BI Norwegian Business School - campus Oslo

GRA 19703

Master Thesis

Thesis Master of Science

The Winners and Losers of COVID-19 - A Global Comparative Study

Navn: Ine Kristine Helgå Lading

Start: 15.01.2021 09.00

Finish: 01.07.2021 12.00

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Lading, Ine Kristine Helgå

MSc in Business - Economics

July 1st, 2021

Abstract

Determinants explaining country-level success and failure when handling COVID-19 are disputed. The gender of state leaders, political affiliation and stringency of containment measures have all been argued as potential elements to maneuver a country successfully through the crisis. This study aims to identify which variables best explain the variance in success when handling the pandemic, empirically substantiating the classification of winners from losers. The estimated results show that female state leaders and political center catch-all governments have performed significantly better than their counterparts, when defining success to be the product of human and economic health. Stringent containment measures are found to have an overall detrimental impact on success, while simultaneously being the variable explaining the largest variation in success.

Supervised by

THORSRUD, LEIF ANDERS

Preface

This master thesis has been carried out at the Department of Economics at BI Norwegian Business School, from August 2020 to July 2021. Writing a master thesis from a kitchen table during lockdown has been a challenge, and I could not have done it without the support that I have received the past year. I would like to thank my supervisor, Leif Anders Thorsrud, for his guidance and candid feedback throughout this period. Thank you also to my dearest friend, classmate and assistant supervisor Hannah Victoria Christiansen, for meeting me weekly to criticize my work over countless cups of coffee and cinnamon buns. Last but not least, thanks to Sander Fagerland Sandøy for his endless love and support, and for being the best home office colleague.

Contents

1 Introduction

1.1 Background

The Coronavirus pandemic has permeated the world in unprecedented ways. Since the first reported case in Wuhan, China, the virus has spread to nearly every country in the world, imposing 85 million cases and 2 million deaths within the first year (World Health Organization, 2021). [1] The pandemic has generated the greatest exogenous shock to the economy since World War II, imposing a dramatic fallback erasing years of progress towards UN development goals, ultimately pushing millions of people back into extreme poverty (The World Bank, 2020a)

When a pandemic unravels across continents, and the number of infected and deceased increase exponentially in an extraordinary pace, the level of crisis preparedness is gravely put to the test. In retrospect it is tempting to point out how countries should have been better prepared to handle COVID-19, considering that although the crisis is unparalleled, it is far from the first influenza pandemic (Tognotti, 2009). The Norwegian Directorate for Civil Protection published a risk analysis report in 2014 stressing how a pandemic was the most likely crisis to strike Norway, a statement they reinforced in a crisis report five years later (Norwegian Directorate for Civil Protection, 2014, 2019). This was also highlighted by the 2018 Worldwide Threat Assessment report, stating that a pandemic was a major threat that has the potential to spread rapidly and kill millions (Senate Select Committee on Intelligence, 2017). Despite this major threat and the repeated warnings about the likelihood of it, the global preparedness report published in 2019 exposed how all countries were overall poorly prepared for a pandemic (Global Preparedness Monitoring Board, 2019). Former Norwegian Prime Minister Gro Harlem Brundtland contributed to the report and has since the advent of COVID-19 described it as *"an announced crisis"* (Haugstad, 2020).

[1] 184 countries have reported COVID-19 cases, 11 countries have no reported incidents.

Countries also had their pandemic preparedness assessed by the Global Health Security Index (2019) prior to the COVID-19 outbreak. The two most prepared countries were identified to be the USA and the UK, while New Zealand was ranked 35th on the index. Being well prepared on paper seems to be relatively irrelevant to how countries perform in the real world, and while the USA and the UK has been criticized for their pandemic response, New Zealand have been applauded for theirs (Pandey, 2021; Yamey & Wenham, 2020).

In response to the pandemic, governments have put in place a wide range of invasive measures to slow down transmission and reduce mortality. While people around the world have been trying to make sense of threats posed by the virus, decision makers have been expected to limit risks to health and livelihoods – containing virus transmission while also protecting the economy. Sustaining the global economy in a period where a dual shock has shifted economic output to an absolute minimum is however, clearly difficult (Del Rio-Chanona et al., 2020).

A key political issue has been the extent to which health outcomes should be weighed against the economic costs related to lockdowns and other virus suppression measures. This broadly debated health economy trade-off confronts policy makers with two evils, enforcing a choice between the severity of the economic recession and the health consequences of governmental interactions. Protecting the economy and accepting uncontrolled transmission could lead to excess all-cause mortality and overwhelmed health systems. On the other hand, enforcing stringent lockdown could leave the economy in total collapse. This health economy trade-off is disputed, and several studies find that countries experiencing the largest economic declines, such as Peru, Spain and the UK, are generally among the countries with the highest COVID-19 death rate (Alvelda et al., 2020; Hasell, 2020). Other studies find that the countries that reduce infections by imposing stringent lockdowns also experience large recessions (Sandri & Grigoli, 2020). Based on these studies, containment measures seem to involve an inevitable short-term economic sacrifice, however, there is no clear agreement in the current literature about the long run effects.

Literature has also been published on several other elements that have protruded as potential causes for success when handling the pandemic. The most preeminent being the differences between countries led by female state leaders, and those led by men. Another interesting component has been the deliberation of political affiliation and whether there has been a significant difference in success between countries led by liberal or conservative governments. Finally, the variation in stringent containment measures has been a focal point since the outbreak of the pandemic.

In the early hindsight of the pandemic, the results of different approaches slowly emerge, and questions arise; *why did some countries fail while others succeeded when handling the pandemic, and what ended up being determinants of success?* My thesis will thus tie all these interesting suppositions together, with the ambition of separating pandemic winners from losers and thereby pinpointing what elements contributed to either success or failure.

1.2 Goals and Research Questions

Garikipati and Kambhampati (2020) find that female-led countries have performed better than countries led by men during the pandemic. Conversely, Dr. Ruth Carlitz at Tulane University find that it is not gender but political affiliation that determines a country's pandemic performance (Taub, 2020). A third perspective is how Hale et al. (2020) find that government stringency is significantly related to COVID-19 deaths, and that stringency has an important impact on the pandemic performance of a country. My thesis will tie all these arguments together, and study them as a conglomerate. Multiple relations already drawn by previous literature will thus be combined and studied as a whole. The goal is thereby to offer valuable contributions within primarily economics and political science. Based on the literature reviewed for this thesis, this has never been done before in light of COVID-19 and will be a new contribution to the literature.

To elaborate the goal further, I will investigate the direct relationship between state leadership and the subsequent country performance during COVID-19. Country characteristics such as gender of the state leader, political orientation of governments and policy stringency are analyzed collectively. The thesis extends existing research on gender and leadership in political science while also contributing to research on political affiliation in pandemics – in the context of economics and public policy.

Finally, the purpose of this thesis is to explore the relationship between various country characteristics and identify which of these variables explain the largest variance in success when handling COVID-19. The goal is to distinguish those characteristics that are coupled with pandemic success, and those that are associated with pandemic failure. My hope is that this will serve as a signal for withstanding pandemics, and that the study can find a common denominator that could facilitate economic prosperity in tandem with health objectives for future pandemics. This leads to the following research questions for the study:

Primary research question

"What strategies and characteristics led countries to succeed or fail when handling COVID-19?"

Secondary research question

"Out of the composition of explanatory variables in focus, which variable can best explain the variance in success when handling COVID-19?"

2 Literature Review

The initial focus throughout this literature review is identifying what characteristics lead countries to succeed or fail when handling COVID-19 while recognizing common agreements and disagreements between researchers on the topic. Moreover, the literature review seeks to uncover any unclear issues from which the thesis can clarify and propose solutions.

The COVID-19 pandemic is not the first crisis to deluge the world, neither is it likely to be the last. It would be ignorant to judge all crises alike, and this crisis is different from previous pandemics in many ways. Considering the subjects in focus, COVID-19 is different from previous crises much because for the first time in the history of pandemics, there is arguably a large enough sample size of female-led countries to compare to those led my men. Out of 196 countries, 24 are led by women during the period of interest.[2] As the outbreak gradually reached more parts of the world, the relationship between female state leaders and their strategy to handle the pandemic received increasingly more attention (Lewis, 2020; Taub, 2020; Wittenberg-Cox, 2020). A study by Garikipati and Kambhampati (2020) use insights from behavioral studies and leadership literature to find that COVID-19 outcomes are systematically better in countries led by women and that this, to some extent, may be explained by the proactive and coordinated policy responses adopted by them. The bold claim asserted in their study is based on "success" being entirely health related, focusing on the rate of mortality and infections. Additionally, the study was published at an early stage in the pandemic and is thus based on data merely from the first quarter.

On the contrary, critics argue that there must be other causes than the X chromosome determining COVID-19 success. Lewis (2020, para. 11) points out that

[2] Taiwan in addition to the 195 countries that are officially recognized by the UN; Period of interest is January to December 2020. See appendix A, table A.1: *Women Government Leaders*.

"the kind of person who becomes a senior politician is, by definition, unusual", and that any woman that succeed as such is likely to be exceptionally tough and determined to rise the ranks. Lewis also highlights how New Zealand's Jacinda Ardern and Canada's Justin Trudeau sell themselves on social and environmental awareness and ability to communicate sensitively with minority groups, a common trait that in many ways make them similar leaders despite their genders. The argument is thus that the debate should not be about gender but rather on leadership styles.

The research largely inspired this thesis to examine if gender could be a determinant for leading a country successfully through COVID-19, when redefining success to include both human and economic health. The variable extracted from this motivation is thereby *the gender of state leaders,* and its ability to explain variance in success.

Evidence from the United Kingdom and the United States are primary sources of motivation to the second variable in focus. First, a study by Mellon et al. (2020) applies British Election Study data from June 2020 to find that left-wing voters are typically more willing to make economic sacrifices to reduce COVID-19 infections. On the contrary, authoritarian voters support draconian measures such as fines and imprisonment of those who violate quarantine rules. The study puts further emphasis on how the Conservatives in the UK government is placed in a difficult position, alienating the core economic right-wing voters when imposing restrictions to reduce infections. The latter points to the previously mentioned health economy trade-off. Second, when researching lockdown differences in the United States, Dr. Ruth Carlitz of Tulane University found no significant difference among men and women. However, she argues that this gender effect could have been muffled by the "all-consuming power of political partisanship" (Taub, 2020, para. 13). Her analysis found a political relationship to pandemic success, where Republican governors, despite gender, took longer to impose lockdowns than their Democratic counterparts. This research was conducted at U.S. regional level and can be affected by the political affiliation of the 2020 incumbent president.[3] However, the result indicates that political conviction could have been a determinant for success during COVID-19. This motivates my research to test if the relationship is significant on a global level, identifying whether the *political orientation* of governments can explain variations in COVID-19 success.

Lastly, the third variable in focus throughout this study is based on discussions considering stringency of policies and the effect these have had on human and economic health. Hale et al. (2021) have developed the Oxford COVID-19 Government Response Tracker, a database where the stringency of policies imposed by governments are measured throughout the pandemic. This quantitative measure of stringency has contributed to great discussion among researchers, whereas some find stringency to be a determinant for success while others disagree. Hale et al. (2020) study the relationship between the stringency index and COVID-19 deaths, and find that a lower degree of government stringency and slower response times were associated with more deaths from the virus. Maloney and Taskin (2020) find voluntary social distancing to reduce mobility more than governmental lockdown directives, and exemplify this by showing that the fall in restaurant reservations in the United States and movie spending in Sweden occurred before the imposition of any non-pharmaceutical interventions. Cross et al. (2020) argue that it is not the stringent policy itself but the timing of it that matter the most, and that stringency has a greater effect on GDP than it has on infection rates. This view is shared by Koh et al. (2020) who highlight examples from Hong Kong and Brunei where they argue that containment is feasible at a moderate level of stringency, if the measures are imposed at an early stage. These arguments motivate *stringency of containment measures* as the last variable of interest in this thesis.

There are naturally many compelling factors that should be considered when delving into the different ways that countries have grappled COVID-19. The outcome of an

[3] This is a working paper and is not peer-reviewed per June 2021.

exogenous shock such as a pandemic is a complex conglomerate built upon numerous factors, in which this thesis aims to include the essential determinants while omitting the excess elements. For the feasibility of this study, it will thereby be necessary to restrict the field of research, which is done by focusing primarily on the three highlighted variables above – gender of state leaders, political orientation, and stringency of policy. As described, these specific variables are chosen because existing literature highlight them as potential determinants explaining COVID-19 performance. My perspective is new as it compiles these variables, whereby I analyze them collectively, in addition to applying updated data from all quarters of 2020. The data assembled to accomplish this is described in more detail in chapter 3.

3 Data

The empirical data utilized in this thesis is collected from several databases. For the feasibility of the study the period of interest is limited to January 1st to December 31st, 2020. A dataset is constructed by merging the three variables in focus together with several control variables, all of which are presented in appendix A, table A.2.

The dataset consists of repeated cross sections over time, with variables of 63 countries collected Q1 through Q4, 2020.[4] This type of data is referred to as panel data, and considering all variables are collected for every country each quarter, the panel is balanced (Wooldridge, 2016).

3.1 Description of Variables

This section describes the data that will be analyzed throughout this study. I will start by providing rationale for including the chosen variables before explicating the different data types. Lastly, summary statistics will be presented to outline the range of datapoints.

In addition to the three primary variables presented and rationalized in chapter 2, several control variables are included in the dataset. These are applied to control for country-specific demographics, political systems, and economic characteristics. Control variables such as population size, political systems, continents and economic development are motivated by the COVID-19 performance study by Leng and Lemahieu (2021), whereby they include all these to investigate correlations to their performance index. Population density and the Human Development Index is chosen as controls by inspiration of Liu et al. (2020), whom finds an unexpected positive

[4] The four quarters of 2020 is comprised to three periods when stringency is lagged *t-1* periods. Stringency is thus included as Q1-Q3, while all other variables are included as Q2-Q4, 2020.

correlation between HDI and the risk of virus infections and deaths. Aldrich and Lotito (2020) suggest female share in legislatures as an important control variable for estimations looking at women leaders in the COVID-19 crisis. Given similar perspectives, I chose to include this variable in my analysis as well. Lastly, debt to GDP ratio and GDP per capita are enclosed to control for economic characteristics in each respective country. This is motivated by several akin studies that apply similar economic controls, in particular Hasell (2020); Pardhan and Drydakis (2020).

The variables are both numerical and categorical and will be presented as such in section 3.1.2 and 3.1.3. The categorical variables include nominal and ordinal data, all of which are decoded to dummy variables.[5]

3.1.1 Definition of Success

The success rate is derived as the product of normalized quarterly percentage change in seasonally adjusted GDP growth and the normalized health performance index.[6]

$$\text{success}_{\text{it}} = performance_{it}^{normalized} * GDP\ growth_{it}^{normalized} \quad \textbf{(i)}$$

$$\text{such that } 0 \leq \text{success} \leq 1$$

To elaborate the definition of success further; equation (i) presents a country's success rate as the product of normalized health performance and normalized quarterly percentage GDP growth, seasonally adjusted. A particular cross section observation is included with the subscript i while the time periods are denoted t. A high degree of success is thus the tandem of maximizing the pandemic health performance and percentage change in GDP growth in the period. A low degree of success is the reverse, minimizing the health performance and the percentage GDP growth.

[5] All dummy variables exclude a baseline-category to avoid a dummy variable trap.

[6] See health performance definition in section 3.1.2.

As opposed to previous studies, my measure of success is new and unprecedented within the literature on COVID-19. Existing literature commonly study a purely economic or solely health related outcome variable. Deriving my own measure of success that incorporates both perspectives separate my outcome variable from current literature. The success index ranked by countries is included for Q2, Q3 and Q4 2020 in appendix B, table A.8 – A.10.

3.1.2 Numerical Variables

i) Detailed Description

Health Performance: Leng and Lemahieu (2021) published a Covid performance index, January 2021. The index reflects how 102 countries have managed the pandemic during the 43 weeks following their hundredth confirmed case of COVID-19. Six different measures were tracked in the period, using fourteen-day rolling averages of new daily figures: Confirmed cases, confirmed deaths, confirmed cases per million people, confirmed deaths per million people, confirmed cases as a proportion of tests and tests per thousand people. An equally weighted average of the rankings across these indicators is calculated and normalized to produce a score from 0 to 100.

