and more. Above that, as quality is hard to define, the operationalizations I will use will be many in order to encompass all of what could be included in the quality of elderly care.

Based on this theoretical view of subjectivity, quality of care will be operationalized by the variables in Table 4. The variables were, as previously mentioned, taken from the database Kolada. There were some variables from the data collected by Kolada that were not included. One such variable was if an elderly lived together with another adult. It is unclear what this has to do with the quality of the elderly care; one could live in a separate apartment by themself, but that does not necessarily have something to do with quality. Another such variable was connected to health status. I choose not to include the variable health status as it does not necessarily say anything about the quality of elderly care. One's health can have been affected by other factors than elderly care.

Table 4 - Operationalization of quality in elderly care

Variable	**Quality**
	Quality of home-care service in ordinary homes
1.	Percentage which say that they have gotten a good or very good treatment from the staff
2.	Percentage which say that they have confidence in all or most of the staff which come home to the patient
3.	Percentage which say that they felt safe or very safe with still living at home with help of the home care service
4.	percentage which say that they always or often get informed by the staff about temporary changes
5.	percentage which say that the administrators decision was adapted based on the patients needs
6.	percentage which say that they are not worried about loneliness
7.	percentage which say that it is easy or very easy to get in contact with the home care service
8.	percentage which say that the staff always or often take their opinions and wishes into account
9.	percentage which say that they know where to turn if they want to present views or complaints
10.	percentage which say that they always or often have the ability to affect which time of the day they get help from the home care service

11.	percentage which say that the staff always or often arrive on time
12.	percentage which say that the staff perform their duties in a good or very good manner
13.	percentage which say that they don't have severe problems with anxiety
14.	percentage which say that the staff always or often have enough time to finish their tasks

Quality of elderly care in special housing homes

1.	percentage which say that the ability to be outside is good or very good
2.	percentage which say that they are happy or very happy with the social activities that are offered
3.	percentage which say that it if needed is easy or very easy to get in touch with a nurse
4.	percentage which say that they have gotten a good or very good treatment from the staff
5.	percentage which say that they are not worried about loneliness
6.	percentage which say that they like their room/apartment
7.	percentage which say that they like the common rooms in the special home
8.	percentage which say that they like the outside environment around the special home
9.	percentage which say that it is easy or very easy to get in contact with the staff at the special home
10.	percentage which say that they have confidence in all or most of the staff in the special home
11.	percentage which say that the staff always or often take their opinions and wishes into account
12.	percentage which say that they always or often get informed by the staff about temporary changes
13.	percentage which say that it is easy or very easy to get in contact with a doctor if needed
14.	percentage which say that the food which is served tastes good or very good
15.	percentage which say that the food was served during a good time of the day
16.	percentage which say that they know where to turn if they want to present views or complaints
17.	percentage which say that they always or often have the ability to affect which time of the day they get help from the home care service
18.	percentage which say that they got a place at their special home of choosing
19.	percentage which say that they don't have severe problems with anxiety
20.	percentage which say that the staff always or often have enough time to finish their tasks
21.	percentage which say that they felt safe or very safe with living at their special home

6.3 Efficiency within elderly care

There are many kinds of efficiencies, such as allocative and dynamic efficiency. The efficiency at focus in this study is cost-efficiency, and by that, I mean "the difference between actual costs and an estimated minimum cost". In order to

measure this, a variable called net-cost deviation within elderly care will be used. The net-cost deviation is based on the municipal cost-equalization system. It is calculated by taking the net cost of a municipality's elderly care and subtracting it by the so-called reference cost. In turn, the reference cost represents what the net cost is supposed to be, i.e., what a municipality actually should spend on its elderly care. It does that by taking into account age structure (share of population between 65-79, 80-89 and 90+), marital status, health status, the share of the population born outside of the Nordic region, how long it takes to travel for the home care service, cost for institutional housing in densely populated areas, wages, building structure in the municipality and if the population increases or decreases.

These variables function as automatic control variables, making the results less skewed. Furthermore, as it takes all of this into account, it will estimate the actual cost of elderly care in a municipality and thus show how much efficiency gains can be achieved.

7. Results

This chapter presents several first difference regression models to answer the research questions. Before performing the regression models, the assumptions discussed in *5.2.2 Assumptions of OLS regression and first difference estimation* must be fulfilled. Consequently, heteroscedasticity and autocorrelation have been controlled for by robust standard errors and normality of residuals by bootstrapping. The assumption of linearity was visually checked (see Appendix). The assumptions related explicitly to the first difference estimation; that there in each dependent variable needs to be some variance between municipalities, and between time (2016-2020) was tested by looking at the difference between the municipality at the 10th percentile and the municipality at the 90th percentile (see Appendix table 12), and regarding variance between the time-periods by seeing if the change from 2016-2020 of the average value was statistically significant (see Appendix, Table 11). As seen in the Appendix, both of these assumptions were fulfilled.

