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The Saving Predicament

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Abstract

The magnified uncertainty brought on by the recent outbreak of the COVID-19 pandemic has reminded us once again that periods of crisis are not restricted to global recessions. This thesis concentrates on the saving response in times of uncertainty, specifically shedding light on the most recent COVID-19 crisis. The thesis employs a fixed effects regression model on a panel of 27 advanced OECD countries over a 26 year time period (1995-2021). The study examines the impact of three measures of uncertainty on our main dependent variable, ie, household savings rate. Our primary measure of uncertainty is the unemployment rate, followed by GDP volatility, and stock market volatility. The measures of volatility are calculated using a GARCH(1,1) model stemming from Mody et al's (2021) empirical methodology. Consistent with previous precautionary literature, our study finds an increase in income uncertainty is paired with heightened household saving rates. We find that both unemployment rate and GDP volatility have a statistically strong relationship with household saving rates, however, stock market volatility indicate a statistically insignificant ambiguous relationship. We then applied our econometric model to identify whether the heightened saving rates during the COVID-19 pandemic period can be attributed to the onset of income uncertainty. The results indicate that about 60 percent of the increase in household saving rates is directly associated with an increase in GDP volatility and unemployment risk during the 2019-2021 pandemic. These outcomes remain consistent even after adding other controls variables that may determine savings such as household net worth (wealth measure), inflation rate, credit availability and disposable income growth. Through our model, we have come to understand that it would take a while for households to go back to pre-pandemic levels of consumptions. Households are still reeling in from the pandemic and will continue to consume conservatively whilst navigating through this "new normal". With the onset of a new-recession coming our way, this study showcases that navigating through periods of uncertainty will require uncovering alternative sources of demand paired with policy initiatives directed to rebuild confidence and minimize uncertainty.

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Introduction

The recent COVID-19 pandemic outbreak is like no other, it brought the world's largest economies to a standstill. It has reminded us once again that periods of crisis are not restricted to global recessions. The IMF reported that global growth projections fell by 6.3 percentage points (Gopinath, G. 2020) (see Figure 1) making the COVID-19 pandemic the worst recessionary period since the Great Depression and significantly worse than the 2007-07 financial crisis (Gopinath, G. 2020). There is a general consensus that periods of crises are analogous to periods of uncertainty and a common consequence of this uncertainty are changes in behavioral patterns, particularly in saving and consumption behavior of individuals.

This thesis concentrates on the saving response in times of uncertainty, specifically shedding light on the most recent crisis at hand, namely, the COVID-19 Pandemic. The first part of this study focuses on the on past periods of crisis which include both recessionary periods as well as pandemics and epidemics over a 26 year time period (1995-2021). The study then moves on to focus on COVID-19 pandemic. By focusing on the pandemic period, the study aims to investigate the importance uncertainty with respect to heightened saving rates for a panel of 27 advanced OECD countries. As far as we can tell, this is topic has received relatively less attention empirically, particularly with respect to the pandemic period and saving behavior conducted on such a macro-scale. This study wishes to therefore add to the large body of saving and uncertainty literature.

Consumers tend to save and hold wealth to insulate themselves from any fluctuations in income brought about by economic uncertainty in the near future (Carroll, D, & Samwick, A. 1997). Kimball (1990b) suggested that the element of prudence is driven by the precautionary saving motive according to which prudence dominates an individual's consumption patterns as uncertainty of future income increases thereby reducing the current consumption levels hence higher savings rate. Testing times of the Great Depression led to households foregoing consumption with the onset of rising income and labor uncertainty brought on by the crisis as deduced in the research of both Romer, C. D. (1990) and Flacco & Parker. (1992).

Similarly, the Great Financial Crisis of 2007-09 also contributed to precautionary saving literature. A critical piece presented by Mody. A, Ohnsorge. F, & Sandri, D. (2012) acts as a novel addition to the literature the study presents two unexplored measures of uncertainty ie, aggregate unemployment rate and GDP volatility (and stock market volatility) and conclude that there exists a positive correlation between savings and the selected measures of uncertainty. We build on Mody et al (2012) empirical methodology, and use the household saving rates as our main element of interest in our study as it is our chosen dependent variable across all methodological specifications.

A critical element to test the effects of uncertainty on saving is the use of uncertainty measure. We employ three measures of uncertainty: the unemployment rate and two additional measures of volatility. Both Bloom, N. (2009) and Mody et al (2012) illustrated how variability in GDP and stock market serve as a measure of uncertainty while studying saving behavior during the global financial crisis of 2007-09. We use the same estimation technique for both GDP and stock market changes via the GARCH(1,1) model of estimation which yields volatility measures for each country, named *gdpvolatility* measuring GDP volatility and *SMvolatility* measuring stock market volatility. We employ a panel regression with fixed effects (FE) where we regress household savings on our three measures of uncertainty as our baseline and add controls to strengthen our model to form the augmented specification. Furthermore, to account for any dynamic effects we also run each of our baseline and augmented specifications with a one-period lag of our dependent variable, namely, household saving rates.

Our main model holds through various specifications and we can confidently deduce that household savings tend to increase in the face of economy-wide uncertainty for advanced economies. We find that the impact on savings rates is largely accounted to any change in labor income and variability in growth rates of economies as opposed to changes in the financial stock markets. We employed robustness checks such as a dynamic savings rate and various controls to ensure valid estimates. Our proposed model passes through all the robustness checks. We then applied our econometric model to identify whether the heightened saving rates during the COVID-19 pandemic period can be attributed to the onset of income uncertainty. The results indicate that about 60 percent of the increase in household saving rates is directly associated with an increase in GDP volatility and unemployment risk. Further, household savings rates also increase following a drop in household wealth and an increase in inflationary pressures. While our model considered