Health Performance Normalized: The health performance index is normalized to be a number $\in [0,1]$. This is done to achieve comparability with normalized GDP growth, so that the two variables can easily be multiplied to form the success index, as illustrated in equation 3.1.1 (i) above. Motivation to normalize the data is drawn from Lakshmanan (2019). His article suggests normalization to convert different data to a common scale. Thus, the data is normalized according to equation (ii), resulting in high performance scores closer to 1 and low scores closer to 0.

$$Performance_i^{normalized} = \frac{max(performance) - performance_i}{max(performance) - min(performance)} \quad \textbf{(ii)}$$

Stringency Index: Data on containment measure stringency is extracted from the Oxford COVID-19 Government Response Tracker. The calculation of this index is based on 19 indicators such as school closures and travel restrictions, indexing countries on a scale from 1 to 100 (Hale et al., 2021). The variable is lagged throughout the analysis to reduce the risk of simultaneity. Replacing a suspected simultaneously-determined explanatory variable with its lagged value is a common practice in applied econometrics, and even though it cannot guarantee the removal of simultaneity, it can reduce the simultaneity bias (W. Robert Reed, 2014). The maximum stringency is extracted per quarter for each country to transform the data from daily to quarterly frequency.

Population Density: The variable is derived as the number of people in a country divided by land area, measured in square kilometers, from the most recent year available. The data is collected from the World Bank World Development Indicators, sourced from Food and Agriculture Organization and World Bank estimates (Roser et al., 2020).

Human Development Index (HDI): A composite index measuring average achievement in three basic dimensions of human development—a long and healthy life, knowledge, and a decent standard of living. Data from 2019 (United Nations Development Programme, 2019).

Female Share in Legislatures: The variable is derived as a weighted average of parliamentary seats in a single or lower chamber held by women (IPU Parline, 2020).

COVID-19 infections per Million: The data portrays quarterly cumulative cases of COVID-19 per million people in each country and is collected from the Health Emergency Dashboard of the World Health Organization (2021).

Debt to GDP Ratio: The variable compares a country's public debt to its gross domestic product (GDP). This ratio indicates a particular country's ability to pay back its debts (World Population Review, 2021).

GDP Growth Rate: The GDP growth rate is measured as percentage change quarter-on-quarter, the data is seasonally adjusted and based on market prices using constant local currency. Aggregates are based on constant 2010 U.S. dollars. The data is calculated as the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. The derivation is done without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. The data is World Bank National Accounts data, OECD National Accounts data files and The Global Economy database (*Real GDP growth, annual percent change*, 2020; The Global Economy, 2021).

GDP Growth Rate Normalized: As with health performance, the percentage change in GDP growth is normalized to be represented as positive values between 0 and 1. The rationale behind this normalization is the same as for health performance, more specifically I want to enable easy multiplication of health performance and GDP growth to form the success variable. This normalization is different from the previous in equation (ii) as GDP growth consists of both positive and negative data. I handle this issue by subtracting the maximum absolute value from each datapoint, making all data positive. After this, the data can be normalized according to equation (iii). Thus, high economic growth is closer to 1 while the largest economic declines are closer to 0.

$$GDP\ growth_i^{normalized} = \frac{(GDP_i - |min(GDP)|) - min(GDP)}{max(GDP) - min(GDP)} \quad \textbf{(iii)}$$

GDP per Capita: GDP per capita is the gross domestic product, as derived and explained above, divided by the midyear population in each respective country.

GDP per Capita Growth: Annual percentage growth rate of GDP per capita is based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. The growth is calculated as the average GDP per capita growth rates from 2017, 2018 and 2019. This variable is helpful to indicate what tendency the individual economies has had the years prior to COVID-19 (World Bank National Accounts, 2019).

ii) Summary Statistics

Table 3.1.2: Summary Statistics for numerical variables

Factor	Min.	Max.	Mean	Median	Std.
Success	0.00	0.65	0.23	0.21	0.14
Performance	4.30	94.40	49.72	46.30	21.49
Performance (norm)	0.00	1.00	0.50	0.47	0.24
Stringency	23.15	100.00	73.48	76.85	17.00
Population Density	3.08	7,915.73	318.00	96.25	1,016.96
HDI	0.51	0.95	0.83	0.86	0.11
Female Share in Leg.	0.10	0.61	0.29	0.28	0.12
Infections per Million	18.77	60,606.91	11,016.76	4,331.75	14,823.39
Debt/GDP	0.08	2.38	0.63	0.56	0.38
GDP growth	-25.90	23.70	-0.03	1.10	8.83
GDP growth (norm)	0.00	1.00	0.46	0.45	0.17
GDP per capita	1,697.71	85,535.38	29,788.52	28,383.00	17,192.09
GDP per capita growth	-2.09	5.94	2.23	1.89	1.78

3.1.3 Categorical Variables

i) Detailed Description

Gender of state leaders: The gender of each country's head of state is collected from CIA Chiefs of State and Cabinet Members of Foreign Governments website (*World Leaders All Foreign Governments*, 2020). The state leader is defined as head of state and/or head of government, and includes presidents, prime ministers, and de facto state leaders.[7]

Political Orientation: Political orientation statistics are retrieved from Scartascini et al. (2018), where governments are categorized on a left-right axis. All countries are in addition manually checked for 2020 changes and updated accordingly. The three following categories are used:

- **Right-wing:** Parties defined as conservative, Christian democratic or right-wing.
- **Left-wing:** Parties defined as communist, socialist, social democratic or left-wing.
- **Center:** Parties defined as catch-all or centrist (e.g., party advocates strengthening private enterprise in a social-liberal context).

Political System: A political system is by Heslop (2020) defined as the set of formal legal institutions that constitute a "government" or a "state." Countries will be categorized as the following:

- **Democracy:** Definition by Merriam-Webster (2021b), democracy is a government in which the supreme power is vested in the people and exercised by them directly or indirectly through a system of representation usually involving periodically held free elections.
- **Authoritarian:** Definition by Merriam-Webster (2021a)**,** an authoritarian regime is the favoring of a concentration of power in a leader or an elite not constitutionally responsible to the people.
- **Hybrid:** A hybrid regime is the balance of a democratic and an authoritarian regime, or regimes that do not fit merely under one label. Examples are Turkey, Uganda and Ukraine (The Economist Intelligence Unit, 2019).

[7] See appendix A, table A.1: Female State Leaders 2020.

Continent: Continents included in the study are Europe, Asia, North America, South America, Africa and Oceania.

Population Size: Total population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship. The collected data are 2019 midyear estimates from The World Bank (2020b). From this, countries are divided into one of the following population size groups:

- **Large population** $>$ 100,000,000 people
- **Medium population** $\in$ [10,100] million people
- **Small population** $<$ 10,000,000 people

Economic Development: This variable is a measure that is intended to reflect basic economic country conditions (UN Department of Economic and Social Affairs, 2021). Countries are classified as the following:

- **Advanced Economy:** A developed or industrialized economy generally has a high quality of life and advanced technological infrastructure relative to other less industrialized nations.
- **Developing Economy:** A developing economy generally has a less developed industrial base and a low Human Development Index relative to other, more advanced economies (UN Department of Economic and Social Affairs, 2021).

ii) Summary Statistics

Table 3.1.3: Summary of Categorical variables

Factor	N
Gender	
Female	15
Male	48
Political Orientation	
Left-Wing	21
Right-wing	27
Center	15
Political System	
Democracy	55
Authoritarian	4
Hybrid	4
Continent	
Europe	32
Asia	13
North America	6
South America	4
Africa	6
Oceania	2
Population Size	
Large	8
Medium	28
Small	27
Development	
Advanced Economy	34
Developing Economy	29

4 Methodology

This chapter will present the research methods that are used to answer the respective research questions presented in chapter 1. Moreover, this section will explicate how the relevant models was identified and justify the choice of these.

4.1 Model Estimation

The preeminent estimation method used throughout this study is pooled OLS.[8] The main empirical model I use can be written as follows:

$$y_{it} = \beta_0 + X_{it}\beta + v_{it}, \qquad t = 1,2,3 \qquad \textbf{(i)}$$

$$v_{it} = c_i + u_{it} \rightarrow \text{composite error term} \qquad \textbf{(ii)}$$

Here, y_{it} is the dependent variable, X_{it} is a vector of explanatory variables measured at time t, β_0 is the estimated intercept and β is the estimated coefficient. A particular cross section observation is included with the subscript i while the time periods are denoted t. The time subscript is not included for estimations where the variables are time-constant. Equation (i) will be the baseline for the pooled OLS estimation, where (ii) is the composite error term. The c_i is the unobserved effect drawn along with the observed data, this effect will not vary over t. The u_{it} represents idiosyncratic errors that vary over i and t.

In addition to pooled OLS, Fixed effects (FE) and random effects (RE) estimation will follow as two additional tests of robustness in chapter 6.

How to estimate equation (i) depends primarily on whether X_{it} is correlated with c_i or not. Estimation by pooled OLS is appropriate when assuming that the regressors

[8] The estimation method is justified in section 4.4.

are uncorrelated with the unobserved component c_i.[9] Estimation by pooled OLS will give consistent estimates of β if the assumptions $\mathrm{E}[X_{it}c_i] = 0$ and $\mathrm{E}[X_{it}u_{it}] = 0$ holds (Biørn & Nymoen, 2010). However, estimation by pooled OLS will ignore the panel data structure of the data, which is a rationale for including FE and RE estimation to check robustness of the panel data (Schmidheiny, 2020). The FE framework allows regressors to be correlated with the unobserved component c_i and can be estimated with within estimation.[10] The estimation methods are rationalized explicitly in section 4.4 - 4.6.

The models will be estimated stepwise. First, I will estimate variable pairs in three separate regressions, applying bivariate pooled OLS regression. Next, the model will be expanded to include all relevant explanatory variables and controls in a multiple pooled OLS. Lastly, I will apply pooled OLS to estimate the cumulative parameters.

As suggested by Grace-Martin (2010), the rationale behind initiating a bivariate regression prior to including all variables in a multiple regression, is to unveil relationships between variable pairs. These ties can disappear or reemerge in new ways when considering all variables in one model. I find it interesting to investigate how these relations potentially change and will therefore include both methods. The cumulative model is included to explore the estimated relationships more in dept, while also looking at the importance of time periods. All versions of these three estimation models are presented below.

Equations for pooled bivariate regression:

$$success_{it} = \beta_0 + gender_i\beta \; + v_{it}, \qquad \mathbf{(1.a)}$$

$$success_{it} = \beta_0 + political\_left_i\beta \; + \; political\_right_i\beta \; + v_{it}, \qquad \mathbf{(1.b)}$$

$$performance_{it} = \beta_0 + stringency_i\beta \; + v_{it}, \qquad \mathbf{(1.c)}$$

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[9] RE framework: $\mathrm{E}(c_i|X_{i1}, \dots, X_{iT}) = \mathrm{E}(\mathrm{c_i})(= 0)$

[10] $FE\ Framework$: $\mathrm{E}(c_i|X_{i1}, \dots, X_{iT}) \neq \mathrm{E}(c_i)$

Equation for pooled regression with all variables:

$$success_{it} = \beta_0 + gender_i\beta + political\_left_i\beta + political\_right_i\beta + stringency_{it-1}\beta + controls_i\beta + v_{it}, \qquad \mathbf{(2)}$$

Equation for cumulative pooled regression:

$$success_{Q2} = \beta_0 + gender_i\beta + political\_left_i\beta + political\_right_i\beta + stringency_{iQ1}\beta + controls_{iQ2}\beta + v_{it}, \qquad \mathbf{(3.a)}$$

$$success_{Q2+Q3} = \beta_0 + gender_i\beta + political\_left_i\beta + political\_right_i\beta + stringency_{iQ1}\beta + controls_{iQ2}\beta + v_{it}, \qquad \mathbf{(3.b)}$$

$$success_{Q2+Q3+Q4} = \beta_0 + gender_i\beta + political\_left_i\beta + political\_right_i\beta + stringency_{iQ1}\beta + controls_{iQ2}\beta + v_{it}, \qquad \mathbf{(3.c)}$$

Robustness in chapter 6 will be estimated by FE and RE estimation, in addition to bivariate pooled OLS. The rationale for choosing these methods is provided in section 4.5 and 4.6. The following models will be applied:

Equation for FE regression (robustness):

$$success_{it} = stringency_{it-1}\beta_1 + c_i + u_{it}, \qquad \mathbf{(4)}$$

Equation for RE regression (robustness):

$$GDP\ growth_{it} = stringency_{it-1}\beta + v_{it}, \qquad \mathbf{(5)}$$

Equation for pooled OLS regression (robustness):

$$performance_{it} = \beta_0 + \text{gender}_i\beta + v_{it}, \qquad \mathbf{(6.a)}$$

$$GDP\ growth_{it} = \beta_0 + \text{gender}_i\beta + v_{it}, \qquad \mathbf{(6.b)}$$

$$performance_{it} = \beta_0 + \text{political\_left}_i\beta + \text{political\_right}_i\beta + v_{it}, \qquad \mathbf{(7.a)}$$

$$\text{GDP growth}_{it} = \beta_0 + \text{political\_left}_i\beta + \text{political\_right}_i\beta + v_{it}, \qquad \mathbf{(7.b)}$$

4.2 Endogeneity

The problem of endogeneity is an important aspect to deliberate in order to estimate the model correctly. Wooldridge (2016, p. 848) defines endogeneity as *"a term used to describe the presence of an endogenous explanatory variable"* which ultimately can result in biased coefficient estimates.[11] In this specific study, the endogeneity issue can distort the results due to reverse causality, simultaneity, self-selection or omitted variables.

Reverse causality could occur for several reasons. First, Lewis (2020) points out how female state leaders could be the symptom of a political system's success, not necessarily the cause of the success itself. Kathleen Gerson, a sociology professor at NYU, told The Guardian that women find gaining power easier in *"a political culture in which there's a relative support and trust in the government"* (Henley & Roy, 2020, para. 23). This raises the question of whether the gender of the state leader has an impact on pandemic success, or whether the gender of the state leader is merely a reflection the preexisting political culture in a country that in its way impacts pandemic success.

Simultaneity is assumed to be present between stringency and success, where the increase in stringency is likely to cause changes in success, and changes in success is expected to cause changes in stringency. As described in section 3.1.2, stringency is therefore lagged to reduce the issue of simultaneity.

Endogeneity due to self-selection could arise if e.g., women self-select into certain types of governments, whereby it becomes more likely that governments focusing on specific core issues attracts higher female participation. For example, if governments

[11] The assumption of zero conditional mean states that the error term has an expected value of zero given any values of the independent variables: $E(u|x1, x2, \dots, xk) = 0$. When the assumption holds, we argue to have exogenous explanatory variables. However, when the error term (u) correlates with at least one of the independent variables we argue that we have a endogenous independent variable, which may result in biased OLS estimators (Wooldridge, 2016).

focusing heavily on healthcare attract more female politicians, it could be the healthcare focus succeeding in crises, rather than the gender of politicians. Control variables on female share in legislatures and political systems are included to mitigate this endogeneity issue for the gender of state leaders.

Lastly, an omitted variable problem may occur if the estimated model excludes relevant variables either due to ignorance or limited data (Wooldridge, 2016). It is fair to assume that the extent of relevant variables for this study is immensely broad, and the omitted variable bias therefore could occur due to leaving out unobservable factors that ultimately determine a country's pandemic success. A generous set of controls is included in the study to specifically tackle this issue.

All these mentioned causes to endogeneity are just a few examples among several possible challenges. Nevertheless, endogeneity is important to consider in the quest of finding an appropriate model. Multiple approaches can be applied to mitigate the issues, whereby lagging the stringency variable, and including a generous set of controls are methods I have applied in this study.

4.3 Statistical Analysis

The statistical analysis will be carried out applying the Panel Data toolbox by Álvarez et al. (2017) in MATLAB.

The purpose of the analysis is to determine whether a change in one explanatory variable x, causes a significant change in the dependent variable y. As opposed to previous studies this thesis aspires to identify which variables among many explanatory variables emerge as the most important determinants for COVID-19 success and failure.

The dataset is comprised of time-varying and time-constant variables, all of which are summarized in the appendix (see appendix A, table A.2). Since the explanatory variables x_i will contain mostly variables that are constant across all quarters for all countries, Δx will amount to zero for these variables. Because of this, pooled OLS is chosen as the primary estimation model. Pooled OLS estimation is apt for deriving unbiased and consistent estimates of parameters even when time-constant attributes are present.

Time-varying variables will be analyzed specifically in the robustness chapter 6, and can be estimated by either simple OLS, FE or RE estimation. I apply Breusch-Pagan's Lagrange Multiplier test and Hausman's test of specification to determine which estimation method best fits the data, both of which are supplied by the MATLAB toolbox.