Above these assumptions, a Cronbach alpha test was performed on all four indexes to test their internal consistency. Three out of four indexes from the beginning reached above the limit of 0,7 and were thus considered internally consistent. In order to strengthen the internal consistency of the index, which did not reach this limit, in the E-service index, one variable - if a municipality had an E-service for assistance - had to be dropped. As the variables in the E-service index are few, dropping a variable could be a downside, but comparatively, not having enough internal consistency and thus having variables that do not measure the same underlying concept would be worse.

The range of scores that a municipality can have on the indexes does not matter when using the relative difference method. It does not matter as the relative difference will be the same no matter the possible range of scores. On the other hand, when it comes to absolute differences, this is not the case. The indexes were rescaled to allow for a more straightforward interpretation of the b-coefficient, so all their scores range from 0-100. Thus, as the scales are the same on all indexes, it becomes easier to analyze them with absolute differences. On the other hand, this is only the case on the indexes I created myself; the cost-efficiency scale instead ranges from -100 to 100.

As shown in Table 5-8, one notable aspect that comes to mind is that the number of observations is different in some of the first difference regressions, despite the same variables being used. This difference in observations is explained by the fact that some municipalities in 2016 started with a score of 0, which made calculating the relative difference from 2016 to 2020 impossible. The observations which started at 0 in 2016 thus became missing observations instead. In other words, when using relative differences, if defining difference as how much a municipality has changed its score on the different indexes, the municipalities that start at 0 will become missing variables.

7.1 Digitalizations effect on cost-efficiency

Table 5: Cost efficiency - Without control variables

Variables	Cost-efficiency		Cost-efficiency		Cost-efficiency	
	Absolute difference	Relative difference	Absolute difference	Relative difference	Absolute difference	Relative difference
Digitalization	0,0002 (0,041)	0,104 (0,411)				
Welfare technology			−0,011 (0,027)	0,23 (0,604)		
E-services					−0,009 (0,034)	-0,342 (0,628)
Constant	0,341 (1,315)	-0,525 (0,678)	0,838 (1,166)	-0,704 (0,727)	0,543 (1,04)	-0,357 (0,729)
***R*2**	0,000	0,000	0,001	0,004	0,001	0,004
N	120	120	124	120	126	118

Significance level: p<0,01 = ***, p<0,05 = **, p<0,1 = *
Robust standard errors with bootstrapping in parentheses
Note: In this table six first difference regressions are performed. In all regressions cost-efficiency is the dependent variable, while welfare technology, E-services and digitalization represent the independent variable in two regressions each, one with absolute differences and one with relative differences. Welfare technology + E-services = Digitalization. The data behind the regressions is accessible by requesting it from the author.

The coefficient of determination, R-squared, represents the proportion of the value in the dependent variable that can be predicted from the independent variable. As can be seen by looking at the R-squared statistics in Table 5, the independent variables in the first difference models explain none or practically none of the variance of cost-efficiency. In other words, neither welfare technology nor E-services, which together represent digitalization within elderly care, explain practically any of the variance in cost-efficiency. The regression model with the most explanatory power is welfare technology and E-services calculated with relative differences. As shown in Table 5, they have an R-squared of 0,004, meaning that welfare technologies and E-services can predict 0,4% of the variation in cost-efficiency.

As a first difference estimation is the method of this study, the interpretation of the b-coefficients cannot be done in the same way as with regular OLS regression. The b-coefficient of 0,104 that digitalization has when using the relative differences method instead means that a 1 percent relative increase in digitalization during a five-year time period will result in a 0,104 percent decrease in cost-efficiency during the same period. It is a decrease, not an increase, as the most cost-efficient score a municipality can get on the net-cost deviation variable is -100, while the least efficient one is 100. -100 means that a municipality spends 100% less than they should according to their current situation.

The interpretation is similar when using absolute differences. Like before, a 1 unit increase in digitalization over a five year time-period means a 0,0002 units decrease in cost-efficiency over the same period, but unlike with relative differences, percentages are not part of the interpretation. Like before, it is vital to keep in mind that net-cost efficiency is measured on a scale from -100 to 100. That cost-efficiency decreases as digitalization increases is indeed a surprise. At

the same time, none of the relationships are significant, so I cannot say if cost-efficiency indeed will decrease by 0,104 percent when digitalization increases by 1 percent, or if cost-efficiency decreases by 0,0002 units when a municipality increases its score on the digitalization index with 1 unit. In other words, I cannot exclude that this small change is due to chance.

