Digitalisation of Public Sectors in Europe

An Outlook on eGovernment Progress and Welfare Regime Types

Master Thesis

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Abstract

Digitalisation of public sectors is high on the agenda of the European Union and among the targets towards a Digital Single Market. Despite the uniform goal, member states have differing government structures influencing the digitalisation of their public sectors. In a new approach, this thesis uses welfare regime typology to consider how eGovernment progress is related to such government structures of European welfare states. By using multiple linear regression analysis upon ten case studies, negative tendencies for Liberal and Conservative welfare states are found along with positive effects of external digitalisation and stratification, as well as negative effects of residualism towards the state.

Contents

Figures and Tables

Abbreviations

ANOVA	Analysis of Variance	G2G	Government to Government
BG	Bulgaria	GDP	Gross Domestic Product
CLT	Central Limit Theorem	H	Hypothesis
D	De-commodification	ICT	Information and Communication Technology
DK	Denmark	IE	Ireland
DESI	Digital Economy and Society Index	IT	Italy
DSM	Digital Single Market	MS	Member State
eGov	eGovernment Progress	MLRA	Multiple Linear Regression Analysis
EE	Estonia	PRISMA	Preferred Reporting Items for Systematic Previews and Meta-Analyses
E	external digitalisation	PA	Public Administration
EC	European Commission	R	Residualism
EU	European Union	SER	Standard Error
FR	France	S	Stratification
DE	Germany	SE	Sweden
G2B	Government to Business	t Stat	t Statistic
G2C	Government to Citizens	Brexit	Withdrawal of the United Kingdom from the European Union
G2E	Government to Employees	UK	United Kingdom

1. Introduction

Information and communication technology (ICT) is digitalising societies and economies at a fast pace. In the public sector, the use if ICT is often referred to as electronic government or eGovernment. eGovernment affects the way governments and citizens communicate with each other and has potential to increase the efficiency, effectiveness, transparency and accountability of government operations. Despite such promising merits, public sectors often adopt rather slowly towards digitalisation.

The European Union (EU) recognises this potential and the different progress towards eGovernment of its member states (MS). With initiatives towards a Digital Single Market (DSM), such as the *European eGovernment Action Plan 2016-2020* or the *Tallinn Declaration*, the EU aims to offer individuals and businesses the best possible access and use of eGovernment.

The *eGovernment Action Plan 2016-2020* for instance, is an EU initiative that recognises the potential of eGovernment to improve the efficiency and inclusiveness of government services towards borderless, personalised and user-friendly end-to-end digital public services for citizens and businesses. It emphasises innovative digital methods to design ICT services in line with the needs and demands of citizens, businesses, and public administrations (PA) (2016-2020, 2016; Tallinn Declaration on eGovernment, 2017).

In 2017 all EU MS and countries in the European free trade area reaffirmed their commitment to such eGovernment progress and signed the *Tallinn Declaration*. The *Tallinn Declaration* marks the political commitment of the EU to ensure high quality and user centric digital public services. In line with the *eGovernment Action Plan 2016-2020*, the *Tallinn Declaration* is a significant impetus for EU MS and the European Commission (EC) to accelerate the modernisation of public sectors in Europe towards a DSM.

Despite the context of EU initiatives and potential merits, the progress of eGovernment across EU MS differs significantly, with front runners such as Denmark (DK) or Estonia (EE), and laggards such as Germany (DE) or Bulgaria (BG) (Capgemini, IDC, Sogeti, and Politecnico di Milano, 2018, pp. 10–12). The reasons for such disparities in eGovernment progress have often been examined and range from mainstream explanations of differing political systems or population size, towards cultural explanations or legal systems (Stier, 2015). Current research focuses for instance on differences of democracies and autocracies in adapting eGovernment (Trondal & Bauer, 2017). Precise causal mechanisms behind eGovernment progress however, remain opaque and mostly focus on mainstream

explanations like democracy indicators or demography. Often overlooked in this debate are different government structures and their connection towards eGovernment progress (Capgemini, IDC, Sogeti, and Politecnico di Milano, 2018). Previous research suggests thereby the examination and operationalisation of different state structures with relevance for eGovernment (Stier, 2015, pp. 276–277).

One system to describe different government structures is the welfare regime typology which clusters states according to their social policies. While some MS have extensive and intrusive social policies with accompanying complex government structures, others have little, discreet social policies with rather minor government structures. In the academic realm of studies looking for eGovernment determinants, previous research mainly considers user characteristics, eGovernment design, or eGovernment services, whereas comparative political and welfare state research mainly considers how ICTs transform welfare states and how government capacities determine variation in eGovernment (deVries, Bekers, & Tumers, 2016; Henman & Dean, 2011; Kalvet, Toots, van Veenstra, 2018; Stier, 2015). In a new approach this thesis directly engages both strands of scholarship of eGovernment determinants and comparative welfare state research to bridge the gap between studies of eGovernment and comparative politics (Stier, 2015, p. 274). By using the welfare regime typology, patterns, trends and associations between welfare state structures of EU welfare states and eGovernment progress are examined. It is postulated that social policies of welfare states are connected towards administrative capacities, which in turn are determinants for eGovernment progress. The arguments raised in line with this explanation provide more nuanced accounts behind the state capacity approach for eGovernment determinants. In that way the thesis has relevance for two strands of academia, studies of eGovernment determinants, especially the ones utilising the capacity approach, as well as comparative welfare state research (Henman & Dean, 2011; Stier, 2015; van Kersbergen & Vis, 2013).

Besides the academic relevance of applying the welfare regime typology to eGovernment determinants, the research has an important practical relevance due to the promising benefits of eGovernment. Offering new explanations of drivers for eGovernment is an important element to advance the digital transformation of governments and progress towards the DSM. This relevance is reflected in EU 2020 goals, which include an expansion of eGovernment and the creation of a DSM as one of the ten central priorities of the EC (Tallinn Declaration on eGovernment, 2017). As a part of the DSM, eGovernment has an important precondition to promoting welfare and economic cohesion across the EU. For instance, potential cost savings for electronic tax invoices through eGovernment could exceed annual savings in the EU above €50 billion (Unit H.4, 2018). The next section introduces

the research questions which guide the examination of welfare state types as eGovernment determinants.

1.1. Research Questions

This section introduces the underlying research questions for the thesis. For an examination of how welfare regime structures of EU MS affect eGovernment progress, the following questions guide the study:

1. *What are the patterns of welfare regime types and eGovernment progress across public sectors in EU MS?*
2. *What are possible effects of welfare regime types as determinants for eGovernment progress?*

The first question is about identifying possible patterns between welfare regime types and progress in eGovernment, while the second question asks further about possible effects of welfare regime types towards the adaption of eGovernment. The quantitative research design of this thesis is developed to deliver descriptive evidence for both questions, which contributes to the comparative welfare state and eGovernment literature in the area of public administration. The answers for the second research question of possible effects between welfare regime types and eGovernment progress are raised with four guiding hypotheses. Evaluating possible effects with the help of four hypotheses increases the ability to construct and verify explanations about the patterns identified with the first research question (King, Keohane, Verba, & Keohane, 1994, p. 15).

Answering the research question in a purely descriptive manner disregards the relevance of the research outside the academic literature, because a discussion of patterns alone is of little practical relevance (King et al., 1994, p. 15). Accordingly, the thesis finds answers for possible effects of welfare regime types upon eGovernment progress through the second research question. The effects and their evaluations are useful to anticipate future developments of welfare states and the digitalisation of public sectors. Since eGovernment is closely intertwined with the operating aspects of welfare states to deliver social services, eGovernment has the potential to increase the performance of governments and their services. States with lower levels of digitalisation in their public sector might learn from other states with similar contexts (welfare regimes), but better functioning public sectors through eGovernment. The comparison and examination of effects of welfare regime types of MS and their eGovernment progress therefore contributes to more predictive answers for improvements of public welfare services (Shadish, Clark, & Steiner, 2008, pp. 7–11). Raising tentative answers about effects gives important insights towards effective strategies for the development of the EU DSM and the

harnessing of eGovernment. Thus, the answers for the second research question are directed towards a theory building approach and are raised cautionary due to the quantitative design of the thesis.

The first research question about patterns raises unambiguous descriptive answers based upon four hypotheses. An evaluation of these answers follows by the second research question about possible effects of welfare regimes upon eGovernment progress and theoretical explanations. The next section offers the thesis outline before the subsequent chapters approach both research questions with guiding hypotheses and theoretical explanations.

1.2. Thesis Outline

With the objective to address the questions of whether and how welfare regime structures affect eGovernment progress, the thesis is organised as follows. The next Chapter *2. Theoretical Framework* introduces the key theories for the thesis and is divided into five sections. Section *2.1 eGovernment* defines the term eGovernment and its use for the thesis. Section *2.2. Welfare Regime Theory* outlines three welfare regime phenomena and five welfare regime types. Section *2.3. PRISMA Literature Review* stablishes the scholarly base for the intersection between the scholarship of eGovernment determinants and comparative welfare state research. This intersection of literature is used in section *2.4. Working Mechanisms* to create the model for the analysis. Section *2.5. Hypotheses* derives four hypotheses to answer the research questions. Chapter *3. Methodology* includes three sections which establish the methodology and methods of the thesis. Section *3.1. Case Selection* uses the welfare regime theory to select ten MS as cases for the analysis. Section *3.2. Multiple Linear Regression* presents the regression method, before section *3.3. Operationalisation and Data* discusses the selection and handling of data. The following chapter *4. Analysis* is divided into seven sections. The first section *4.1. Ten Welfare States* begins with a pooled analysis with fixed effects for the ten selected welfare states. The subsequent sections *4.2. Liberal Welfare States*, *4.3. Conservative Welfare States*, *4.4. Social Democratic Welfare States*, *4.5. Mediterranean Welfare States* and *4.6. Post Socialist Welfare States*, deal with the analyses of the five welfare regime types and their interaction effects. Section *4.7 Summary* takes the results of all the analyses into account. The thesis ends with chapter *5. Conclusion* which reflects upon the results of the analysis in three sections *5.1. Implications*, *5.2. Limitations* and *5.3. Future Research*.

2. Theoretical Framework

This chapter defines the concept of eGovernment, the welfare regime theory, the working mechanisms between them and locates the work in the academic literature. The chapter begins with a brief explanation of the definition procedure, which is followed by section *2.1. eGovernment* to define the conceptual use of the term. Similarly, section *2.2. Welfare Regime Theory* explains welfare regime theory, phenomena and types. These first two descriptive sections build upon mainstream literature in the respective academic fields, which is expanded in section *2.3. PRISMA Literature Review*. In this section the PRISMA method is used to identify literature that engages with both academic branches of eGovernment determinants and comparative welfare state research, in order to identify the research gap of interest and literature that demarcates this research gap. This literature is used in section *2.4. Hypotheses* which defines four hypotheses to examine and raise answers for the research questions. The chapter ends with section *2.5. Working Mechanisms* to establish the model for analysis.

The thesis distinguishes the concept of eGovernment and the welfare regime theory for an empirical use according to four elements. First, the *term* as a linguistic label. Second, the *attributes* that define the term with a definition, intension, connotation and properties. Third, the *phenomena* that define the term with the definition of referents, extension and denotation. Fourth, the *indicators* for a location of the concept and theory in the empirical space with operationalisations and measurements (Gerring, 2012, p. 414). This chapter covers the first three elements (term, attributes and phenomena) for the concept of eGovernment and the foundations of welfare regime theory, before the fourth elements (indicators) are outlined in section *3.3. Operationalisation and Data*.

2.1. eGovernment

This section outlines the term, attributes and phenomena of eGovernment, respectively for the use in this thesis. This is done pragmatically by trying to avoid further reaching distracting semantic discussions. The section begins by describing the prevalent ambivalence of terms in PA that deal with digitalisation in the public sector, before defining the chosen term eGovernment with its attributes and phenomena for the use in this thesis. The benefits of the chosen definition of eGovernment are then briefly outlined by considering other available definitions.

It is challenging to define a term that covers the digitalisation of the public sector accurately, due to a lack of standardised definitions, changes in ICT and academia that researches these changes. Different terms with differing understandings and definitions of digitalisation in the public sector are prevalent in PA (Grönlund & Horan, 2005; Prins, 2001, pp. 13–15, 2007, p. 6). Such terms include eGovernment, eGovernance, eGov, digital government or government 4.0 (Yildiz, 2007, pp. 648–649). Each of these terms has different definitions, specific viewpoints and focuses. Whilst all terms deal in some sense with the digitalisation of the public sector, some terms focus on transparency whilst others emphasise participation or cost effectiveness of ICT in the public sector (Yildiz, 2007, pp. 662–664).

This thesis uses the term eGovernment and adapts a rather minimal and prevalent definition in academia of eGovernment as,

"[…] a generic term for web-based services from agencies of local, state and federal government. In e-government, the government uses information technology, in particular, the internet to support government operations, engage the citizens and provide government services. The interaction may be in the form of obtaining information, filings, or making payments and a host of other activities via the World Wide Web." (Palvia, Jain, & Sharma, 2007, pp. 1–3)

The term eGovernment and this definition are adapted due to its brief, yet much encompassing attributes and phenomena. With respect to eGovernment attributes, the definition includes the broad use of "*information technology*". The definition also includes a wide range of eGovernment phenomena by referring to *"government operations"* (Backus, 2001; Carter & Bélanger, 2005, pp. 5–8). This allows for an inclusion of eGovernment activities according to four useful models with government operations between,

Government to Government (G2G), as digital interactions between government agencies;

Government to Citizens (G2C), as digital interactions between government and citizens;

Government to Business (G2B), as digital interactions between government and businesses and other non-governmental organisations;

as well as, Government to Employees (G2E), as digital interactions between government and government officials, such as salary payments (Jeong & Hai, 2007).

These operations contain processes and communication at all levels of government, such as communal, national or international levels.

Explaining why other definitions are omitted helps for an understanding why the adopted definition is useful for the scope of this research. For instance, one general non-academic definition of eGovernment is found at the World Bank, which defines the term as follows,

"E-Government refers to the use by government agencies of information technologies (such as Wide Area Networks, the Internet, and mobile computing) that have the ability to transform relations with citizens, businesses and other arms of government. These technologies can serve a variety of different ends: better service delivery of government services to citizens, improved interaction with businesses and industry, citizen empowerment though access to information, or more efficient government management. The resulting benefits can be less corruption, increased transparency, greater convenience, revenue growth, and/or cost reductions." (Panzardi, 2017)

While the term eGovernment has similar attributes, such as the *"use"* of *"information technology"*, it has widened focus upon phenomena such as *"corruption"*, *"transparency"*, *"convenience"*, *"revenues"* and *"cost"*; phenomena which are not directly relevant for the scope of this thesis. Similarly, many definitions of eGovernment are often normative and include other phenomena for the purpose of examining welfare regime type with eGovernment progress (EU eGovernment Action Plan 2016-2020, 2016).

Having outlined a definition of the term eGovernment with attributes and phenomena, the chosen *term* eGovernment is confined. Many different terms are often used mixed up or synonymously in discourses about eGovernment. For instance, this thesis analyses eGovernment and not eGovernance because, although often confused, the terms have different meanings with differing attributes and phenomena. On a basic level, eGovernment concentrates on the attributes of ICT operations with phenomena in the public sector. Whilst eGovernance focuses on similar attributes, the use of ICT in (public) organisations, eGovernance also emphasises different phenomena to achieve some sort of better type of governance (Lemke, 2018, p. 22; Palvia et al., 2007). eGovernance is a wider concept than eGovernment because it often includes the ways citizens and governments relate to each other with a focus on phenomena like participation, engagement or the governance of ICT through regulations or opinion shaping processes (Palvia et al., 2007). eGovernance shifts the focus from ICT as objects, towards ICT as instruments and facilitators for social changes and transformations (Martin Plendl, 2000). With the focus upon the progress of ICT use in the public sector, eGovernment is therefore the more precise term for this thesis.

Similarly, the terms digital government and digital governance are also frequently used in discussions of digitalisation in the public sector. For an understanding in this thesis these terms are understood synonymously with eGovernment and eGovernance respectively. This pragmatic approach is used to avoid demarcations which would move into deeper distracting semantics for the scope of this thesis.

In a nutshell, eGovernment is the most compelling term and concept for this thesis. The term eGovernment includes the use of ICT in government as an attribute and includes the phenomena of G2G, G2C, G2B, and G2E. The chosen definition of eGovernment is later complemented with an operationalisation towards an indicator in chapter *3.3. Operationalisation and Data*. The next section explains the usage of the welfare regime typology.

2.2. Welfare Regime Theory

This section outlines key terms, attributes and phenomena of the welfare regime typology as the theoretical focus for this thesis. The section starts with an overview of welfare regime theory and its four working logics, before proceeding towards the key phenomena of *de-commodification*, *stratification* and *residualism*. These three phenomena are then used to define the five welfare regime types, *Liberal, Conservative, Social Democratic, Mediterranean* and *Post-Socialist*.

The welfare regime typology is a theoretical framework which is used to categorise states according to their social policies, which guard and reassure the economic and social security of their citizens. The theoretical focus of the welfare regime typology helps to reduce the complexity of states to create a common denominator for categorisations and comparisons. The terms welfare regime, welfare regime typology, welfare regime category and welfare state are prevalent in academia and often used interchangeably (Castles, Leibfried, & Lewis, 2010, pp. 13–15). This thesis refers to welfare regime when discussing welfare regime theory, to welfare regime typology or category, when discussing welfare regime types and to welfare state, when referring to manifestations of welfare regime types on specific states.

Welfare regimes are closely connected towards the system of capitalism, both are part of the same coin. Welfare states try to correct market imperfections of the capitalist system by providing social protection and distributional justice (Scharpf & Schmidt, 2000b, pp. 18–24). Welfare regime theory makes distinctions between different types of welfare regimes and their approach to market imperfections. The original welfare regime typology is based on the works of Gøsta Esping-Andersen, who introduced the categorisation of states into *Liberal*, *Conservative* or *Social Democratic* welfare regime types (Esping-Andersen, 1999). Each of these welfare regime types has a distinct organisation of social policies, patterns of social inequality and stratifications of employment systems, as well as forms of social integration of exclusion. These patterns of welfare regimes are described as three

dimensions or phenomena of *de-commodification*, *stratification* and *residualism*. These three phenomena are key concepts for this thesis and will be further described later in this section.

The welfare regime categorisation enables an empirical classification of states to reduce their complexity towards meaningful comparative types with respect to their social policies, as is the purpose for this thesis. Similar to the pragmatic definition and use of eGovernment, the thesis uses mainstream literature of welfare regime theory and typologies to avoid deeper digging semantic discussions (Esping-Andersen, 2013; Hemerijck, 2013; Lessenich, 2016; van Kersbergen & Vis, 2013).