4.3.1 Breusch-Pagan's Lagrange Multiplier test

In order to identify whether a simple OLS regression or a RE estimator is better for the time-varying data, a Breusch-Pagan LM test will be conducted. The test is a Baltagi and Li (1990) version of the Lagrange multiplier test of individual effects proposed by Breusch and Pagan (1980). This test contrasts the existence of individual effects by checking its variance under the null hypothesis of no individual effects is equal to zero, and the LM statistic is distributed as χ_1^2.

4.3.2 Hausman's Test of Specification

The Hausman test is applied to determine whether FE or RE estimation is more appropriate for the model with time-varying variables (Hausman, 1978). If the null hypothesis is rejected, a FE model would be appropriate, as portrayed below:

$$H0: coef(FE) - coef(RE) = 0 \rightarrow Random\ effects\ estimation$$
$$HA: coef(FE) - coef(RE) \neq 0 \rightarrow Fixed\ effects\ estimation$$

When choosing between estimation with FE and RE the main consideration is whether the unobserved effect c_i and the explanatory variables x_i are correlated. I will apply both methods and test for statistically significant differences in the coefficients on the time-varying explanatory variables. The idea of the test is to use RE estimates unless the test rejects $Cov(x_{itj}, c_i) = 0,\ \mathrm{t} = 1,2,\ldots,\mathrm{T};\ \mathrm{j} = 1,2,\ldots,\mathrm{k}$.

4.4 Pooled OLS Estimation

The primary estimation in this thesis will be done by applying pooled OLS estimation. In the choice of estimation methods, FE, RE and pooled OLS have been presented as options. FE can only estimate consistent estimates of time-varying regressors and is not viable for the time-constant variables in the dataset. This narrows down the estimation options to RE or pooled OLS. In this case, pooled OLS is preferred over RE. Angrist and Pischke (2009, p. 166) argue that *"RE models... promises to be more efficient if the assumption of the RE model are satisfied... We prefer fixing OLS standard errors to GLS. GLS requires stronger assumptions than OLS, and the resulting asymptotic efficiency gain is likely to be modest, while finite-sample properties may be worse."* Hence, RE estimation will not be expedient in this specific study. In the case of panel data with mainly time-constant variables, the preferred estimation method will thus be pooled OLS clustered by countries (Wooldridge, 2016).

Pooled OLS estimation with clustering on countries will assume a constant intercept and slopes regardless of group and time. According to Wooldridge (2010), pooled OLS will provide consistent estimators of β whenever $\mathrm{E}(y_t|x_t) = x_t\beta$; it does not matter that the idiosyncratic errors u_t are serially correlated. The two assumptions for pooled OLS to consistently estimate β are assumed to hold.[12] In order to apply the usual OLS statistics from the pooled OLS regression across i and t, the assumption of homoskedasticity and no serial correlation must also be fulfilled. These latter assumptions are controlled for in section 4.7.

[12] Assumption pooled OLS: $\mathrm{E}[X_{it}c_i] = 0$ and $\mathrm{E}[X_{it}u_{it}] = 0$

4.5 Fixed Effects Estimation

FE estimation will allow the unobserved effect c_i to be arbitrarily correlated to the explanatory variables x_i and all relevant factors will be collected (Wooldridge, 2010). A key benefit of using FE on panel data is its ability to control for both unobserved unit-specific and time-invariant confounders, as well as modelling the direction of the causal relationship (Allison et al., 2017). Thus, FE regression can obtain consistent estimators even in the presence of omitted variables, assuming that all fixed effects assumptions hold.[13] This estimation methods will thus be applicable as robustness tests for the time-varying data.

4.6 Random Effects Estimation

RE estimation is applicable as a robustness test for the time-varying data.
The RE estimation is synonymous with zero correlation between the unobserved effect c_i and the explanatory variables x_i: $Cov(x_{it}, c_i) = 0, t = 1,2,\dots,T$ (Wooldridge, 2010). In contrast to the FE estimation, this method will not collect all relevant factors, however, it will be able to analyze all variables included in the analysis and determine what variable has the biggest impact on the dependent variable y_{it}. For consistent estimators the RE assumptions must hold.[14]

[13] Assumption 1 FE: $\mathrm{E}(u_{it}|c_i, X_{i1}, \dots, X_{iT}) = 0, t = 1,2,\dots,T$; Assumption 2 FE: $\mathrm{E}(U_i U_i'|X_i, c_i) = \sigma_u^2 I_T$; Assumption 3 FE: $rank(\sum_{t=1}^{T} \mathrm{E}(\ddot{x}_{it}'\ddot{x}_{it}')) = rank[\mathrm{E}(\ddot{X}_i'\ddot{X}_i')] = K$.

[14] Assumption 1 RE: $\mathrm{E}(u_{it}|c_i, X_{i1}, \dots, X_{iT}) = 0, t = 1,2,\dots,T$; Assumption 2 RE: $\mathrm{E}(c_i|X_{i1}, \dots, X_{iT}) = \mathrm{E}(c_i) = 0$; Assumption 3 RE: $\mathrm{E}(U_i U_i'|X_i, c_i) = \sigma_u^2 I_T$ and $\mathrm{E}(c_i^2|X_i) = \sigma_c^2$

4.7 Serial Correlation and Heteroscedasticity

This section explicates how serial correlation and heteroscedasticity is tested and handled in the models. In addition to the controls mentioned for the three estimation methods below, a correlation matrix of all numerical non-dummy variables is formed to illustrate potential multicollinearity in the data (see appendix A, table A.3). Apart from Human Development Index (HDI) and GDP per capita having a high correlation of 0.8357 ($p<0.01$), there is limited correlation between the variables, with most of the coefficients being in the span $\in [-0.2,0.2]$.

i) Pooled OLS estimation

Standard errors robust to heteroscedasticity is adjusted for the 63 country clusters. When clustering standard errors by countries I assume no serial correlation between countries while allowing arbitrary correlation in the error terms within countries. This clustering is assumed to be reliable for panel data with more than 42 clusters (Angrist & Pischke, 2009). These adjustments will thus account for serial correlation and heteroscedasticity in the estimations.

ii) Fixed Effects Estimation

Wooldridge's test of serial correlation will be applied to the time-varying data estimated by the FE model. Under the null hypothesis of no serial correlation in the errors v_{it}, the time demeaned errors of a within regression are negatively serially correlated, with correlation $\rho = -1/(T-1)$. Thus, a test of serial correlation can be performed by regressing within estimation residuals $\hat{v}_{it}$ over their lag $\hat{v}_{i,t-1}$: $\hat{v}_{it} = \alpha + \rho\hat{v}_{it} + \epsilon_{it}$, and testing whether $\hat{\rho} = -1/(T-1)$, using a Wald test with clustered standard errors (Wooldridge, 2010). This test is carried out using Wooldridge's test as provided in the panel data toolbox in MATLAB.

Robust standard error estimation can be derived for the FE model. Standard errors robust to heteroscedasticity are adjusted and clustered by countries in the Panel Data Toolbox software. The toolbox computes clustered-robust standard errors using the observation groups as the different clusters, a method proposed by Liang and Zeger (1986) and Arellano (2009).

iii) Random Effects Estimation

Serial correlation in RE estimation will be tested using the Lagrange multiplier test for random effects, as proposed by Baltagi and Li (1990) as an extension of Breusch and Pagan (1980). The test is included in the MATLAB panel data toolbox, and is according to Álvarez et al. (2017, p. 20) a *"test that contrasts the joint null hypothesis of serial correlated and random individual effects".*

As with FE, robust standard errors can also be derived for the RE model. Thus, heteroscedasticity is controlled for by using robust standard errors, as described in ii) fixed effects estimation, above.

5 Results and Discussion

In the following chapter, results will be presented and discussed in relation to relevant literature. The pooled OLS regression is conducted with N=189 observations, T=3 time periods, clustered by n=63 countries. Goodness-of-fit measures will be reported and applied to the discussion of how well the estimates fit the data, more specifically R^2, adjusted R^2(referred to as $\bar{R}^2$) and robust standard errors. Partial correlation coefficients and partial r^2 are derived to interpret the importance of the estimated coefficients.[15] Standard errors robust to heteroscedasticity are adjusted for the 63 country clusters. When clustering standard errors by countries I assume that there is no serial correlation between countries while allowing arbitrary correlation in the error terms within countries. This assumption is presumed to be reliable for panel data with more than 42 clusters, according to Angrist and Pischke (2009).

5.1 Comparison of Preparedness and Success

Before delving into the estimations and their consecutive results, the success index should be briefly discussed. As stated in the introduction, countries had their pandemic preparedness assessed by the Global Health Security Index (2019) prior to the COVID-19 outbreak. After listing up and ranking countries according to my own definition of success, it is interesting to compare how countries differ across the two rankings. The two most prepared countries were identified by the GHSI to be the USA and the UK, while New Zealand was ranked 35th on the index. In contrast, my

[15] Partial correlation coefficient is a measure of the strength of a linear relationship between two variables after correlations with other variables is removed. See full table in appendix A, table A.5. Partial r^2 is the coefficient of determination from a linear model attributed to a single predictor. See full table in appendix A, table A.7.

success index ranks the USA at the bottom seven worst performing countries throughout 2020, while the UK fluctuates more between quarters – being at the bottom twenty in Q2 and Q4, with a modest peak in Q3 at the top twenty best performing countries. New Zealand is the absolute winner according to my Q3 success index, while also maintaining a high position among the top ten countries in Q2 and Q4. Other notable mentions from my index are Taiwan and Iceland, ranked as winners in Q2 and Q4, respectively. With the assumption that the GHSI ranking is accurate, I find that according to my definition of success - being theoretically well-prepared to handle a pandemic has little to no root in reality.[16]

5.2 Pooled Bivariate Regression

The purpose of this section is to identify and explain simple relationships between variable pairs. It is interesting how these relationships change from this section to the multivariate regression in section 5.3, as these relations can disappear or emerge in new – and sometimes unanticipated ways, once all the variables are considered together in one model (Grace-Martin, 2010). The primary variables in focus are regressed in this section, starting with gender of state leaders, followed by political orientation of governments and lastly, stringency of policies. These are regressed against the dependent variable success, except for stringency – which is a variable analyzed in a FE model in robustness chapter 6. As will be explained in section 6.1, stringency regressed on success is tested to fit FE estimation well, and stringency is therefore regressed merely on performance in this bivariate pooled regression.

[16] The complete success index can be found in appendix A, table A.8 - A.10.

Table 5.2.1: Estimation output - Gender on Success

Panel: Pooling estimation (PO)

```
N = 189  n = 63  T = 3 (Balanced panel)
R-squared = 0.07617    Adj R-squared = -1.80129
Wald F(1, 62) = 8.963854 p-value = 0.0040
RSS = 3.301795 ESS = 10.502921 TSS = 10.502921
Standard errors robust to heteroskedasticity adjusted for 63 clusters
```

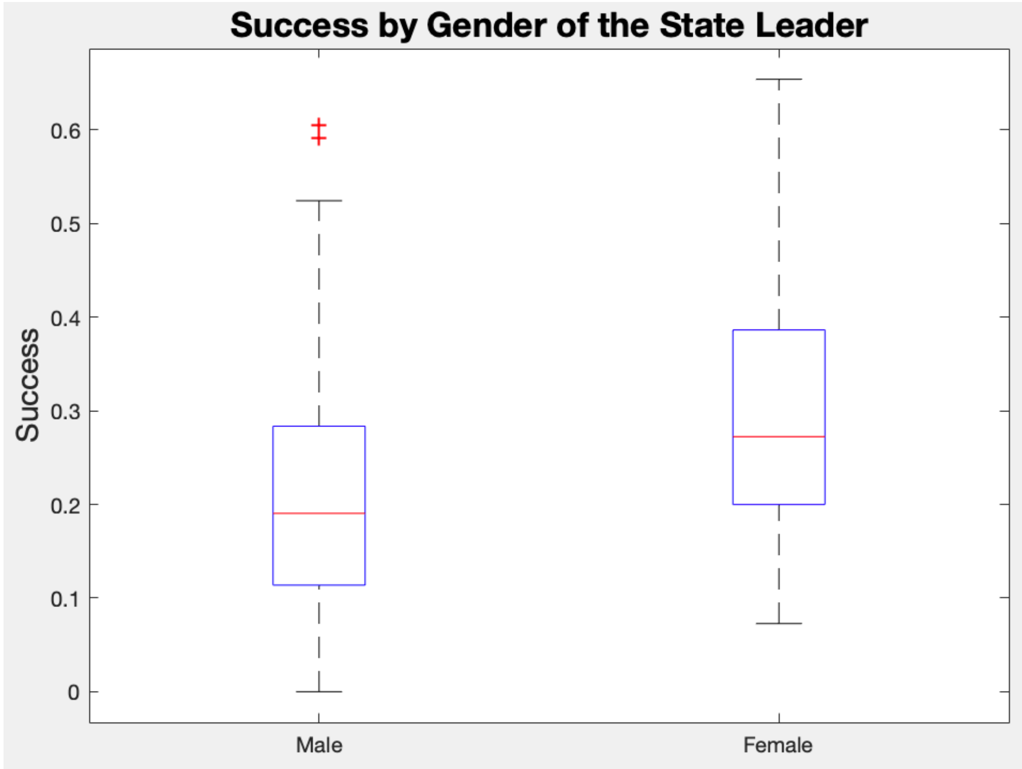
success	Coefficient	Rob.Std.Err	t-stat	p-value
gender	0.089108	0.029763	2.9940	0.004 ***
CONST	0.211444	0.015838	13.3506	0.000 ***

If all other variables are held constant, countries with *female state leaders* on average score 0.0891 points higher on the success index than countries led by men (p<0.01).[17] This answers the primary research question of *"what strategies and characteristics led countries to succeed or fail when handling the pandemic?"* by indicating that women led countries did handle COVID-19 better than countries led by men.

This result substantiates the findings by Garikipati and Kambhampati (2020). They found that there was a significant and systematic difference by the gender of the state leader in the number of infections and deaths in the first quarter of the pandemic. This conclusion is extended by the result from my estimation, whereby I use all quarters of 2020 and include economic measures. Boxplot 5.2.1 graphically depicts the range and distribution of gender data relative to the success index. The median success for female state leaders is higher than the median success for their male counterparts. Still, the range is wider for the female-led countries, indicating a larger spread of success between the countries led by women.

[17] Gender is a dummy variable; the baseline is male state leaders and is excluded to avoid a dummy variable trap.

Plot 5.2.1: Success by Gender of the State Leader



On the contrary, even though recent literature focus massively on female state leaders leading their countries more competently than male state leaders, most of these papers fail to communicate that the majority of these female state leaders represent highly developed, rich democracies. Additionally, Schwindt-Bayer (2011) points out how female state leaders often win elections because they play by men's rules, and that female presidents and prime ministers therefore are much like other male politicians. If this is the case for the COVID-19 pandemic, differences in performance could very likely be caused by other factors than their gender.