Table 6: Cost efficiency - With control variables

	Cost-efficiency		**Cost-efficiency**		**Cost-efficiency**	
Variables	Absolute difference	Relative difference	Absolute difference	Relative difference	Absolute difference	Relative difference
Digitalization	0,014 (0,043)	0,063 (0,437)				
Welfare technology			-0,003 (0,027)	0,252 (0,58)		
E-services					0,000 (0,034)	-0,423 (0,613)
Median income	−0,402 (0,27)	5,434 (40,025)	-0,387 (0,312)	6,743 (42,575)	-0,439 (0,367)	10,181 (38,718)
Violent crime rate	−0,003 (0,004)	2,437 (2,142)	−0,003 (0,004)	2,58 (2,235)	0,000 (0,004)	2,605 (2,256)
Share that is foreign born	−0,194 (0,977)	−1,271 (5,999)	−0,053 (0,959)	−2,432 (6,317)	−0,33 (0,96)	−0,546 (5,983)
Share of population above 80	-8,104*** (2,76)	−16,214** (7,947)	-7,089** (2,931)	−17,224** (8,303)	-8,839*** (2,807)	−13,412* (7,518)
Constant	8,034* (4,497)	0,237 (3,546)	8,006 (5.152)	0,087 (3,7)	9,476 (5,874)	−0,104 (3,368)
***R*2**	0,115	0,026	0,091	0,032	0,116	0,026
N	120	120	124	120	126	118

Significance level: p<0,01 = ***, p<0,05 = **, p<0,1 = *
Robust standard errors with bootstrapping in parentheses
Note: In this table six first difference regressions are performed. In all regressions cost-efficiency is the dependent variable, while welfare technology, E-services and digitalization represent the independent variable in two regressions each, one with absolute differences and one with relative differences. Welfare technology + E-services = Digitalization. The four control variables are represented in every first difference regression. The data behind the regressions is accessible by requesting it from the author.

As discussed in *5.6 Control variables*, one crucial aspect to keep in mind when using first difference estimations is omitted variable bias (OVB). OVB risks giving the effect of a variable not included in the model to the included variables, i.e., digitalization, welfare technology and E-services. Because of the risk of OVB, I have included four control variables shown in Table 6 above. As the R-squared of the regression models without control variables is practically 0, the need for control variables could be seen as minor. However, it could be the case that the effect of digitalization, welfare technology and E-services on cost-efficiency is conditional on the control variables, so they will still be analyzed in the context of the study. The control variables also fulfill the criteria for being a control variable in a first difference regression. They are time-varying during the study's timespan, and they vary between municipalities (see Appendix).

While the R-squared is still low, it has increased compared to when only one independent variable was included in each regression model. An increase can especially be seen in the models using absolute differences. Regarding digitalization, R-squared has increased to 0,115, meaning when the four control variables are included in the model, they, together with digitalization, explain 11,5% of the variance in cost-efficiency. At the same time, this is still low, especially as more variables are now included in the model. That R-squared is still low despite many variables being included in the model indicates that what affects cost-efficiency in elderly care is a complex process that is hard to pinpoint.

Out of the control variables, the share of population above 80 shows significant results on all regression models, meaning there is less than a 10 percent chance that its b-coefficient is due to chance. The share of people above 80 has a significant b-coefficient of -16,214 in the model where relative differences are used, digitalization is the independent variable, and cost-efficiency is the dependent variable. In other words, when the share of the population that is above 80 years old increases by 1 percent, cost-efficiency increases by 16,214 percent. As mentioned before, it is not a decrease with 16,214 percent as the more cost-efficient a municipality is, the lower its score is on the cost-efficiency scale. On the other hand, any secure claims about violent crime rate, median income and share of the population that is foreign-born are challenging to make as they do not show any significant results.

An interesting aspect to take out of the Tables is that the b-coefficient in the different regression models go in different directions when adding the control variables. The b-coefficient of how digitalization affects cost-efficiency increases when using the absolute difference method while it decreases when using relative differences. That it goes in different directions indicates that the control variables, as a whole, have a suppressing effect when using the absolute difference method while they have a confounding effect when using the relative difference method. This could mean one of two things, either that this is due to chance because of the insignificant relationships or that calculating differences in an absolute or relative way yields different results. As both the relative and absolute way of calculating differences generated insignificant results and, above that, very weak and similar relationships, it speaks for the first scenario, that it was due to the insignificant results.