The welfare provisions of states include wider ranging definitions of welfare with a focus on services, such as education, health and social services, along with narrower definitions of welfare as family benefits or insurances for work, accidents, disabilities, pensions, sickness, maternity, or unemployment. Welfare states provide such welfare services and benefits for citizens through a social risk management by assigning different weights and emphasis upon the three major institutions that guarantee social security: the *state,* the *market* and the *family*. Together, the state, market and family constitute main components of different welfare regime types. These welfare regime types have patterns in their institutional apparatuses which put different weights upon the state, the market, and the family, to provide welfare (Barr, 2005; Esping-Andersen, 1999, pp. 72–77; Jenkin, 1951). For an understanding of welfare regimes and their typologies, it is helpful to look upon the reasons and history of welfare states. The existence of the welfare state can be attributed to four logics, or raisons d'être. First, for *socio-economic development and modernisation*; second, *political integration and state building*; third, *need satisfaction and risk reappointing*; and fourth, *class compromises and redistribution* (Zutavern & Kohli, 2010, p. 169).

The first logic, *socio-economic development and modernisation*, reasons that the welfare state is an outcome of a causal chain of modernisation. The industrial revolution in the late 18th century for instance, led to changing working conditions for individuals and social disintegration with an accompanying high market dependence and loss of income security. This high market dependence for welfare became problematic when market failure led to disorder and disintegration, to a magnitude where a need for state intervention for welfare provisions became necessary. Industrial workers were not able to sell their labour as a commodity for income when the forces of supply and demand failed. This created a necessity for a welfare state to de-commodify labour, to lessen the requirement of individuals to sell their workforce on the labour market for their own survival (Hemerijck, 2013, pp. 42–44).

The second logic, *political integration and state -building*, dates to the late 19th century when the first actual modern welfare state was used as a conservative state-building tool by the Prussian Chancellor Otto von Bismarck. Bismarck granted social rights for citizens to enhance the integration of Prussian society and forge a bond between workers and the state with the goal to strengthen the latter. These welfare provisions inter alia included pensions for elderly people, health insurance, or accident insurance. The goal of these social policies and the welfare state was not necessarily the welfare of the citizens, but to maintain traditional hierarchical relations of Prussian state authority against rising ideologies of liberalism and socialism. The welfare provisions and social policies were created to discourage social unrest and welfare was used as an instrument for statecraft to stabilise internal order, create legitimacy of the Prussian state and foster loyalty to the state versus challenging ideologies (Zutavern & Kohli, 2010, pp. 33–39).

The third logic *need satisfaction and risk reappointing*, reasons that the private market is unable to provide insurance against risks threatening the welfare provision. According to the invisible hand theorem of the market, markets should perform well without market failures if perfect competition reigns in "complete" markets (Barr, 2005, pp. 72–75). This would mean an equilibrium, where goods and services cost as much as people are prepared to pay. In reality however, market operations often bear the risk of malfunctioning due to market failures caused by information asymmetries. The results of such market failures are unemployment or poverty. Need satisfaction and risk reappointing argues that insurance against these risks cannot be offered by the private market because of an adverse selection of private insurers. Private insurers objective is to be profitable in and with this intention they offer inadequate coverage, benefits and contributions. Consequently, the welfare state must create mandatory insurance schemes without a focus on profitability to reappoint risks. Critics of this logic often argue this creates a moral hazard, which makes people less risk averse and reliant on public welfare benefits. But unemployment insurance is perhaps the clearest illustration to exemplify the need satisfaction and risk reappointing rationale. In periods of economic decline, such as the 2007-2008 financial crisis, the risk of unemployment created systematic externalities which were hard to estimate and calculate. Thereby an insurance company could not have offered unemployment insurance at such times because the contributions of unemployment schemes would have become too high (van Kersbergen & Vis, 2013, p. 44; Wolf, 1979, pp. 110–114).

The final logic, *class compromises and redistribution*, reasons the welfare state is required to equalise uneven social risks among social classes and positions. Different from the functionalist first logic of socio-economic development and modernisation, the rationale of class compromises and redistribution includes the push and pull forces of political actors. The logic assumes that class

differences in power and risks are a source of distributional struggles where lower classes lack resources to deal with social risks. Historically, this led to social movements when parties struggled for social protection and redistribution. The idea is that the better the lower classes are organised in labour movements, the more push and pull forces they can exert upon political actors and thereby the more extensive is the welfare state (Korpi, 2006). This builds upon ideas of Karl Marx, that the proletariat working population needs to become a class and act in its interest to create welfare policies.

These four logics help to understand the welfare state and to build towards theories for possible causal mechanisms linking functional demands for welfare states and their relationship to eGovernment. Before looking into these more specific working mechanisms between eGovernment progress and welfare regime types, the intellectual roots of the welfare regime typology are considered to arrive at the central phenomena of welfare regimes.

Although the four logics for the welfare state can be dated back to the 18th century, the intellectual roots and ideas of the welfare regime approach date back until the 1950s, when Wilensky and Lebeaux introduced the idea of residual welfare institutions as the normal first line function of welfare services, when the state, market and family fail to provide welfare (Blau, Wilensky, & Lebeaux, 1958, p. 138). In the 1970s followed Titmuss with his influential work upon three welfare models. The models include a residual type, with interference only in serious market and family failure, an industrial-achievement-performance model, where a person's welfare entitlements are dependent upon performance on the labour market, and an institutional redistributive variety, with encompassing and egalitarian features (Abel-Smith & Titmuss, 1974). Ideas of these concepts have been further used by Esping-Andersen in the 1990s, who first introduced the typology of welfare regimes. Esping-Andersen identified three welfare regime models with specific patterns, the *Liberal*, *Conservative* and *Social Democratic* welfare regimes, and thereby created a fundamental heuristic tool for comparative welfare state research; which also serves as a foundation for this study (Esping-Andersen, 2013; van Kersbergen & Vis, 2013, p. 53). Esping-Andersen identified the three sources of welfare, the state, the market, and the family. Furthermore, Esping-Andersen laid the base for three important phenomena to classify welfare states, *de-commodification*, *stratification*, and *residualism*. The following paragraphs describe these three phenomena before applying them to the three categories of Liberal, Conservative, and Social Democratic welfare regimes.

de-commodification refers to the extent to which an individual can uphold a decent standard of living independent from the labour market. Hence encompassing the relative independence of individual social security from risks and pressures from the market. The higher the level of de-commodification, the lower is the individual dependence to sell work as a commodity to ensure the

own survival. De-commodification comes therefore through social security separated from the market (Scruggs & Allan, 2006, pp. 60–63). The need to de-commodify labour in a capitalist market is closely intertwined the third logic of the welfare state, need satisfaction and risk reappointing.

stratification refers to social inequality with respect to social policies and their distinguishing between social classes through different social rights (Esping-Andersen, 1993). This involves the vertical and horizontal economic and social divisions of society in terms of income and social status. Social security systems and welfare benefits are therefore instruments which influence stratification since they effect redistribution and social inequalities. A high extent of stratification means that social policies distinguish between classes to maintain social differences within a welfare state (Esping-Andersen, 1999, p. 69). Whereas a low extent of stratification means that social policies are untargeted and rather universal. A universal basic income would for instance mean a very low extent of stratification (Esping-Andersen, 2013, pp. 67–70). Stratification is thus closely intertwined with the second and fourth logics of the welfare state (political integration and state -building and class compromises and redistribution).

The third phenomena, *residualism*, refers to the interplay between the three sources of welfare for the social security of individuals, the state, the market, and the family (Esping-Andersen, 1999, p. 85). Residualism describes the extent to which the state interferes in the mixed relationship between the private and public provision of welfare (Esping-Andersen, 2013, pp. 79–81). With respect to the third logic of the welfare state, need satisfaction and risk reappointing, residualism describes the emphasis of risk reappointing upon the state, the market, and the family.

Although not exclusively, these three phenomena of de-commodification, stratification and residualism allow definitions of welfare regimes such as the Liberal, Conservative and Social Democratic welfare regime typologies of Esping-Andersen (Esping-Andersen, 2013, p. 25). In context of this thesis the three phenomena are also used to create respective variables to answer the first research question about possible effects between welfare regime types and eGovernment progress. The following *Table 1: Welfare Regime Types and Dimensions*, depicts the three welfare typologies by Esping-Andersen and two supplementary welfare regime types, the *Mediterranean* and *Post-Socialist* welfare regimes. The following paragraphs after the table explain the five welfare regime types with their attributes and the three welfare regime phenomena, beginning with the Liberal, Conservative, and Social Democratic welfare regimes of Esping Andersen.

Table 1: Welfare Regime Types and Phenomena (Own depiction, based on: Schmid, 2010)

	Liberal welfare regime	*Conservative* welfare regime	*Social Democratic* welfare regime	*Mediterranean* welfare regime (Family Resemblance to Conservative)	*Post-Socialist* welfare regime
de-commodification	Low	Moderate	High	Moderate	No fit
stratification	High	Moderate	Low	Moderate	
residualism (State, Market, and Family)	Market	Family	State	Family	

The *Liberal*, or Anglo-Saxon, welfare regime has little social policies and welfare assistance is mostly for individuals that are most in need. With little state interference the welfare production of the market is emphasised and social protection is left largely to private insurance providers and the family (Hemerijck, 2013, pp. 156–157). The general de-commodification in the Liberal welfare regime is therefore weak with little social entitlements. The stratification of social entitlements is high, because social provisions are means tested and are served on a case-by-case basis for the very poor rather than being commonly applicable. Instead of general welfare provisions, income redistribution is ought to happen on moral grounds and voluntarily. The residualism of the Liberal welfare regime puts therefore an emphasis on the market as an important source for welfare provision (van Kersbergen & Vis, 2013, pp. 63–66). The precedent European example of a Liberal welfare state is the United Kingdom (UK).

The *Conservative*, or continental, welfare regime is based on strong social policies which underline the status maintenance of individuals. Despite strong social policies, the degrees of de-commodification and stratification are just moderate. This is because in the Conservative welfare regimes, wealthy individuals receive higher welfare entitlements than poorer individuals (Hemerijck, 2013, pp. 157–159). This medium level of de-commodification with a benefit coverage bound to income levels, is also referred to as Bismarckian. Under the Bismarckian benefit coverage, poor individuals cannot merely rely on their low welfare benefits and have a dependence on the labour market to uphold a decent standard of living. The medium level of stratification is similarly explained. Whereas the poor receive a general minimum welfare assistance, the wealthy often receive higher welfare assistance, which is adjusted to their income. On the one hand, this contributes to the maintenance of class differences, while reducing social inequalities by assisting the poor on the other hand. With respect to residualism, the Conservative welfare regime puts strong emphasis upon the family as a subsidiary source of welfare. This is particularly due to a prominence of the male-

breadwinner model, with only one family member who provides income and welfare benefits like health insurance, while the non-earner takes care of the children and the elderly. In addition to the family, traditional non-governmental organisations, such as the church or charitable organisations, play important roles to offer welfare provisions (van Kersbergen & Vis, 2013, p. 66). A precedent European example of the Conservative welfare regime is Germany (DE).

The third type of Esping-Andersen's framework is the *Social Democratic*, or Scandinavian, welfare regime. The Social Democratic welfare regime is coined by universal social policies with a strong de-commodification aiming towards equality and full employment (Hemerijck, 2013, pp. 155–156). The goal of these social policies is to minimise individual dependence on the private sector and the family as sources of welfare. Due to the universalist social policies, the stratification of the Social Democratic welfare regime is low. With reference to residualism, an emphasis is on the state as a main source of welfare. In contrast to the conservative male-breadwinner model, the Social Democratic welfare regime supports a dual earner model and thereby lessens the importance of the family as a source of welfare (van Kersbergen & Vis, 2013, p. 66). A precedent European example of the Social Democratic welfare regime is Sweden (SE).

Meta analyses conclude that Esping-Andersen's three part welfare regime typology remains a useful and relevant tool for empirical research (Arts & Gelissen, 2010, pp. 580–582). Yet they add, further empirical advancements require firmer theoretical foundations of contemporary welfare state regimes (Ferragina & Seeleib-Kaiser, 2011, pp. 584–586; Powell & Barrientos, 2011, pp. 74–78; van der Veen & van der Brug, 2013, pp. 325–328). Much effort has been devoted in criticising, adjusting and developing the three welfare regime typology further. This led to two additional welfare regime types as developments towards more precise classifications in the EU, the *Mediterranean* and the *Post-Socialist* welfare regime types. These two additions to the traditional categorisations are less sophisticated and more contested among welfare state scholars. Yet they encompass, specific institutional traits or historical background apart from de-commodification, stratification and residualism, which makes their addition towards an examination of eGovernment determinants in connection towards the welfare regime typology useful.

The *Mediterranean*, or Southern-European, welfare regime was first perceived as a distinct welfare regime type in the early 1990s (Hemerijck, 2013, p. 159). The Mediterranean welfare regime has a family resemblance to the Conservative welfare regime, but with certain traits and institutional structures (Ferrera, 1996, pp. 20–22; L. Moreno, 2000). Welfare provisions in the Mediterranean welfare regime are often coined by an insider and outsider cleavage with individuals in the core and peripheral sectors and individuals in underground sectors. This bears mixed forms of de-

commodification and stratification. De-commodification exists to a moderate extent. For instance, public pension schemes cover limited sections of the working population, the core and parts of the peripheral sectors. Such public pension schemes are usually low and only generous for the core, former public servants and central industrial workers. Outsiders of these public pension schemes are not covered. Similarly, the stratification of the benefits coverage is also to a medium extent and mixed. Whereas healthcare is universal, pensions are bound to former income levels and resemble Bismarckian benefits. Likewise, the social safety net for basic benefits is rudimentary, not well developed and suffers occasionally from inadequate implementation and patronage, which sustain class differences (Lessenich & Ostner, 1998). Regarding residualism, the family is the primary source of welfare production. Especially the extended family is a significant source of care and welfare, which makes up for deficits in the social welfare system.(Trifiletti, 1999, pp. 58–60). Since social care is largely provided informally by women, Mediterranean welfare states suffer from a low level of female participation in the labour market (Karamessini, 2008, pp. 44–46). A precedent European example of the Mediterranean welfare state type is Italy (IT).

The fifth and final category is the *Post-Socialist*, or Central and Eastern European, welfare regime. The Post-Socialist welfare regime is for welfare states who share similar historical backgrounds and transitioned from socialism under the Soviet Union towards a market economy and joined the EU in 2004 and in 2007 (Fenger, 2007). The Post-Socialist welfare states have their origins in the collapse of the Soviet Union and can be described authoritarian, remodelled Social Democratic welfare states, due to their extensive social policies during the soviet time. Post-Socialist welfare states are institutional hybrids encompassing old characteristics of the Soviet Union and new characteristics of western European models (Adascalitei, 2012). Due to the radical changes of state-socialism towards privatisation, it is infeasible to capture the Post-Socialist welfare regime on a par with the previous four welfare regimes in a single group (Lipsmeyer, 2009). A precedent European example of the Post-Socialist welfare state is BG.

In summary, the primary sources of welfare are the state, the market, and the family. These three sources are influenced by welfare states, whose existence can be attributed to four logics, socio-economic development and modernisation, political integration and state building, need satisfaction and risk reappointing, and class compromises and redistribution. These four logics are intertwined with the three phenomena de-commodification, stratification and residualism, which in turn are used to deduct the five welfare regime types, Liberal, Conservative, Social Democratic, Mediterranean and Post-Socialist. These phenomena and concepts are crucial building blocks for the remaining parts of this thesis. As they will be used for the working mechanisms between eGovernment progress and

welfare regimes, as model variables, and for the case selection. Before doing so, the next section identifies relevant literature that engages the welfare regime typology with eGovernment.

2.3. PRISMA Literature Review

After the demarcation of the concept of eGovernment and the theoretical foundations of welfare regimes on the basis of the surface of mainstream literature in the previous sections, this section moves towards the connection between the two subjects. The *Preferred Reporting Items for Systematic Reviews and Meta-Analyses* (PRISMA) literature review is used as a method to identify more specific academic literature that engages in the connection of eGovernment and welfare regimes. The PRISMA method is used as a tool to have a minimum set of items to conduct a systematic literature review in order to identify, evaluate and synthesise the existing body of work which subjects eGovernment towards comparative welfare state research (Fink, 2005; Moher, Liberati, Tetzlaff, & Altman, 2009). The section begins with an explanation of the PRISMA method and then proceeds along the PRISMA steps by outlining the search terms, search engines, filter criteria and content criteria. The section ends by outlining the research gap based on the literature of the PRISMA review.

The focus of this thesis is on the relationship between eGovernment and welfare states, neither literature on eGovernment, nor literature on welfare states is the focus itself, but literature that engages in the intercept between eGovernment and welfare states. While both academic fields have ample literature and research themselves, the intersection between them is rather small and offers a research gap to fill (Stier, 2015, p. 272). The previous two sections used mainstream academic resources for eGovernment and welfare regimes, without offering a deeper digging discussion into the literature. For the narrower identification of literature which addresses the interaction of eGovernment and welfare states, the PRISMA method is used. This search process according to the PRISMA method is displayed in the following *Figure 1: PRISMA Flow Diagram* and explained in the subsequent paragraphs.