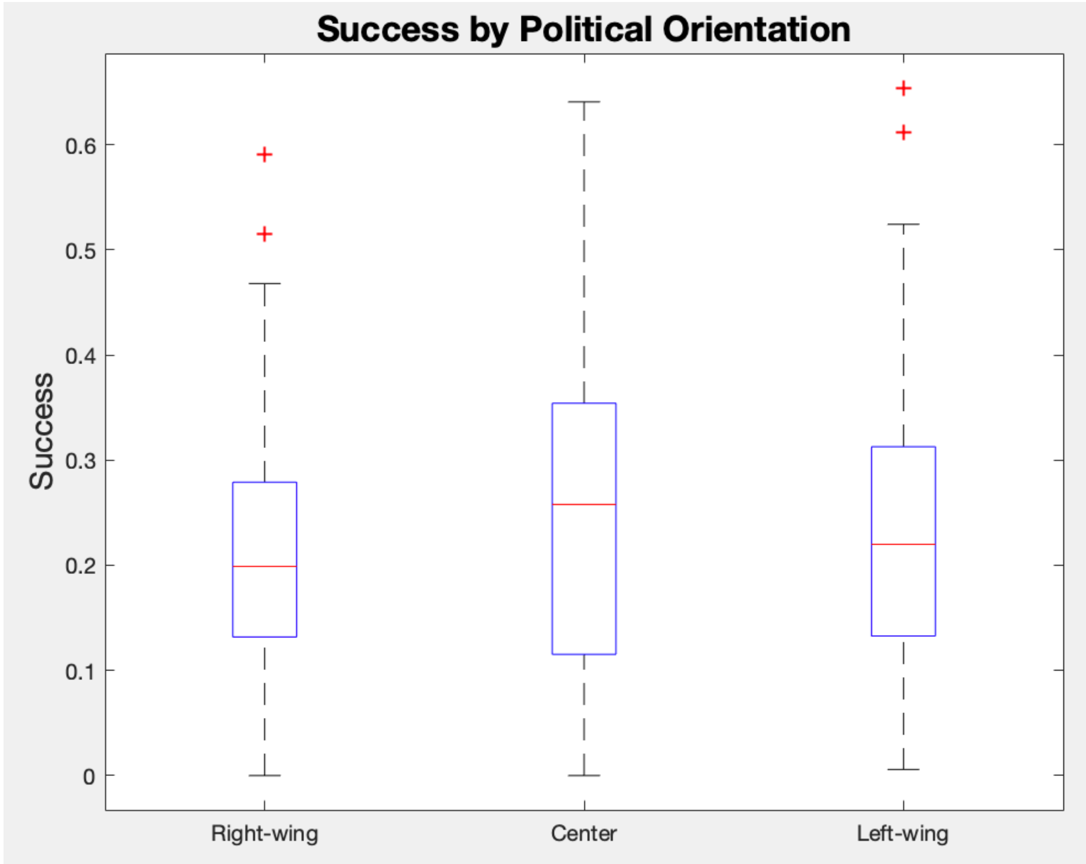
Table 5.2.2: Estimation output – Political Orientation on Success

```
Panel: Pooling estimation (PO)

N = 189  n = 63  T = 3 (Balanced panel)
R-squared = 0.01501    Adj R-squared = -1.98674
Wald F(2, 62) = 0.722412 p-value = 0.4896
RSS = 3.520380 ESS = 10.284337 TSS = 10.284337
Standard errors robust to heteroskedasticity adjusted for 63 clusters

----------------------------------------------------------------------
        success |   Coefficient   Rob.Std.Err      t-stat    p-value
----------------------------------------------------------------------
 political_left |     -0.025447      0.038594     -0.6594    0.512
political_right |     -0.042985      0.035855     -1.1989    0.235
          CONST |      0.259565      0.028997      8.9515    0.000 ***
----------------------------------------------------------------------
```

All else equal, countries with *left-winged governments* and *right-winged governments* on average score 0.0255 and 0.0430 lower on the success index than countries with center-oriented governments. The results are, however, not statistically significant, except for the constant ($p<0.01$). In this estimation, the constant represents center-oriented governments.[18] Seeing these results in line with those of Dr. Ruth Carlitz, where she found that Republican governors took longer to impose stay-at-home orders than the Democratic governors – the estimated coefficients in my analysis slightly imply the same for political orientation of governments (Taub, 2020). Based on the assumption that the U.S. Democratic Party is categorized as a left-winged party while the Republican Party is categorized as a right-winged party. However, they both succeed less than center-oriented governments. This is a finding that cannot be directly compared to the American study, considering the two-party nature of U.S. politics, without center-oriented governors.

[18] Political orientation is a dummy variable; the baseline is center-oriented governments and is excluded to avoid a dummy variable trap.

Plot 5.2.2: Plot of Success by Political Orientation



Political orientation is illustrated in boxplot 5.2.2 to be distributed relatively equally on a left-right axis. The interquartile range of center-oriented governments is wider than the other two, meaning that these countries have a wider variability in success than those led by purely right-winged or left-winged governments. Center-oriented governments also have a slightly higher median success measure than the other political orientations, however this difference is minimal, and the overall result from this bivariate analysis is that political orientations have little to no impact on COVID-19 success in my bivariate analysis.

Table 5.2.3: Estimation output – Stringency on Performance

Panel: Pooling estimation (PO)

N = 189 n = 63 T = 3 (Balanced panel)
R-squared = 0.09351 Adj R-squared = -1.74871
Wald F(1, 62) = 13.929775 p-value = 0.0004
RSS = 9.696653 ESS = 49.037646 TSS = 49.037646
Standard errors robust to heteroskedasticity adjusted for 63 clusters

performance	Coefficient	Rob.Std.Err	t-stat	p-value
stringency	-0.004292	0.001150	-3.7323	0.000 ***
CONST	0.819526	0.081771	10.0222	0.000 ***

The estimation of stringency on normalized performance reaps a statistically significant coefficient of -0.0043 ($p<0.01$). This means that a point increase in stringency will on average decrease a country's normalized performance by 0.0043 points. When measuring performance from 0 to 100, this is equal to a 0.3867 reduction in performance. Recall from section 3.1.2 that *performance* consists of confirmed cases, deaths, cases and deaths per million people, cases as a proportion of tests and tests per thousand people.

When regressing stringency on normalized infections per million, I find a statistically significant coefficient of -0.0048 ($p<0.001$). This imply that a point increase in stringency decrease infections per million by 293.08 on average (see appendix B, table B.1).

The finding that higher stringency implies lower health performance while also reducing infections is interesting. This could mean that it is the other components of health performance that is negatively related to stringency. The result contradicts some scientific studies that find significant relationships between stringency measures and reduction in COVID-19 infections and deaths (Deb et al., 2020). The effects of governmental policies on the spread of COVID-19 have however been found to vary in previous literature, and Zhang et al. (2021) highlight that some containment measures are linked to lower COVID-19 spread, while some measures pull in the opposite direction. A blog post by The International Growth Centre state that

"While containment measures help in slowing the spread of the virus, more stringent lockdowns with curfews might not be more effective in reducing mortality" (Anis, 2020, para. 12). A cross country comparison by Chaudhry et al. (2020) also find that full lockdowns, rapid border closures and wide-spread testing were not associated with reduction in the number of critical cases or COVID-19 mortality rates, but rather resulted in more recoveries. My analysis complies with these findings, as stringent containment measures seem to reduce normalized infections per million while simultaneously decreasing the overall performance.

Goodness-of-fit

The three models vary slightly in their goodness-of-fit. Based on the F-statistic and the respective p-values, the first and last models are statistically significant ($p<0.01$). [19] The second model has a p-value of 0.4896 and is not, as a whole, statistically significant. The three models are estimated to have relatively low values of R^2 and $\bar{R}^2$, implying that the models account for small percentages of the total variance in countries' success and performance when handling COVID-19. Given the panel data structure I want to rely more on individual and overall significance of the model than R^2 and $\bar{R}^2$, and conclude that the first and last models fit relatively well to the data, because of the individual and overall significant results. The second model has a poor fit to the data with no statistical significance combined with very low R^2 and $\bar{R}^2$.

5.3 Pooled Regression with all Variables

The objective of this section is to estimate all primary variables while simultaneously including all relevant controls. From this, the intention is to identify possible solutions to the research questions, in particular the secondary research question *"Out of the composition of explanatory variables in focus, which variable can best explain the variance in success when handling COVID-19?"*.

---

[19] For definition of F-statistic see appendix B, B.4.

Table 5.3.1: Estimation output – All variables on Success

Panel: Pooling estimation (PO)

N = 189 n = 63 T = 3 (Balanced panel)
R-squared = 0.42410   Adj R-squared = -0.74628
Wald F(20, 62) = 15.363919 p-value = 0.0000
RSS = 2.058284 ESS = 11.746433 TSS = 11.746433
Standard errors robust to heteroskedasticity adjusted for 63 clusters

success	Coefficient	Rob.Std.Err	t-stat	p-value
gender	0.063292	0.025463	2.4856	0.016 **
political_left	-0.054997	0.034884	-1.5766	0.120
political_right	-0.049191	0.031726	-1.5505	0.126
stringency	-0.001396	0.000517	-2.7009	0.009 ***
democracy	0.023332	0.044087	0.5292	0.599
authoritarian	0.092221	0.057535	1.6029	0.114
europe	-0.163895	0.047735	-3.4334	0.001 ***
africa	0.009897	0.061342	0.1613	0.872
north_america	-0.080522	0.035820	-2.2479	0.028 **
south_america	-0.078239	0.059832	-1.3076	0.196
oceania	0.061670	0.059722	1.0326	0.306
female_share	0.004983	0.121084	0.0412	0.967
pop_density	0.000004	0.000015	0.2339	0.816
population_larg	-0.118770	0.028190	-4.2132	0.000 ***
population_smal	0.057843	0.027621	2.0942	0.040 **
debt_gdp	-0.007354	0.035889	-0.2049	0.838
gdp_cap	-0.000001	0.000002	-0.7913	0.432
gdp_cap_growth	0.017876	0.009334	1.9151	0.060 *
hdi	0.125540	0.273743	0.4586	0.648
development	0.094789	0.060179	1.5751	0.120
CONST	0.265122	0.227057	1.1676	0.247

This regression is directly linked to the secondary research question: *"Out of the composition of explanatory variables in focus, which variable can best explain the variance in success when handling COVID-19?"*. Partial correlation coefficients and partial r^2 are derived to interpret the importance of the estimated coefficients.[20]

[20] Partial correlation coefficient is a measure of the strength of a linear relationship between two variables after correlations with other variables is removed. See full table in appendix A, table A.5; Partial r^2 is the coefficient of determination from a linear model attributed to a single predictor. See full table in appendix A, table A.7.

Out of the primary explanatory variables gender, political orientation and stringency – the estimation finds that *stringency* explains the largest variance in success, with the largest partial correlation coefficient of -0.1935 ($p<0.05$) and largest partial r^2 of 0.0374. For a one unit increase in *lagged stringency*, the success score is expected to decrease by 0.0014 points, holding all other variables constant ($p<0.01$). Stringent policies do thus not necessarily result in success when handling COVID-19 – at least not when including both human and economic health in the success measure. As described in section 5.2, this result coincides with previous literature, where the effect of stringency on the spread of COVID-19 has been found to vary. Comparing this to the previous finding, higher stringency is hereby estimated to reduce both health performance and overall success in my analysis.

However, new literature have found that countries such as Taiwan and Iceland have thus far managed to keep infection rates low without imposing mandatory lockdowns (Harman & Angerer, 2020; Nguyen-Okwu, 2021). Taiwan and Iceland are, among other successful countries, classified as "low stringency" countries in the dataset and are examples exhibiting how stringent containment measures are not fundamental for pandemic success.

Gender of the state leader follows up as the second most important parameter with a partial correlation coefficient of 0.1888 ($p<0.05$) and partial r^2 of 0.0356. This can be interpreted such that countries with female state leaders, on average, will score 0.0633 points higher on the success index than countries led by men. The result substantiates the finding from section 5.2 and indicates that the gender of state leaders has an impact on COVID-19 success. This extends the finding of Garikipati and Kambhampati (2020). They found female-led countries to succeed more than male led countries when it comes to low infection rates and low mortality, however, my finding estimates female-led countries to also perform better in terms of upholding economic growth during the pandemic.

Neither of the political orientation variables are found to be statistically significant. *Political right-wing* and *left-wing governments* are both estimated to succeed less than center-oriented governments, with partial coefficients of -0.1387 and -0.1429 ($p<0.1$) and partial r^2 of 0.0192 and 0.0204. Countries led by right-winged governments will on average score 0.0492 points lower on the success index than center-oriented governments. Countries with left-winged governments score, on average, 0.0550 lower on the success index than center-oriented governments. As in section 5.2, political orientation claims no statistical significance. The finding that center-oriented governments seem to have performed better than both left- and right-winged governments is reinforced in this model and is a new finding in the literature.

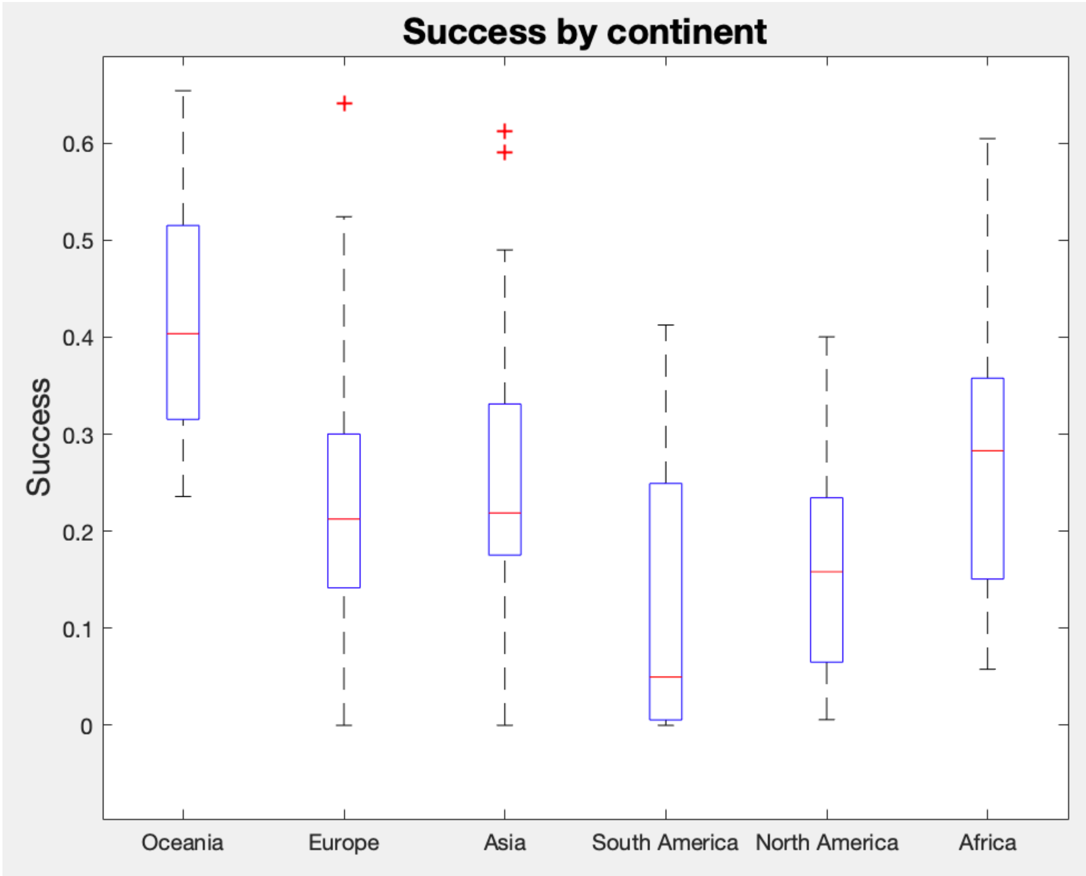
To briefly comment the control variables, the ones that stand out are the estimated differences between continents and population size.

The dummy variables included for continents show how Europe and North America score significantly lower on the success index than the baseline Asia ($p<0.05$).[21] Oceania and Africa are the only continents that is estimated to have positive coefficients, meaning countries in Oceania and Africa on average score 0.0617 and 0.0099 points higher on the success index than Asia. However, these latter results are not statistically significant ($p=0.306$ and 0.872). These findings are in line with similar studies pointing out how Asia and Oceania have performed best, and significantly better than the Americas and Europe (Zahid & Perna, 2021). In a recent paper by Navarro (2021) reasons for countries succeeding in Asia are highlighted to be prior experience with pandemics, cultural factors and various successful public health policies. In addition, Africa is pointed out as being relatively successful in this estimation, a result that can likely be explained by the late emergence of COVID-19 on the continent and hence fewer cases, deaths and higher economic growth in the period of comparison (Lalaoui et al., 2020).

---

[21] Continents are dummy variables; the baseline is Asia and is excluded to avoid a dummy variable trap.