7.2 Digitalizations effect on quality of care

Table 7: Quality of care - without control variables

Variables	**Quality of elderly care**		**Quality of elderly care**		**Quality of elderly care**	
	Absolute difference	Relative difference	Absolute difference	Relative difference	Absolute difference	Relative difference
Digitalization	-0,013 (0,012)	0,000 (0,004)				
Welfare technology			−0,013 (0,008)	-0,001 (0,002)		
E-services					0,004 (0,009)	0,000 (0,004)

Constant	0,032 (0,379)	-0,004 (0,005)	0,087 (0,328)	-0,002 (0,004)	-0,444 (0,317)	-0,005 (0,004)
***R*2**	0,009	0,000	0,016	0,002	0,001	0,000
N	99	99	101	99	103	96

Significance level: p<0,01 = ***, p<0,05 = **, p<0,1 = *
Robust standard errors with bootstrapping in parentheses
Note: as before, the reason there are a lower number of cases in some models when using the relative method is because some observations started at 0 which makes calculating differences impossible. In this table six first difference regressions are performed. In all regressions quality of care is the dependent variable, while welfare technology, E-services and digitalization represent the independent variable in two regressions each, one with absolute differences and one with relative differences. Welfare technology + E-services = Digitalization. The data behind the regressions is accessible by requesting it from the author.

As with the first research question, the effect of the independent variables on the quality of care is very weak, if not non-existent. The model with the highest R-squared, welfare technologies effect on quality when using absolute differences, only explains 0,16 percent of the variation in the quality of care. Furthermore, the relationships are not significant, meaning there is a risk that the b-coefficients are due to chance. That the regression models are not significant is understandable as the R-squared is so low, and the relationship between the independent and the dependent variables is thus very weak.

That the explanatory power of the relationships are weak and that the b-coefficients are not significant does not mean that they should be neglected. It goes back to the discussion about if digitalization really is the holy grail solution to our demographic problems. What the results mean will be discussed more thoroughly in *8. Analysis*.

Table 8: Quality of care - with control variables

	Quality of elderly care		**Quality of elderly care**		**Quality of elderly care**	
Variables	Absolute difference	Relative difference	Absolute difference	Relative difference	Absolute difference	Relative difference
Digitalization	-0,005 (0,013)	0,001 (0,003)				
Welfare technology			-0,007 (0,009)	-0,001 (0,002)		
E-services					0,007 (0,009)	0,001 (0,003)
Median income	-0,155 (0,098)	-0,317 (0,267)	-0,146 (0,107)	-0,297 (0,291)	-0,158 (0,123)	-0,302 (0,304)
Violent crime rate	0,001 (0,001)	0,012 (0,015)	0,001 (0,001)	0,012 (0,016)	0,001 (0,001)	0,015 (0,016)
Share that is foreign born	-0,587 (0,342)	-0,034 (0,052)	-0,507 (0,359)	-0,027 (0,055)	-0,414 (0,32)	-0,005 (0,055)
Share of population above 80	-1,094 (0,867)	-0,034 (0,063)	-0,797 (0,892)	-0,022 (0,067)	-0,487 (0,898)	0,005 (0,07)
Constant	3,13* (1,635)	0,025 (0,023)	2,909 (1,758)	0,024 (0,024)	2,485 (1,951)	0,018 (0,025)
***R*2**	0,088	0,052	0,083	0,049	0,081	0,061
N	99	99	101	99	103	96

Significance level: p<0,01 = ***, p<0,05 = **, p<0,1 = *

Robust standard with bootstrapping errors in parentheses
Note: In this table six first difference regressions are performed. In all regressions quality of care is the dependent variable, while welfare technology, E-services and digitalization represent the independent variable in two regressions each, one with absolute differences and one with relative differences. Welfare technology + E-services = Digitalization. The four control variables are represented in every first difference regression. The data behind the regressions is accessible by requesting it from the author.

The same control variables have been applied to control for omitted variable bias in the second research question. The same control variables are being used as I argue that all control variables affect both efficiency and quality variables. As shown in Table 8 above, the effect of including control variables is about the same as with the first research question, but none of the variables are significant. While not significant, the results are still interesting, especially median income. The b-coefficient of median income in all models is negative. This means that when the average median income increases by one percent or one unit (1000 kronor) during five years, the quality of care decreases. In other words, the quality of care decreases the richer the municipality becomes. This is surprising as one would probably expect that a more affluent municipality has a higher quality of elderly care. A probable explanation could be that the wealthier municipalities, compared to the poorer municipalities, had a high score on the quality of care index in 2016. As a result, the change from 2016 to 2020 was smaller because it was challenging to increase the quality from an already high score. When it comes to the key independent variables, then the results differ. Digitalization and welfare technology have a slight negative impact on quality of care when using absolute differences, while E-services have a positive impact. When using relative differences, the impact is practically 0 in all models. One should remember that none of these models are significant, so there is a risk of them being due to chance.

While not significant, the b-coefficients of the regression models are increasing in most models. That they are increasing is like before a sign that the control variables have a suppressing effect on the relationship, meaning it increases the predictive validity of another variable.