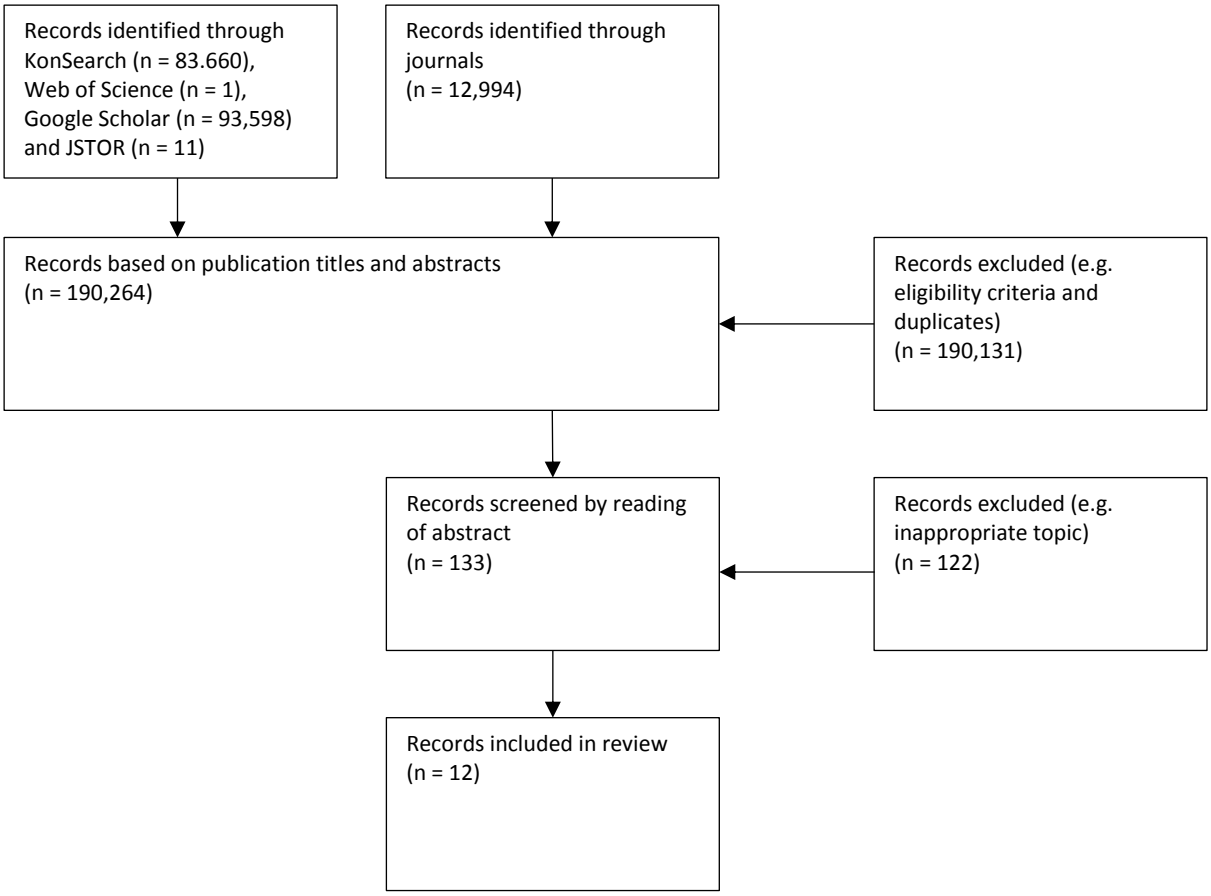

Figure 1: PRISMA Flow Diagram (Own depiction, based on: deVries et al., 2016, p. 150)

For the identification of relevant literature, the following criteria were chosen. Relevant literature must principally address a possible connection between eGovernment and welfare states, with respect to their attributes, phenomena or indicators from the previous sections. As shown, the concepts and their terms are not universally defined and are often referred to synonymously or differently. In order to avoid an exclusion of relevant literature, the following search terms were chosen to gain a further reach than the specified definitions in this research: “eGovernment”, “eGovernance”, “digital government”, “digital governance”, “welfare state”, and “welfare regime”. Each of the first four search terms towards eGovernment is was used in combination with the latter two search terms towards welfare states.

This combination of search terms was used on the following four search engines: *KonSearch*, the search engine of the University of Konstanz; *Web of Science*, the search engine of the University of Utrecht, *Google Scholar*, Google’s search engine for academic literature, and *JSTOR*, a digital library of academic journals. Whilst *KonSearch* and *Web of Science* were chosen for an accessibility of the sources found, *Google Scholar* was used to cast a wide net and look for articles as broadly as possible,

while *JSTOR* was selected for its good grasp on academic articles. By the same token, the following PA Journals *Public Administration Review*, *Journal of Public Administration Research And Theory*, *Public Management Review*, *Governance*, *Public Administration*, *The American Review of Public Administration*, *Administration & Society*, *International Review of Administrative Sciences*, *International Public Management Journal,* and *Local Government Studies,* were also used in the search to find relevant key literature with a high h5-Index among the top 20 PA Journals. The h5-Index served as a metric that measures the citation impact of publications based on the number of citations and used in this thesis as an aim to find literature with a significant influence in PA (Helder, 2012).

The search with these terms in the listed search engines created 190.264 results.[1] These results were approached and filtered according to the following criteria: The literature must be situated in the academic field of PA or comparative welfare state research; the literature has been published since 2010, the year since eGovernment is on the wider agenda of the EU with the first eGovernment Action Plan of the EU (European Commission, 2010); the literature is peer reviewed, as a quality criterion to warrant scientific authenticity; the literature is publicly, online or through the libraries of the *University of Konstanz* or the *Utrecht University* accessible; and the removing of duplicates. With the application of these criteria 133 articles remained.

These articles were screened by reading the abstract with the requirement that the concept of eGovernment and the theory of welfare regimes with respect to its attributes, phenomena or indicators are included. If these content criteria were met the article has a relevance for the research objective of this thesis to examine patterns and possible effects between eGovernment progress and welfare regime types of EU MS. These selection criteria resulted in twelve articles which serve along with their sources as academic anchors with relevance for this thesis (Ahn & Bretschneider, 2011; Buhr, 2017; Eichhorst & Rinne, 2017; Fishenden & Thompson, 2013; Henman & Dean, 2011; Krishnan, Teo, & Lim, 2012; Pedersen & Wilkinson, 2018; Ramani, 2018; Schou & Hjelholt, 2018; Stier, 2015; Trondal & Bauer, 2017; Williamson, 2014).

A lot of studies in the area of comparative welfare state research focus on classifications and definitions of welfare states, while studies in the realm of eGovernment largely address digitalisation with its risks and opportunities for modern welfare states. Such studies are usually preoccupied with potential opportunities of digitalisation for the productivity of welfare sates and risks for labour markets (Brynjolfsson & McAfee, 2014). With such debates, there is little research available with respect towards possible patterns and effects of eGovernment and welfare states. Existing bodies of

[1] Searches were conducted on the 21.03.2019.

literature breaches upon this topic with the subject of "Welfare 4.0" (Buhr, 2017, pp. 17–20). Welfare 4.0 however, examines the more general relationship of digitalisation as a broader phenomenon upon the role of welfare states. For example, welfare state research is often preoccupied with challenges caused by digitalisation, such as the need for society to adopt to changes in the labour market with special knowledge and skills of individuals to function in a digital environment (Buhr et al., 2017). This leaves space for the underlying question of this thesis, which specifies digitalisation towards eGovernment and rather than considering the effects of eGovernment upon welfare states, examines the relationship vice versa. Accordingly, this thesis about patterns and effects between eGovernment progress and welfare state types, engages in a novel field by combining strands of eGovernment and comparative welfare state research in a new manner (Ifinedo & Singh, 2011). In order to approach this research gap, the sources identified in the PRISMA literature review are used together with the outlined concept of eGovernment and theory of welfare regimes to derive four hypotheses as answers towards the research questions in the next section.

2.4. Hypotheses

This section uses the identified literature with the *PRISMA method* to deduce four hypotheses as attempts to answer the two research questions,

1. *What are the patterns of welfare regime types and eGovernment progress across public sectors in EU MS?*
2. *What are possible effects of welfare regime types as determinants for eGovernment progress?*

For a systematic examination of these questions the following four hypotheses are used to explain how welfare regime types and government capacity influence eGovernment progress:

Hypothesis 1: external digitalisation (E) is positively related to eGovernment progress (H1);

Hypothesis 2: de-commodification (D) is positively related to eGovernment progress (H2);

Hypothesis 3: stratification (S) is positively related to eGovernment progress (H3);

Hypothesis 4: residualism towards the state (R) is positively related to eGovernment progress (H4).

These four hypotheses allow an answer towards the research questions with respect to the concept of external digitalisation and the three phenomena of the welfare regime typology (Kellstedt & Whitten, 2018). Because of the gradual concepts, the hypotheses are probabilistic, meaning that external digitalisation, de-commodification, stratification and residualism influence the magnitude and likelihood of eGovernment progress (Holzinger & Schimmelfennig, 2012, p. 294). The underlying reasoning for the hypotheses is that welfare regimes with extensive social policies are more prone to

eGovernment progress due to their larger state capacity than welfare regimes with less intrusive social policies. The following paragraphs explain how the four hypotheses are derived.

H1 reasons that the more advanced *external digitalisation* is, the more advanced eGovernment will be. External digitalisation forces refer to changes in the environment that create new demands and settings for welfare states, such as economic pressures like automatization in the labour market and emerging social policy needs or infrastructure conditions (Arntz, Gregory, & Zierahn, 2016). On the one hand, these external digitalisation forces influence welfare states to foster new skills and abilities of individuals to operate in changing labour markets (Loukis, 2008). This includes questions about managing the digital divide between highly skilled and demanded individuals, versus lowly skilled and unutilized individuals. For instance, if a person becomes unemployed due to digitalisation processes and requires re-training or unemployment benefits by the welfare state afterwards, (digital) government operations related to this process are referred to as external digitalisation forces. External digitalisation forces therefore include the question of how welfare states should handle social inequalities caused by digitalisation (Ramani, 2018). These external digitalisation effects constitute the main body of comparative welfare state research that engages with eGovernment. Research along these lines describes a rather reactive adjustment of the welfare state towards the digitalisation of the private sector.

On the other hand, External Digitalization also includes broadband infrastructure provisions for internet access, such as high-speed broadband which creates potential productivity gains and stimulates economic growth in the private sector (Fourie & Bijl, 2018). Such internet access provisions also have potential spill over effects for the welfare state and eGovernment (Gawer, 2014). Like the reactive changes of the welfare state towards digitalisation in the labour market, the influence of internet access infrastructure factors upon eGovernment is discussed in previous literature and confirmed with a positive influence upon eGovernment progress. The discussion in the literature does not revolve so much as to whether external digitalisation forces affect eGovernment progress positively, but rather how much (Girish, Yates, & William, 2012).

Hence, H1 retests established findings of previous literature and is included to link the thesis within the academic debate, check the data itself, examine the impact of external digitalisation and offer a solid context for comparison of the other three variables. Negative, no associations or statistically insignificant results with respect to the first hypothesis would indicate problems with the proposed model or data. Statistically significant results for this hypothesis are likely and will offer a context for comparison for the remaining hypotheses.

These relationships described in H2-4 encompassed the new approach of this thesis, examining the concepts of welfare regime types with eGovernment progress, because *de-commodification, stratification* and *residualism* are largely determined by the welfare regime categories. The phenomena de-commodification, stratification and residualism are assumed to be tied to the state capacity which in turn influences the eGovernment progress. This idea uses previous explanations of state capacity as an eGovernment determinant and expands the idea with novel variables (Zhang, Xu, & Xiao, 2014, pp. 633–635). This contributes to more nuanced explanations for eGovernment determinants. Instead of defining regime types as democracies or aristocracies, the welfare regime typology links eGovernment less towards political determinants and more towards state structures coming from social policies (Bussell, 2011, pp. 269–271; Girish et al., 2012).

The causal arguments tying the three welfare regime *phenomena* of H2-4 to eGovernment progress are the *capacity approach* of eGovernment studies combined with the *path dependency* assumption based on welfare regime theory. Previous research examining eGovernment progress reasons that government capacity in the bureaucratic context is positively related to eGovernment progress (Stier, 2015, pp. 274–275). Research along these lines finds for instance, that population size stimulates eGovernment development because governments with economies of scale increasingly benefit from eGovernment services. Taken together with contradicting empirical results of other studies however, it is apparent that this theoretical understanding of determinants for eGovernment progress is yet limited and a comprehensive theoretical framework that might explain convergences in eGovernment progress is still missing (Stier, 2015).

The basic ideas of H2-4 contribute towards new theoretical approaches for eGovernment determinants (Eichhorst & Rinne, 2017). H2-4 assume that welfare regimes influence state capacities, which in turn influence eGovernment progress. In context to the phenomena and variables of welfare regimes, this assumption implicates that high degrees of de-commodification (H2), stratification (H3), and residualism towards the state (H4), affect eGovernment progress positively. It is assumed that high degrees of the three phenomena are likely to be linked to extensive social policies, which need large institutional apparatuses and are in turn related to larger state capacities.

H2 reasons therefore that more *de-commodification*, (more independence for individuals from the market for their own survival), requires more state capacity, which in turn, benefits from eGovernment more than a small state capacity under little de-commodification. A high degree of de-commodification entails that individuals have little reliance upon the labour market to uphold a decent standard of living. In order to ensure this, a welfare state needs an extensive PA apparatus which administers and offers the social services necessary for a de-commodification. For instance, if a person

becomes unemployed in a highly de-commodified welfare state, he or she is entitled to unemployment benefits. Such unemployment benefits require a state apparatus that inter alia records unemployment, receives and proceeds unemployment claims and distributes unemployment benefits. Such processes require capacities such as public employees, financial assets or infrastructures for service deliveries. Which ultimately offer more potential and for extensive digitalisation than smaller institutional apparatuses (Stier, 2015).

Similarly, H3 reasons, the more *stratified* social services are (the more means tested social services are), the bigger is the state apparatus which administers these selective social services, and thereby the more advanced eGovernment will be because stratification conscribes how social services are offered. A high degree of stratification entails selective social policies. This selection entails two options. Either stratification requires state capacity in PA to distribute social services according to complex selection criteria, or the selection criteria for stratification are designed for means tested social services to minimise state intervention. For the latter option residualism would entail a smaller state capacity. The argument for stratification effects towards eGovernment progress is therefore raised more tentatively.

The last H4 involves that *residualism* towards the state (the state, rather than the family or the market has a strong role to ensure individual welfare), requires a larger state capacity. This state capacity in turn benefits from eGovernment which should influence eGovernment progress positively. This hypothesis involves the mix between the state, the market, and the family to provide welfare for individuals. If residualism relies on the state as an important source of welfare, the provisions for such welfare services require a sophisticated institutional apparatus and thereby state capacity. On the contrary, if residualism emphasises the market or the family for provisions of welfare, there is less institutional capacity needed.

The arguments behind H2-4 build upon former research that established the capacity approach as an eGovernment determinant (Krishnan et al., 2012). The thesis adopts this argument which reasons that large state capacities benefit from eGovernment processes more than smaller institutional apparatuses from lower state capacities. According to this reasoning, welfare regimes with strong social policies and large institutional apparatuses have more incentives to adopt eGovernment. The importance of state capacity or administrative capacity for eGovernment is due to the continually evolving state of the art of ICT in digital government. With more sophisticated eGovernment programs, the improvements and maintenance of complex ICT systems is arguably tied to administrative capacities (Norris & Moon, 2005, pp. 66–69). Although eGovernment has the potential to increase the efficiency and effectiveness of government operations, the management of sophisticated

eGovernment requires skilled personnel and administrative resources (Henman & Dean, 2011). States with little social policies and weak state capacities would lack the resources to adapt complex eGovernment operations. In line with this thought of H2-4 and correspondingly to eGovernment services, which become increasingly sophisticated and complex, this relationship between eGovernment and state capacity is likely to grow in importance (Krishnan et al., 2012).

Although organizational obstacles for states with big capacities to adapt eGovernment should be most severe with the introduction of new ICT and their implementation into bureaucratic systems, once installed, ICT in the public sector might catch on and increase under a strong state capacity (Ramani, 2018). This is due to the possibility of a path dependence which could accelerate future eGovernment programmes where more effective and efficient eGovernment is mutually reinforced by a strong state capacity.

Welfare regime types thereby influence the architecture of institutional capabilities and in that way make up path dependent complementary packages through de-commodification, stratification and residualism, for arrangements and programmatic features of eGovernment. Accordingly, it is postulated with H2-4 that welfare regimes with intrusive social policies come along with more eGovernment progress, in contrast to welfare regimes with slight social policies which are accompanied by little eGovernment progress (Frey & Osborne, 2017, pp. 255–259).

With respect to the five welfare categories themselves, the arguments behind H2-4 expect heterogeneous effects for different welfare regimes towards eGovernment progress. The Social Democratic welfare regime is expected to have the strongest impact on eGovernment progress (high de-commodification, low stratification, residualism towards the state). Then, the Conservative and Mediterranean welfare regimes should follow (moderate de-commodification, moderate stratification, residualism towards the family). The Liberal welfare regimes should have the lowest eGovernment progress (low de-commodification, high stratification, residualism towards the market) and the Post-Socialist welfare regimes should be ranked idiosyncratically to their levels of the three phenomena.

H2-4 encompass the new approach of this thesis and will be compared to H1 for an evaluation towards the previously confirmed effect of external digitalisation (Krishnan et al., 2012). H1 is thus expected to offer the clearest and strongest results, whereas H2-4 are raised more cautionary to approach possible answers for the second research question. Accordingly, the open-ended null hypotheses expect therefore no, or negative patterns between external digitalisation, de-commodification, stratification and residualism towards the state, and eGovernment progress. The null hypotheses are also theory-based statements but indicate what to expect if the proposed

theoretical working mechanism for the hypotheses is incorrect. The null hypotheses indicate that Connectivity, de-commodification, stratification and residualism towards the state do not influence eGovernment progress, that the welfare regime phenomena are not connected towards state capacity, or even arguments along the line that small state capacities with small institutional apparatuses are beneficial for eGovernment progress (Kellstedt & Whitten, 2018, pp. 138–139). Such results hint towards a different theoretical working mechanism and suggestions for further research with different theoretical and methodological approaches (Gerring, 2007, pp. 17–35). For an examination of H1-4 the next section presents the model for examination.

2.5. Working Mechanisms

This section uses the concept of eGovernment and the welfare regime typology in connection with the identified sources from the PRISMA literature review and H1-4 as building blocks to construct the theoretical propositions and working mechanisms for the postulated model in this thesis (Goertz, 2012, p. 1). The section begins with a review of the four logics of the welfare state and digitalisation to build a connection between eGovernment and the welfare state. Then follows the framework model with the assumed working mechanisms based on H1-4, linking state capacity to welfare regime theory. The section ends by using the concept of internal digitalisation in combination with other model assumptions to outline the limitations of the proposed model.

With far-reaching impacts of digitalisation upon society, influences of digitalisation upon the welfare state and the public sector appear self-evident. For instance, the first logic of the welfare state, socio-economic development and modernisation, is directly linked to changes in the labour market caused by digitalisation. As two parts of the same coin, the welfare state reacts to changes in employment, such as job losses caused by automation and digitalisation, by offering systems of social protection. Far-reaching impacts upon society also influence welfare states which tackle specific problems, needs and difficulties such as changes in the labour market (Offe, 1972, pp. 480–483). By the same token, plausible connections between digitalisation and political integration and state-building, need satisfaction and risk reappointing, or class compromises and redistribution can be drawn (Hansen, Lundberg, & Syltevik, 2018, pp. 68–71). Arguments are raised that ICT technology and digitalisation diminish the significance of borders and creates transnational communities, which may well be connected to political integration and state building (Trondal & Bauer, 2017, pp. 75–80). Likewise, digitalisation influences market mechanisms with online platforms such as *eBay* or *Uber*, which are entangled to large scale job losses and the role of need satisfaction and risk reappointing of

the welfare state (Schou & Hjelholt, 2018). Finally, phenomena such as the digital divide, an uneven utilisation of ICT among different social groups, suggest that digitalisation also influences the class compromise and redistribution of the welfare state (Ahn & Bretschneider, 2011, pp. 415–417).