Plot 5.3.1: Success by Continent



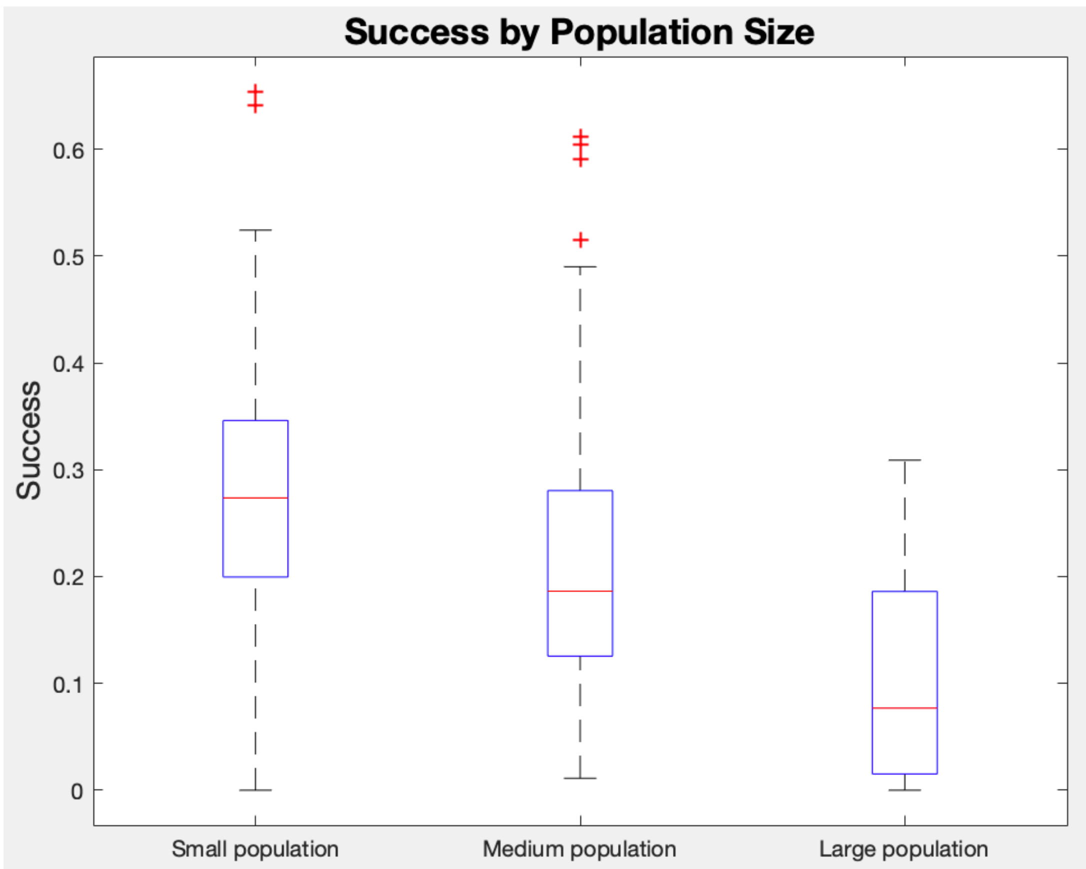
The significant differences between continents becomes apparent in the clearly different medians and quartile ranges. Oceania protrude as the continent scoring on average highest on the success index, while South America score below par. Iceland, Malaysia and Taiwan are noted as outliers in Europe and Asia.

If all other variables are held constant, countries categorized as having *large populations* on average score 0.1188 points lower on the success index than countries with medium sized populations ($p<0.01$).[22] This relationship between population size and success is reinforced by the estimated coefficient for countries with small populations, where these countries on average score 0.0578 points higher on the success index than medium sized countries ($p<0.05$). Leng and Lemahieu (2021, para. 15) describe a similar result from their Covid performance index study:

[22] Population size is a dummy variable; the baseline is medium sized populations and is excluded to avoid a dummy variable trap.

"Categorizing countries based on their population size revealed the greatest difference in experience with the COVID-19 challenge (…) Smaller countries with populations of fewer than 10 million people consistently outperformed their larger counterparts throughout 2020, although this lead narrowed slightly towards the end of the examined period". Several recent studies confirm the result, and impose how population size and per capita COVID-19 cases are positively correlated (Jahangiri et al., 2020; Lulbadda et al., 2021).

Plot 5.3.2: Success by Population Size



Boxplot 5.3.2 substantiates the estimation result with regards to success and population size.[23] The prominent relationship is here illustrated with clear differences between the three categories, with a negative relationship between population and

[23] Large population > 100,000,000 people; Medium population ∈ [10,100] million people; Small population < 10,000,000 people

success – the larger the population in a country the less success the country is expected to have when handling COVID-19 in terms of health and economy.

Goodness-of-fit

The model fits the data well and is significant at the 0.01 significance level ($p<0.01$). R^2 of 0.42 implies that the model accounts for 42 percent of the total variance in countries' success when handling COVID-19. Due to individual and overall significance combined with relatively high values of R^2, I conclude that the regressors produce good predictions of COVID-19 success.

5.4 Pooled Cumulative Regression

The purpose of this estimation is to identify if the relationships found in section 5.3 changes when regressing the same variables and controls but at a quarterly scale. Hence, the explanatory variables are kept similar throughout all three estimations in this section, whereby it is Q2 that is regressed. The dependent variable *success* is altered, starting with success Q2 in the first regression, before cumulatively regressing *success* Q2+Q3 and lastly regressing *success* Q2+Q3+Q4. By modelling the estimation along these lines, the link between country differences in Q2 and the cumulative success will be presented. This can potentially unveil new findings or substantiate what I have already found, and ultimately augment the proposed solution to the research questions.

Table 5.4.1: Estimation output – All variables on Success Q2

Panel: Pooling estimation (PO)

```
N = 63  n = 63  T = 1 (Balanced panel)
R-squared = 0.74923    Adj R-squared = 0.74923
Wald F(20, 62) = 21.713321 p-value = 0.0000
RSS = 0.300796 ESS = 4.025506 TSS = 4.025506
Standard errors robust to heteroskedasticity adjusted for 63 clusters
```

Success Q2	Coefficient	Rob.Std.Err	t-stat	p-value
gender	0.083929	0.028656	2.9289	0.005 ***
political_left	-0.054528	0.036863	-1.4792	0.144
political_right	-0.055042	0.036528	-1.5068	0.137
stringency	-0.004423	0.001047	-4.2229	0.000 ***
democracy	-0.050268	0.078523	-0.6402	0.524
authoritarian	0.079629	0.074782	1.0648	0.291
europe	-0.107741	0.055126	-1.9544	0.055 *
africa	0.053725	0.075141	0.7150	0.477
north_america	-0.080230	0.039858	-2.0129	0.048 **
south_america	-0.055137	0.048775	-1.1304	0.263
oceania	0.108014	0.075216	1.4360	0.156
female_share	0.046103	0.136783	0.3370	0.737
pop_density	-0.000015	0.000014	-1.0628	0.292
population_larg	-0.089842	0.035336	-2.5425	0.014 **
population_smal	0.080547	0.031630	2.5466	0.013 **
debt_gdp	-0.021004	0.035180	-0.5970	0.553
gdp_cap	0.000001	0.000002	0.4473	0.656
gdp_cap_growth	0.025177	0.007181	3.5060	0.001 ***
hdi	0.157438	0.393688	0.3999	0.691
development	0.034059	0.063756	0.5342	0.595
CONST	0.437543	0.341541	1.2811	0.205

First, the model is estimated with success Q2 being the dependent variable. As in section 5.3, gender and stringency are statistically significant ($p<0.01$) and the estimated coefficients have the same directions as before. This validates the previous findings and strengthens the potential answer to the research question – that female state leaders are estimated to lead countries to succeed during COVID-19, while a point increase in stringency is estimated to reduce success by 0.0044 points. At least in the second quarter of 2020.

Table 5.4.2: Estimation output – All variables on Success Q2+Q3

Panel: Pooling estimation (PO)

N = 63 n = 63 T = 1 (Balanced panel)
R-squared = 0.68464   Adj R-squared = 0.68464
Wald F(20, 62) = 10.368592 p-value = 0.0000
RSS = 0.990605 ESS = 14.869423 TSS = 14.869423
Standard errors robust to heteroskedasticity adjusted for 63 clusters

Success Q2+Q3	Coefficient	Rob.Std.Err	t-stat	p-value
gender	0.095223	0.056360	1.6895	0.096 *
political_left	-0.125980	0.056907	-2.2138	0.031 **
political_right	-0.131015	0.058722	-2.2311	0.029 **
stringency	-0.003578	0.001888	-1.8953	0.063 *
democracy	0.059277	0.103246	0.5741	0.568
authoritarian	0.143349	0.108623	1.3197	0.192
europe	-0.235437	0.104405	-2.2550	0.028 **
africa	0.121366	0.135456	0.8960	0.374
north_america	-0.164365	0.083180	-1.9760	0.053 *
south_america	-0.150446	0.121031	-1.2430	0.219
oceania	0.237814	0.165887	1.4336	0.157
female_share	-0.032534	0.254686	-0.1277	0.899
pop_density	-0.000028	0.000033	-0.8377	0.405
population_larg	-0.235118	0.066289	-3.5468	0.001 ***
population_smal	0.124073	0.061111	2.0303	0.047 **
debt_gdp	0.024699	0.068447	0.3608	0.719
gdp_cap	0.000000	0.000004	0.1055	0.916
gdp_cap_growth	0.045749	0.017024	2.6873	0.009 ***
hdi	0.320204	0.677024	0.4730	0.638
development	0.085037	0.129497	0.6567	0.514
CONST	0.422656	0.586926	0.7201	0.474

Going forward, the dependent variable is set to be success Q2+Q3. The estimated coefficients have the overall same directions as previously, however, this time around new parameters appear to be statistically significant. In particular, political left-winged and right-winged governments are estimated to succeed less than those led by center-oriented governments ($p<0.05$). The coefficients of gender and stringency are estimated to have similar directions as before and they are repeatedly statistically significant. These results confirm the result from section 5.3 and strengthens it by providing significance of political orientation when regressed against cumulative success Q2+Q3.

Table 5.4.3: Estimation output – All variables on Success Q2+Q3+Q4

Panel: Pooling estimation (PO)

N = 63 n = 63 T = 1 (Balanced panel)
R-squared = 0.64531   Adj R-squared = 0.64531
Wald F(20, 62) = 55.214875 p-value = 0.0000
RSS = 2.542021 ESS = 35.316964 TSS = 35.316964
Standard errors robust to heteroskedasticity adjusted for 63 clusters

Success Q2+Q3+Q	Coefficient	Rob.Std.Err	t-stat	p-value
gender	0.180685	0.078296	2.3077	0.024 **
political_left	-0.182104	0.107308	-1.6970	0.095 *
political_right	-0.156246	0.102212	-1.5286	0.131
stringency	-0.006962	0.002915	-2.3879	0.020 **
democracy	0.097597	0.160800	0.6070	0.546
authoritarian	0.324730	0.190381	1.7057	0.093 *
europe	-0.407116	0.158292	-2.5719	0.013 **
africa	0.075527	0.216496	0.3489	0.728
north_america	-0.220136	0.120215	-1.8312	0.072 *
south_america	-0.246872	0.202768	-1.2175	0.228
oceania	0.282546	0.189203	1.4933	0.140
female_share	-0.073686	0.422071	-0.1746	0.862
pop_density	-0.000011	0.000060	-0.1774	0.860
population_larg	-0.374261	0.092000	-4.0680	0.000 ***
population_smal	0.174245	0.093192	1.8697	0.066 *
debt_gdp	-0.010374	0.120345	-0.0862	0.932
gdp_cap	-0.000004	0.000007	-0.6161	0.540
gdp_cap_growth	0.057262	0.032197	1.7785	0.080 *
hdi	0.231836	1.022540	0.2267	0.821
development	0.258379	0.206253	1.2527	0.215
CONST	1.111385	0.895704	1.2408	0.219

Lastly, the total cumulative sum of success Q2+Q3+Q4 is regressed as the dependent variable. Similar results as seen in section 5.3 appear, while also reaching statistical significance of nearly all relationships drafted before. Gender of state leaders and stringency of policies are estimated to be significant at a 0.05 level. Political orientation loses its significance, with a slight exception of political left-winged governments at a 0.1 level. Hence, the proposed answer to the research questions is reinforced in this cumulative regression – female state leaders are estimated to lead countries to succeed also when modelling the quarters of 2020. Political center-oriented governments are estimated to do significantly better than their left and right counterparts, and stringency is estimated to have a negative coefficient in all models – meaning that an increase in stringency leads the cumulative success to fall.

Goodness-of-fit

The cumulative models fit the data well. The three models are statistically significant ($p<0.01$) and are estimated to have high values of R^2 and $\bar{R}^2$. This implies that the models account for large percentages of the total variance in success, both when regressing the variables on success Q2 and when regressing the cumulative success Q2+Q3+Q4.

5.5 Primary Regression Summary

The results that emerge through the bivariate estimation in section 5.2 are validated and reinforced when adding a broad range of controls in the primary regression in section 5.3, in addition to being reinforced when modelling the cumulative estimation in section 5.4. This can indicate robustness of the estimated coefficients. Concurrently, multiple control variables are statistically significant ($p<0.05$). These can be potential confounding variables and must be acknowledged. Going forward, the coefficient robustness will be examined further in chapter 6.

6 Robustness

This chapter will control the main results from chapter 5, whereby I will examine how the primary regression coefficient estimates behave when the regression specification is modified by applying new estimation methods. If the coefficients are plausible and robust, this is commonly interpreted as evidence of structural validity (Lu & White, 2014). Robustness will be checked for the three primary variables: Gender, political orientation, and stringency. The analysis is thus expanded to include FE and RE estimation for the time-varying variable stringency, while pooled OLS will check the robustness of the time-constant variables gender and political orientation.

6.1 Fixed Effects Estimation

Stringency on Success

The Breusch-Pagan LM test for random effects in statistically significant and rejects H0: $\sigma_\mu^2 = 0$, suggesting that FE or RE is preferred over standard OLS (p<0.01). The Hausman test is applied to determine whether FE or RE is the most fitting estimation method and is significant at the 0.05 level. This rejects H0: $coef(A) - coef(B) = 0$. The key RE assumption $Cov(x_{itj}, \alpha_i) = 0$, $t = 1,2,\ldots,T$; $j = 1,2,\ldots,k$. is rejected, and the time-varying variable stringency should thus be estimated using FE. Wooldridge's test for serial correlation returns a p-value of 0.0301. Thus, at a 0.01 level the null hypothesis is not rejected, indicating no serial correlation in the error term (see appendix B, table B.2).

Table 6.1.1: Estimation output – Stringency on Success

```
Panel: Fixed effects (within) (FE)

N = 189  n = 63  T = 3 (Balanced panel)
R-squared = 0.00285    Adj R-squared = -0.49972
Wald F(1, 62) = 0.411783 p-value = 0.5234
RSS = 1.181682 ESS = 12.623035 TSS = 12.623035
Standard errors robust to heteroskedasticity adjusted for 63 clusters
```

success	Coefficient	Rob.Std.Err	t-stat	p-value
stringency	-0.000346	0.000540	-0.6417	0.523

The estimated parameter for lagged stringency has a negative coefficient of -0.0004, meaning, a point increase in a country's lagged stringency will on average decrease the success score by 0.0004 points. This result substantiates the results found in chapter 5, where negative coefficients were estimated for stringency on performance in the bivariate regression, and for stringency on success in the multivariate regression. However, in this fixed effect estimation the result is not statistically significant, and the result must be interpreted carefully as the model fits the data poorly.

Goodness-of-fit

Based on no statistical significance and low values of both R^2 and $\bar{R}^2$ the model is deemed as being unfit to the data.

6.2 Random Effects Estimation

Stringency on quarterly GDP growth

The Breusch-Pagan LM test for random effects rejects H0: $\sigma_\mu^2 = 0$, suggesting that FE or RE is preferred over standard OLS (p<0.01). The Hausman test is applied to determine whether FE or RE is the most fitting estimation method and does not reject H0 (p=0.9144). The key RE assumption $Cov(x_{itj}, u_i) = 0$ holds, and the variables should thus be estimated using RE. Baltagi and Li's test for serial correlations is significant (p<0.01) and rejects H0. Thus, there are random effects or serial correlation in the estimation (see appendix B, table B.3).

Table 6.2.1: Estimation output – Stringency on quarterly GDP growth

```
Panel: Random effects (RE)

N = 189  n = 63  T = 3 (Balanced panel)
R-squared = 0.00028    Adj R-squared = -2.03142
Wald Chi2(1) = 0.403787 p-value = 0.5251
RSS = 14659.438765 ESS = 4.224472 TSS = 4.224472
Standard errors robust to heteroskedasticity adjusted for 63 clusters

----------------------------------------------------------------------
        GDP_QoQ |   Coefficient   Rob.Std.Err      z-stat    p-value
----------------------------------------------------------------------
     stringency |      0.008664      0.013635      0.6354    0.525
          CONST |     -0.664655      0.978438     -0.6793    0.497
----------------------------------------------------------------------
sigma_mu = 0.000000      rho_mu = 0.000000
 sigma_v = 10.772038     sigma_1 = 0.914453
   theta = 0.000000
----------------------------------------------------------------------
```

Considering stringency has been regressed against both success and health performance, the last and highly interesting variable to regress the explanatory variable against is GDP growth. The RE estimation finds stringency to have an estimated positive coefficient on quarterly GDP growth. A point increase in stringency is thus estimated to increase the quarterly GDP growth by 0.0087 percent. The result is not statistically significant (p=0.525), and thus uncertain. Seeing this in line with section 5.2, where stringency was estimated to have a statistically significant coefficient of -0.0043 (p<0.01) on health performance, there seems to be two forces pulling stringency's relationship to success in opposite directions. A point increase in stringency is thus estimated to increase GDP growth while decreasing health performance. The balance between these opposing forces is, according to chapter 5 and the FE robustness check in 6.1, resulting in stringency having an overall negative impact on success.