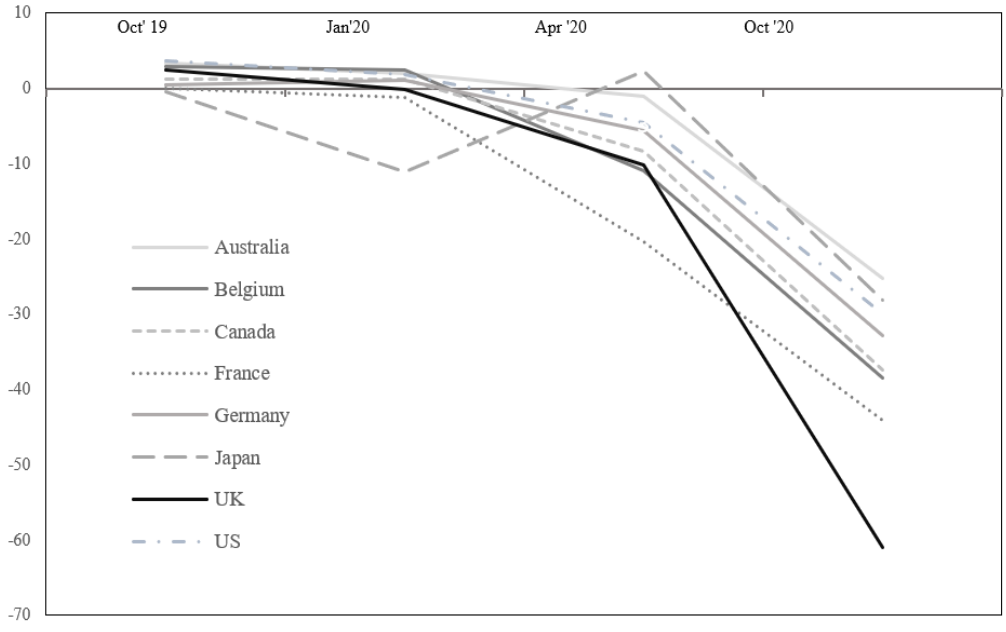
a variety of aspects related to savings, it could not take every element into account due to data unavailability. Therefore the study can be further built on to consider other elements such as age demographics, domestic policies changes and can also be expanded in the context of developing nations.

The thesis begins by featuring a preliminary analysis of saving behavior in times of uncertainty followed by investigating past literature in the literature review. We then move on to detailing the methodology used in the thesis and defining the data. Lastly, we present the results of our model and detail its relevance to the pandemic period (2019-2021) and present some concluding remarks.

Preliminary Analysis of Saving and Uncertainty Behavior

In this section we cover some preliminary findings on saving behavior in times of uncertainty, specifically the recent COVID-19 pandemic across chosen OECD countries. The pandemic period observed an uncommon global standstill starting in late 2019, the uncertainties were highlighted in the continual and substantial downward revision of growth projections (Figure 1).

Figure 1: Forecasted Real GDP Growth in 2020

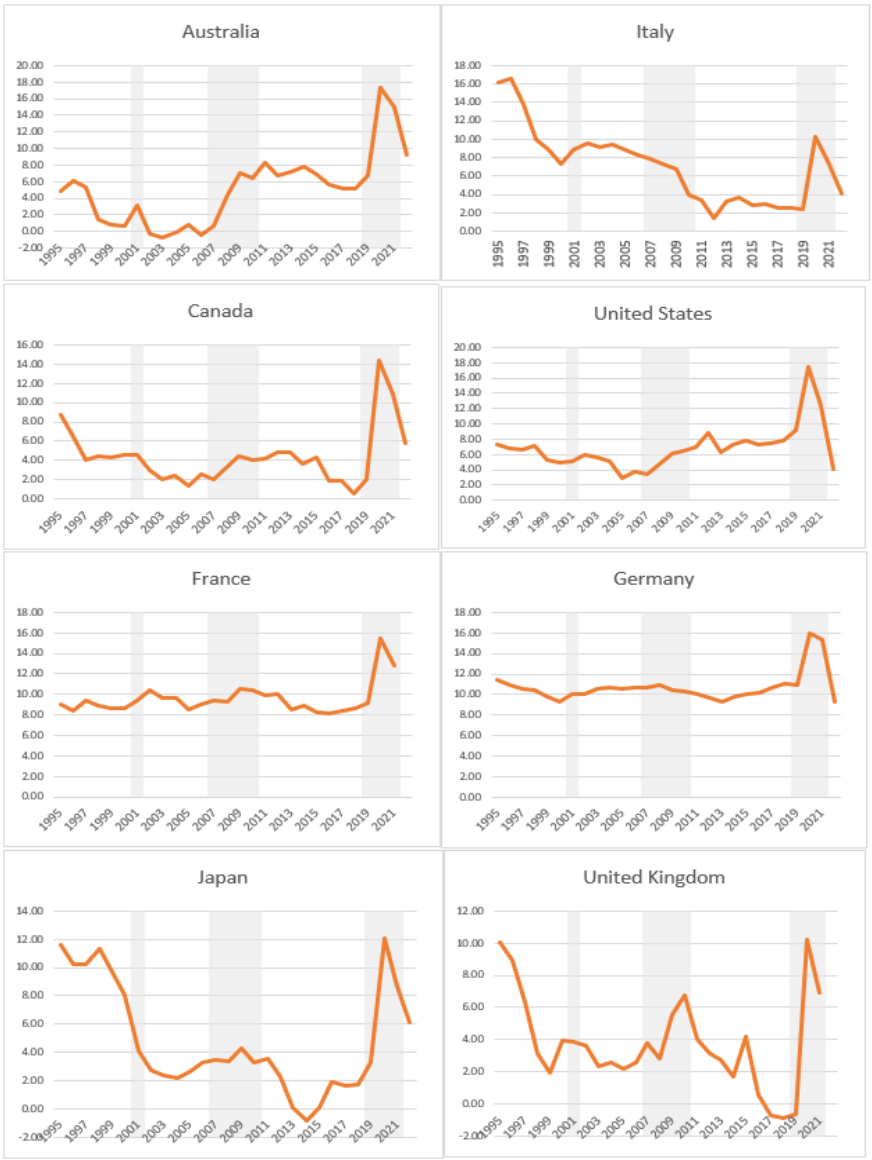


Source: OECD National Accounts database

An onset of economy-wide uncertainty is said to propel the incentive to save. Therefore, it is worthwhile to analyze the movement of household saving rates during times of crises as presented in Figure 2. The period of crises presented in the graphs encompass global recessions and global

pandemics. It can be observed that during times of crises as represented by the shaded areas in the graph, household saving rates tend to rise quite analogously. It is starkly evident for countries like Australia, Canada and the United States and relatively less evident for France, Germany, Italy and Japan. While the rise in household saving rates during the last global recession is well documented for some countries in the works of Carroll et al., (2012), Mody et al., (2012) and Alan et al., (2012), the COVID-19 pandemic takes precedence with 23 out of 27 countries in the sample observed a significant increase in household saving rates between 2019-2021. The United Kingdom, Canada, Italy and Japan observed a sharp rise in household saving rates specifically for the year 2020.

Figure 2: Household saving rates during periods of crises:



Data source: OECD National Accounts; Notes: Shaded areas are periods of crisis which include global recessions and global pandemics as defined by the World Bank and World Health Organisation . Entire sample graphs are not included due to space constraints but can be found in the Appendix.