With credible connections between digitalisation and the four logics of the welfare state, connections between digitalisation in the form of eGovernment progress and welfare regime types do not appear farfetched. Previous research that engages digitalisation and the study of welfare regimes examines the potential for change of welfare states due to digitalisation. According to this strain of thought, it is clear that ICT significantly influences welfare states. What is less clear however, is whether and how welfare states relate to the adaption of eGovernment. Research along this line of thought usually argues that, whereas production systems in the private sector are quick to adapt to digitalisation changes due to market mechanisms such as competition, the public sector redistribution systems of welfare states, including eGovernment, are more change persistent and path dependent (Buhr, 2017, p. 17; Haley, 2016). Previous research and the derived arguments upon it with the four hypotheses allow the creation of the following model to test H1-4 on to answer the two research questions.

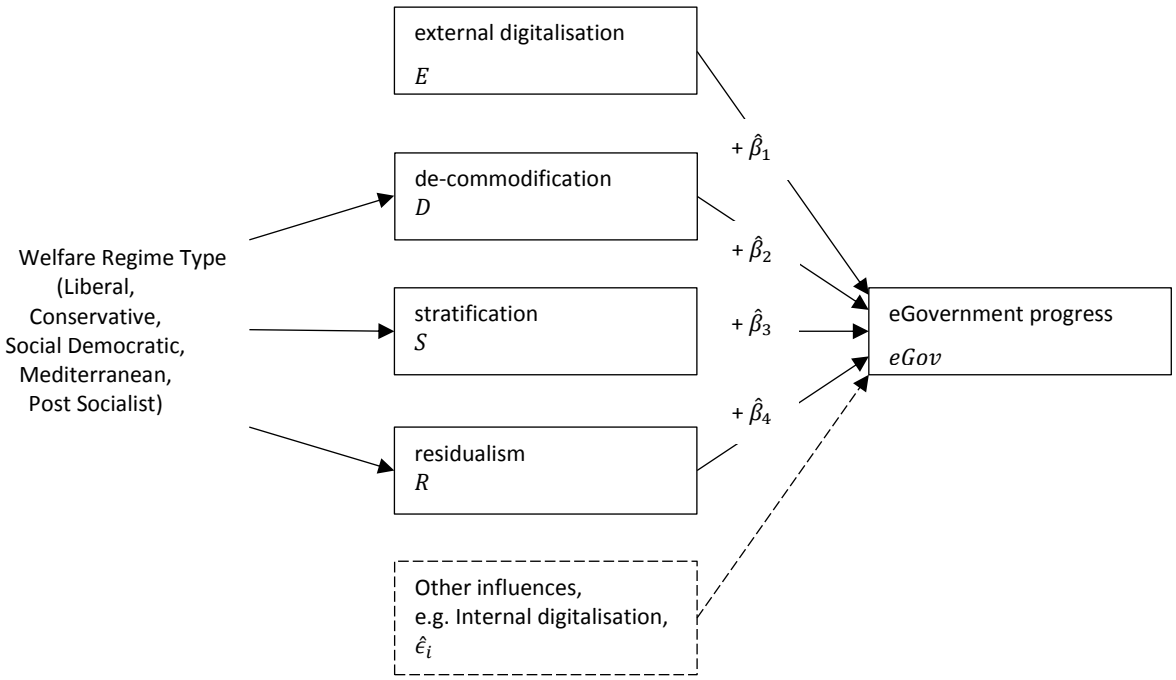

Figure 2: Framework model

eGovernment progress thereby constitutes the dependent variable on the right side ($eGov_i$) and is affected by five paths ($\hat{\beta}_{1-4}$ for H1-4, and the dotted path) coming from *external digitalisation (E), de-commodification (D), stratification (S), residualism (R),* and *other influences* ($\hat{\epsilon}_i$), as the five variables on in the middle. The first four of these are independent observed variables, of which the three variables (D, S, R) are determined by the welfare regime type indicated on the left, which is not a variable but indicates the case selection. The last variable on the bottom is an unobserved error variable. The model assumes that the five variables in the middle influence eGovernment progress. The following paragraphs explains the causal paths of the model towards the hypotheses.[2]

First, the model assumes a positive effect ($+\hat{\beta}_1$) of external digitalisation (E_i) upon eGovernment progress ($eGov_i$) according to H1. In line with previous research, it is assumed that the more advanced the ICT infrastructure environment and labour market is, the more advanced eGovernment will be. As parts of the same coin, digitalisation effects from the private sector are likely to have spill over effects upon the public sector. For example, technological innovation such as ICT use in the public sector depends on the exchange of ideas and information, fostered in market-oriented environments. This rather intuitive approach includes the findings of previous research in the model and retests the positive relationship to confirm prior studies to offer an evaluation context for the remaining three variables (Stier, 2015, pp. 274–275). Second, the model assumes positive effects ($+\hat{\beta}_{2-4}$) of *de-commodification (D), stratification (S)* and *residualism (R)* upon eGovernment progress ($eGov$). These relationships encompass the new approach of this thesis depicted in H2-4 and examining the concepts of welfare regime types with eGovernment progress.

The four causal paths reason that digitalisation puts existing welfare state structures under pressures to adjust. These pressures to adjust are demarcated according to the three welfare regime phenomena (D, S, R) and the impact of external digitalisation forces. However, next to External digitalisation forces, Internal digitalisation forces on welfare regimes are also part of the conceptual frameworks of previous literature (Buhr, 2017, p. 15). *internal digitalisation* forces, refer to changes within the public sector, through proactive modernisation forces for eGovernment from political push or pull factors (Hemerijck, 2013, p. 163). According to internal digitalisation, institutional change such as eGovernment progress is not only conditioned by external environmental pressures, but similarly by endogenous complementary policies and institutional structures (Rhodes, 2000; Scharpf & Schmidt, 2000a). This includes EU initiatives, such as the *Tallinn Declaration* or the *eGovernment Action Plan 2016-2020*, because these political pressures of the EU also affect the welfare states of MS. The theoretical claim of internal digitalisation is that institutional change such as eGovernment progress is

[2] Causal path in terms of the assumed model, not as a proven causality.

conditioned by variations of policy designs and interest mediations. Here the discussion resolves largely around how democracies, autocracies and other government forms political processes relate to the adaption of eGovernment, with mostly ambiguous findings (Ramani, 2018; Robson, 2018). Theoretically, when External and internal digitalisation forces are in equilibrium, there are optimal conditions for eGovernment with technical innovations from the private sector, prearranged infrastructure conditions and modernisation incentives within the public sector. Thereby the public sector fosters eGovernment by actively adapting ICT spill over effects from the private sector.

Determinants of eGovernment progress such as internal digitalisation forces are demarcated in the model in the last variable "Other influences" with the error term ($\hat{\epsilon}_i$). This includes for instance political pressures in the form of internal digitalisation forces. The error term of the model is latent and unobserved. The reasons for an unobserved error term are two folded. First, a measurement of other factors such as political internal digitalisation forces, requires a different methodological approach than used in this thesis. Second, by examining EU MS and their commitment under the *eGovernment Action Plan 2016-2020*, it is assumed that political determinants for internal digitalisation forces are to a minimum extent similar between EU MS.[3] Classifying an error variable which is to some extent captured by internal digitalisation and other unknown factors, is therefore a necessary limitation of the study design (Bennett & Checkel, 2015, pp. 227–232).

By the same token, it is assumed that welfare regime types affect progress in eGovernment with the three variables de-commodification, stratification, and residualism, but that there is no effect vice versa. The underlying reasoning against this feedback loop and a two-directional causality is that the welfare state was existent before digitalisation and eGovernment. The first welfare states can be dated back to the early 19th century, in contrast to digitalisation which began around the last two decades (Schmid, 2010). Accordingly, the effect of welfare regime types towards the adaption of eGovernment should be dominant because welfare states have a long history and are rather change-resistant and stable (Hemerijck, 2013). *De facto*, this relationship is likely to be reciprocal, with eGovernment affecting the operations of welfare states (Buhr et al., 2017). external digitalisation forces for instance, put pressure upon the welfare states to de-commodify labour against large scale job losses caused by automation, to stratify social policies against the digital divide, or to shift residual welfare delivery between the state, the market, and the family. Accordingly, welfare states change over time and adapt to challenges in their environment, such as digitalisation and eGovernment (van Kersbergen & Vis, 2013, p. 54). Such an influence of eGovernment over welfare states is even likely to change in the

[3] For an examination of internal digitalisation forces, see:
Pedersen and Wilkinson (2018)

future, through new government types and governance methods caused by digitalisation (Lemke, 2018). With a primary focus upon eGovernment progress as the dependent variable however, these changes are not pivotal for this model and in context of the time frame for the proposed model (between 2012 and 2019), this relationship is not encompassed (van Kersbergen & Vis, 2013, pp. 10–13).

Correspondingly, although the model serves as the theoretical mechanism for the credibility of the causal effect estimates in the analysis, it has important limitations. The reasoning and working mechanisms of the model are assumed to be in concert with other unknown mechanisms (Morgan & Winship, 2015). Likewise, the depicted paths are sufficient for possible effects of causality, but not necessary, since alternative paths could produce the same outcome. Therefore, identified unknowns, such as internal digitalisation forces in the error variable, and unidentified unknowns are not controlled for. Consequently, data patterns, trends and associations in the analysis might be indicators for correlations but are alone not sufficient for assumptions of causation (Hedström & Ylikoski, 2010, p. 59). Equifinality, many different causal paths to the same outcome, multifinality, many different outcomes from the same values in the independent variables, and multicausality due to contextual factors, are therefore not be entirely omitted with the proposed theory and its model (Bennett & Elman, 2006, pp. 471–473). The relevance and relative strength of the conclusions according to the model serve therefore as a baseline and are not sophisticated enough as evidence for causalities. Due to the little research in the area, the model serves as a starting point for an increased understanding of state capacity as an eGovernment determinant to increase possible explanations of connections between welfare regime types and eGovernment progress and illuminate tendencies between welfare regime types and eGovernment progress. The methodology to gain answers for such tendencies based on the model, its four hypotheses and their open-ended null hypotheses is outlined in the next chapter.

3. Methodology

This chapter introduces the methodology and methods of the research to discuss their benefits and drawbacks with respect to the design of the thesis. The chapter is divided into three sections. The first section *3.1. Case Selection* uses welfare regime theory to select ten cases as dummy variables for the analysis, which will be explained in the second section *3.2. Multiple Linear Regression*. The third section *3.3. Operationalisation and Data* defines indicators for the variables in the proposed model and their data sources.

3.1. Case Selection

This section outlines EU MS as the sample for the analysis and defines ten cases, UK, Ireland (IE), DE, France (FR), SE, DK, IT, EE, and BG, which are used as dummy variables in the multiple linear regression analysis (MLRA). These dummy variables offer comparative cases to evaluate the impact of welfare regime type upon eGovernment progress. The section begins with the methodology of the case selection, before continuing towards explaining the cases. At the end of the section the drawbacks of the selected cases are discussed.

When addressing the subject of welfare states in Europe and their eGovernment progress, the population, sample and units of analysis are the 28 EU MS (Ebbinghaus, 2012, p. 6). The 28 MS thereby constitute the sample for the MLRA and offer insights for the four examined variables in the model (external digitalisation, de-commodification, stratification, and residualism). In order to approach the research questions and examine the connection between eGovernment progress and welfare regime types further, dummy cases for comparisons of welfare state categories and their eGovernment progress are chosen.

With the observational research approach of the thesis, a clear methodology for this case selection is important because a randomisation is not possible. In other words, chosen cases affect the answers created (Geddes, 1990, pp. 133–134). With the intention to be clear about this problem, welfare regime theory guides the selection process to gain a certain degree of control over confounding variables, such as the unobserved internal digitalisation forces in the error term, which are not accounted for in the heuristic working mechanisms.

The premise of fixing the analysis upon EU MS, is to have comparable cases which share some commonalities, such as substantial political integration, due to their EU membership (Lijphart, 1975,

pp. 159–161; Petrov & Kalinichenko, 2016). While EU membership offers some extent of comparability, the observational design and the rather small number of 28 EU MS makes a random sampling not possible. In order to avoid an arbitrary case selection or even selection bias, the basis and guidance for the selection of cases out of EU MS is provided by welfare regime theory (King et al., 1994, p. 140). According to the five welfare regime types, ten EU MSs are chosen out of the sample of EU MS to create dummy variables for the analysis. Selecting two cases per welfare regime category creates a diverse case selection with a variance for each welfare regime category.

Thereby the diverse case selection is complemented by most-similar cases, two cases of each welfare regime, according to the method of difference (Teune & Przeworski, 1970). By selecting two states for each welfare regime category, the states in each category are similar in terms of the three welfare regime phenomena and indendent variables (de-commodification, stratification, and residualism), but might differ in the dependent variable (eGovernment progress). Choosing intentionally two EU MS per welfare regime category, offers little variation in the explanatory variables (de-commodification, stratification, and residualism) between the welfare states in the same category, and differences in unaccounted influences, such as internal digitalisation the error term. The dependent variable (eGovernment progress) is not regarded in this selection process, other than that there is some variance in it (King et al., 1994). Because countries are complex aggregates which vary in many respects, matching two MS of each welfare regime category offers comparable cases with respect to the welfare regime typology (Lijphart, 1971, pp. 684–686). The variation of the diverse case selection and the method of difference with two cases for each welfare regime category, offers complementary feedback towards hypotheses two to four and the research questions (Gerring, 2007). According to this diverse case selection design, the following cases are chosen:

The UK and IE as cases for Liberal welfare states;

DE and FR as cases for Conservative welfare states;

SE and DK as cases for Social Democratic welfare states;

IT and ES as cases for Mediterranean welfare states;

EE and BG as cases for Post-Socialist welfare states.

This selection is guided by trying to include distinct and unambiguous countries for each welfare regime category (Ebbinghaus, 2012, pp. 3–5). Nonetheless, the welfare regime typology is a continuous concept with family resemblance categorisations (i.e. the continental and Mediterranean welfare regimes). The categorisation of welfare regimes is a matter of degrees and states therefore do not always have a clear fit (Collier & Mahon, 1993, p. 847). The procedures to assign such fuzzy cases are displayed in the previous *Table 1,* which depicts the decisive variables (de-commodification,

stratification and residualism) for the welfare regime categorisation in context of this thesis. These variables are, however, not all encompassing to categorise welfare states. In order to avoid wider reaching methodological problems when categorising welfare states, the case selection relies on mainstream categorisations within comparative welfare state research. The following abstracts briefly categorise the selected cases into their welfare regime categories.

The only two available candidates for Liberal welfare states in the EU are the UK and IE, which are both selected as dummy variables. The UK and IE have inclusive social protection systems, which are stratified and not universal (Daly & Yeates, 2003, p. 87). De-commodification is low. Flat-rate benefits are small and social protection is targeted and needs based for the very poor. By the same token, unemployment benefits have a short duration and are low. Taxation is relatively low, wages are highly dispersed, the labour markets are very deregulated and social insurance is often provided by the private sector (Hall, 2015, pp. 11–13). Welfare residualism and provision relies mainly on the market and persons without enough income are ought to reach a basic levels of welfare through self-help (Hemerijck, 2013, p. 156). Similarly, family care and servicing are mostly seen as a private matter (Daly & Kelly, 2015). While the UK and IE share these traits, IE has moved away from a highly deregulated market, towards corporatist wage agreements with social partners. Similarly, IEs welfare state is more gendered than the UKs, as stay at home motherhood is privileged and a strong emphasis is put upon voluntary catholic charity organisations. Moreover, the political system in IE has a proportional representation, whereas the UK and its Westminster political system has a more adversarial 'first-past-the-post' nature (Hemerijck, 2013; van Kersbergen & Vis, 2013).

Often categorised Conservative welfare states in the EU include Austria, the Benelux countries, DE and FR, from which the latter two are selected as dummy variables. DE and FR have a tradition of Bismarckian, stratified social insurance which is linked to the work position and family status. The de-commodification replacement rates for unemployment insurance are long and the social security coverage is very inclusive, although fragmented (Offe, 2018). The taxation levels are accordingly high. Social insurance models are structured to a benefit formulae, proportional to earnings and are underpinned by residualism upon the family with traditional single-breadwinner family values (Emmenegger, Häusermann, Palier, & Seeleib-Kaiser, 2012). The common assumption in DE and FR is that men work full time for uninterrupted and lengthy careers. Employer associations and trade unions actively participate in governing social protection insurance schemes and obligations for insurance come into effect automatically at the beginning of jobs which exceed a threshold for minimum payment (Hemerijck, 2013, pp. 157–159).

Usually considered Social Democratic welfare states in the EU are Finland, SE and DK, from which the latter two are selected as dummy variables. SE and DK have a low stratification with universal social protection coverage and high de-commodification with universal basic guarantees. The systems of SE and DK offer generous replacement rates and public services beyond education and health, such as labour market programmes to foster equality between the sexes. Public social services emphasise residualism upon the state as an important source of welfare and free women from unpaid caring tasks which generates opportunities to participate in the labour market (Offe, 2018). The Social Democratic welfare states are financed by general and high taxation. Public employment is widespread and controls the provision of benefits and services; apart from unemployment insurance, which is organised by trade unions (Robson, 2018).

Regularly referred Mediterranean welfare states in the EU are Portugal, Greece, IT and ES, from which the latter two are selected as dummy variables (Offe, 2018). Although IT and ES share a family resemblance to the Conservative welfare regime category, they have specific institutional traits. On the one hand, social protection benefits in IT and ES have Bismarckian income transfers related to former income and high pensions for former public servants, along with certain industrial workers. Such public pension schemes are stratified and fragmented, covering only a limited section of the working population. On the other hand, IT and ES have Beveridgean, fully universal, national healthcare (Lameire, Joffe, & Wiedemann, 1999, pp. 3–6). The de-commodification of the social safety net for basic benefits is not well developed and general taxation is combined with social charges, such as taxes on employers and employees. The deficiencies in basic benefits are often balanced out by residualism towards the family as an important source for social security and welfare. IT and ES suffer from low levels of female participation in the labour market because social care is primarily provided informally by women. Furthermore, the labour markets are highly regulated and have strong politically polarised systems of labour relations, where pay bargaining generally takes place at a company level (F. Moreno, Javier, & Mari-Klose, 2016). The implementation of social policies in IT and ES suffers from inadequate administrative capacities, patronage and clientelism (L. Moreno, 2000). These circumstances lead to social protection policies with insider and outsider characteristic, between those in regular and irregular sectors, versus those in underground sectors (Hemerijck, 2013, pp. 158–160).

The Mediterranean welfare states share a family resemblance to the Conservative welfare states. Their different institutional traits, however, make IT and ES useful cases for the analysis, because they allow a comparison with the Conservative welfare regime to get insights about the significance of unaccounted traits and the influence of the error term (Maggetti, 2013; Seawright, 2016). This allows to make assumptions about the significance of uncontrolled effects.