Goodness-of-fit

This RE estimation returns no statistical significance and low values of both R^2 and $\bar{R}^2$. The model is therefore deemed as being unfit to the data.

6.3 Bivariate Pooled OLS

Table 6.3.1: Estimation output – Gender on Performance

Panel: Pooling estimation (PO)

```
N = 189  n = 63  T = 3 (Balanced panel)
R-squared = 0.13210    Adj R-squared = -1.63171
Wald F(1, 62) = 11.640496 p-value = 0.0011
RSS = 9.283891 ESS = 49.450409 TSS = 49.450409
Standard errors robust to heteroskedasticity adjusted for 63 clusters
```

Performance	Coefficient	Rob.Std.Err	t-stat	p-value
gender	0.203011	0.059502	3.4118	0.001 ***
CONST	0.455813	0.033726	13.5152	0.000 ***

Table 6.3.2: Estimation output – Gender on quarterly GDP growth

Panel: Pooling estimation (PO)

```
N = 189  n = 63  T = 3 (Balanced panel)
R-squared = 0.00002    Adj R-squared = -2.03220
Wald F(1, 62) = 0.110910 p-value = 0.7402
RSS = 14663.245688 ESS = 0.417549 TSS = 0.417549
Standard errors robust to heteroskedasticity adjusted for 63 clusters
```

GDP QoQ	Coefficient	Rob.Std.Err	t-stat	p-value
gender	0.088663	0.266230	0.3330	0.740
CONST	-0.049096	0.131835	-0.3724	0.711

Delving deeper into differences between female and male state leaders, I separate the success variable to estimate the dummy variable *gender* on performance and GDP growth. The results unveil that female state leaders perform significantly better than male state leaders with regards to both human and economic health. The estimated coefficient for GDP growth portrays countries led by female state leaders to have 0.0887 percentage higher GDP growth than countries led by men. Despite no statistical significance of this estimated coefficient, the result is interesting and signify how countries led by women are estimated to perform better than countries led by men, both in containing COVID-19 but also on sustaining economic growth.

Table 6.3.3: Estimation output – Political Orientation on Performance

Panel: Pooling estimation (PO)

N = 189 n = 63 T = 3 (Balanced panel)
R-squared = 0.01961   Adj R-squared = -1.97279
Wald F(2, 62) = 0.712447 p-value = 0.4944
RSS = 10.487139 ESS = 48.247160 TSS = 48.247160
Standard errors robust to heteroskedasticity adjusted for 63 clusters

performance	Coefficient	Rob.Std.Err	t-stat	p-value
political_left	-0.044205	0.074894	-0.5902	0.557
political_right	-0.084301	0.070627	-1.1936	0.237
CONST	0.555013	0.051637	10.7484	0.000 ***

Table 6.3.4: Estimation output – Political Orientation on quarterly GDP growth

Panel: Pooling estimation (PO)

N = 189 n = 63 T = 3 (Balanced panel)
R-squared = 0.00065   Adj R-squared = -2.03030
Wald F(2, 62) = 1.803004 p-value = 0.1733
RSS = 14654.028833 ESS = 9.634404 TSS = 9.634404
Standard errors robust to heteroskedasticity adjusted for 63 clusters

GDP QoQ	Coefficient	Rob.Std.Err	t-stat	p-value
political_left	-0.565478	0.301626	-1.8748	0.066 *
political_right	-0.483498	0.314982	-1.5350	0.130
CONST	0.367721	0.258694	1.4215	0.160

Political orientation is as aforementioned, found to be the variable that explains the smallest degree of variance in success. When checking robustness of the dummy variable in this section, center-oriented party governments are, once again, estimated to perform better than its left- and right-winged counterparts. This is estimated to be the case both for health performance and for GDP growth. Political left-wing governments, on average, perform 3.9829 points lower than center-oriented governments, when ranking performance from 0 to 100. Political right-winged governments perform 7.5955 points lower than center-oriented governments, on the same scale. Political left-wing governments are also estimated to have 0.5655 percent lower economic growth than center-oriented governments. Right-winged governments are estimated to have 0.4835 percent lower economic growth than the center-oriented baseline. However, with the slight exception of political left-wing governments ($p<0.10$), these estimations are not found to be statistically significant, and must be interpreted carefully.

6.4 Robustness Summary

Estimations in this robustness chapter validate the results from chapter 5, while also providing some new insights to the relationships between the primary variables and the different factors of success – performance and GDP growth. I find similar results as with pooled OLS when applying two new estimation methods. The finding that the estimated coefficients behave like the primary regression indicate that they can be plausible and robust, a result that suggests evidence of structural validity. However, the estimated coefficients lose their statistical significance in this procedure. Also, apart from gender regressed on performance, all models are established as having poor goodness-of-fit, with extensively low values of R^2 and $\bar{R}^2$ and neither being statistically significant.

7 Limitations

The results presented in this study must be interpreted with caution and several limitations should be addressed. The following chapter will present and discuss such limitations, both in terms of methodology and research.

7.1 Methodological Limitations

7.1.1 Sample Bias and Small Sample Size

Country data does not represent a random sample, and only countries with available data was included in the study. The sample is therefore rather skewed. Continents are represented in an unbalanced manner because of the large unavailability of data. Roughly 72% of Europe, 27% of Asia, 26% of North America, 29% of South America, 11% of Africa and 14% of Oceania is covered in the study.

An important point in this study is the impact of female state leaders on COVID-19 success. Even though the number of female state leaders are at a record high level, the sample is still small. A total of 24 female state leaders are identified in the sample period of 2020, however, only 15 of these countries are included in the dataset due to data availability. [24] The dataset is therefore skewed also in this perspective, where 76% of the countries included are led by male state leaders and merely 24% are led by women. Small sample sizes can affect the reliability and validity of the study and ultimately make it difficult to determine if the outcomes are true findings.

[24] For full table of female state leaders see appendix A, table A.1.

7.2 Research Limitations

7.2.1 Limited Access to Data

Limited access to data is largely related to section 7.1.1. Conducting research on COVID-19 during the pandemic has excluded the countries that for whatever reason have not been able to publish data consecutively. Preferably, I would want to include all countries to ensure a fair representation. The largest challenge with limited access to data was encountered when collecting GDP data. Measures taken to overcome this issue was to supplement online databases with data from national statistics bureaus. My gratitude goes to Brian Oquendo at the Development Economics Data Group at The World Bank and Natia Matsiashvili at the National Statistics Office of Georgia – for supplying me the GDP data that was missing from online databases.

The statistics on COVID-19 infections and deaths are limited and likely to have unreported incidents that could potentially change the estimated outcomes in this study. An example is a recent study by Hortaçsu et al. (2021), they find that a large number of infections in the United States have not been reported during March 2020, and that this could possibly be the case in several countries.

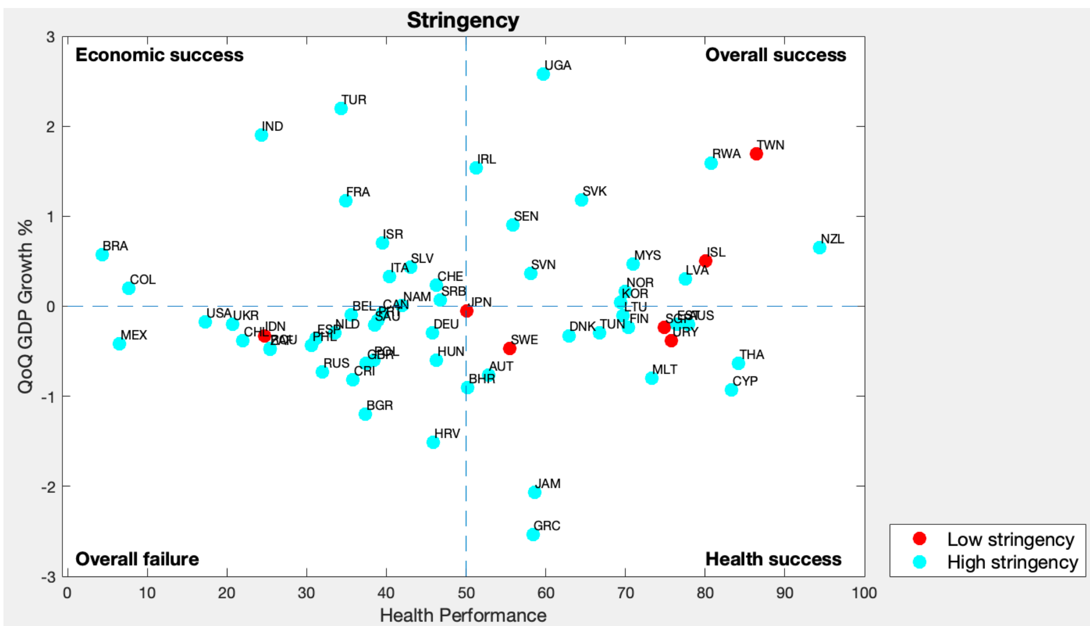
7.2.2 Time Constraint

A complete dataset of GDP figures for 2020 is expected to be published by The World Bank in July 2021. Due to the deadline of this thesis being July 1st, there is a time constraint present that largely complicated the data collection of GDP data. Multiple data sources are therefore utilized to compile as much GDP data as possible. If this time constraint had not been present, and all GDP data was available at the time of analysis, the sample size could potentially include a larger variety of countries. The time constraint has thus reduced the available sample size drastically, considering only countries with available GDP data could be included in the dataset. When the time constraint is eliminated, it would be interesting to include more countries and analyze a fuller dataset by also introducing interaction effects among the variables. This could be an idea for future research.

8 Conclusion

In the early hindsight of COVID-19, it is tempting to point out how countries should have been better prepared to handle the pandemic. However, the intent of this thesis is not to praise certain pandemic strategies while condemning others, but rather to indicate which factors are propitious and which factors are detrimental in a conglomerate of multiple country characteristics. More specifically, I have analyzed what factor explain the largest variation in success focusing on the gender of state leaders, political orientation of governments and the stringency of containment measures. The results are summarized in the three following plots.

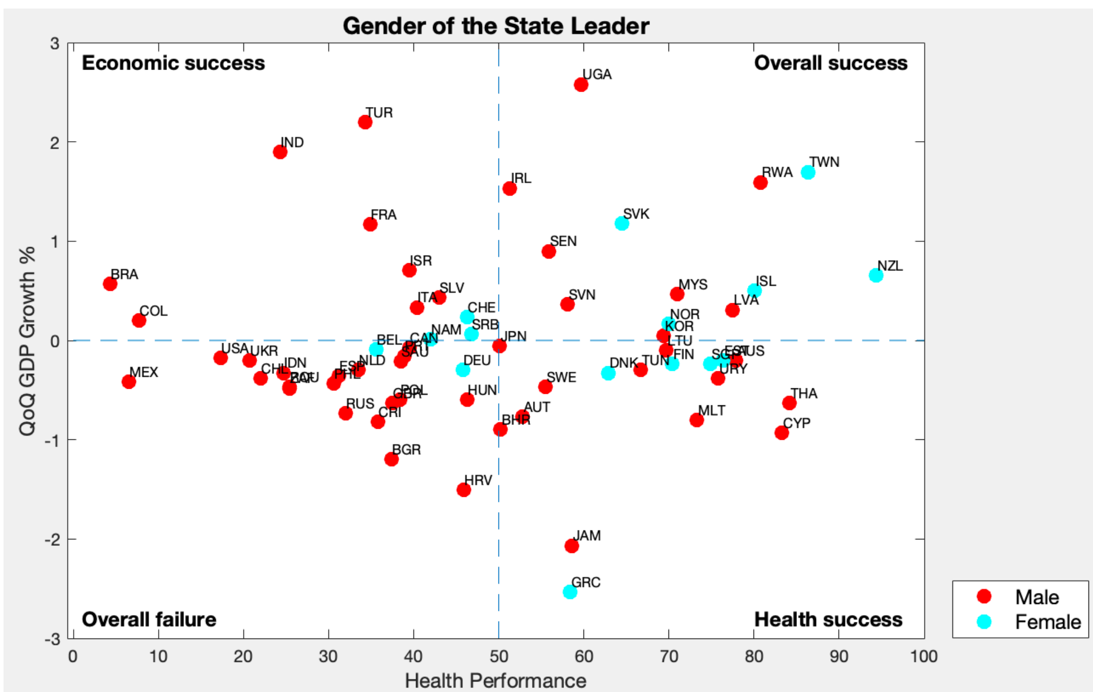
Plot 8.1: The Winners and Losers of COVID-19 – Stringency



When answering the secondary research question *"Out of the composition of explanatory variables in focus, which variable can best explain the variance in success when handling COVID-19?"*, stringency protrudes as *the* variable explaining the largest variance in success. This is estimated to be true when comparing the partial correlation coefficients and partial r^2 to the other variables. Stringent containment measures are found to be, rather intuitively, negatively related to

COVID-19 infections. More surprisingly, stringent containment measures are estimated to be positively related to GDP growth. The aforementioned health-economy trade-off where stringent containment measures were assumed to suffocate the economy is thereby not supported in my analysis. When compiling multiple factors to form a health performance variable, higher stringency is estimated to reduce performance, holding all other variables equal. Altogether, these opposite effects culminate stringency to have a negative relation to success. The preeminent winners can be seen in plot 8.1, where some notable countries have managed to keep performance exceptionally high while also obtaining stable GDP growth without imposing strict containment measures – thereby being characterized as highly successful in this study, despite low stringency.[25] In particular, Taiwan and Iceland protrude in the upper right quadrant as "low stringency" countries.

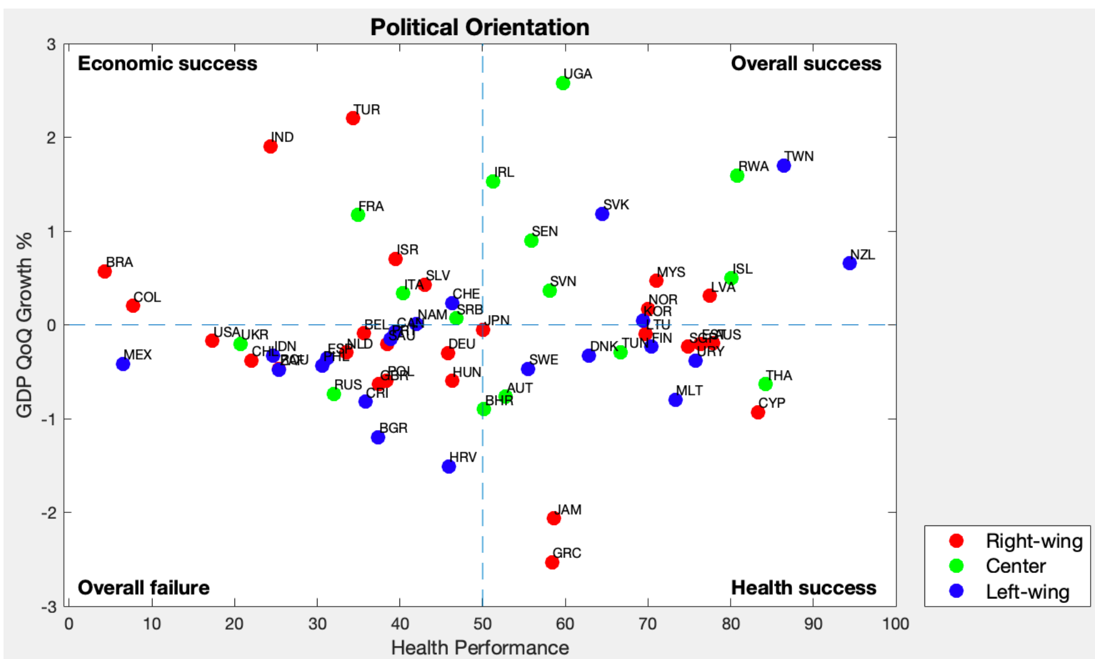
Plot 8.2: The Winners and Losers of COVID-19 – Gender



[25] Low stringency < 65 < High stringency (on scale from 1 to 100); Note that plot 8.1 is based on each country's average stringency index score Q1-Q3, 2020.