8. Analysis

In this chapter, I will discuss the results in relation to the hypotheses and theory. In Table 9 below, a brief overview of the hypotheses and which, based on the results, were either accepted or rejected can be seen. As can be seen in Table 9, all hypotheses were rejected.

Table 9 - Result of hypotheses

Hypotheses: expected results	Result
Increased digitalization within elderly care positively affects how cost-efficient a municipality is regarding its elderly care.	Rejected
A higher usage of welfare technology within elderly care positively affects how cost-efficient a municipality is regarding its elderly care.	Rejected
A higher usage of e-services within elderly care positively affects how cost-efficient a municipality is regarding its elderly care.	Rejected
Increased digitalization positively impacts the quality of elderly care.	Rejected
A higher usage of welfare technology positively impacts the quality of elderly care.	Rejected
A higher usage of E-services positively impacts the quality of elderly care.	Rejected

Note: The table above illustrates the results of my 6 alternative hypotheses mentioned in *4. Hypotheses*. That all were rejected suggests that the null-hypotheses are correct.

8.1 Digitalization and cost-efficiency

Based on the theory of digital era governance, the three first hypotheses, which emphasize how digital technology can increase cost-efficiency, should have shown that increased use of digital technology also increases cost-efficiency. For example, with the use of passive alarms and an E-service for time booking, processes that were previously needed would be replaced by what digital era governance call zero-touch technology, radical disintermediation and electronic service delivery. As mentioned in the results, the increase in cost-efficiency cannot be seen; instead, the connection is insignificant and almost non-existent. Thus, the results suggest that digitalization is not the "holy grail" solution to our demographic problems and that it instead has been exaggerated because of the current digital transformation of our society.

That we are not only gradually but rather exponentially transforming our society into a digital world is something that has been happening almost automatically. Consequently, digitalization has been hyped as a solution to many of the problems facing the public sector, especially elderly care. The theory of digital era governance is a perfect example of this, yet the effects promised by

DEG cannot be seen in this study. On the contrary, they are almost non-existent. The non-existent effects are true for both sub-indexes of digitalization regarding elderly care, i.e., welfare technology and E-services. The fact that an overall digitalization index does not positively affect cost-efficiency speaks against some aspects of DEG. The elements of DEG mentioned in *2. Digital era governance* that was applied to the study - zero-touch technology, radical disintermediation and electronic service delivery - thus did not live up to its promises when it came to increasing the efficiency in elderly care.

While digitalization within elderly care, in this study, has not been shown to have any positive effect regarding cost-efficiency, it at the same time does not necessarily mean that the usage of digital technology in elderly care has no impact on cost-efficiency at all. Dunleavy et al. (2005) write that to benefit from digitalization's possibilities, the digital changes must be all-encompassing, i.e., the entire operation must be digital. It is possible that the increased usage of digital technology has not reached that level, and thus the cost-efficiency gains have not been realized yet. Furthermore, as older people, to a lesser degree, are digitally literate, this might also affect the relationship between digital use and cost-efficiency. For example, if people do not know how to go online and book a time, then that technology will have a negative effect on cost-efficiency. In other words, even if the new digital technologies that have been applied in elderly care were all-encompassing, this would not have had an effect if the customers (the elderly) did not understand how the technology worked.

A third possibility is that the efficiency gains that increased digitalization within elderly care could result in have not yet been realized. That the effects may not yet have been realized is because it can take time until the benefits of an investment are seen, in this case, more than five years. If it is the case that it does take more than five years and the benefits thus have not been seen yet, I, on the other hand, cannot say for sure as it was not what was investigated in this study. An indication that it does not take more than five years is that in some of the earlier studies such as Hedman et al. (2013), digitalization had shown to have positive effects on cost-efficiency when the timespan was lower than five years. At the same time Hedman et al. (2013) did not study elderly care, but instead another part of the public sector.

The reason that efficiency gains have not been realized could also be that many municipalities are classified as type B, type C or type D organizations in Dimios (see *3.1 What is digitalization?*). Consequently, while they may have done many digitalization projects, such as increased their use of welfare technology and E-services, it is possible that the gains from these projects cannot be realized due to organizational difficulties. The mechanisms within the digitalization process that make it successful, in other words, could be lacking.

It should be stated that the possibilities mentioned above are not controlled by any data but by reasoning and assumptions based on earlier research. As a consequence, the conclusions must be interpreted with caution and not as absolute facts.

The only possibility that is based on the data from this study is that digitalization is not in itself a "holy grail" solution. Thus the most probable conclusion to be drawn from this study is that the reality is indeed what the results show, that increased use of digital technologies is not the holy grail solution to the increasing costs of elderly care. So while all the criteria mentioned by Dunleavy et al. (2005) - that the applied technology is all-encompassing and that its users

understand it - may have been fulfilled, it still does not result in increased digitalization lowering the cost of elderly care. That digitalization is not the perfect solution regarding costs was also concluded by Bailey et al. (2013) in their study about the use of electronic data in emergency care. While emergency care is another area than elderly care, the same pattern could thus be seen in the results in this study. That both the absolute and relative way of calculating differences for the first difference estimation showed non-significant results is furthermore evidence that methodological choices did not determine the results.