Candidates for the Post-Socialist welfare regime category include the eight new central and eastern European MS which entered the EU in 2004, EE, Latvia, Lithuania, Poland, Hungary, the Czech Republic, Slovakia, Slovenia, BG and Romania who joined the EU in 2007, as well as Croatia which entered the EU in 2013 (Fenger, 2007). From these countries EE and BG are selected for dummy variables. EE and BG countries experienced two major changes in the past 75 years. The change from capitalism to state-socialism in the 1940s and the shift from state-socialism back to capitalism post 1989. After the Post-Socialist change to capitalism and democracy, the heritage of egalitarianism persisted and social expenditures in the Post-Socialist countries remained high in relation to their level of economic development (Cook, 2010; Lipsmeyer, 2009). Other than that, economic, social and political changes since 1989 were diverse and led to EE and BG being institutional hybrids of the previous four welfare regimes, rather than clear members of a certain welfare regime cluster (Blum, 2016, pp. 22–26). It is not possible to cluster EE and BG on par with stable characteristics, because the Post-Socialist welfare regime has no fit for the three phenomena de-commodification, stratification, and residualism (Kuitto, 2018, p. 137). However, similar to the Mediterranean welfare states IT and ES, the historical background apart from the three welfare regime phenomena, make EE and BG useful cases for dummy variables. They offer insights into whether a similar historical background might have a significant relevance, which is unaccounted in the working mechanisms. Furthermore, EE has a very advanced eGovernment structure and BG has low economic indicators. These idiosyncratic factors make their inclusion into the analysis relevant for possible confounding factors. As outliers they can offer indicators to detect omitted variables of the model or exclude certain cases for future analyses.

While meta-analyses of comparative welfare state research suggests that these selected cases are most suitable for the five categories, the chosen states still have differing fits to their welfare regime categories (Ebbinghaus, 2012, pp. 16–17). These differing fits are part of the natural drawbacks of a typology. Although the welfare regime typology allows useful categorisations, it disregards the complexity and often mixed forms of welfare states in reality. When applying the welfare regime typology, the categorisation between welfare states is not necessarily mutually exclusive (welfare states might fit into more than one welfare regime category), nor jointly exhaustive (welfare states might not fit properly into any of the existing welfare regime categories). *De facto*, welfare states have idiosyncratic relevant features that are not included in the welfare regime typology or do not fit clearly into a single welfare regime category (Sartori, 1970, p. 1039).

The differing fits into the welfare regime typology influence the generalizability of the sample cases upon the general population of cases, other welfare states in the EU, and further, welfare sates outside the EU (Slater & Ziblatt, 2013). Noteworthy, IE, IT and ES, are contested as hybrid cases, which

are also often identified as Conservative welfare states (Ebbinghaus, 2012, p. 16). Similarly, while the Post-Socialist welfare states EE and BG belong to the same welfare regime category, the category itself is less solid than the other four categories. This means that deviations from indicator values and the guiding hypotheses might be expected for IE, IT, ES, EE, and BG. The results for the Liberal welfare regime with IE as a vague case, and especially the Mediterranean welfare regime with both IT and ES, as well as the Post-Socialist welfare regime with both EE and BG, will have a curtailed internal validity for their welfare regime categories (Lynch, 2014, p. 383; Yin, 2014). Whereas results for the unambiguous cases of the Conservative welfare regime with DE and FR, and the Social Democratic welfare regime with SE and DK, will have a higher internal validity for their welfare regime categories. Finally, although the UK is going to leave the EU (Brexit), during the period of analysis the UK was a MS of the EU and is therefore suitable as a selected case. Although the Brexit curtails the generalisability of the findings for the future (Gerring, 2007, p. 217). How the ten selected cases are used as dummy variables is explained in the next section which explains the benefits and use of the MLRA.

3.2. Multiple Linear Regression

This section discusses the chosen MLRA method, beginning with an introduction and explanation of MLRA, dummy variables for fixed and interaction effects, regression outputs and their use for this thesis. This is followed by a reflection upon the assumptions taken for the use of the MLRA.

MLRA is used to find answers for the research questions,

1. *What are the patterns of welfare regime types and eGovernment progress across public sectors in EU MS?*
2. *What are possible effects of welfare regime types as determinants for eGovernment progress?*

With the help of the four hypotheses related to external digitalisation, de-commodification, stratification, and residualism. This non-experimental, observational approach uses the 28 MS with several empirical time series observations per case and ten dummy variables for a reflection on the relationship between observations of the indicators for the model variables and their implication for the theoretical concepts and working mechanism of eGovernment progress and the welfare regime typology (Blatter & Haverland, 2012, p. 19). This approach is valuable for several reasons. First, although MLRA is a common tool for comparative welfare state research, MLRA has not been used to test the three phenomena of de-commodification, stratification, and residualism, with respect to eGovernment (Stier, 2015). Likewise, studies of Government determinants generally make use of cross-sectional methods for only one year each, offering space for the MLRA to examine temporal

effects upon eGovernment (Kumar, Mukerji, Butt, & Persaud, 2007). Second, MLRA offers a statistical examination of the postulated working mechanisms on panel data. It is thereby possible to gain insights into the assumed patterns and effects by comparing dummy variables of the selected cases over a certain time (Blatter & Haverland, 2012, p. 57; Lijphart, 1971, pp. 684–685).

With respect to the model of the assumed workings mechanisms, MLRA is a suitable tool for examination because the model involves a certain composition of variables (Lijphart, 1971, p. 684). It is postulated that the dependent variable, eGovernment progress, is dependent upon five variables external digitalisation, de-commodification, stratification, residualism, and an error term with unaccounted phenomena such as internal digitalisation as unobserved determinants. The first four of these variables are observed as panel data (over cross-sectional units, welfare states, observed over time series) and thereby enable an examination of the relationship between the four variables and eGovernment progress through MLRA. This is done in two steps. First, by conducting a MLRA with country dummy variables for fixed effects of the ten selected cases. The MLRA with dummy variables for the ten cases allows a general examination of welfare regime types and their three phenomena upon eGovernment progress, to offer answers for the first research question. Then follow ten separate MLRAs with dummy variables for the fixed effects and interaction effects (towards Connectivity, de-commodification, stratification and residualism) of each selected country (Kellstedt & Whitten, 2018, pp. 210–211). These ten country specific MLRAs allow more detailed insights by controlling for the ten selected cases and their interaction effects (Kellstedt & Whitten, 2018, p. 198).

The MLRA according to the model and the dummy variables for the fixed and interaction effects of the selected cases is:

$$eGov_{it} = \hat{\alpha}_{it} + \hat{\beta}_1 E_{it} + \hat{\beta}_2 D_{it} + \hat{\beta}_3 S_{it} + \hat{\beta}_4 R_{it} + \hat{\epsilon}_{it}$$

where,

$eGov_{it}$ indicates the dependent variable eGovernment progress, as a linear function of the independent variables, with the following regression parameters,

$\hat{\alpha}$ indicates the estimated eGovernment progress when all independent variables, E_{it}, D_{it}, S_{it}, and R_{it} take on the value zero, the intercept.

$\hat{\alpha}_{it}$ indicates dummy variables for the fixed effects of welfare states or their interaction effects (with E, D, S and R), each multiplied by their respective regression coefficients;

$\hat{\beta}_1 E_{it}$ indicates the estimated effect, $\hat{\beta}_1$, of external digitalisation, E_{it}, on $eGov_{it}$, when D_{it}, S_{it}, and R_{it}, are held constant;

$\hat{\beta}_2 D_{it}$ indicates the estimated effect, $\hat{\beta}_2$, of de-commodification, D_{it}, on $eGov_{it}$, when E_{it}, S_{it}, and R_{it}, are held constant;

$\hat{\beta}_3 S_{it}$ indicates the estimated effect, $\hat{\beta}_3$, of stratification, S_{it}, on $eGov_{it}$, when E_{it}, D_{it}, and R_{it}, are held constant;

$\hat{\beta}_4 R_{it}$ indicates the estimated effect, $\hat{\beta}_4$, of residualism, R_{it}, on $eGov_{it}$, when E_{it}, D_{it}, and S_{it}, are held constant;

$\hat{\epsilon}_{it}$ indicates the estimated error term, which embodies the probabilistic nature of the model and unobserved parameters, such as internal digitalisation.

The variables $eGov_{it}$, E_{it}, D_{it}, S_{it}, and R_{it}, are observed quantities on welfare states as individual cases, *i*, at points in time*, t*, and are therefore not denoted with a "hat", whereas $\hat{\alpha}$, $\hat{\beta}_1$, $\hat{\beta}_2$, $\hat{\beta}_3$, $\hat{\beta}_4$, and $\hat{\epsilon}$, indicate estimates from the sample population of the selected cases, for actual values of those quantities in the population, all existing welfare states. For instance, $\hat{\beta}_1$ is the estimate based on the MLRA of the 28 sample cases, of β_1 on the actual population of all existing welfare states (Kellstedt & Whitten, 2018, pp. 183–199; Wooldridge, 2014).

The estimated effect of $\hat{\beta}_1$ for instance, is obtained by taking the portions of $eGov_{it}$ that D_{it}, S_{it}, and R_{it} cannot explain and trying to explain it with the portion of E_{it}. The estimated effects $\hat{\beta}_2$, $\hat{\beta}_3$, and $\hat{\beta}_4$, are obtained the same way, by taking the portions of the dependent variable $eGov_{it}$, that the other independent variables $E_{it}/D_{it}/S_{it}/R_{it}$, cannot explain and try to explain it with portions of $D_{it}/S_{it}/R_{it}$.

With respect to the outputs of the regression, the following statistics are considered with their interpretation. First, the *goodness of fit* measures to know about how the regression fits the data.

Multiple R is considered to know how strong the linear relationship is, with one for a perfect positive relationship and zero as no relationship at all.

The Adjusted R Square is considered because it encompasses, that the larger the variance explained with the regression model is, the larger are the independent variables $\hat{\beta}_1 E, \hat{\beta}_2 D, \hat{\beta}_3 E$ and $\hat{\beta}_4\ R$, explanatory power. The interpretation of Adjusted R Square is how good the model with multiple independent variables explains a certain percent of the variance in $eGov$.

The *Standard Error* of the regression is considered, as an estimate of the standard deviation of the error $\hat{\epsilon}$. The SER is the precision of the measured regression coefficients and describes the average distance that the observed values have from the regression estimates. Smaller values are therefore better because they indicate that the observations fit closer to the regression estimates.

The last regression statistic is the number of observations which is relevant for the validity of the regression coefficients.

Second, the interpretation of the regression coefficients. The *coefficients* are the (fixed) effect estimates as the least squares of the independent variables (and dummy variables), $\hat{\beta}_1$, $\hat{\beta}_2$, $\hat{\beta}_3$, $\hat{\beta}_4$,

upon the dependent variable $eGov$. The coefficients provide the baseline to examine the first research question if there are patterns and possible effects between welfare regime types and eGovernment progress (Blatter & Haverland, 2012, pp. 318–320). Utilising the coefficients of the independent variables in connection with coefficients for dummy variables has several advantages. The coefficient results for the pooled panel data offer general trends with mean coefficients for the whole time period without accounting for differences between welfare states (heterogeneity), whereas the dummy variables allow examinations of fixed effects for specific welfare states and their interaction effects towards the four independent variables, which are less noisy and more reliable for inferences towards specific welfare regime categories (Åström, 2012; Kittel & Winner, 2005, p. 289). The regression coefficients have the following statistical indicators.

The *SER of the coefficient least square estimates*, from the *SER of the goodness* of fit.

The *t Statistic* (t Stat) to check the influence of the independent and dummy variables. The greater the difference between the mean value of the dependent variable $eGov_{it}$, across the values of the independent variables, the greater the value of the t Stat. This value should be unequal to zero, otherwise the coefficient would not have an influence.

The *P-value* to test if there is a meaningful effect. A low p value smaller than 0.05 indicates that the null hypothesis can be rejected and that there is a meaningful effect. Low P-values of the independent variables suggest that they are a meaningful addition to the model and are not caused randomly. In other words, low P-values suggest that changes in the independent variable are related to changes in the dependent variable.

The calculation of the MLRA is done with Microsoft Excel.[4] Together, the goodness of fit outputs and the regression coefficients offer the base for the analysis. For display, the decimal places for the outputs have been rounded to three. The validity and credibility of these outputs relies on several model assumptions. These assumptions are mentioned in the following paragraphs and discussed if necessary.

The explanatory power of these MLRA outputs depends on more than just the regression outputs. Three of the five assumptions necessary for the MLRAs stochastic components are contained in the mathematical statement

$$u_{it} \sim N(0, \sigma^2)$$

[4] The calculation outputs R Square, the analysis of variance (ANOVA) table and the lower and higher Quantiles are not considered in the analysis. R square is not needed because the Adjusted R square is considered for the MLRA, the ANOVA table is not needed because an analysis of differences among group means is not necessary for the underlying research questions, while the intervals are not necessary for the cases considered.

This formula encompasses that the stochastic components of the concepts (u_{it}) are distributed normally ($\sim N$) with a mean equal to zero and a variance equal to σ^2. The first assumption is that u_i, the stochastic or random component of the dependent variable $eGov_i$, is normally distributed according to the central limit theorem (CLT)(Kellstedt & Whitten, 2018, pp. 160–162). The CLT established that the variables E, D, S and R tend towards a normal linear distribution, even if original variables are not normally distributed (Kellstedt & Whitten, 2018, pp. 122–128). The CLT assumption is reasonable with regards to eGov and C but less so for D, S and R ,who are not expected to be linear themselves. The second assumption, zero bias (E (u_{it}) = 0), supposes that the best guess for the expected outcome (E) of the stochastic component (u_i) is for each individual value zero. In other words, the model is not expected to overpredict or underpredict if all confounding variables would be included (Kellstedt & Whitten, 2018, p. 178). As shown in the theory section this assumption cannot be given in context of this thesis. The third assumption is, u_{it} has variance (σ^2), known as homoscedasticity. Homoscedasticity means uniform error variance and assumes that the established regression model fits each of the observed individual observation (it) the same (Kellstedt & Whitten, 2018, pp. 178–179). Homoscedasticity can also be not ensured with respect to the regression outputs. The answers raised based upon the model can therefore have biased parameters and need to be considered cautiously and in context to the theory.

The other two assumptions are, no autocorrelation and correct working mechanism specification. Autocorrelation occurs when stochastic terms are systematically related to each other. This is especially important for the panel data in the analysis and missing values according to trend functions, which will be subject in the next section (Kellstedt & Whitten, 2018, p. 179). Having a correct working mechanism specification is a rather hubristic statement which is be broken down in two assumptions to highlight. First, the model does not leave causal variables out, nor does it include noncausal variables. Second, parametric linearity, the assumption that the parameters $\hat{\beta}_{1-4}$ for the relationships between $E_{it}, D_{it}, S_{it}, R_{it}$ and $eGov_{it}$ are the same for all values of $E_{it}, D_{it}, S_{it}, R_{it}$. For instance, the model assumes that "one-unit increase" in D_{it} from "1 to 2" has the same effect as moving from "13 to 14" would have.

Both assumptions cannot be met. Despite the four independent variables specified and observed in the model, there are likely to be other independent variables that influence $eGov_{it}$, such as internal digitalisation. Because confounding variables exist, which are not controlled for in the regression model, a possible bias cannot be disregarded (Kellstedt & Whitten, 2018, p. 199). Furthermore, as described in the working mechanisms, there might be a threshold obstacle before a path dependency towards eGovernment progress occurs. In that case effects of the independent variables might be

lower at the beginnings of eGovernment progress than in more advanced phases. Other significant assumptions taken for the MLRA are related to the data and are considered in the next section.

3.3. Operationalisation and Data

This section is about the data, operationalisation and data collection for the variables in the MLRA model. The section begins with an operationalisation of the variables in the proposed model based on eGovernment determinants and welfare regime theory which is followed by a description of the data collection and processing to reflect upon the reliability, validity and limitations of the data.

The operationalisation is the fourth and final element after the term, attributes, and phenomena, to distinguish the latent concepts behind the variables of eGovernment progress, external digitalisation, de-commodification, stratification and residualism for their empirical use (Gerring, 2007, p. 157). The following paragraphs discuss the chosen indicators and their measurements for a location of the concepts in the empirical space (Gerring, 2012, p. 414).

The concepts of eGovernment progress, external digitalisation, de-commodification, stratification and residualism can be measured in qualitative and quantitative ways, such as social public expenditures or social rights (Brady & Collier, 2010, p. 295). Due to the panel design of the MLRA with repeated observations over time, the research uses quantitative continuous indicators (Kellstedt & Whitten, 2018, p. 135). The continuous indicators for the conceptualisation of welfare regime phenomena enables an analysation in the variation in eGovernment progress that suits the underlying theories. By looking at welfare regime differences in degree, instead of just differences in kind (from the case selection), allows answers towards both research questions about patterns and effects (Collier & Adcock, 1999, pp. 540–542). Political regimes like welfare regime types can be regarded as *"bounded wholes"* (Sartori, 1987, p. 87). While this classificatory reasoning reflects institutional characteristics and unique social policy configurations, it does not dig deeper into more specified answers towards an evaluation of effects for the second research question (Collier & Adcock, 1999, pp. 547–550). Accordingly, the dummy variables of welfare regime types from the case selection are complemented by an analysis of continuous variables. This approach makes therefore use of both, the case selection for dummy variables on mainstream literature, as well as defined continuous indicators (Kotarba, 2017, pp. 125–129).

Underlying selection criteria for these indicators for reliability are, that they are publicly accessible, published on a yearly basis, have transparent methodologies and that their source does not suggest an intentional bias (i.e. certain political motivation). Besides these practical criteria, all five

variables in the model and their concepts share the difficulty that they are multidimensional and encompass phenomena which are hard to capture within a single indicator. This restricts the validity of the indicators for the concepts and the extent to which the observations of the indicators approximate the actual value of the concept aimed to measure. The reasoning of the five quantitative indicators is therefore outlined in the next passages, with reflections of their validity (Marks, 2007, p. 4).