Contrary to stringency, which is estimated to be negatively related to success, female state leaders are estimated to explain the largest variation in success on the positive side. The finding that female state leaders are exceeding their male counterparts on containing pandemic cases and deaths is on par with previous literature, however, the finding that they also uphold economic growth is to my knowledge, a new empirical revelation within the field. In plot 8.2, a clear majority of female-led countries appear in the upper right "overall success" quadrant, while the lower left "overall failure" quadrant is dominated by countries led by male state leaders. Nevertheless, the sample of female state leaders is small and as discussed previously – female state leaders commonly represent rich, well developed democracies and often share many similarities with male politicians. Hence, I cannot declare that gender is the sole explanation in this matter, and several underlying factors could be determinants affecting the estimated outcome.

Plot 8.3: The Winners and Losers of COVID-19 – Political Orientation



Lastly, political orientation is estimated to affect success less than the other two variables in focus. Nevertheless, I find governments led by center-oriented parties to slightly exceed their left- and right-winged counterparts. As discussed in the literature review, a British study found that left-wing voters are more willing to make economic sacrifices to reduce COVID-19 infections, as opposed to right-wing voters. Additionally, a recent study from the U.S. found a difference in COVID-19 responsiveness among Democratic and Republican governors. My study extends these results by analyzing the difference in pandemic success among ruling political parties. The finding that both left- and right-winged parties in my study succeed less than center-oriented parties, contradicts the previous literature that found left-winged governors succeeding more than right-winged governors. Center catch-all governments vaguely emerge as winners among the three, and the finding that these specific governments succeed more than their counterparts is a new contribution to the literature. However, these results have little to no statistical significance and emerge as the least important among the three variables in my study.

The control variables offer several interesting perspectives to the research questions. Population size and geographic locations are all estimated to explain large variations in success. All else equal, countries with less than 10 million people are estimated to succeed more than countries with larger populations. Inversely, countries populated by more than 100 million people score below par in terms of both human and economic health. Also, countries located in Asia, Africa or Oceania are estimated to perform better than countries located on the other continents. These findings are validated by previous literature, where several papers highlight that population size and geographic factors are determinants for handling COVID-19. Geographical difference in success is commonly rationalized by previous literature as occurring because some regions have prior experience with pandemics, differences in cultural factors and various successful health policies.

When an unprecedented crisis unravels with all its devastation and imprudence, it quickly becomes a race where countries compete to find the optimal strategy. Among several country characteristics, my thesis has identified female state leaders and center catch-all parties to bolster pandemic success in this race. Contrarily, countries that impose stringent containment measures fall behind. In light of my definition of success, *this is what separates the winners and losers of COVID-19.*

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Appendix A

A.1 Table: Female State Leaders 2020

Country	Name	Title
Aruba	Evelyn Wever-Croes	Prime Minister
Bangladesh	Shiekh Hasina Wajed	Prime Minister
Barbados	Mia Mottely	Prime Minister
Belgium	Sophie Wilmès	Prime Minister
Bolivia	Jaenine Áñez	President
Denmark	Mette Frederiksen	Prime Minister
Estonia	Kersti Kaljulaid	President
Ethiopia	Sahle-Work Zewde	President
Finland	Sanna Marin	Prime Minister
Georgia	Salome Zurabishvili	President
Germany	Angela Merkel	Chancellor
Greece	Katerina Sakellaropoulou	President
Iceland	Katrín Jakobsdótter	Prime Minister
Myanmar	Aung San Suu Kyi	State Counsellor
Namibia	Saara Kuungongelwa	Prime Minister
Nepal	Bidhya Devi Bhandari	President
New Zealand	Jacinda Ardern	Prime Minister
Norway	Erna Solberg	Prime Minister
Serbia	Ana Brnabic	Prime Minister
Singapore	Halimah Yacob	Prime Minister
Slovakia	Zuzana Čaputová	President
Switzerland	Simonetta Sommaruga	President
Taiwan	Tsai Ing-wen	President
Trinidad and Tobago	Paula-Mae Weekes	President

A.2 Table: Variable description

Variable	Time
Success	Varying
GDP growth QoQ	Varying
Performance	Constant
Gender of the State Leader	Constant
Political left-wing	Constant
Political center	Constant
Political right-wing	Constant
Stringency Index	Varying
Democracy	Constant
Authoritarian	Constant
Hybrid democracy/authoritarian	Constant

Female Share in legislatures	Constant
Population Density	Constant
Population	Constant
Population large	Constant
Population medium	Constant
Population small	Constant
Debt/GDP ratio	Constant
Human Development Index	Constant
Development	Constant
GDP per capita	Constant
GDP per capita average growth	Constant
Continent	Constant

A.3 Table: Correlation matrix of all numerical non-dummy variables

	debt_gdp	female_share	gdp_cap	gdp_cap_growth	GDP_QoQ	HDI	infections	performance	population	pop_density	stringency	success
debt_gdp	1	−0.15447	0.12948	−0.19982	−0.021576	0.12555	0.061657	−0.11036	0.067502	0.18543	−0.036585	−0.10081
female_share	−0.15447	1	0.018595	−0.15915	0.017883	−0.055091	−0.018466	0.094564	−0.23503	−0.11291	−0.028341	−0.046966
gdp_cap	0.12948	0.018595	1	−0.17501	−0.0064543	0.83565	0.16891	0.21999	−0.19095	0.41291	−0.25598	0.19844
gdp_cap_growth	−0.19982	−0.15915	−0.17501	1	0.017045	−0.10707	−0.10019	0.14122	0.14486	−0.036223	−0.02313	0.068614
GDP_QoQ	−0.021576	0.017883	−0.0064543	0.017045	1	−0.025927	0.14201	0.0070532	0.027364	−0.0033679	0.016673	0.25867
HDI	0.12555	−0.055091	0.83565	−0.10707	−0.025927	1	0.20487	0.17914	−0.24576	0.11779	−0.28689	0.2211
infections	0.061657	−0.018466	0.16891	−0.10019	0.14201	0.20487	1	−0.25231	−0.042555	0.025376	−0.33603	−0.18941
performance	−0.11036	0.094564	0.21999	0.14122	0.0070532	0.17914	−0.25231	1	−0.31998	0.17458	−0.30579	0.72606
population	0.067502	−0.23503	−0.19095	0.14486	0.027364	−0.24576	−0.042555	−0.31998	1	−0.019696	0.1548	−0.20036
pop_density	0.18543	−0.11291	0.41291	−0.036223	−0.0033679	0.11779	0.025376	0.17458	−0.019696	1	−0.1339	0.11181
stringency	−0.036585	−0.028341	−0.25598	−0.02313	0.016673	−0.28689	−0.33603	−0.30579	0.1548	−0.1339	1	−0.29153
success	−0.10081	−0.046966	0.19844	0.068614	0.25867	0.2211	−0.18941	0.72606	−0.20036	0.11181	−0.29153	1

A.4 Table: P-values of correlation matrix A.3

1.0000	0.0338	0.0758	0.0058	0.7682	0.0852	0.3993	0.1306	0.3561	0.0106	0.6172	0.1675
0.0338	1.0000	0.7995	0.0287	0.8070	0.4515	0.8009	0.1956	0.0011	0.1219	0.6987	0.5210
0.0758	0.7995	1.0000	0.0160	0.9298	0.0000	0.0202	0.0024	0.0085	0.0000	0.0004	0.0062
0.0058	0.0287	0.0160	1.0000	0.8159	0.1425	0.1702	0.0526	0.0467	0.6207	0.7521	0.3482
0.7682	0.8070	0.9298	0.8159	1.0000	0.7232	0.0513	0.9233	0.7086	0.9633	0.8199	0.0003
0.0852	0.4515	0.0000	0.1425	0.7232	1.0000	0.0047	0.0136	0.0007	0.1065	0.0001	0.0022
0.3993	0.8009	0.0202	0.1702	0.0513	0.0047	1.0000	0.0005	0.5610	0.7289	0.0000	0.0090
0.1306	0.1956	0.0024	0.0526	0.9233	0.0136	0.0005	1.0000	0.0000	0.0163	0.0000	0.0000
0.3561	0.0011	0.0085	0.0467	0.7086	0.0007	0.5610	0.0000	1.0000	0.7879	0.0334	0.0057
0.0106	0.1219	0.0000	0.6207	0.9633	0.1065	0.7289	0.0163	0.7879	1.0000	0.0662	0.1256
0.6172	0.6987	0.0004	0.7521	0.8199	0.0001	0.0000	0.0000	0.0334	0.0662	1.0000	0.0000
0.1675	0.5210	0.0062	0.3482	0.0003	0.0022	0.0090	0.0000	0.0057	0.1256	0.0000	1.0000

A.5 Table: Partial correlation coefficients

Partial Correlation Coefficients

	success	gender	political_left	political_right	stringency	democracy	authoritarian	europe	africa	north_america
success	1	0.18878	−0.14288	−0.13866	−0.19347	0.039563	0.14047	−0.26498	0.012798	−0.15214
gender	0.18878	1	0.15474	0.24585	−0.1224	−0.013555	−0.15228	0.19874	0.045108	−0.16987
political_left	−0.14288	0.15474	1	−0.69414	0.018607	0.14506	−0.051663	−0.43641	−0.20611	−0.12473
political_right	−0.13866	0.24585	−0.69414	1	0.048101	0.17357	0.00027763	−0.34594	−0.2351	−0.0040515
stringency	−0.19347	−0.1224	0.018607	0.048101	1	0.13396	0.12938	0.19379	−0.081547	0.084597
democracy	0.039563	−0.013555	0.14506	0.17357	0.13396	1	−0.5879	−0.15693	0.10845	−0.010814
authoritarian	0.14047	−0.15228	−0.051663	0.00027763	0.12938	−0.5879	1	−0.021199	−0.030728	−0.10801
europe	−0.26498	0.19874	−0.43641	−0.34594	0.19379	−0.15693	−0.021199	1	−0.31709	−0.49128
africa	0.012798	0.045108	−0.20611	−0.2351	−0.081547	0.10845	−0.030728	−0.31709	1	−0.40077
north_america	−0.15214	−0.16987	−0.12473	−0.0040515	0.084597	−0.010814	−0.10801	−0.49128	−0.40077	1
south_america	−0.14276	−0.080624	−0.095705	0.019406	−0.027195	0.16475	−0.049989	−0.20313	−0.27824	−0.37213
oceania	0.067689	0.099005	−0.28181	−0.18337	0.28345	−0.15884	−0.10173	−0.66376	−0.2184	−0.35599
female_share	0.0035717	0.31917	0.13241	−0.17053	−0.041744	0.1993	0.12355	0.2733	0.2698	0.4053
pop_density	0.021128	0.034639	0.25471	0.19112	−0.12811	0.14834	0.052866	0.21928	−0.019442	0.0046479
population_large	−0.27614	0.16338	0.063707	−0.093242	−0.12597	0.27189	0.27523	−0.085871	−0.27116	0.056843
population_small	0.19937	0.26299	0.030608	−0.1597	−0.021628	0.2844	0.15233	0.21673	−0.085723	0.31406
debt_gdp	−0.018433	0.035596	−0.39776	−0.26779	0.086919	0.023868	−0.091286	−0.33917	−0.068266	−0.048784
gdp_cap	−0.07201	0.061327	−0.3258	−0.13724	0.15721	−0.2951	−0.03552	−0.43622	0.097324	−0.15985
gdp_cap_growth	0.19589	−0.13377	−0.2043	−0.12832	−0.035137	0.09877	−0.19072	−0.022686	−0.39044	−0.22558
hdi	0.034413	0.057166	0.13002	−0.028107	−0.25619	0.43078	0.1312	0.22446	−0.55201	−0.014954
development	0.14507	−0.21061	0.41987	0.38161	−0.15245	0.14661	−0.020754	0.76958	0.2977	0.2652

south_america	oceania	female_share	pop_density	population_large	population_small	debt_gdp	gdp_cap	gdp_cap_growth	hdi	development
−0.14276	0.067689	0.0035717	0.021128	−0.27614	0.19937	−0.018433	−0.07201	0.19589	0.034413	0.14507
−0.080624	0.099005	0.31917	0.034639	0.16338	0.26299	0.035596	0.061327	−0.13377	0.057166	−0.21061
−0.095705	−0.28181	0.13241	0.25471	0.063707	0.030608	−0.39776	−0.3258	−0.2043	0.13002	0.41987
0.019406	−0.18337	−0.17053	0.19112	−0.093242	−0.1597	−0.26779	−0.13724	−0.12832	−0.028107	0.38161
−0.027195	0.28345	−0.041744	−0.12811	−0.12597	−0.021628	0.086919	0.15721	−0.035137	−0.25619	−0.15245
0.16475	−0.15884	0.1993	0.14834	0.27189	0.2844	0.023868	−0.2951	0.09877	0.43078	0.14661
−0.049989	−0.10173	0.12355	0.052866	0.27523	0.15233	−0.091286	−0.03552	−0.19072	0.1312	−0.020754
−0.20313	−0.66376	0.2733	0.21928	−0.085871	0.21673	−0.33917	−0.43622	−0.022686	0.22446	0.76958
−0.27824	−0.2184	0.2698	−0.019442	−0.27116	−0.085723	−0.068266	0.097324	−0.39044	−0.55201	0.2977
−0.37213	−0.35599	0.4053	0.0046479	0.056843	0.31406	−0.048784	−0.15985	−0.22558	−0.014954	0.2652
1	−0.14925	0.023164	−0.044703	−0.074727	0.063477	−0.1119	−0.08139	−0.31372	−0.079436	0.039915
−0.14925	1	0.23062	0.22676	0.061191	0.094397	−0.38673	−0.38358	−0.19	0.2302	0.59081
0.023164	0.23062	1	−0.096485	−0.21054	−0.3383	−0.064821	0.20701	−0.043715	−0.17794	−0.075242
−0.044703	0.22676	−0.096485	1	−0.17041	0.079348	0.45876	0.67025	0.25351	−0.35771	−0.50229
−0.074727	0.061191	−0.21054	−0.17041	1	−0.2876	0.15611	0.20665	0.097186	−0.33757	0.003793
0.063477	0.094397	−0.3383	0.079348	−0.2876	1	−0.13914	0.15888	−0.084605	−0.24929	−0.0071643
−0.1119	−0.38673	−0.064821	0.45876	0.15611	−0.13914	1	−0.35335	−0.38477	0.13541	0.53015
−0.08139	−0.38358	0.20701	0.67025	0.20665	0.15888	−0.35335	1	−0.15805	0.72981	0.51255
−0.31372	−0.19	−0.043715	0.25351	0.097186	−0.084605	−0.38477	−0.15805	1	−0.23127	0.28131
−0.079436	0.2302	−0.17794	−0.35771	−0.33757	−0.24929	0.13541	0.72981	−0.23127	1	−0.0776
0.039915	0.59081	−0.075242	−0.50229	0.003793	−0.0071643	0.53015	0.51255	0.28131	−0.0776	1