As discussed in *5.2.1 First differences estimation*, the main benefit of using this method is that variables that might affect the relationship but do not vary over time are automatically controlled for. The chance that the results were biased because I have not included variables that might affect the relationship is thus small. The time-varying control variables also indicated that the results were not biased. With this in mind, there is still a chance that time-varying aspects that affect the relationship between the independent and dependent variables were missed, which would bias the result. Because of this, the results should be interpreted in a probabilistic manner and not as absolute facts.

8.2 Digitalization and quality of care

Like the three hypotheses connected to the first research question, the three hypotheses connected to the second were also rejected, as shown in Table 9. As with the first three hypotheses, the hypotheses connected to the second research question were rejected as they showed insignificant results. Consequently, I cannot say that increased usage of welfare technology and E-services positively affected the perceived quality of elderly care. With that being said, digitalization has not on a grand-level had any statistically significant negative impact on the quality either, which was something that had been seen in other public sectors such as education.

The theory of digital era governance claims that the use of digital technologies will increase quality. An example of this is when zero-touch technologies remove processes altogether. In the context of elderly care, this could make it easier to contact a nurse. In the same way, as with the previous research question, this positive effect would not occur if the elderly did not understand the new technology. As there was no significant negative relationship between the increased usage of digital technologies and quality of care, it is reasonable to assume that the elderly indeed, at least to some degree, understood this new technology. Consequently, the most probable conclusion is again that neither digitalization nor its subparts, welfare technology and E-services, functions as a holy grail solution regarding the quality of care.

While some of the earlier research mentioned in *3.3 Digitalization and quality,* such as Donker et al. (2013) and Paré et al. (2014), showed that specific digitalization measures increased quality of care, this is not against what the results of my study indicate. On the contrary, that specific digitalization measures can have positive effects both regarding the quality of care and cost efficiency is undeniable based on studies such as Donker et al. (2013) and Paré et al. (2014).

On the other hand, this study illustrates that all these initiatives put together do not live up to the promises of theories such as digital era governance.

9. Conclusions

When our society is becoming increasingly digital, it is essential to know whether digitalization really lives up to its promises, i.e., is it the holy grail solution that can solve the problems facing our elderly care? Based on the results of this study, the simple answer to that question is no: neither welfare technology nor E-services have practically any effect whatsoever on the quality and cost-efficiency of elderly care in Sweden. The non-existent effect was at the same time only on a grand scale where all measures were put together into indexes. So while the hypotheses were rejected, the results still have a contribution. This is especially true since there was not just a weak, insignificant relationship, but a close to a non-existing relationship. In other words, neither digitalization or its subparts, welfare technology and E-services, had any impact whatsoever on cost-efficiency and quality of care. That the results suggest that digitalization on a grand scale does not live up to its promises regarding elderly care should lead public agencies, municipalities, and such to reevaluate its strategies regarding digitalization and maybe instead focus on more specific projects.

9.1 Implications for future research

This thesis opens up many questions, which need further research to draw conclusions on. Questions such as why digitalization does not live up to its promises and what mechanisms are needed to make digital technology beneficial in elderly care? A more in-depth analysis of how organizational aspects could impact how well the use of digital technologies affects cost-efficiency and quality would certainly be valuable to understand the subject of this study better. The value of understanding how organizational differences affect the relationships of this study is especially the case since the trust delegation (Tillitsdelegationen) was created in 2016 to create an alternative to the supposed flaws of new public management.

Furthermore, some of the uncertainties mentioned in *8. Analysis* also makes further research warranted. For example, the fact that older people are generally less digitally literate could mean that the efficiency and quality gains that digitalization has not resulted in are only so because of a lack of knowledge of the technology. Studying this further would give a more detailed explanation of the research questions.

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Appendix

Table 10 - List of Municipalities in my sample after deleting the municipalities in Socialstyrelsen´s original sample that did not meet the 10% criterion.