First, the dependent variable eGovernment progress ($eGov$) is measured with the indicator *Digital Public Services* out of the *Digital Economy and Society Index* (*DESI*). The *DESI* is a composite index by the EC, which summarises indicators on EU MS to track their digital performance. *DESI* data is publicly available and published annually since 2014 until current data from 2019 (Unit F.4, 2014-2019). The DESI includes five measurement dimensions for the digital performance of MS, *Connectivity, Human Capital, Use of Internet Services, Integration of Digital Technology* and *Digital Public Services* (Unit F.4, 2019b, pp. 2–3). Because eGovernment is defined in this thesis as the use of ICT technology for government operations including G2G, G2C, G2B and G2E, the Digital Public Services measurement dimension of the DESI offers valid observations to measure eGovernment progress. Digital Public Services consists of six sub-indicators with observations, which approximate the G2G, G2C, G2B and G2E dimensions of eGovernment (Unit F.4, 2019b, p. 4):

eGovernment users as a percentage of internet users who submit forms to the PA via internet (G2C);

the extent of data which is already known by the PA and presented in pre-filled forms (G2G, G2C, G2B and G2E);

the extent to which various steps in dealing with the PA can be performed completely online (G2G, G2C, G2B and G2E);

the degree to which public services for businesses are interoperable with ICT (G2B);

the government's commitment to open data (G2G, G2C, G2B and G2E);

the percentage of people who use health care services online (G2C).

These six measurement dimensions are together summarised into the indicator Digital Public Services. The subsequent indicator ranges from 0 to 100, with 0 designating the lowest extent and 100 the maximum extent of Digital Public Services (Marks, 2007, pp. 1–10). By having six measurement dimensions corresponding with the eGovernment concept adopted in this thesis, the Digital Public Service indicator has a solid validity.

Second, the independent variable external digitalisation (E) is measured with the indicator *Connectivity* out of the *DESI*. Like Digital Public Services, data for Connectivity is publicly available from

2014 until 2019. Connectivity consists of measures for the deployment of broadband infrastructure and its quality, inter alia broadband coverage, mobile broadband, data speed of broadband coverage, 4G coverage and broadband pricing (Unit F.4, 2019a, pp. 2–3). Noteworthy, the Connectivity indicator does not encompass the whole concept of external digitalisation, but merely a part of it. Important facets, such as the IT skillset of the population or the use of ICT in the private sector are not directly included in the Connectivity indicator. The reasoning behind choosing Connectivity as an indicator for external digitalisation, is that the data infrastructure is to a large extent interconnected to other facets of external digitalisation. For instance, the proliferation of IT skillsets and ICT use in the private sector rely upon broadband infrastructure (Briglauer & Gugler, 2013, pp. 822–824). Hence, although Connectivity does not measure the whole concept dimensions of external digitalisation, it is a suitable indicator with validity for the concept. The Connectivity indicator has the same scaling as Digital Public Services and ranges from 0 to 100, with 0 designating the lowest extent and 100 the maximum extent of broadband infrastructure.

Third, the independent variable de-commodification (D) is measured with the indicator *Social Protection Benefits, in % of Gross Domestic Product* (GDP*)* from the *Eurostat* database.[5] *Eurostat* is the official database of the EU and provides publicly accessible data for comparisons between countries (Eurostat, 2019). Country data on Social Protection Benefits, is published annually and available from the 1990s until 2017 and includes the spending on the following social services: childcare and support for children, unemployment benefits, minimum income, old age income, pensions, health care, inclusion of people with disabilities, long-term care, housing, assistance for the homeless and access to essential services (Eurostat, 2018). Measuring these social protection expenditures in per cent of GDP offers the same scaling as for the measurements of the other two independent variables (S and R, which are outlined in the late paragraphs). Furthermore, the wide-ranging social policy areas fit well into the demarcation of de-commodification as the extent to which an individual can uphold a decent standard of living independent from the labour market. It is likely that a country with a higher expenditure upon Social Protection Benefits decreases the individual dependence of its citizens upon the market. Social Protection Benefits thereby provide an appropriate measurement validity for de-commodification as the concept of interest, though with notable limitations (van Kersbergen & Vis, 2013, p. 60). For instance, a high number of Social Protection Benefits could exist despite a low level of de-commodification and state capacity, when the expenditures are distributed unequally or disturbed through corruption (Esping-Andersen, 1999, pp. 50–53; Richardson, Carr, Netuveli, & Sacker, 2018, pp. 392–395). Measuring de-commodification with further indicators would however, decrease

[5] Hereinafter referred to as Social Protection Benefits.

the reliability of the MLRA results and therefore Social Protection Benefits is used with the noted limitation (Kühner, 2007).

Fourth, the independent variable stratification (S) is measured with the indicator M*eans Tested Benefits, in % of GDP* from *Eurostat*.[6] Country data for Means Tested Benefits, is available from the 1990s until 2017 (Eurostat, 2019). The measure in per cent of GDP offers the same scaling as for the indicators of the other two independent variables (D and R). Means Tested Benefits include social benefits where entitlements are implicitly or explicitly conditional on the beneficiary's income or wealth. This contains cases where income or wealth determine only the entitlement or both the entitlement and the amount of benefits (Eurostat, 2017). Since stratification is defined as how much social policies distinguish between social classes in economic and social terms, Means Tested Benefits, offers an appropriate indicator with validity (van Kersbergen & Vis, 2013, p. 61). Despite this, the indicator has limitations because it does not encompass how means tested benefits are distributed. Comparable to Social Protection Expenditure, this limitation for Means Tested must be kept in mind for the validity of the MLRA outputs.

The final indicator for the fourth independent variable residualism (R) *is Social Protection Benefits on Family and Children, in % of GDP* from *Eurostat*.[7] Country data on Social Protection Benefits on Family and Children is available in yearly periods from the 1990s until 2017 (Eurostat, 2019). The measurement in per cent of GDP offers the same scaling as for the previous two independent variables (D and S). Social Protection Benefits on Family and Children includes support in connection with pregnancy, childbirth, childcaring and caring for other family members. This gives an indication in how far the family is involved in the interplay with the market and the state to provide welfare. A high spending on Social Protection Benefits on Family and Children indicates that the market and the family are involved to a reduced extent to provide social protection whereas the state takes an increasing role. A low spending on Social Protection Benefits on Family and Children indicates that the market, the family, or both have an advanced involvement to provide social protection (van Kersbergen & Vis, 2013, p. 62). The indicator thus does not make evident which realm is the main source of welfare, but rather suggests a degree the state might have in the welfare provision mix between the state, the market and the family. Similarly, to the previous two indicators, Social Protection Benefits on Family and Children is used for the analysis whilst noting the limitation that a wider-ranging validity of residualism in the empirical realm would require more indicators for the phenomenon. This in not done because additional indicators would make the MLRA impractical.

[6] Hereinafter referred to as Means Tested Benefits.
[7] Hereinafter referred to as Social Protection Benefits on Family and Children.

Combined, the longitudinal data offer an overlapping time frame with yearly data from 2014 until 2017. Because the earliest measurements from the *DESI*, Digital Public Services and Connectivity, are available from 2014 and the latest measurements from *Eurostat* for Social Protection Benefits, Means Tested Benefits and Social Protection Benefits on Family and Children, are available until 2017. This time frame of three years with balanced observations is rather short for longitudinal insights (Wooldridge, 2014, pp. 22–25). Therefore, the missing data from the *DESI*, between 2012 and 2014, and the missing data from *Eurostat*, for 2018 and 2019, are complemented as far as possible with the same indicators from national sources (2 observations) and the remaining missing indicators calculated with the trend function from Microsoft Word, based on the observed data (Genesis Online Datenbank, 2019; Statistics Estonia, 2019). This calculation increases the time frame by allowing a MLRA based on data from 2012 until 2019. Thus, from the 1120 observations, 331 observations (around 29.6 %) are calculated according to the trend function,

$y = bx + a$

This trend function is comparable to the MLRA and assumes a linear trend (bx) and intercept (a) of the known data to calculate the missing data (y) accordingly.

This calculation of the missing data is a double-edged sword. On the one hand the data is not empirically observed and therefore weakens the empirical base of the MLRA, whilst on the other hand the calculated data increases the time frame from for the MRA from three to seven years. Although 29.6 % is a large amount of artificial data, it allows to increase the time frame for the MLRA by 233 %. With this argument of increasing the balanced time frame of analysis unproportionally to the calculated data, the artificial data is included (Kellstedt & Whitten, 2018, p. 171). Despite the larger time frame, calculating the missing values according to linear trends based on the existing data increases the problem of autocorrelation and measurement errors (Kellstedt & Whitten, 2018, pp. 170–171). Autocorrelation and measurement errors decrease the reliability from the MLRA and the explanatory power of the stochastic component u_i (Kellstedt & Whitten, 2018, p. 179). This is partly due because all of the data used in this thesis are complex aggregates from secondary sources which have not been collected specifically for this thesis (Leuffen, Shikano, & Walter, 2013, pp. 42–45). When considering the variables more closely, there are several kinds of potential errors in the measurement besides the calculated missing values. For instance, illegal economic activities which are not included in GDP calculations, or varying definitions of social expenditures within countries, which can distort measurements (Fox, 2015). Such measurement errors and the calculated missing values must be kept in mind and prohibit assumptions of causal inference based on the MLRA, but nonetheless allow an identification of possible patterns, tendencies and associations.

With respect to previous studies, no studies were found that analysed eGovernment progress over such an extended timeframe with a common empirical framework. Due to good reasons previous studies followed diverse methodological approaches and coding schemes, since the "state of the art" of ICT application develops quickly (Karpf, 2012, pp. 640–642). This influences the nature of the Digital Public Services and Connectivity indicators in the poled dataset. They have a higher rate of change than the other three indicators, Social Protection Benefits, Means Tested Benefits and Social Protection Benefits on Family and Children (King et al., 1994, pp. 497–501). This is partly due because digitalisation changes occurred faster than welfare regime changes and because the measurements for the welfare regime phenomena are scaled as per cents of GDPs. One benefit of the rate of change of the Digital Public Services indicators, is that a linear relationship of the Panel data for the MLRA can be assumed. Furthermore, the standardisation of Social Protection Benefits, Means Tested Benefits and Social Protection Benefits on Family and Children, adjusted to the GDP allows for comparisons over time with the fast changing DESI indicators (Yin, 2014, pp. 16–19).

Another problem overlooked in previous studies concerning the nature of eGovernment data is, that most authors did not address that their data are coded in the year prior to the release, which produces time lags with empirical consequences (Stier, 2015, p. 276). Time lags result in imprecise causal assumptions. Accordingly, for the data in this thesis the independent variables (E, D, S and R) are coded one year preceding towards the dependent variable ($eGov$) to avoid reverse causality.

Similarly to the MLRA, the data entails mathematical assumptions for its validity. First, that $eGov$ data varies, which is not an issue. Second, that the number of cases (28) and observations exceeds the number of parameters to be estimated (E,D, S, R and dummy variables), which is not the case because the dummy variables are split between the ten selected cases (Kellstedt & Whitten, 2018, p. 170). Third, that there is no perfect multicollinearity, or exact linear relationship between any of the four independent variables (E, D, S and R) which is not the case for the selected data. The calculation of the missing data avoids this problem because missing values are just calculated according within their observed indicators of the same variable.

To summarise, the variables eGovernment progress and external digitalisation are measured with the *DESI* indicators Digital Public Services and Connectivity which are both scaled from 0 to 100. The other three variables, de-commodification, stratification, and residualism are measured with the indicators, Social Protection Expenditure, Means Tested Benefits, and Social Protection Benefits on Family and Children, which are all scaled as per cents of GDP and coming from *Eurostat*. The next chapter presents the results of the analysed data.

4. Analysis

This chapter presents the empirical findings of the MLRAs to test the four hypotheses and answer the two research questions. The chapter is structured into seven sections, the first section *4.1. Ten Welfare States* covers the analysis with dummy variables of all ten welfare states to gain fixed effects for welfare state types. Then follow the five sections *4.2. Liberal Welfare States, 4.3. Conservative Welfare States, 4.4. Social Democratic Welfare States, 4.5. Mediterranean Welfare States* and *4.6. Post Socialist Welfare States*, each covering analyses with dummy variables for interaction effects of the ten selected welfare states. The last section *4.7. Summary* reviews and combines the results from the fixed effects and interaction effects.

4.1. Ten Welfare States

The next *Table 2: Regression with dummy variables for ten welfare states* depicts the MLRA outputs of the pooled analysis of the 28 EU MS between 2012 and 2019, as well as ten dummy variables for fixed effects of the selected welfare states.

The Multiple R of 0.803 shows a good model fit with linear relationships between Digital Public Services ($eGov$), the indicators for the independent variables Connectivity, Social Protection Benefits, Means Tested benefits and Social Protection Benefits on Family and Children (E, D, S and R) and the dummy variables for the ten cases (UK, IE, DE, FR, SE, DK, IT, ES, EE and BG). Similarly, the Adjusted R Square shows that around 62 % of the variance in eGovernment can be accounted for by the model with a SER of 7.865.

The coefficients of the independent variables display ambivalent results. As expected, Connectivity (E) has a positive effect of 0.643 and the most solid statistical indicators, a low SER of 0.49, a high t Statist 13.05 and a low P-value of 7.22^{-29}. Thereby confirming H1 that external digitalisation (E) is positively related to eGovernment progress ($eGov$).

Social Protection Benefits (D) have a smaller positive effect of 0.227 but unsolid statistical indicators with a t Stat of 1.23 and a P-value of 0.22. Thereby suggesting positive effects according to H2 that de-commodification (D) is positively related to eGovernment progress ($eGov$), which cannot be confirmed however due to unsolid statistical indicators.

Means Tested Benefits (S) also have a larger positive effect of 2.844 with two promising statistical indicators. A t Stat of 3.378 and a P-value of 0.001, as well as a weighty SER of 0.842. Thereby confirming H3 that stratification (S) is positively related to eGovernment progress ($eGov$), although less solidly than H1.

Social Protection Benefits on Family and Children (R) have an unanticipated negative effect of -2.145 with relevant statistical indicators of a t Stat of -2.005 and a P-value of 0.46, as well as substantial SER 1.069. Thereby refuting H4 that residualism towards the state (R) is positively related to eGovernment progress and suggesting a negative effect between residualism towards the state and eGovernment progress according to the null hypothesis.

Table 2: Regression with dummy variables for ten welfare states

Regression Statistics of ten welfare states, dependent variable: Digital Public Services (eGov)				
Multiple R	0.803			
Adjusted R Square	0.621			
Standard Error	7.865			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	5.138	3.492	1.471	0.143
Connectivity (E)	0.643	0.049	13.052	7.22^{-29}
Social Protection Benefits, in % of GDP (D)	0.227	0.184	1.230	0.220
Means Tested Benefits, in % of GDP (S)	2.844	0.842	3.378	0.001
Social Protection Benefits on Family and Children, in % of GDP (R)	-2.145	1.069	-2.005	0.046
UK (Liberal)	-9.097	4.172	-2.180	0.030
IE (Liberal	-2.999	4.963	-0.604	0.546
DE (Conservative)	-10.204	3.450	-2.958	0.003
FR (Conservative)	-0.876	3.307	-0.265	0.791
SE (Social Democratic)	6.278	3.294	1.906	0.058
DK (Social Democratic)	-18.351	8.465	-2.168	0.031
IT (Mediterranean)	1.736	3.159	0.550	0.583
ES (Mediterranean)	-0.722	3.220	-0.224	0.823
EE (post socialist)	23.323	3.041	7.671	6.39^{-13}
BG (post socialist)	3.303	2.975	1.111	0.268

With respect to the dummy variables for fixed effects of welfare states the results are indecisive as well. The postulated theory would expect Liberal welfare states to have the weakest effect (low de-commodification, high stratification, residualism on the market), followed by the Mediterranean and Conservative welfare states (moderate de-commodification, moderate stratification, residualism on the family). The Social Democratic welfare states should have the strongest positive effect (high de-commodification, low stratification, residualism on the state) and the Post-Socialist welfare states should have idiosyncratic effects (no specific fit for de-commodification, stratification and residualism. Although both Liberal welfare states, the UK and IE have negative effects of -9.097 with solid statistical indicators and –2.999 with unsolid statistical indicators, they are not much different from the effects of the Conservative welfare states DE with-10.204 with solid statistical indicators and FR with -0.876 with unsolid statistical indicators. The Mediterranean welfare states IT and ES showcase a surprising difference of 1.736 and -0.722, both with unsolid statistical indicators, towards DE and FR, despite their family resemblance. While SE has a positive effect of 6.278 with unsolid statistical indicators, DK has an unexpected negative and strong effect of -18.351 with solid statistical indicators. Finally, EE has a strong positive effect of 23.323 with solid statistical indicators and a BG a weaker positive effect of 3.303 with unsolid statistical indicators.

Possible patterns from these results are therefore that Liberal and Conservative welfare regimes might have a negative effect upon eGovernment progress. This could be due to low means tested benefits as reasoned with H3, or a low residualism of the state in the provision of welfare, as reasoned by the refuted H4.

For a better evaluation of these assumptions the next five sections examine the ten welfare states separately to evaluate their fixed effects in combination with their interaction effects. As more detailed interaction effects of one state out of the 28 EU MS, the regression statistics and especially the statistical indicators of the interaction effects in the following ten MLRAs are naturally less valid than the MLRA outputs of the previous *Table 2* with the ten dummy variables. This is because the fixed effects of a single country out of 28 describe more detailed effects than the effects of country wide variables or the fixed effects of all variables included in one country in *Table 2*. The depictions of the more specified interaction effects of each welfare state allow however, to further examine the assumptions made in this section. The analyses focus therefore on the interaction effects and their statistical indicators. For general fixed effects the sections refer to *Table 2,* because of the underlying stronger model. The regression statistics as well as the coefficient results of the country specific tables are just mentioned if they show a statistical significance or deviate from the findings outlined above. Otherwise the focus in the following sections lie son the dummy variables for interaction effects.

4.2. Liberal Welfare States

This section looks upon the interaction effects of the Liberal welfare states UK and IE. The following *Table 3: Regression with dummy variables for the UK* and *Table 4: Regression with dummy variables for IE* depict the MLRA outputs of the pooled analyses of the 28 EU MS between 2012 and 2019, with five dummy variables for the fixed effects and interaction effects of the UK and IE.