Generally theory dictates, as a consumer saves more, they spend less and vice-versa. Therefore it is worthwhile to look into another aspect in this preliminary analysis is the relation between household saving behavior and consumption behavior in times of heightened uncertainty. Figure 3 highlights the nearly unequivocal decline in consumption growth in our sample of 27 OECD countries between the end of 2019- 2021. It is evident from the figure that the reduction in consumption growth is linked to an increase in household saving rates in most cases, particularly in the United Kingdom during the 2 years of the pandemic.

Figure 3: Change in Saving Rates and Consumption Growth between 2019-2021

Data source: OECD Key-Short term Economic Indicators Database

Given the sustained rise in household saving rates as shown in Figure 2 and the associated consumption decline observed in Figure 3, it provides grounds to think that the rise in uncertainty and an increase in household savings are related, at least on a peripheral level. However, this preliminary analysis is only surface level. These preliminary observations justify an in-depth statistical analysis of saving behavior in times of uncertainty. Therefore, examining that proposition will be the purpose of this thesis. Before we begin looking into the methodological specification, we shall start by looking back by investigating the literature related to saving behavior and uncertainty in the next section.

Literature Review

The basis of this thesis primarily centers around the response of savings patterns in times of uncertainty. The IMF estimated European households saved around 19% of their income during the pandemic years of 2020-2021 contrary to ordinary time saving rates centered around 12% (McGregor, Suphaphiphat & Toscani, 2022). The sharp increase in the saving rates across households during these two years points towards response to uncertainty of future income and potential employment loss caused due to the pandemic. These large accumulated savings play a pivotal role in revitalization of economies across the European Union. The central question to policy makers currently face is whether household spending patterns will regain the previous pre-pandemic momentum or whether precautionary saving motives will continue to dominate saving patterns as a new uncertain future lingers?

To understand how saving patterns alter in times of uncertainty, it is essential to dedicate a brief note to the evolution of the precautionary saving motive. The section begins with revisiting the buffer-stock model and the consumption puzzle. It then covers more contemporary research done on precautionary saving motive, specifically focusing on saving and uncertainty. The section concludes by highlighting empirical studies focusing on the precautionary saving motive throughout periods of crises.

2.1 Theoretical Precautionary saving literature

2.1.1 The Consumption Puzzle

The failure of the PIH brought into question the empirical significance of the "consumption puzzle". A deeper look into precautionary saving literature re-iterates the failure of the Permanent income hypothesis (PIH) in three key aspects. The PIH fails to address inconsistencies in consumption behavior, namely, *excess-growth, excess-smoothness and excess-sensitivity.* Deaton (1987) presents the empirical findings to showcase failure of life-cycle model and PIH in relation to "excess growth" of consumption. The findings highlight that consumption patterns observe "persistent consumption growth despite negative real interest rates in the United States" (Deaton, 1987). Subsequently Deaton (1987) stressed that consumption patterns deviate from the traditional PIH assumptions as changes in aggregate incomes are relatively smaller than that of changes in aggregate consumption; as well as variance of income from the trend is relatively larger than that

of consumption. Therefore, showcasing how aggregate consumption is relatively "smoother" as compared to aggregate income levels. Lastly, Flavin (1981) propounded the failure of the PIH as it failed to address the phenomenon of "excess sensitivity" in consumption relative to current income (Flavin, 1981). The paper highlights empirical evidence showcasing the over-response of consumptions to transitory shocks to income growth relative to current income. These findings stand contradictory to the traditional PIH literature. Whilst there have been multiple attempts to solve these three aspects of the consumption puzzle such as liquidity constraints, dogmatism in policy and general equilibrium considerations amongst other, economists have found that the precautionary saving motive appears to be a consistent and appropriate explanation for the puzzle represented in the works of Zeldes (1989), Deaton (1991), Caroll (1994) to name a few.

2.1.2 The Buffer Stock Model & Precautionary Saving Motive

The permanent income hypothesis propounded that consumption decisions of individuals are largely based on their current income flow as well as wealth accumulation (Douglas G. Steigerwald, 1999). While some aspects of the Permanent Income Hypothesis (PIH) does capture consumption behavior correctly, the hypothesis largely ignores the element of uncertainty. The traditional PIH model states that lower income growth would imply lower lifetime consumption, lower consumption and hence higher saving rates (Carroll, C. 1997). However, Carroll, Hall & Zeldes (1992) put forth an alternative to the traditional theory by illustrating the importance of incertitude in employment expectation and weakness of consumption, namely the Buffer Stock Model of Saving. The model centers itself around a target wealth-to-permanent income ratio. This target ratio is dominated by two forces namely prudence and impatience. "Impatience" is the sense that if future income were known with certainty an individual would choose to consume more than their current income (Carroll, C. 1997) whereas Kimball (1990b) defined "prudence" as the sense of saving more when faced with uncertainty of future income. The element of prudence is driven by the precautionary saving motive according to which prudence dominates an individual's consumption patterns as uncertainty of future income increases thereby reducing the current consumption levels hence higher savings rate. Each of these two elements dominate alternatively, meaning, if a consumer's wealth is below the target level then prudence dominates and vice-versa (Levenko, 2020). Similar studies have also been proposed by (Zeldes, 1989) and (Deaton, 1991) as well, the only exception being the buffer stock model proposed by Carroll et al (1992) also considers unemployment expectation when evaluating saving behavior.

2.2 Savings and Uncertainty: Methodology

Uncertainty is a ubiquitous concept, however it is tangible magnified in times of economic uncertainty. The inability to forecast a stable future alters human behavior, and for that reason, it is essential to investigate the key channels of both uncertainty and correspondingly the saving patterns in times of uncertainty. Although this thesis encapsulates parts of the precautionary saving motive, it focuses its attention to specifically saving behavior. We begin our discussion by taking a deeper look into the dependent variable, followed by disentangling the element of uncertainty by analyzing measures of uncertainty in precautionary saving literature.

2.2.1 Dependent Variable:

An integral element of understanding the relation between savings and uncertainty is how one defines the dependent variable. Literature over the years largely allocates this dependent variable to either be savings, wealth or consumption. As the name "precautionary saving" suggests, an apparent first step would be to analyze the savings equation. Large body of literature can be found with respect to the saving equation, spearheading the research is the works of Hahm, J. H., & Steigerwald, D. G. (1999). The study focuses on time-varying income uncertainty and finds evidence that indicates consumers are inherently forward-looking and therefore gradually adjust their shares of savings with changing income uncertainty. Further, Menegatti, M. (2010) and Jappelli, T., & Pagano, M. (1994), both find corresponding results of positive precautionary saving in times of economic uncertainty. A relatively novel method of analyzing savings and uncertainty is via the use of subjective measures of precautionary savings. Notable work in this respect is presented by Deidda, M. (2013). The study assesses the main determinants of precautionary saving motive by relying on a direct question targeting the desired amount of precautionary wealth from the Italian survey of households income and wealth during the 2002 wave of uncertainty. The study concludes that by excluding income risk, other sources of risk are more prominent in saving behavior such as labor income and financial risk. Furthermore, results indicate that the use of a subjective measure of precautionary wealth allows one to detangle previous income shocks or market imperfections from the current precautionary motive which ultimately leads to lower precautionary wealth targets Deidda, M. (2013).