Ale	Falköping	Härryda	Laholm	Olofström	Svedala	Vansbro
Alvesta	Filipstad	Hässleholm	Lekeberg	Osby	Svenljunga	Vara
Arboga	Flen	Högsby	Leksand	Oskarshamn	Säter	Vetlanda
Arjeplog	Forshaga	Jokkmokk	Lidköping	Perstorp	Sävsjö	Vilhelmina
Arvika	Färgelanda	Jönköping	Lindesberg	Piteå	Söderhamn	Vimmerby
Bengtsfors	Gislaved	Kalix	Ljungby	Ronneby	Sölvesborg	Vänersborg
Bjurholm	Gnosjö	Kalmar	Luleå	Rättvik	Tanum	Värnamo
Bjuv	Grästorp	Karlsborg	Lycksele	Sala	Tibro	Västervik
Bollebygd	Gullspång	Karlshamn	Lysekil	Sandviken	Tidaholm	Ydre
Bollnäs	Göteborg	Karlskoga	Malung-Sälen	Sjöbo	Tingsryd	Ystad
Borlänge	Götene	Karlskrona	Mariestad	Skara	Tjörn	Älmhult
Borås	Habo	Katrineholm	Markaryd	Skellefteå	Torsby	Älvdalen
Bromölla	Hagfors	Kiruna	Mellerud	Skurup	Torsås	Åmål
Burlöv	Hallsberg	Klippan	Motala	Skövde	Tranemo	Ånge
Dals-Ed	Hammarö	Kramfors	Mullsjö	Sorsele	Trollhättan	Åre
Degerfors	Heby	Kristinehamn	Munkfors	Sotenäs	Töreboda	Åsele
Eksjö	Hedemora	Krokom	Mönsterås	Stenungsund	Uddevalla	Ödeshög
Eskilstuna	Hjo	Kumla	Mörbylånga	Strängnäs	Ulricehamn	Örnsköldsvik
Essunga	Hudiksvall	Kungsör	Nybro	Strömsund	Uppvidinge	Överkalix
Fagersta	Hällefors	Kävlinge	Nässjö	Svalöv	Vaggeryd	Övertorneå

Note: The reason that the number of municipalities is higher than in the regression tables is because some of the municipalities did not answer all of the questions in Socialstyrelsen´s questionnaire that I am applying to this study, and thus became missing values.

Table 11 - Assumption (significant change from 2016 to 2020)

Variables	Is there any variation in time regarding the dependent variables and control variables
Digitalization index Research question 1	23,344*** (1,755)
Digitalization index Research question 2	23,623*** (1,92)
Welfare technology index Research question 1	25,737*** (2,39)
Welfare technology index Research question 2	27,12*** (2,628)

E-service index Research question 1	16,675*** (1,779)
E-service index Research question 2	15,554*** (2,698)
Violent crime rate	-93,979*** (31.256)
Population above 80	0,263** (0,129)
Median income	14,574*** (1,131)
Share that is foreign born	0,967* (0,561)

Significance level: p<0,01 = ***, p<0,05 = **, p<0,1 = *
standard error in parentheses
Note: The numbers that are not in parentheses show the change in average score between 2016 and 2020. The reason the same indexes have different scores during research question 1 and 2 is because of different weighting being applied. The numbers in the table illustrate that there was a significant change in the average score from 2016 to 2020, and that the assumption was thus fulfilled. The data behind the regressions is accessible by requesting it from the author.

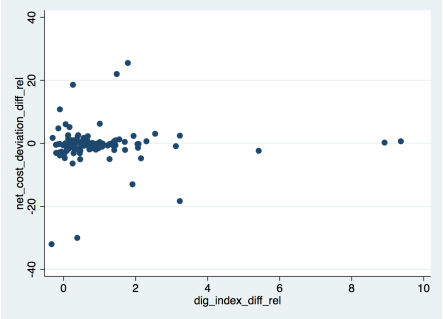
Table 12 - Assumption (Is there any variation between the municipalities in the dependent variables regarding how much they changed between the two time-periods?)

Variables	10th percentiles difference	90th percentiles difference
Digitalization index Research question 1 Relative method	0,003	2
Digitalization index Research question 1 Absolute method	0,12	48,277
Digitalization index Research question 2 Relative method	0,044	2,095
Digitalization index Research question 2 Absolute method	1,793	48,255
Welfare technology index Research question 1 Relative method	−0,041	1,964
Welfare technology index Research question 1 Absolute method	−0,917	64,347
Welfare technology index Research question 2 Relative method	0,24	2,78
Welfare technology index Research question 2 Absolute method	0,799	63,563
E-service index Research question 1 Relative method	−0,4	2,333
E-service index Research question 1 Absolute method	−16,667	58,333
E-service index Research question 2 Relative method	−0,261	2,333
E-service index Research question 2 Absolute method	−16,667	50
Violent crime rate Relative method	−0,374	0,181