Table 3: Regression with dummy variables for the UK

Regression Statistics UK, dependent variable: Digital Public Services (eGov)				
Multiple R	0.721			
Adjusted R Square	0.500			
Standard Error	9.034			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9.162	3.339	2.744	0.007
Connectivity (E)	0.687	0.052	13.242	1.25^{-29}
Social protection benefits, in % of GDP (D)	0.186	0.138	1.351	0.178
Means tested benefits, in % of GDP (S)	1.074	0.314	3.427	0.001
Social protection benefits on family and children, in % of GDP (R)	-2.954	0.952	-3.101	0.002
UK	22.935	224.956	0.102	0.919
UK – Connectivity (E)	-0.081	0.590	-0.138	0.890
UK – Social protection benefits, in % of GDP (D)	-3.018	16.699	-0.181	0.857
UK – Means tested benefits, in % of GDP (S)	-3.830	49.120	-0.078	0.938
UK – Social protection benefits on family and children, in % of GDP (R)	28.813	172.074	0.167	0.867

Table 4: Regression with dummy variables for IE

Regression IE, dependent variable: Digital Public Services (eGov)				
Multiple R	0.722			
Adjusted R Square	0.502			
Standard Error	9.016			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	8.250	3.460	2.384	0.018
Connectivity (E)	0.687	0.052	13.118	3.07^{-29}
Social protection benefits, in % of GDP (D)	0.244	0.144	1.687	0.093
Means tested benefits, in % of GDP (S)	0.829	0.341	2.427	0.016
Social protection benefits on family and children, in % of GDP	-3.021	0.945	-3.196	0.002
IE	-9.871	73.710	-0.134	0.894
IE – Connectivity (E)	0.080	0.343	0.234	0.815
IE – Social protection benefits, in % of GDP (D)	1.737	18.535	0.094	0.925
IE – Means tested benefits, in % of GDP (S)	2.915	38.337	0.076	0.939
IE – Social protection benefits on family and children, in % of GDP (R)	-22.449	131.787	-0.170	0.865

The coefficients of the interaction effects of Connectivity (E) for the UK and IE show unanticipated effects. Connectivity has a slight negative effect for the UK of -0.081 and only a slight positive effect of 0.08 for IE. Thereby showing that Connectivity might affect Liberal welfare states less than its overall effect of 0.643 in *Table 2*. This indicates that H1, which assumes a positive effect of external digitalisation (E) upon eGovernment progress ($eGov$) and is confirmed with a positive general effect of 0.643 in *Table 2*, might not hold for Liberal welfare states. This could be due to a heterogeneous effect of Connectivity which differs between and within welfare state types.

Interaction effects with Social Protection Benefits (D) are negative for the UK with -3.018 in *Table 3* and positive for IE with 1.737 in *Table 4*. Thereby the interaction effects of the UK and IE are showing no associations for the relationship suggested in H2 of positive influences of de-commodification (D) upon eGovernment progress ($eGov$). This is not surprising when considering the general effect of de-commodification of 0.227 with unsolid statistical indicators in *Table 2.*

Similarly, the interaction effects with Means Tested Benefits (S) are negative for the UK with -3.83 in *Table 3* and positive for IE with 2.915 in *Table 4*. Thereby not strengthening the established H3 of a positive relation of stratification (S) and eGovernment progress ($eGov$) further. The cases of the UK and IE deviate from the general trend of 2.844 with solid statistical indicators for H3 displayed in *Table 2*.

Interaction effects with Social Protection Benefits on Family and Children (R) are positive for the UK with 28.813 in *Table 3* and negative for IE with -22.449 in *Table 4*. Although the interaction effects for Social Protection Benefits on Family and Children are much bigger than the previous interaction effects of Connectivity (E), Social Protection Benefits (D) and Means Tested Benefits (S), the SER is also greater, with 172.074 for the UK and 131.787 for IE. Thereby H4, which assumes that residualism towards the state (R) is positively related to eGovernment progress ($eGov$) and is rejected on basis of the general trend of -2.145 in *Table 2* is not refuted further on the cases of the UK and IE, despite the large coefficients for the interaction effects.

On the cases of the UK and IE the aforementioned answers, that Liberal welfare regimes might have a negative effect upon eGovernment progress which could be due to low means Tested Benefits (confirmed H3) or low Social Protection benefits on family and Children (refuted H4), cannot be further strengthened. The case studies of the UK and IE show however, that even the established positive effect of Connectivity upon eGovernment progress postulated in H1, is likely to be a heterogeneous effect which differs between welfare states and can also show negative associations as in the case of the UK. The next section investigates the interaction effects of the Conservative welfare states.

4.3. Conservative Welfare States

This section looks upon the interaction effects of the Conservative welfare states DE and FR. The following *Table 5: Regression with dummy variables for DE* and *Table 6: Regression with dummy variables for FR* depict the MLRA outputs of the pooled analyses of the 28 EU MS between 2012 and 2019, with five dummy variables each for the fixed effects and interaction effects of DE and FR.

Table 5: Regression with dummy variables for DE

Regression DE, dependent variable: Digital Public Services (eGov)				
Multiple R	0.728			
Adjusted R Square	0.510			
Standard Error	8.938			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	8.762	3.312	2.645	0.009
Connectivity (E)	0.680	0.051	13.244	1.23^{-29}
Social protection benefits, in % of GDP (D)	0.197	0.137	1.444	0.150
Means tested benefits, in % of GDP (S)	1.018	0.305	3.340	0.001
Social protection benefits on family and children, in % of GDP	-2.536	0.961	-2.638	0.009
DE	164.878	789.907	0.209	0.835
DE – Connectivity (E)	0.364	0.645	0.564	0.573
DE – Social protection benefits, in % of GDP (D)	-18.829	64.111	-0.294	0.769
DE – Means tested benefits, in % of GDP (S)	-8.801	62.440	-0.141	0.888
DE – Social protection benefits on family and children, in % of GDP (R)	115.034	435.354	0.264	0.792

Table 6: Regression with dummy variables for FR

Regression FR, dependent variable: Digital Public Services (eGov)				
Multiple R	0.722			
Adjusted R Square	0.502			
Standard Error	9.015			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9.886	3.352	2.950	0.004
Connectivity (E)	0.689	0.052	13.134	2.74^{-29}
Social protection benefits, in % of GDP (D)	0.152	0.144	1.060	0.291
Means tested benefits, in % of GDP (S)	1.032	0.308	3.357	0.001
Social protection benefits on family and children, in % of GDP	-3.030	0.943	-3.212	0.002
FR	73.633	954.096	0.077	0.939
FR – Connectivity (E)	0.537	0.552	0.971	0.332
FR – Social protection benefits, in % of GDP (D)	-8.449	77.285	-0.109	0.913
FR – Means tested benefits, in % of GDP (S)	62.769	553.269	0.113	0.910
FR – Social protection benefits on family and children, in % of GDP (R)	-18.472	123.797	-0.149	0.882

The coefficients of the interaction effects with Connectivity (E) for DE and FR show both positive effects. Connectivity has a positive effect of 0.364 for DE as shown in *Table 5* and a positive effect of 0.537 for FR as shown in *Table 6*. Thereby exhibiting that Connectivity might affect Conservative welfare states with positive effects proximate to the overall Connectivity effect of 0.643 in *Table 2*. This indicates that H1 which assumes a positive effect of external digitalisation (E) upon eGovernment progress ($eGov$) holds for Conservative welfare states.

In contrast, interaction effects with Social Protection Benefits (D) are negative for DE and FR, with -18.829 and -8.449 respectively displayed in *Table 5* and *Table 6*. These negative interaction effects suggest a negative association against the assumption of H2 that de-commodification (D) is positively related to eGovernment progress ($eGov$). This is unsurprising with respect to the unsolid statistical effects for the general effect of Social Protection Benefits in *Table 2*.

The interaction effects for Means Tested Benefits (S) are unclear for DE and FR. Whereas DE has a negative interaction effect of -8.801 in *Table 5*, Fr has a very strong positive effect of 62.769 with a high SER of 553.269 in *Table 6.* Hence, no patterns are observed for H3, that stratification (S) is positively related to eGovernment progress ($eGov$), although this effect has been confirmed with solid statistical indicators and an effect of 2.844 as a general trend in *Table 2*.

By the same token, interaction effects for Social Protection Benefits on Family and Children (R) are contradictory for DE and FR. DE displays a high interaction effect of 115.034 and a corresponding high SER of 435.354 in *Table 5,* whereas FR has an interaction effect of -18.472 presented in *Table 6.* Thereby not displaying patterns for connections between residualism towards the state (R) and eGovernment progress ($eGov$). Hence, not refuting H4 any further on the cases of DE and FR despite the statistical relevant negative general effect of -2.145 found in *Table 2*.

The cases of DE and FR hint towards negative interaction effects of de-commodification (D) Conservative welfare regimes. These negative interaction effects refute H2 on DE and FR as cases for Conservative welfare regimes. Whilst these fixed effects are contrary to the postulated expectation of positive effects for welfare regime phenomena and eGovernment progress, DE and FR show positive associations for external digitalisation (E) and therefore consolidate H1 for Conservative welfare regimes. The next section investigates the interaction effects of the two Social Democratic welfare states SE and DK.

4.4. Social Democratic Welfare States

This section looks upon the interaction effects of the Social Democratic welfare states SE and DK. The following *Table 7: Regression with dummy variables for SE* and *Table 8: Regression with dummy variables for DK* depict the MLRA outputs of the pooled analyses of the 28 EU MS between 2012 and 2019, with five dummy variables each for the fixed effects and interaction effects of SE and DK.

Table 7: Regression with dummy variables for SE

Regression SE, dependent variable: Digital Public Services (eGov)				
Multiple R	0.724			
Adjusted R Square	0.503			
Standard Error	8.998			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	11.131	3.502	3.178	0.002
Connectivity (E)	0.669	0.053	12.731	5.22^{-28}
Social protection benefits, in % of GDP (D)	0.147	0.140	1.050	0.295
Means tested benefits, in % of GDP (S)	1.182	0.324	3.652	3.27^{-3}
Social protection benefits on family and children, in % of GDP (R)	-3.288	0.954	-3.446	0.001
SE	-8.394	391.659	-0.021	0.983
SE – Connectivity (E)	0.415	0.858	0.484	0.629
SE – Social protection benefits, in % of GDP (D)	-0.200	47.469	-0.004	0.997
SE – Means tested benefits, in % of GDP (S)	-6.583	280.566	-0.023	0.981
SE – Social protection benefits on family and children, in % of GDP (R)	-1.248	537.082	-0.002	0.998

Table 8: Regression with dummy variables for DK

Regression DK, dependent variable: Digital Public Services (eGov)				
Multiple R	0.721			
Adjusted R Square	0.500			
Standard Error	9.032			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9.067	3.345	2.711	0.007
Connectivity (E)	0.692	0.052	13.315	7.30^{-30}
Social protection benefits, in % of GDP (D)	0.173	0.144	1.202	0.231
Means tested benefits, in % of GDP (S)	1.144	0.458	2.500	0.013
Social protection benefits on family and children, in % of GDP (R)	-2.983	0.983	-3.035	0.003
DK	118.093	517.597	0.228	0.820
DK – Connectivity (E)	-0.456	0.515	-0.886	0.377
DK – Social protection benefits, in % of GDP (D)	-0.301	10.054	-0.030	0.976
DK – Means tested benefits, in % of GDP (S)	-6.575	49.223	-0.134	0.894
DK – Social protection benefits on family and children, in % of GDP (R)	-1.652	56.989	-0.029	0.977

The coefficients of the interaction effects of the Social Democratic welfare states SE and DK with Connectivity (E) are reminiscent to the effects of Connectivity with Liberal welfare states. As displayed in *Table 7*, Connectivity has a positive effect of 0.415 for SE and as displayed in *Table 8*, Connectivity has a negative effect of - 0.456 for DK. In combination, the positive and negative effects suggest that Connectivity might affect Social Democratic welfare states differently. This indicates that H1, which assumes a positive effect of external digitalisation (D) upon eGovernment progress ($eGov$) and has been confirmed on the basis of the general analysis with a statistically significant effect of 0.643 in *Table 2*, might not hold for Social Democratic welfare states. This could be due to a heterogeneous effect of Connectivity which differs between and within welfare state types.

Both interaction effects with Social Protection Benefits (D) are similarly negative for SE and DK. For SE, *Table 7* displays that Social Protection Benefits have a negative effect of -0.2 and for DK *Table 8* displays a slightly bigger negative effect of -0.301. These two negative interaction effects of SE and DK are showing along with the negative interaction effects of the Conservative welfare states, negative associations contradicting the relationship suggested in H2 of positive influenced of de-commodification (D) upon eGovernment progress ($eGov$) for the Social Democratic welfare states SE and DK. This is unsurprising in context of the unsolid statistical indicators for the general effect of H2 in *Table 2*.

Likewise, there are negative interaction effects with Means Tested Benefits (S) for both SE and DK. *Table 7* displays negative interaction effects of -6.583 with Means Tested Benefits for SE and *Table 8* displays negative interaction effects of -6.575 with Means Tested Benefits for DK. Thus, not consolidating the assumed positive relationship of H3 between stratification (S) and eGovernment progress ($eGov$) found in the general analysis in *Table 2* further and suggesting arguments along the null hypothesis with negative associations between stratification and eGovernment progress for the Social Democratic Welfare States SE and DK.

With regards to the effects with Social Protection Benefits on Family and Children (R) negative effects are found for both SE and DK. For SE Social Protection Benefits on Family and Children has a negative effect of -1.248 as displayed in *Table 7* and for DK Social Protection Benefits on Family and Children has a negative effect of -1.652 as displayed in *Table 8*. Therefore, consolidating the assumed positive relationship of H4 between residualism towards the state (R) and eGovernment progress ($eGov$) further for Social Democratic welfare states on the basis of SE and DK, along with the results of the general negative effect of -2.145 in *Table 2.*

The cases of the Social Democratic welfare states SE and DK showcase along with the Liberal welfare states that the general positive effects of external digitalisation (E) differs between welfare regimes and might affect Social Democratic and Liberal welfare states without patterns, despite a general positive effect in accordance to H1. With respect to H2-4 SE and DK show the most surprising results. The fixed effects for SE and DK show negative associations towards H2, that de-commodification (D) is positively related towards eGovernment progress ($eGov$) along with negative associations towards H3, that stratification (S) is positively related to eGovernment progress. H4 is also rejected based on the interaction effects of SE and DK, which show negative associations of residualism towards the state and eGovernment progress. These fixed effects are contradicting the expectations that the extensive social policies of Social Democratic welfare regimes would have a positive influence upon eGovernment progress. The next section considers the interaction effects of the two Mediterranean welfare states IT and ES.

4.5. Mediterranean Welfare States

This section looks upon the interaction effects of the Mediterranean welfare states IT and ES. The following *Table 9: Regression with dummy variables for IT* and *Table 10: Regression with dummy variables for ES* depict the MLRA outputs of the pooled analysis of the 28 EU MS between 2012 and 2019, with five dummy variables each for the fixed effects and interaction effects of IT and ES.

Table 9: Regression with dummy variables for IT

Regression IT, dependent variable: Digital Public Services (eGov)				
Multiple R	0.721			
Adjusted R Square	0.500			
Standard Error	9.026			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9.087	3.346	2.716	0.007
Connectivity (E)	0.700	0.053	13.160	2.27^{-29}
Social protection benefits, in % of GDP (D)	0.154	0.146	1.058	0.291
Means tested benefits, in % of GDP (S)	1.034	0.309	3.349	0.001
Social protection benefits on family and children, in % of GDP (R)	-2.947	0.969	-3.042	0.003
IT	-41.860	488.232	-0.086	0.932
IT – Connectivity (E)	-0.246	0.308	-0.799	0.425
IT – Social protection benefits, in % of GDP (D)	2.456	17.404	0.141	0.888
IT – Means tested benefits, in % of GDP (S)	-4.461	14.943	-0.299	0.766
IT – Social protection benefits on family and children, in % of GDP (R)	-4.497	17.507	-0.257	0.798

Table 10: Regression with dummy variables for ES

Regression ES, dependent variable: Digital Public Services (eGov)				
Multiple R	0.721			
Adjusted R Square	0.499			
Standard Error	9.039			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	9.068	3.386	2.678	0.008
Connectivity (E)	0.690	0.053	12.918	1.33^{-28}
Social protection benefits, in % of GDP (D)	0.182	0.140	1.303	0.194
Means tested benefits, in % of GDP (S)	0.989	0.311	3.174	0.002
Social protection benefits on family and children, in % of GDP (R)	-2.938	0.964	-3.048	0.003
ES	-54.754	249.190	-0.220	0.826
ES – Connectivity (E)	0.026	0.262	0.101	0.920
ES – Social protection benefits, in % of GDP (D)	6.434	29.450	0.218	0.827
ES – Means tested benefits, in % of GDP (S)	-3.017	29.325	-0.103	0.918
ES – Social protection benefits on family and children, in % of GDP (R)	-70.045	306.765	-0.228	0.820

Like the Liberal and Social Democratic welfare states, the coefficients of the interaction effects of Connectivity (E) for the Mediterranean welfare states IT and ES showcase differing effects. As displayed in *Table 9*, Connectivity has a negative effect of -0.246 for IT and as displayed in *Table 10*, Connectivity has a slight positive effect of 0.026 for ES. In combination, the negative and positive effects suggest that Connectivity might affect Mediterranean welfare states in different ways without patterns. This indicates that H1, which assumes a positive effect of external digitalisation (D) upon eGovernment progress ($eGov$) and has been confirmed on the basis of the general analysis with a statistically significant effect of 0.643 in *Table 2*, might not hold for Mediterranean welfare states. This could be due to a heterogeneous effect of Connectivity which differs between and within welfare state types.

The coefficients of the interaction effects with Social Protection Benefits (D) for IT and ES show both positive effects. The indicator Social Protection benefits has a positive effect of 2.456 for IT as shown in *Table 10* and a positive effect of 6.434 for ES as shown in *Table 11.* Thereby exhibiting that Social Protection Benefits could affect Mediterranean welfare states positively, like the overall positive Social Protection benefits effect with insignificant statistical indicators of 0.227 in *Table 2*. This indicates that H2 which assumes a positive effect of de-commodification (D) upon eGovernment progress ($eGov$) might hold for Mediterranean welfare states welfare states. Although this statement is just made as a suggestion based on weak statistical indicators.

Both interaction effects with Means Tested Benefits (S) are negative for IT and ES. *Table 10* displays negative interaction effects of -4.461 with Means Tested Benefits for IT and *Table 11* displays negative interaction effects of -3.017 with Means Tested Benefits for ES. Thus, not consolidating the assumed positive relationship of H3 between stratification (S) and eGovernment progress ($eGov$) found in the general analysis in *Table 2* further and suggesting arguments along the null hypothesis with negative associations between stratification and eGovernment progress for the Mediterranean welfare states IT and ES, resembling the pattern found for the Social Democratic welfare states SE and DK.

With regards to the effects with Social Protection Benefits on Family and Children (R) negative effects are found for both IT and ES. For IT Social Protection Benefits on Family and Children has a negative effect of -4.497 as displayed in *Table 10* and for ES Social Protection Benefits on Family and Children has a strong negative effect of -70.045 with a strong SER of 306.765 as displayed in *Table 11.* Therefore, consolidating the assumed positive relationship of H4 between residualism towards the state (R) and eGovernment progress ($eGov$) further for Mediterranean welfare states on the basis of

IT and ES, along with the results of the general negative effect of -2.145 in *Table 2* and similar patterns found for the Social Democratic welfare states SE and DK.