Alternatively, the use of consumption is also commonly used as an empirical approach. Conventional economic theory dictates that individuals observe a reduction in current

consumptions and thereby increased consumption patterns for the future in an uncertain circumstance. A pioneer in this field of literature is Zeldes (1989), wherein the study concludes that a positive and significant precautionary saving motive exists with the inclusion of an uncertainty measure. Similar results have been found by Dardanoni., (1991); Carroll., (1994) ; Miles., (1997) and Menegatti., (2010). On the contrary, Dynan (1993) extended Kimball, 1990 work and put forth an alternative argument stating there is no precautionary saving motive in play when empirically investigating the coefficient of relative prudence present within the Consumer Expenditure Survey. In addition, Benito, A.(2006) modeled the consumption variable in a probit estimation and concluded that while an objective uncertainty measure yields a positive and significant precautionary saving motive, there is inconclusive evidence with respect to a subjective or self-reported measure of uncertainty (Achleitner., 2020).

2.2.2 Measures of uncertainty:

Risk as defined by American economist Frank Knight as a "known probability distribution over a set of events." (Knight, F. H. 1921). His argument presented a scenario of tossing a coin; flipping a coin is considered risky as for a fair toss there is a 50-50% chance of getting either heads or tails. In contrast, Knight also coined the definition for "*uncertainty*" which described it as an individuals' inability to forecast the likelihood of an event happening (Bloom, N., 2014). Therefore following Knight's analogy, uncertainty would be the inability to estimate the number of coins produced ever minted. Although the terms have distinct defining characteristics, they are often used interchangeably. Hence for the purpose of this thesis, the two terms shall be used interchangeably under the broader umbrella term of "uncertainty". Given that uncertainty as a concept is vast and nuanced, it is no wonder that the concept is hard to capture in a tangible empirical way. The use of proxies has been a popular method to therefore interpret uncertainty, specifically economic uncertainty. Few key channels or proxies to analyze behavioral patterns in an economy primarily focus on labor market indicators such as unemployment rate, GDP volatility and stock market volatility.

1. *Unemployment rate:*

A large chunk of variation in uncertainty can be attributed to changes in current and future employment opportunities. Economic downturns transcend to individuals through rising unemployment and layoffs. Therefore, a branch of literature focuses on labor market uncertainty and consequently uses the unemployment rate as a measurable proxy for uncertainty.

Individuals and households carry the largest burden of economic downturns, therefore disaggregating uncertainty and vis-a-vis its proxy down to micro-levels provides valuable insights towards the argument. Literature focusing on micro-based estimations have been observed to rely on the ex-ante subjective likelihood of furlough such as the works of Lusardi, A. (1998) who found that individuals' behavior is altered to saving more if they expect an increase in income risk in the future. Additionally, literature presented by Benito, A (2006) highlights the significant association between the precautionary saving motive and unemployment risk. Following suit Ceritoglu, E. (2013) and Lugilde et al. (2018) both study precautionary saving patterns in Turkey and Spain respectively, however the two find opposing results. The study presented by Ceritoglu, E. (2013) found a significant precautionary motive and its association with unemployment risk in the Turkish sample, on the contrary Lugilde et al. (2018) found no evidence within the Spanish sample.

Uncertainty and unemployment are synonymous at every level of aggregation. Labour market conditions often use unemployment rates as a proxy when studied through a macro-economic lens. A large body of literature attest to the common theory that an increase in savings is associated with a rise in unemployment rates. One key piece of literature presented by Mody et al (2012) showcases this very same precautionary saving motive whilst studying saving patterns across 27 advanced economies. The study is novel in precautionary saving literature as it introduces two measures of uncertainty, namely, aggregate unemployment rate and GDP volatility and concludes that there exists a positive correlation between savings and both measures of uncertainty. Likewise, Bande, R., & Riveiro, D. (2013) find similar results using regional employment rate and future income volatility as proxies for uncertainty.

2. *Income Volatility:*

Measures of uncertainty can additionally be attributed to elements which are under the umbrella of income volatility but not captured completely by unemployment risk. Therefore, a body of literature focuses on proxies based on the variability of income. A panel study conducted by Kazarosian, M. (1997) in the United States proxied uncertainty as the variation of residual within income-age profile estimates. The study thereby successfully obtained individual income uncertainty estimates within their sample. Another strand of income volatility literature focuses on the more popular source of uncertainty within an economy, that being, GDP volatility. Separate

studies conducted by Hahm & Steigerwald (1999) and Menegatti, M. (2010) both highlight the use of GDP volatility as a measure of uncertainty while studying saving behavior in OECD countries. Both studies attest to the existence of a positive precautionary saving motive which thereby affects consumption decisions. Additionally, Mody et al (2012) not only use GDP volatility as an uncertainty measure but also include stock market volatility to capture income variability shocks to savings. However, Mody et al (2012) did not find a significant impact of variations in the stock market to affect saving rates. While the use of objective measures of uncertainty is the more popular empirical route, Lusardi (1998) and Guiso, Jappelli & Terlizzese (1992) investigate the use of subjective measures of income uncertainty. The use of subjective measures of income variability allows the precautionary saving motive to be determined by the variance of future income flows/shocks. However, the Guiso, Jappelli & Terlizzese (1992) study concluded that a precautionary saving motive has a very limited role in explaining overall saving behavior. Similar results were also found in the Lusardi (1998) study which attributed only 1-3.5 percent of total savings to the precautionary saving motive.

2.3 Savings and Uncertainty: Throughout history

Saving behavior has always been tested in times of crises. Before we proceed to the empirical section of the thesis, revisiting saving patterns during times of uncertainty throughout historical events is necessary. This section of the literature will therefore cover saving and consumption behavior during times of crises, particularly focusing on recessions and pandemics.