A.6 Table: Partial correlation p-values to coefficients in table A.5

Partial Correlation p-values

	success	gender	political_left	political_right	stringency	democracy	authoritarian	europe	africa	north_america
success	0	0.013686	0.063063	0.071342	0.011476	0.60849	0.067697	0.00047935	0.86844	0.047647
gender	0.013686	0	0.043929	0.001231	0.11182	0.86073	0.047439	0.0093728	0.55916	0.026789
political_left	0.063063	0.043929	0	9.1331e-26	0.80968	0.059111	0.50344	2.6956e-09	0.0070055	0.1051
political_right	0.071342	0.001231	9.1331e-26	0	0.53335	0.023602	0.99713	3.825e-06	0.0020278	0.95818
stringency	0.011476	0.11182	0.80968	0.53335	0	0.081568	0.092652	0.011338	0.29044	0.27271
democracy	0.60849	0.86073	0.059111	0.023602	0.081568	0	3.4971e-17	0.040981	0.15921	0.88869
authoritarian	0.067697	0.047439	0.50344	0.99713	0.092652	3.4971e-17	0	0.78378	0.69079	0.1609
europe	0.00047935	0.0093728	2.6956e-09	3.825e-06	0.011338	0.040981	0.78378	0	2.5184e-05	1.0305e-11
africa	0.86844	0.55916	0.0070055	0.0020278	0.29044	0.15921	0.69079	2.5184e-05	0	6.1103e-08
north_america	0.047647	0.026789	0.1051	0.95818	0.27271	0.88869	0.1609	1.0305e-11	6.1103e-08	0
south_america	0.063287	0.29595	0.21443	0.80168	0.72482	0.0318	0.51739	0.0078893	0.00023897	5.8293e-07
oceania	0.38046	0.19897	0.00019689	0.016685	0.00017994	0.038557	0.18681	5.9352e-23	0.0042209	1.8952e-06
female_share	0.96313	2.2135e-05	0.085194	0.02619	0.58886	0.0091718	0.10846	0.00031096	0.00037365	4.1922e-08
pop_density	0.78449	0.65384	0.00080227	0.012542	0.095925	0.053534	0.49355	0.0040664	0.80131	0.95203
population_large	0.0002674	0.033272	0.40917	0.22651	0.10167	0.00033495	0.00028074	0.26553	0.00034793	0.46157
population_small	0.009146	0.00053055	0.69194	0.037498	0.77952	0.00017084	0.047365	0.0045294	0.26636	3.0369e-05
debt_gdp	0.81143	0.64492	7.8194e-08	0.00041473	0.25972	0.75736	0.23645	6.0535e-06	0.3764	0.52755
gdp_cap	0.35073	0.42693	1.4546e-05	0.074316	0.04062	9.3594e-05	0.64562	2.7435e-09	0.20674	0.037318
gdp_cap_growth	0.010463	0.082028	0.0075323	0.095385	0.64918	0.20004	0.012729	0.76903	1.4128e-07	0.0030996
hdi	0.65595	0.45902	0.091048	0.71597	0.00074594	4.5218e-09	0.088115	0.0032541	6.0594e-15	0.84653
development	0.059082	0.0058389	1.2004e-08	2.8289e-07	0.047187	0.056415	0.78821	1.4927e-34	8.0578e-05	0.00047383

south_america	oceania	female_share	pop_density	population_large	population_small	debt_gdp	gdp_cap	gdp_cap_growth	hdi	development
0.063287	0.38046	0.96313	0.78449	0.0002674	0.009146	0.81143	0.35073	0.010463	0.65595	0.059082
0.29595	0.19897	2.2135e-05	0.65384	0.033272	0.00053055	0.64492	0.42693	0.082028	0.45902	0.0058389
0.21443	0.00019689	0.085194	0.00080227	0.40917	0.69194	7.8194e-08	1.4546e-05	0.0075323	0.091048	1.2004e-08
0.80168	0.016685	0.02619	0.012542	0.22651	0.037498	0.00041473	0.074316	0.095385	0.71597	2.8289e-07
0.72482	0.00017994	0.58886	0.095925	0.10167	0.77952	0.25972	0.04062	0.64918	0.00074594	0.047187
0.0318	0.038557	0.0091718	0.053534	0.00033495	0.00017084	0.75736	9.3594e-05	0.20004	4.5218e-09	0.056415
0.51739	0.18681	0.10846	0.49355	0.00028074	0.047365	0.23645	0.64562	0.012729	0.088115	0.78821
0.0078893	5.9352e-23	0.00031096	0.0040664	0.26553	0.0045294	6.0535e-06	2.7435e-09	0.76903	0.0032541	1.4927e-34
0.00023897	0.0042209	0.00037365	0.80131	0.00034793	0.26636	0.3764	0.20674	1.4128e-07	6.0594e-15	8.0578e-05
5.8293e-07	1.8952e-06	4.1922e-08	0.95203	0.46157	3.0369e-05	0.52755	0.037318	0.0030996	0.84653	0.00047383
0	0.052082	0.76431	0.56269	0.3328	0.41087	0.14627	0.29137	3.1016e-05	0.30315	0.6053
0.052082	0	0.0024812	0.0029429	0.42796	0.22079	1.8952e-07	2.4277e-07	0.013075	0.002528	2.2401e-17
0.76431	0.0024812	0	0.2107	0.0058539	6.4193e-06	0.40102	0.0067575	0.57137	0.020261	0.32947
0.56269	0.0029429	0.2107	0	0.0263	0.30369	3.1426e-10	1.5855e-23	0.0008509	1.6759e-06	2.9767e-12
0.3328	0.42796	0.0058539	0.0263	0	0.00014307	0.042069	0.0068569	0.20738	6.7407e-06	0.96085
0.41087	0.22079	6.4193e-06	0.30369	0.00014307	0	0.070355	0.038503	0.27266	0.0010443	0.92612
0.14627	1.8952e-07	0.40102	3.1426e-10	0.042069	0.070355	0	2.2839e-06	2.2113e-07	0.078302	1.048e-13
0.29137	2.4277e-07	0.0067575	1.5855e-23	0.0068569	0.038503	2.2839e-06	0	0.039548	1.4991e-29	8.986e-13
3.1016e-05	0.013075	0.57137	0.0008509	0.20738	0.27266	2.2113e-07	0.039548	0	0.0024104	0.00020236
0.30315	0.002528	0.020261	1.6759e-06	6.7407e-06	0.0010443	0.078302	1.4991e-29	0.0024104	0	0.3145
0.6053	2.2401e-17	0.32947	2.9767e-12	0.96085	0.92612	1.048e-13	8.986e-13	0.00020236	0.3145	0

A.7 Table: Partial r^2 for all variables and controls

Derived as: $Partial\ r^2 = \frac{RSS_{reduced} - RSS_{full}}{RSS_{reduced}}$ whereby each predictor is left out of the full model in turn, leading to the following table of partial $\boldsymbol{r^2}$:

Variable	Partial r^2
Gender	0.0356
Political Left	0.0204
Political Right	0.0192
Stringency	0.0374
Democracy	0.0016
Authoritarian	0.0197
Europe	0.0702
Africa	0.0002
North America	0.0231

South America	0.0204
Oceania	0.0046
Female Share	0.0000
Population Density	0.0005
Population Large	0.0763
Population Small	0.0397
Debt/GDP	0.0003
GDP per capita	0.0052
GDP per capita growth	0.0384
HDI	0.0012
Development	0.0210

A.8 Table: Success Index Q2 2020

#	Country	Performance norm	GDP growth norm	Success
1	Taiwan	0.91	0.67	0.61
2	Singapore	0.78	0.60	0.47
3	Estonia	0.80	0.55	0.44
4	South Korea	0.72	0.61	0.44
5	Finland	0.73	0.58	0.42
6	Iceland	0.84	0.50	0.42
7	Norway	0.73	0.57	0.41
8	Australia	0.82	0.50	0.41
9	Latvia	0.81	0.50	0.41
10	New Zealand	1.00	0.40	0.40
11	Thailand	0.89	0.44	0.39
12	Lithuania	0.73	0.53	0.38
13	Uganda	0.61	0.58	0.36
14	Senegal	0.57	0.20	0.36
15	Rwanda	0.85	0.42	0.36
16	Denmark	0.65	0.51	0.33
17	Ireland	0.52	0.63	0.33
18	Uruguay	0.79	0.40	0.32
19	Slovakia	0.67	0.47	0.31
20	Cyprus	0.88	0.34	0.30
21	Bahrain	0.51	0.58	0.30
22	Namibia	0.42	0.69	0.29
23	Sweden	0.57	0.49	0.28
24	Slovenia	0.60	0.42	0.25
25	Japan	0.51	0.47	0.24
26	Malta	0.77	0.31	0.24
27	Switzerland	0.47	0.50	0.23
28	Serbia	0.47	0.45	0.21
29	Saudi Arabia	0.38	0.55	0.21
30	Austria	0.54	0.38	0.21
31	Greece	0.60	0.33	0.20

32	Germany	0.46	0.43	0.20
33	Russia	0.31	0.19	0.19
34	Malaysia	0.74	0.25	0.19
35	Israel	0.39	0.46	0.18
36	Poland	0.38	0.45	0.17
37	Costa Rica	0.35	0.48	0.17
38	Jamaica	0.60	0.27	0.17
39	Bulgaria	0.37	0.42	0.16
40	Canada	0.39	0.39	0.15
41	Netherlands	0.32	0.46	0.15
42	Hungary	0.47	0.30	0.14
43	Italy	0.40	0.34	0.14
44	Turkey	0.33	0.40	0.13
45	Belgium	0.35	0.38	0.13
46	Croatia	0.46	0.28	0.13
47	Portugal	0.38	0.32	0.12
48	Indonesia	0.23	0.51	0.11
49	France	0.34	0.33	0.11
50	Tunisia	0.69	0.15	0.10
51	El Salvador	0.43	0.22	0.09
52	Romania	0.23	0.38	0.09
53	Philippines	0.29	0.29	0.09
54	Ukraine	0.18	0.43	0.08
55	United Kingdom	0.37	0.18	0.07
56	Chile	0.20	0.34	0.07
57	USA	0.14	0.45	0.07
58	Spain	0.30	0.21	0.06
59	South Africa	0.23	0.25	0.06
60	Colombia	0.04	0.30	0.01
61	Mexico	0.02	0.24	0.01
62	Brazil	0.00	0.45	0.00
63	India	0.22	0.00	0.00

A.9 Table: Success Index Q3 2020

#	Country	Performance norm	GDP growth norm	Success
1	New Zealand	1.00	0.65	0.65
2	Tunisia	0.69	0.85	0.59
3	Malaysia	0.74	0.80	0.59
4	Rwanda	0.85	0.55	0.47
5	Cyprus	0.88	0.48	0.42
6	Slovakia	0.67	0.57	0.38
7	Uruguay	0.79	0.45	0.36
8	Slovenia	0.60	0.59	0.35
9	Malta	0.77	0.45	0.34
10	Thailand	0.89	0.39	0.34

11	Latvia	0.81	0.41	0.33
12	Austria	0.54	0.58	0.31
13	Ireland	0.52	0.58	0.30
14	Italy	0.40	0.72	0.29
15	Taiwan	0.91	0.31	0.28
16	Jamaica	0.60	0.47	0.28
17	Uganda	0.61	0.45	0.28
18	Lithuania	0.73	0.38	0.28
19	France	0.34	0.81	0.27
20	United Kingdom	0.37	0.73	0.27
21	Hungary	0.47	0.56	0.26
22	Iceland	0.84	0.30	0.26
23	El Salvador	0.43	0.59	0.25
24	Portugal	0.38	0.63	0.24
25	Norway	0.73	0.33	0.24
26	Turkey	0.33	0.72	0.24
27	Australia	0.82	0.29	0.24
28	Denmark	0.65	0.35	0.23
29	Sweden	0.57	0.39	0.22
30	Spain	0.30	0.74	0.22
31	India	0.22	0.99	0.22
32	Germany	0.46	0.47	0.21
33	Croatia	0.46	0.46	0.21
34	Finland	0.73	0.28	0.21
35	Estonia	0.80	0.26	0.21
36	Switzerland	0.47	0.43	0.20
37	Belgium	0.35	0.57	0.20
38	Serbia	0.47	0.42	0.20
39	Singapore	0.78	0.25	0.20
40	Israel	0.39	0.49	0.19
41	Canada	0.39	0.48	0.19
42	Japan	0.51	0.36	0.18
43	South Korea	0.72	0.25	0.18
44	Senegal	0.57	0.79	0.17
45	Greece	0.60	0.28	0.17
46	Poland	0.38	0.44	0.17
47	South Africa	0.23	0.64	0.15
48	Netherlands	0.32	0.44	0.14
49	Philippines	0.29	0.45	0.13
50	Bulgaria	0.37	0.32	0.12
51	Bahrain	0.51	0.22	0.11
52	Saudi Arabia	0.38	0.24	0.09
53	Romania	0.23	0.37	0.09
54	Ukraine	0.18	0.47	0.08
55	Costa Rica	0.35	0.24	0.08
56	Namibia	0.42	0.17	0.07
57	Chile	0.20	0.35	0.07

58	Indonesia	0.23	0.28	0.06
59	USA	0.14	0.43	0.06
60	Russia	0.31	0.71	0.06
61	Colombia	0.04	0.50	0.02
62	Mexico	0.02	0.60	0.01
63	Brazil	0.00	0.44	0.00

A.10 Table: Success Index Q4 2020

#	Country	Performance norm	GDP growth norm	Success
1	Iceland	0.84	0.76	0.64
2	Rwanda	0.85	0.71	0.60
3	Malta	0.77	0.68	0.52
4	Australia	0.82	0.63	0.52
5	Taiwan	0.91	0.54	0.49
6	Estonia	0.80	0.55	0.44
7	Cyprus	0.88	0.50	0.44
8	Thailand	0.89	0.49	0.44
9	Uganda	0.61	0.67	0.41
10	Uruguay	0.79	0.52	0.41
11	El Salvador	0.43	0.93	0.40
12	Latvia	0.81	0.48	0.39
13	Greece	0.60	0.60	0.36
14	South Korea	0.72	0.48	0.35
15	Singapore	0.78	0.43	0.34
16	Norway	0.73	0.44	0.32
17	New Zealand	1.00	0.32	0.32
18	Finland	0.73	0.42	0.31
19	Japan	0.51	0.61	0.31
20	Senegal	0.57	0.22	0.29
21	Denmark	0.65	0.44	0.29
22	Jamaica	0.60	0.46	0.28
23	Croatia	0.46	0.60	0.28
24	Lithuania	0.73	0.38	0.27
25	Malaysia	0.74	0.37	0.27
26	Slovakia	0.67	0.41	0.27
27	Serbia	0.47	0.56	0.26
28	Tunisia	0.69	0.37	0.26
29	Philippines	0.29	0.82	0.24
30	Costa Rica	0.35	0.67	0.23
31	Hungary	0.47	0.50	0.23
32	Saudi Arabia	0.38	0.61	0.23
33	Canada	0.39	0.57	0.22
34	India	0.22	1.00	0.22
35	Sweden	0.57	0.38	0.21
36	Bulgaria	0.37	0.56	0.21

37	Bahrain	0.51	0.39	0.20
38	Israel	0.39	0.51	0.20
39	Switzerland	0.47	0.42	0.19
40	Germany	0.46	0.42	0.19
41	Slovenia	0.60	0.32	0.19
42	Chile	0.20	0.91	0.18
43	Romania	0.23	0.76	0.18
44	Turkey	0.33	0.52	0.17
45	United Kingdom	0.37	0.47	0.17
46	Namibia	0.42	0.40	0.17
47	Portugal	0.38	0.41	0.16
48	Indonesia	0.23	0.61	0.14
49	Belgium	0.35	0.38	0.13
50	Poland	0.38	0.34	0.13
51	Spain	0.30	0.42	0.13
52	Netherlands	0.32	0.38	0.12
53	South Africa	0.23	0.51	0.12
54	Russia	0.31	0.17	0.12
55	Austria	0.54	0.18	0.10
56	Italy	0.40	0.25	0.10
57	France	0.34	0.29	0.10
58	Ukraine	0.18	0.45	0.08
59	USA	0.14	0.47	0.07
60	Colombia	0.04	0.85	0.03
61	Mexico	0.02	0.65	0.02
62	Brazil	0.00	0.64	0.00
63	Ireland	0.52	0.00	0.00

Appendix B

B.1 Table: Estimation Output - Stringency on Infections

```
Panel: Pooling estimation (PO)

N = 189  n = 63  T = 3 (Balanced panel)
R-squared = 0.11292    Adj R-squared = -1.68986
Wald F(1, 62) = 10.050289 p-value = 0.0024
RSS = 9.982555 ESS = 7.498178 TSS = 7.498178
Standard errors robust to heteroskedasticity adjusted for 63 clusters

----------------------------------------------------------------------
infections_norm |   Coefficient   Rob.Std.Err      t-stat    p-value
----------------------------------------------------------------------
     stringency |     -0.004837      0.001526     -3.1702    0.002 ***
          CONST |      0.536982      0.122771      4.3738    0.000 ***
----------------------------------------------------------------------
```

B.2 Table: Estimation Output - Wooldridge's test for Serial Correlation FE estimation

```
Wooldridge's test for serial correlation

H0: Corr(res_{T-1}, res_T) = rho. No serial correlation
rho = -1/(T-1) = -0.500000
F(1,62) = 4.927065
p-value = 0.0301
```

B.3 Table: Estimation Output - Baltagi and Li's test for Serial Correlation RE estimation

```
Baltagi and Li's test for serial correlation and random effects

H0: No random effects and no serial correlation.
H1: Random effects or serial correlation.
Chi2(2) = 311.783004
p-value = 0.0000
```

B.4 Explanation of F-statistic:

The F-statistic is calculated from the ANOVA table as the ratio of the model to the residual $F = \frac{model\ SS/df_{model}}{Residual\ SS/df_{residual}}$. This statistic tests the joint null hypothesis that all the coefficients in the model excluding the constant are zero. Thus, the p-value associated with this F-statistic is the chance of observing a larger F-statistic (Vijayamohanan, 2016).