The cases of the Mediterranean welfare states IT and ES showcase along with the Liberal and Social Democratic welfare states that the general positive effects of external digitalisation (E) differs between welfare regimes and might affect Mediterranean welfare states without patterns, despite a general positive effect in accordance to H1. With respect to H2 IT and ES are the only cases which have positive fixed effects according to the postulated hypothesis, that de-commodification (D) is positively related towards eGovernment progress ($eGov$). H3, that stratification (S) is positively related to eGovernment progress is along with H4, that residualism towards the State (R) is positively related to government progress rejected upon IT and ES with both negative associations of stratification and residualism towards the state. Despite a family resemblance, fixed effects are unlike the fixed effects of the Conservative welfare states DE and FR, which indicates that the selected indicators alone do not encompass all the full extent of welfare regime characteristics. The next section considers the interaction effects of the two Post Socialist welfare states EE and IT.

4.6. Post Socialist Welfare States

This section looks upon the interaction effects of the Post Socialist welfare states EE and BG. The following *Table 11: Regression with dummy variables for EE* and *Table 12: Regression with dummy variables for BG* depict the MLRA outputs of the pooled analysis of the 28 EU MS, with five dummy variables for the fixed effects and interaction effects of EE and BG.

Table 11: Regression with dummy variables for EE

Regression EE, dependent variable: Digital Public Services (eGov)				
Multiple R	0.782			
Adjusted R Square	0.595			
Standard Error	8.129			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	5.609	3.048	1.840	0.067
Connectivity (E)	0.660	0.047	14.056	3.17^{-32}
Social protection benefits, in % of GDP (D)	0.417	0.128	3.253	0.001
Means tested benefits, in % of GDP (S)	1.190	0.278	4.277	2.85^{-5}
Social protection benefits on family and children, in % of GDP (R)	-3.703	0.856	-4.327	2.32^{-05}
EE	31.176	135.420	0.230	0.818
EE – Connectivity (E)	-0.179	0.432	-0.414	0.679
EE – Social protection benefits, in % of GDP (D)	-0.711	15.393	-0.046	0.963
EE – Means tested benefits, in % of GDP (S)	-1.625	94.195	-0.017	0.986
EE – Social protection benefits on family and children, in % of GDP (R)	6.470	57.711	0.112	0.911

Table 12: Regression with dummy variables for BG

Regression BG, dependent variable: Digital Public Services (eGov)				
Multiple R	0.721			
Adjusted R Square	0.499			
Standard Error	9.038			
Observations	1120			
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	8.965	3.457	2.594	0.010
Connectivity (E)	0.690	0.053	13.132	2.78^{-29}
Social protection benefits, in % of GDP (D)	0.198	0.141	1.402	0.162
Means tested benefits, in % of GDP (S)	1.048	0.311	3.371	0.001
Social protection benefits on family and children, in % of GDP (R)	-3.127	0.953	-3.281	0.001
BG	-31.143	122.548	-0.254	0.800
BG – Connectivity (E)	0.014	0.400	0.036	0.971
BG – Social protection benefits, in % of GDP (D)	2.240	17.636	0.127	0.899
BG – Means tested benefits, in % of GDP (S)	-1.622	2.618	-0.619	0.536
BG – Social protection benefits on family and children, in % of GDP (R)	-2.314	144.621	-0.016	0.987

Like the Liberal, Social Democratic and Mediterranean welfare states, the coefficients of the interaction effects of Connectivity (E) for the Post Socialist welfare states EE and BG showcase differing effects. As displayed in *Table 11*, Connectivity has a negative effect of -0.179 for EE and as displayed in *Table 12*, Connectivity has a slight positive effect of 0.014 for BG. In combination, the negative and positive effects suggest that Connectivity might affect the EE and BG welfare states in different ways. This indicates again that H1, which assumes a positive effect of external digitalisation (D) upon eGovernment progress ($eGov$) and has been confirmed on the basis of the general analysis with a statistically significant effect of 0.643 in *Table 2*, might not hold for EE and BG. This could be due to a heterogeneous effect of Connectivity which differs between and within welfare state types.

Interaction effects with Social Protection Benefits (D) are negative for EE with -0.711 in *Table 11* and positive for BG with 0.014 in *Table 12*. Thereby the interaction effects of EE and BG are showing no associations for the relationship suggested in H2 of positive influences of de-commodification (D) upon eGovernment progress ($eGov$). This is not surprising when considering the general effect of de-commodification of 0.227 with unsolid statistical indicators in *Table 2.*

Interaction effects with Means Tested Benefits (S) for both EE and BG are negative. *Table 11* displays negative interaction effects of -1.625 with Means Tested Benefits for EE and *Table 12* displays negative interaction effects of -1.622 with Means Tested Benefits for BG. Thus, not consolidating the assumed positive relationship of H3 between stratification (S) and eGovernment progress ($eGov$) found in the general analysis in *Table 2* further and suggesting arguments along the null hypothesis with negative associations between stratification and eGovernment progress for the Post Socialist welfare states EE and BG.

The interaction effects for Social Protection Benefits on Family and Children (R) are contradictory for EE and BG. EE displays a interaction effect of 6.47 and in *Table 11,* whereas BG has an interaction effect of -2.314 displayed in *Table 12.* In that way not exhibiting patterns for connections between residualism towards the state (R) and eGovernment progress ($eGov$). Consequently, not refuting H4 further on the cases of EE and BG, despite the statistical relevant negative general effect of -2.145 found in *Table 2*.

The cases of EE and BG hint towards negative interaction effects of stratification (S). These negative interaction effects refute H3 on EE and BG and are contrary to the postulated expectations of positive effects for de-commodification and eGovernment progress ($eGov$). This possible pattern rests however on weak statistical indicators and has a low internal validity due to little coherence within the Post Socialist welfare regime category. Regarding the other three variables of external

digitalisation, de-commodification and residualism, EE and BG do not showcase patterns. The next section summarised the findings of the analysis from *Table 2* and the analyses on the cases from *Tables 3 to 12*.

4.7. Summary

This section looks upon the fixed effects of the ten cases in combination with their interaction effects to raise combined answers towards the four hypotheses. The following *Table 13: Summary of Hypotheses and Welfare Regime Patterns* summarises the MLRAs form above.

Table 13: Summary of Hypotheses and Welfare Regime Patterns

Summary of Hypotheses and Welfare Regime Patterns						
	Pooled analysis with ten cases	*Liberal*	*Conservative*	*Social Democratic*	*Mediterranean*	*Post Socialist*
H1: external digitalisation (E) is positively related to eGovernment progress ($eGov$)	0.643* (not generalisable on cases)	-0.0814 UK 0.08 IE	0.364 DE 0.537 FR	0.415 SE -0.456 DK	-0.246 IT 0.026 ES	-0.179 EE 0.014 BG
H2: de-commodification (D) is positively related to eGovernment progress ($eGov$)	0.227 (not generalisable on cases	-3.0175 UK 1.737 IE	-18.829 DE -8.449 FR	-0.2 SE -0.301 DK	2.456 IT 6.434 ES	-0.711 EE 2.240 BG
H3: stratification (S) is positively related to eGovernment progress ($eGov$)	2.844* (not generalisable on cases)	-3.83 UK 2.915 IE	-8.801 DE 62.769 FR	-6.583 SE -6.575 DK	-4.461 IT -3.017 ES	-1.625 EE -1.622 BG
H4: residualism towards the state (R) is positively related to eGovernment progress ($eGov$)	-2.145* (not generalisable on cases)	2.813 UK -22.449 IE	115.034 DE -18.472 FR	-1.248 SE -1.652 DK	-4.497 IT -70.045 ES	6.47 EE -2.314 BG
Welfare state effects (Pooled analysis with ten cases)		-9.097 UK -2.999 IE	-10.204 DE* -0.876 FR	6.78 SE -18.351 DK	1.763 IT -0.722 ES	23.323 EE* 3.303 BG
Welfare regime effects (E, D, S, R)		No pattern	Positive association of E, Negative association of D	Negative association of D, S and R	Positive association of D, Negative association of S and R	(Negative association of S, but no proper welfare regime category fit)
Welfare regime pattern on $eGov$		Negative association	Negative association	No pattern	No pattern	(Positive association, but no proper welfare regime category fit)

*statistically significant

Associations and patterns of this table are deduced if the values in a cell are either both negative, or both positive. Accordingly, the findings on basis of the MLRAs translate towards the hypotheses as follows.

H1 is confirmed with a statistically significant positive effect for external digitalisation upon eGovernment progress of 0.643. The fixed effects MLRAs suggest with statistical insignificant results that H1 might just hold steadily for Conservative welfare regimes.

H2 is just cautiously confirmed as a positive tendency with a statistically insignificant positive association for de commodification and eGovernment progress. The fixed effects MLRAs suggest with statistical insignificant results that H2 might just hold for Mediterranean welfare regimes, whereas the hypothesis is refuted on Conservative and Social Democratic welfare regimes.

H3 is confirmed with a statistically significant positive effect for stratification upon eGovernment progress of 2.844. The fixed effects MLRAs suggest with statistical insignificant results that H3 might not hold for Social Democratic and Mediterranean welfare regimes.

H4 is Refuted with a statistically negative effect for residualism towards the state upon eGovernment progress of -2.145. The fixed effects MLRAs suggest with statistical insignificant results that H4 might not hold for Social Democratic and Mediterranean welfare regimes. The next chapter uses these results of H1-4 to answer the research questions.

5. Conclusion

This chapter begins by summing up the answers for the research questions raised by the four hypotheses. Then follows the section *5.1. Implications* discusses the practical and academic relevance of the findings, before the thesis ends with the sections *5.2. Limitations* and *5.3. Future Research.*

The following answers to the research questions,

1. *What are the patterns of welfare regime types and eGovernment progress across public sectors in EU MS?*
2. *What are possible effects of welfare regime types as determinants for eGovernment progress?*

are raised. Based on the analysis, patterns for negative associations of Liberal and Conservative welfare states upon eGovernment progress are found. Statistically significant positive effects for such patterns on welfare states in the EU are external digitalisation and stratification, as well as a negative effect of residualism towards the state. On basis of the ten welfare states it is assumed that these effects have heterogeneity and affect welfare regimes differently, which can be broken down further into tendencies of,

positive associations of external digitalisation for Conservative welfare regimes;

negative associations of de-commodification for Conservative and Social Democratic welfare regimes, along with positive associations for Mediterranean welfare regimes (supported by findings of the Post Socialist states);

negative associations of residualism towards the state for Social Democratic and Mediterranean welfare regimes.

These patterns are somewhat contradictory to the theoretical working mechanism which hypothesised positive associations between the four independent variables and eGovernment progress. With the pooled MLRA of all EU MS, these positive effects are congruent with the postulated theory and confirmed for Connectivity and stratification, whereas de-commodification suggests statistically insignificant associations. While these results alone do not directly connect welfare regime types to eGovernment progress, they do offer an important baseline for the credibility of the postulated theoretical working mechanism. This is crucial because residualism towards the state has an unforeseen statistically confirmed negative effect. Paired with the ambivalent fixed effects, this indicates that the postulated working mechanisms are to some extent incorrect or incomplete. Especially the negative effect of residualism towards the state indicates that the proposed model has important restrictions, because a counterargument along the current capacity approach would reason

that a small state capacity fosters eGovernment progress through small institutional obstacles; which is be incongruent with respect to the positive effect of stratification (Stier, 2015).

More conceivable reasons for these unanticipated disparities could be that the welfare regime typology is not as apparently connected to state capacity as presumed. State capacity itself might not be enough of an explanation, or important unaccounted confounding variables are not included in the present model. With respect to the identified tendencies alternative explanations could include arguments along the following lines. Heterogeneous effects and continuous positive associations of external digitalisation for only Conservative welfare regimes might be attributed to Connectivity as a limited indicator, which only accounts for passive broadband infrastructure. Therefore, different explanations could assume that the pivotal factor of external digitalisation is the digitalisation of the private sector and human capital with spill over effects into the public sector. Further, the statistically weak positive associations of de-commodification show that the most general indicator of Social Protection Benefits does not automatically entail more administrative state capacity. For arguments along this line, more specified social expenditures like Means Tested Benefits and Social Protection Benefits on Family and Children indicate more promising results to draw upon.

Such reasons are tied to a more sophisticated theoretical framework of eGovernment determinants. Although the matches between some of the empirical indicators and the expectation deduced from welfare regime theory do not allow assumptions of causality, they do show that applying comparative political theory to the study of eGovernment determinants and PA offers valuable results. These new results, like the tendencies for stratification and residualism towards the state as possible eGovernment determinants, allow to build such advanced theoretical constructions. The academic and practical implications of these findings are discussed in the next section.

5.1. Implications

In this section the results from above are discussed with their academic and practical implications. Besides the intended academic contribution of this thesis towards newly identified eGovernment determinants, the regression results for external digitalisation effects partially contradict previous academic findings. While the overall positive effect of external digitalisation is in line with findings of previous literature, the fixed effects of welfare states suggest surprising nuances of the overall positive effects of external digitalisation for certain welfare states. This strengthens findings which argue that external digitalisation causes digitalisation in terms of services and processes, which need to be

accompanied however, by internal digitalisation forces for a holistic and sustainable digitalisation change (Mergel, Edelmann, & Haug, 2019, p. 11).

The subjected welfare regime concepts offer policymakers and practitioners in PA new contexts for comparison. Policies depend on specific conditions and are not easily adopted form one country to the next. Countries and PAs with lower eGovernment progress levels can therefore compare themselves to other countries and PAs with similar social policy systems, but more advanced eGovernment levels. For *Capgemini* for instance, the findings of this research offer a complementary policy roadmap for comparisons along the lines of *eGovernment Benchmarks* (Capgemini, IDC, Sogeti, and Politecnico di Milano, 2018). The welfare regime typology comparisons in this thesis are particularly useful because they reach further than mainstream capacity explanations, which usually rely on commonplace financial or workforce capacities as eGovernment determinants. In practical environments such capacities are often limited. The elaborated contexts of eGovernment progress and social policies offer therefore alternative approaches for comparisons and ultimately optimisations, apart from typical financial and staffing explanations.

For instance, the Social Democratic welfare states, SE, DK and Finland, often seem to be in beneficial positions in terms of eGovernment progress (Unit F.4, 2019b, p. 4). The empirics of this thesis indicate that their eGovernment progress is not necessarily due to external digitalisation and strong economic environments as pivotal determinants for their eGovernment progress but might stem from other internal digitalisation forces. It may therefore be reasonable for politicians and PAs to concentrate on internal digitalisation effects, by creating political coherence, cultural environments and comprehensive management for Digital Public Services. For policy makers this would mean to pay more attention towards tracing the processes of specified digitalisation programmes in specific areas of social policies. By looking upon the initiation of certain digitalisation programmes, the trajectories of eGovernment progress can be identified and seen why *path dependencies* according to more general digitalisation trends might occur and how a comparable digitally transformed (or untransformed) PA could look like.

When considering the finding of negative associations of residualism towards the state for Social Democratic and Mediterranean welfare regimes for example. It could be useful for policy makers in IT and ES to look at SE or DK when implementing digitalisation processes concerning Social Protection Benefits for Families and Children. Because IT, ES, SE and DK are the only welfare states that had consistently negative associations between Digital Public Services and Social Protection Benefits for Families and Children. These statistical findings hint towards similar problems that might occurred in the practical implementation. Such a practical exchange could be initiated directly, or based on

comparing key policy documents on country profiles from the DESI or eGovernment Benchmarks (Capgemini, IDC, Sogeti, and Politecnico di Milano, 2018; Unit F.4, 2014-2019). The patterns identified in this thesis therefore serve policy makers as a lens in the search of specific country templates when implementing social policies along the line of:

comparing the associations of the digitalisation of social policies related to external digitalisation and de-commodification between DE and FR;

comparing the associations of the digitalisation of social policies related to de-commodification, stratification and residualism towards the state between SE and DK;

comparing the associations of the digitalisation of social policies related to de-commodification, stratification and residualism towards the state between IT and ES.

Although the findings in this section show that such recommendations are raised cautiously, the theory guided comparisons do not entail major drawbacks if qualitative country specific comparisons are considered in practical contexts as well. In that case the patterns and effects identified in this thesis offer promising search guidelines for comparable cases and precedent cases of digitalisation of certain social policy fields between certain countries. This offers guidance towards more explicit solutions for comparable country specific digitalisation approaches.

5.2. Limitations

The above-mentioned results and implications bear four notable limitations. First, the outcomes of the fixed effects approach suggest a heterogeneity of the effects of the independent variables upon different welfare states. While this creates opportunities to examine patterns, the weak statistical results and European perspective of the fixed effects show that these patterns cannot purely rely on statistical indicators and need firmer theoretical explanations.

Second, the analysis did not consider temporal effects. It might well be that eGovernment develops differently at certain phases. Like a snowball effect, eGovernment progress could speed up after certain path dependent levels have been established (Karpf, 2012, pp. 655–656). Such differing speeds and phases of eGovernment progress are not accounted for in the results of this thesis.

Third, as a statistical analysis of eGovernment determinants, the outputs from the analysis suffers from a crucial limitation regarding the disparity between indicators and outcomes. The empirical MLRAs only measure outputs and do not capture outcomes such as the real importance of eGovernment for PAs, the public service delivery and its usage by citizens (Mergel et al., 2019; Yildiz,

2007, pp. 659–661). In other words, eGovernment progress differs from eGovernment benefits and more eGovernment does not automatically equal an improved public service provision. For a more meaningful examination of eGovernment it is necessary to consider digital transformation in the public sector with a more comprehensive approach along with multiple indicators, including service delivery and citizens perspectives as important stakeholders and reasons for digitalisation changes.

Fourth, variances in eGovernment are likely to differ across public sectors. With a primary focus upon social services, eGovernment of sectors such safety or security is not considered. There might be public sectors with different likelihoods to adapt ICT (Mergel et al., 2019, p. 12). The welfare regime typology does not offer a sensibility of such differences.

Due to these reasons, the results of this thesis must be regarded as preliminary and should be revisited with newer data to replace the artificially calculated values to solidify or falsify the assumed tendencies. The next section suggests steps for future research to do so.

5.3. Future Research

Currently, the precise causal working mechanisms behind eGovernment determinants remain vague. Building on the theoretical and empirical foundations of this EU comparison, logical next steps for further research along the line of this thesis could be to re-examine the suggested associations with expanded data on other countries or new data. The findings of this thesis would also benefit from complementary examinations of internal digitalisation forces of eGovernment progress and welfare regime types with the help of mixed methods, such as process tracing, qualitative policy analysis or interviews with officials, users and experts. Such studies could focus on more in-depth examinations of effects for specific welfare regimes, e.g. examinations why Connectivity just shows consistently positive associations for Conservative welfare regimes. Finally, the presented and calculated effects in this thesis offer starting points for further research into the capacity approach combined with the welfare regime typology (Shadish, Cook, & Campbell, 2002).

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