Defining the term “crisis” is an integral starting point whilst re-visiting the literature. Building from the idea propounded by Rietz, T. A. (1988). Barro, Robert J. (2006) coined the “rare-disaster” framework. The paper created the categorical definition for the term “crises” which was described as the period of economic shock or collapse which led to subsequent negative effects on an economy. The study identified the interrelation between anticipation of economic downfall and the subsequent fall in real interest rates (Barro, Robert J. 2006). These periods of “rare-disaster" can be alternatively designated as “times of crises”. The bounds of the term “times of crises” therefore encompasses not only financial crises such as the great depression and the financial crisis of 2007-09 but also extends to times of economic turmoil such as epidemics like the Spanish Influenza flu or a more recent pandemic of COVID-19. In its essence, the definition of a “crisis” can be attributed to an event which substantially affects the GDP and current as well as the future consumption patterns of a geographical entity.

2.3.1 Recessions

Uncertainty and economic recessions are intertwined concepts. Bond markets, stock markets and GDP all see a steep increase in volatility with the induction of a financial recession such as the Great Depression or more recently the Great Recession (2007-2009) (Bloom, N. (2014). Contrary to the popular theory that the economic downturn was a result of declining output levels in the summer of 1929 during the Great Depression. Romer, C. D. (1990) highlighted the distinct gap in the reasoning as to why there was a heavy acceleration in the decline in economic activities and a collapse of stock prices in the latter half of 1929, spilling over through the 1930s. Romer, C. D. (1990) extended Bernanke's (1983) theory relating to the fall of investment spending as a result of heightened uncertainty. The paper put forth empirical evidence that the stock market crash of 1929 generated temporary uncertainty about future income which in turn led to consumers foregoing the purchase of durable and semi-durable goods in the late 1929 and much of the 1930s (Romer, C. D. 1990). Flacco & Parker. (1992) further extends the empirical literature by employing a linear moment model to study the variance of income as a measure of uncertainty from 1921-1930. The study deduced the inclusion of the variance of income estimates attributes significantly towards explaining the initial fall in consumption that marks the beginning of the Great Depression (Flacco & Parker. 1992).

Additionally, the relatively recent financial crisis or The Great Recession has contributed significantly to the empirical literature relating to saving behavior and uncertainty. One of the most notable works in recent literature is by Mody et al (2012). This paper studied precautionary saving patterns throughout the 2007-07 financial crisis across a panel of developed OECD countries. The study propounded that heightened uncertainty brought on by the onset of the Great Recession has substantially contributed to the increase in saving rates and in-turn led to resulting in lower levels of consumption and GDP growth (Mody et al. 2012). The Mody et al (2012) estimates deduced approximately two-fifth of the sharp increase in saving rates across 2007-09 can be attributed to the precautionary saving motive (Mody et al. 2012). Correspondingly, similar results were yielded in the United States by Carroll et al (2012) a. They investigated the "buffer" stock model in the presence of labor market uncertainty and credit constraints in the United States. The study concluded that credit constraints, shocks to household wealth and income uncertainty proxied by unemployment risk have been significant factors attributed to driving US household saving rates. Likewise, Ravn, M. O., & Sterk, V. (2017) also studied a model with respect to household saving

behavior and uninsurable unemployment risks during the Great Recession. They deduced that the market observes a depression in demand credited to the precautionary saving motive and in turn leads to lowering job vacancies producing an amplification of the mechanism further (Ravn, M. O., & Sterk, V. 2017) .

2.3.2 Pandemics

An alternative "rare-disaster" or crisis the thesis will cover are epidemics and pandemics. Large-scale outbursts of diseases not only impact the geography and demography of a population but also cause substantial economic disruptions (Madhav, Nita, et al., 2018). Studying the association of health-crises such as pandemics and their economic implications have been a focus of many health-economists over time. One such notable work is presented by Barro et al (2020) which studies the mechanisms of the COVID-19 pandemic in comparison to that of the Great Influenza pandemic (Barro et al, 2020). The study included data points of 43 countries from 1918-1920 during the great influenza pandemic to potentially collate a possible outcome in the novel COVID-19 pandemic. They deduced that after controlling for WWI effects, a typical country observes a fall of 6-8% in GDP and consumption. The paper also deduced that a higher death rate meaningfully decreases real returns of stocks and government short-term bills (Barro et al., 2020). On a similar line of thought, it was observed that household saving patterns observed an increase in liquid asset balances. This observation was magnified in middle-income and low-income households relative to their pre-pandemic saving shares (Cox et al. 2020). Research presented by Dietrich, et al (2022) which encompassed a tailor-made survey capturing consumer perceptions about the onset of the COVID-19 pandemic in the United states between 2020-2021 further bolster this argument. The research observed a rise in household uncertainty attributed to approximately two-thirds of the fall in output (Dietrich et al. 2022). Thereby, solidifying the argument that labor uncertainty is pervasive and later saving behaviors.

Methodology

This section encompasses the empirical methods used in this thesis by first outlining our model specifications. It then provides insights on why we employ a panel fixed effects regression and concludes with detailing our chosen identification strategy. The section also lists some diagnostics tests we ran before proceeding to running our methodological specifications.

3.1 Model Specification:

A pronounced problem when using an OLS regression for our chosen sample is the element of country fixed effects. OLS estimates will only be unbiased and estimated correctly given that country effects are zero. However, in the case that country effects are non-zero, OLS estimates will no longer satisfy the classic OLS assumptions meaning error might not be equal to zero or might be correlated with other independent variables.

3.1.1 Panel Fixed Effects:

Therefore to account for the problems encountered with the use of a simple OLS regression, the study employs the use of a panel fixed effects model. The chosen dataset is a fixed panel data with nearly equal number of years in the selected time period and the number of countries. The dataset is long and unbalanced in nature. By and large, panel datasets allow the use of both time series and cross-sectional dimensions. Therefore, this study uses panel data models, specifically fixed effects with country and time-specific effects (FE hereafter).

Employing a country-time-specific FE model accounts for both heteroskedasticity and autocorrelation as country-fixed effects are constant and are captured by the intercept. Along with the FE model, the study also employs other controls on the baseline to account for any other omitted variable bias.

3.2 Main Identification Strategy:

Before we specify the baseline specification, it is beneficial to recall some of the literature and understand the workings of each of the chosen variables. We begin by considering the relationship between savings and the uncertainty measures. What is essential to remember is that our uncertainty measure is driven by the element of "crisis", therefore according to the literature we previously studied, we expect that in periods of crisis, we observe a positive coefficient of uncertainty. A positive coefficient of uncertainty implies that with higher uncertainty as experienced in times of crises would ideally lead to an increase in the saving rates across our sample.