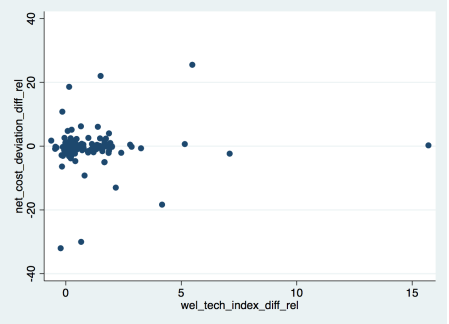
Violent crime rate Absolute method	−401,026	279,27
Population above 80 Relative method	−0,019	0,124
Population above 80 Absolute method	−0,106	0,691
Median income Relative method	0,06	0,088
Median income Absolute method	11,65	16,55
Share that is foreign born Relative method	−0,005	0,174
Share that is foreign born Absolute method	−0,047	2,378

Note: The reason the same indexes have different scores during research question 1 and 2 is because of different weighting being applied. The numbers above illustrate the score of the municipality located in the 10th and 90th percentile in each variable. As can be seen, there is a change between these scores in every variable and the assumption of variation between municipalities is thus fulfilled. The data behind the regressions is accessible by requesting it from the author.

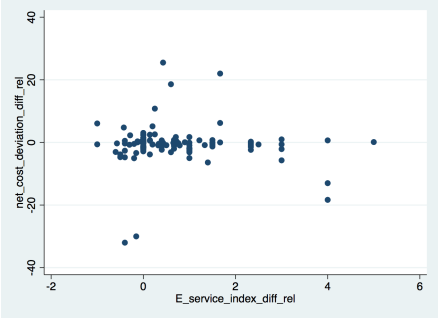
Graph 1



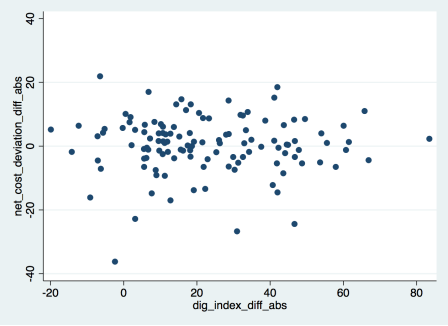
Graph 2



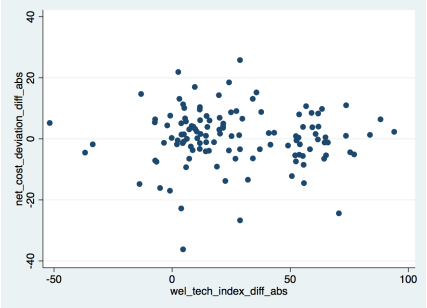
Graph 3



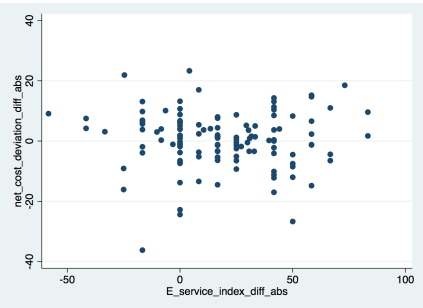
Graph 4



Graph 5

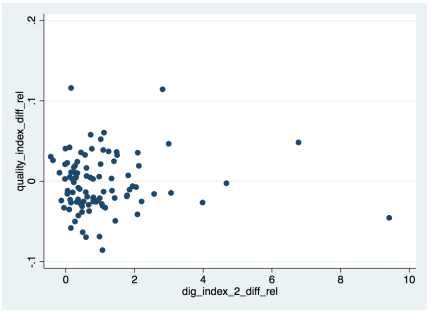


Graph 6

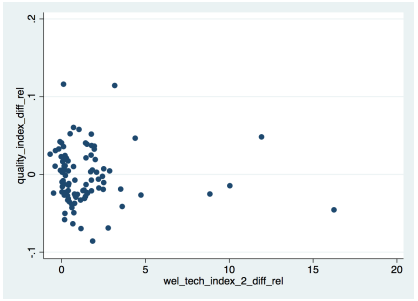


Graph 7

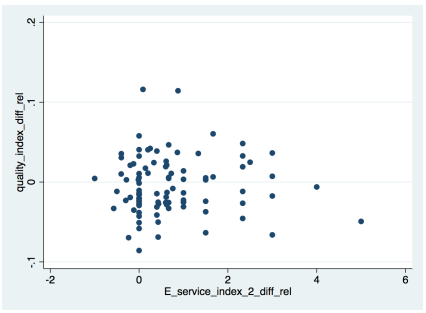
Graph 8



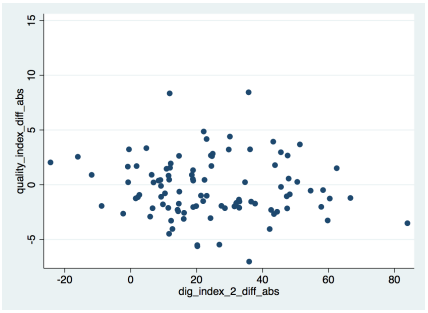
Graph 9



Graph 10



Graph 11



Graph 12