3.2.1 Baseline Specification:

The household saving rate (S_{it}) acts as the dependent variable across all the specifications estimated in this thesis. The study then covers a baseline specification in which our main independent variables are the uncertainty measures as estimated in Mody et al. (2012). Hence, to better

understand the relationship of uncertainty and savings- we begin by concentrating on income/labor uncertainty and running a FE regression with the unemployment rate for i country and t time period denoted by UR_{it} as seen in equation (1). We then add our second measure of uncertainty, GDP volatility measured by using the GRACH(1,1) model to assess the impact of global changes. Lastly our baseline specification is completed with the addition of our stock market volatility measure. In addition to these specifications, we also ran FE regressions with each of our chosen regressors separately on household savings rates. The results can be found in the appendix and discussed further on in the study.

To add an element of robustness, we estimate the equations, with dynamic savings ie, adding a one-period lag of household savings. We run equation 1-3 without lags at first. However we add the lagged savings over 1 period to account for any omitted variable bias as we expect that current household saving rates are influenced by previous household savings rates as observed in equation (4-6).

Without Lagged Savings:

$$S_{it} = \beta_0 + \beta_1 UR_{it} + country_i + time_t + \varepsilon_{it} \quad (1)$$

$$S_{it} = \beta_0 + \beta_1 UR_{it} + \beta_2 gdpvolatility_{it} + country_i + time_t + \varepsilon_{it} \quad (2)$$

$$S_{it} = \beta_0 + \beta_1 UR_{it} + \beta_2 gdpvolatility_{it} + \beta_3 SMvolatility_{it} + country_i + time_t + \varepsilon_{it} \quad (3)$$

With Lagged Saving:

$$S_{it} = \beta_0 + \beta_1 S_{it-1} + \beta_2 UR_{it} + country_i + time_t + \varepsilon_{it} \quad (4)$$

$$S_{it} = \beta_0 + \beta_1 S_{it-1} + \beta_2 UR_{it} + \beta_3 gdpvolatility_{it} + country_i + time_t + \varepsilon_{it} \quad (5)$$

$$S_{it} = \beta_0 + \beta_1 S_{it-1} + \beta_2 UR_{it} + \beta_3 gdpvolatility_{it} + \beta_4 SMvolatility_{it} + country_i + time_t + \varepsilon_{it} \quad (6)$$

β_0 is the constant or the intercept and β_1 denotes the coefficient for the lagged variables. Similarly β_2 represents the estimated effect of unemployment on household saving rates for each country in our specified time period. Lastly, β_3 and β_4 represent the coefficients for GDP volatility and stock market volatility respectively. The variables $country_i$ denotes country fixed effects and $time_t$ denotes time fixed effects. Lastly, ε_{it} is the error term.

3.2.2 Augmented Specification:

We use the baseline specification to understand the relationship between saving and our uncertainty measures. We then build on to the baseline by adding controls and analyzing saving behavior across our panel with nuances like wealth, credit and inflation controls. We repeat the

same process as before with respect to lagged savings. Therefore the two augmented specifications can be observed in equation (7-8):

Equation 7:

$$S_{it} = \beta_0 + \beta_1 UR_{it} + \beta_2 gdpvolatility_{it} + \beta_3 SMvolatility_{it} + \beta_4 inflation_{it} + \beta_5 wealth_{it} + \beta_6 credit_{it} + \beta_7 income_{it} + country_i + time_t + \varepsilon_{it} + country_i + time_t + \varepsilon_{it}$$

Equation 8:

$$S_{it} = \beta_0 + \beta_1 S_{it-1} + \beta_2 UR_{it} + \beta_3 gdpvolatility_{it} + \beta_4 SMvolatility_{it} + \beta_5 inflation_{it} + \beta_6 wealth_{it} + \beta_7 credit_{it} + \beta_8 income_{it} + country_i + time_t + \varepsilon_{it}$$

Where $inflation_{it}$ is our control for inflation rates for country *i* and time *t*. We similarly account for wealth controls proxied by household net worth and $credit_{it}$ which denotes credit constraints. To account for any change in expected income we include the one-period ahead real disposable income growth represented as $income_{it}$ for country i and time t. Optimally, the addition of controls enhance the internal validity of the study and behave as an additional robustness check.

3.3 Diagnostic Tests:

It is integral to the study that our estimates are consistent and unbiased in nature. Hence, running the following diagnostic tests will ensure the sanctity of our model before running any regression specifications.

3.3.1 Considering Time Fixed Effects:

One caveat of using panel data is the possibility of data in the same unit being correlated with each other, this is more pronounced as the panel gets longer (Baltagi et al. 2012). We add $time_t$ as our time-fixed effects variable to account for any unobserved heterogeneity within our chosen sample. The addition of a time-fixed effects variable can account for any time-invariant unobserved correlation with our dependent variable i.e, household savings. We run a simple STATA test (testpram i.year). The test reveals that the dummies for all years are non-zero, this indicates a strong requirement for the addition of time-fixed effects variables. Therefore, we have gone ahead with a time-effects variable irrespective as it acts as an additional quality assurance and measure of control in our model.

3.3.2 Considering Autocorrelation and Heteroskedasticity:

A. Heteroskedasticity:

To ensure valid and unbiased results we need to account for the presence of heteroskedasticity. Heteroskedasticity arises when variances of residuals are not constant or equal in nature. Therefore we need to test for heteroskedasticity within our sample. We do so by running the modified Wald test (xttest3) with the null hypothesis being that homoscedasticity is present. The results suggest that we can reject the null hypothesis, hence, implying the presence of heteroskedasticity. We control and resolve any issues with respect to heteroskedasticity by employing the Driscoll and Kraay (DK hereafter) standard errors when running our regression specifications.

B. Autocorrelation:

Another important aspect to consider is autocorrelation as it may impact the accuracy of our predictions. It is integral to take this into consideration as the presence of autocorrelation may distort the R-square value for our model specification. Hence we need to check the presence of autocorrelation in our sample data. We therefore run the Breusch- Pagan LM test (lmtest) to test the null hypothesis of no autocorrelation. However, we could not reject the null hypothesis, suggesting some element of autocorrelation. Similar to the presence of heteroskedasticity, we account for auto-correlation in our sample through the aforementioned DK standard errors. We do so as the DK standard errors are clustered by country and the error structure is excellently suited for both issues one might encounter with a long panel. Hence, making our study more consistent and unbiased.

In conclusion, running our regression specifications with Driscoll and Kraay standard errors most suitable to our study as it is the most robust to both autocorrelation as well heteroskedasticity. Before we move on to the next section, the thesis will be reporting the associated R-square for each of our specifications in conjunction with the above diagnostic tests before drawing any conclusions about our model's performance.

Data

This section covers the data sources used as part of the thesis and it provides insight on the chosen variables. Additionally it briefly elaborates on the rationale for choosing the specific variables. The sample spans over 26 years and includes a selection of 27 OECD countries. The main dataset this thesis uses is the *OECD National Accounts Database: Household Accounts (NA Database* hereafter) which serves as an exhaustive source of historical data for all 27 countries since 1970-2022.

4.1 Saving Indicators

As households provide a rich insight on economic behavior and link well to policy changes, we use household-level data to conduct our analysis. We begin with our dependent variable i.e, household saving rates. The *NA Database* encompasses household-level data across the selected OECD countries for our 26 year time period. We also include an element of lagged savings over 1 period to account for any omitted variable bias as we expect that current household saving rates are influenced by previous household savings rates.

4.2 Uncertainty Measures

The element of uncertainty is an integral part of this thesis, specifically income uncertainty. Hence, to appropriately capture it we use measures of uncertainty proxied by unemployment rates for the selected time-period. Additionally, because external factors affect uncertainty- we also account for GDP changes and stock market changes into our baseline. Data for unemployment rates and Real GDP rates per capita were sourced exclusively from the *WEO database*. Subsequently, Data related to stock market changes were sourced from S&P 500 historical data over a period of 2 years (2020-2021). Mody et al. (2012) illustrated how variability in GDP and stock market serve as a measure of uncertainty while studying saving behavior during the global financial crisis of 2007-09. We will use the same estimation technique for both GDP and stock market changes via the GARCH(1,1) model of estimation which yields volatility measures for each country, named *gdpvolatility* & *SMvolatility*.

4.3 Control Variables

While the baseline analyses saving behavior in times of uncertainty, we also include certain controls to account for omitted variable bias and as a measure of robustness check.

4.3.1 Wealth and Credit constraint Measures

Wealth measures are proxied by household net worth. Data for the wealth measure is sourced using the *NA Database* which include household level macro-panel data for the selected time period across all 27 OECD countries. Our household indebtedness ratio captures credit availability of a household. The measure encompasses loans, both mortgage loans and consumer credits and other accounts payable and is calculated as a percentage of net disposable income. We expect that our wealth measure is negatively correlated with our dependent variable ie. household saving rates.

4.3.2 Inflation

Including the inflation rate as a measure of control is important as high inflation is largely associated with recessionary periods. The IMF WEO Database contains historical yearly inflation rates for our time series data. The addition of the inflation rate measure acts as a robustness check for our baseline.

4.3.3. Income Growth

A note of caution needs to be adhered to when using the unemployment rate as an uncertainty measure. A rise in unemployment tends to affect both the future income distribution and expected income. Hence, to account for any change in expected income we include one-period ahead real disposable income growth. The data related to real disposable income is sourced using the *NA Database.* However, due to lack of data availability, the indicator only accounts for 13 years of the time period and excludes Switzerland, Estonia, New Zealand, Luxembourg, South Korea and Slovakia.

Results

This section discusses the results obtained from our methodological specification. This section begins by firstly discussing the relationship between savings and income uncertainty. It then moves on to elaborate on the impact of other uncertainty measures considered in our thesis, namely, GDP volatility and stock market volatility. We lastly cover the other determinants of saving, which is our augmented model specification. This augmented specification is a robustness check as the specification includes selected control variables.

5.1 Savings and uncertainty

5.1.1 Unemployment Rate

Table 1 presents the results of the baseline regression we run and establishes the groundwork for our thesis. We begin by running a FE regression on unemployment rate (UR_{it}) to analyze the relationship with household savings for our 27 sample OECD countries in column (1) which gives us positive significant results. The results indicate that a 1 percent increase in unemployment is associated with 0.38 percent increase in household saving rates across our sample. While these results are a good indicator of the relationship between savings and uncertainty, we need to assess the results in column (3) to highlight the nuanced relationship. Notably, the results are consistent

with the initial findings in column (1). A 1 percent increase in unemployment rate is associated with a 0.37 percent increase in household saving rates. To further account any past value impact on our estimates, we consider the coefficient results in column (6) which include the one-period lagged-saving rates across our sample to solidify the argument. The specification in column (6) account for the dynamic effects of household saving rates. It is integral to include in our model as they are statistically significantly associated with the current saving rate. As expected, the results hold, we observe highly statistically significant coefficient values for our unemployment rate estimates.

Table 1: Baseline Specification: with and without lagged savings

Baseline fixed-effects regression with Drisc/Kraay standard errors						
Variables	Country & Time Fixed Effects					
Household saving rate	(1)	(2)	(3)	(4)	(5)	(6)
Unemployment rate	0.386***	0.373***	0.372***	0.311***	0.310***	0.32***
	[2.800]	[2.57]	[2.54]	[3.23]	[3.74]	[3.72]
gdp volatility		0.52**	0.519**		0.131***	0.130***
		[1.96]	[1.98]		[2.72]	[2.712]
SM volatility			0.23			-0.22
			[0.32]			[-0.07]
Lagged savings				0.792**	0.795***	0.794***
				[2.12]	[2.73]	[1.99]
Constant	8.112***	8.220***	7.848**	3.427**	2.794***	2.652***
Number of obs =	714	714	706	687	687	679
Number of groups =	27	27	27	27	27	27
Within R-squared =	0.7109	0.7429	0.7201	0.7476	0.7477	0.7365

t-statistic in brackets****p<00.01 **p <0.05 *p<0.1*Coefficients for country and year dummies are not reported

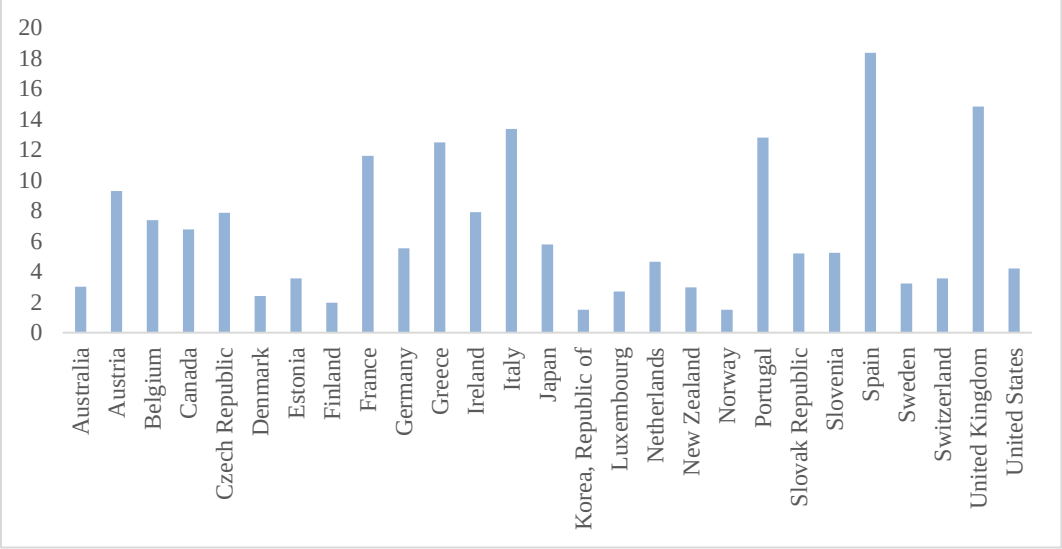
5.1.2 Other Measures of Uncertainty:

Before we begin to expand our baseline specifications, it is valuable to mention that we ran each uncertainty measure individually as well, the results of which can be found in the annex (Table F). The results illustrate a statistically strong significant relationship between unemployment rate and household saving rates. Similar results were found in the case of GDP volatility and household saving rates. While both unemployment rate and GDP volatility remain statistically significant with the addition of a one-period lagged value of saving rates, stock market volatility loses its strength to become statistically insignificant.

We now expand our considerations to the other measures of uncertainty. As mentioned before, the two other measures of uncertainty are, GDP volatility ($gdpvolatility_{it}$) and stock market volatility

SMvolatility$_{it}$. Our first measure of income uncertainty *gdpvolatility*$_{it}$ is defined as the time variability standard deviations of per-capita real GDP growth. It was estimated using the first-order GARCH model. A general consensus is that smaller economies experience a higher degree of GDP volatility. However, certain points in our selected time-period have exacerbated GDP volatility rates in larger economies as well, for example Japan and Korea during the Asian Financial crisis (1997) or Ireland and Italy during the Eurozone crisis (2009-2011). Hence while we expected that there would be a heightened amount of GDP volatility across our sample, we expected the smaller economies in our sample to experience relatively higher degrees of GDP volatility when we looked into the COVID-19 pandemic (2019-2021). However, it was surprising to note that larger economies in the sample experienced relatively higher GDP volatility during the pandemic period (2019-2021) as compared to smaller economies. Evident in Figure 4, The United Kingdoms, Italy, France feature sharp spikes in volatility as compared to Slovenia and the Slovak Republic.

Figure 4: Change in fitted GDP volatility 2019-2021



Data source: OECD National Accounts

We add the volatility measures one by one so as to accurately assess the impact. Consistent with the literature and our expectations, the coefficient of GDP volatility is statistically significant in all the regression specifications, highlighting the positive relationship between household savings and the degree of instability in the economic output of a country. A 1 percent increase in income uncertainty proxied by GDP volatility specifically is associated with a half a percentage point

increase in household savings when a one-period saving lag is not present and a 0.1 percentage point increase with the addition of lagged savings. Further, our unemployment rate estimates remain broadly consistent as we included this GDP volatility proxy. Therefore, indicating that the prominence of unemployment rate and GDP volatility is evidence to support the changes in saving behavior in times of uncertainty.

Similar to our measure of GDP volatility, we add the stock market volatility measure as well. As indicated in Bloom, N. (2009) and Bloom, N (2014) stock market volatility have been associated with the alteration of consumption behavior across advanced economies. Following this line of thought, we add our stock market volatility measure in our baseline specification, evident in column (3) and column (6) in Table 1. Higher levels of volatility do stimulate the saving motive, however the possibility of negative returns acts as a deterrent implying an ambiguous relationship. Consequently, our stock market volatility measure estimates are statistically insignificant and therefore is consistent with our expectations that the relationship between household savings and stock market volatility remain ambiguous, at least for our case.

5.2 Other determinants of savings

Considering other determinants of savings is an integral exercise to preserve the accuracy of our estimates. Hence, adding various controls to our baseline serves as a robustness check for our model. Deaton, A. S. (1991) highlighted the importance of an optimal wealth buffer to counter income shocks as part of the buffer-stock model of precautionary savings. Carroll et at (2003) further build on the argument to find precautionary wealth variation in households in times of income uncertainty across various income groups. We therefore begin by adding our first measure of control, namely, household wealth proxied by household net worth across our sample of 27 advanced economies. Table 2 reports the outcome when adding our household wealth measure in column (7) and (8), the results are consistent with our model and expectations, household savings and household wealth are negative associated with one another. Although, household net worth only represents the financial health of a household, we decided to use household net-worth as a proxy because it reflects the capacity to meet financial ambitions and also to combat unexpected expenses. Hence, household net worth provides a broad perspective and acts as a good representative to measure household wealth accumulation.

Another notable determinant of saving behavior is credit availability and credit constraints. Research by Jappelli, T. & Pagano, M. (1994) illustrated how liquidity constraints or credit constants are an important determinant of saving behavior. Our model follows the theory which exemplifies the phenomenon that looser credit constraints reduce preemptive saving motives and alternatively tighter credit constraints increase saving motives. This is further exacerbated in times of known uncertainty. We therefore employ our credit availability measure proxied by household indebtedness ratio. The results highlight statistically reliable estimates that are analogous with the past literature and our model.

Table 2: Augmented Specification: with and without lagged savings

	Baseline fixed-effects regression with and without lagged savings						Augmented specification with and without lagged savings	
Household saving rate	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Unemployment rate	0.386***	0.373***	0.372***	0.311***	0.310***	0.32***	0.242***	0.253***
	[2.800]	[2.57]	[2.54]	[3.23]	[3.74]	[3.72]	[4.08]	[3.49]
gdp volatility		0.52**	0.519**		0.131***	0.130***	0.241**	0.291***
		[1.96]	[1.98]		[2.72]	[2.712]	[2.43]	[4.00]
SM volatility			0.23			-0.22	0.21	0
			[0.32]			[-0.07]	[0.64]	[-0.01]
Lagged savings				0.792**	0.795***	0.794***		0.644***
				[2.12]	[2.73]	[1.99]		[4.54]
Household wealth							-0.011***	-0.032***
							[-6.79]	[-5.26]
Inflation rate							0.368***	0.200***
							[4.38]	[3.07]
Credit Availability							-0.042**	-0.080***
							[-2.25]	[-2.97]
Disposable income growth							-0.061**	-0.081**
							[-2.25]	[-2.34]
Constant	8.112***	8.220***	7.848**	3.427**	2.794***	2.652***	5.314***	4.887***
Number of obs =	714	714	706	687	687	679	630	622
Number of groups =	27	27	27	27	27	27	21	21
Within R-squared =	0.7109	0.7429	0.7201	0.7476	0.7477	0.7365	0.7608	0.8014

t-statistic in brackets; ****p<00.01 **p <0.05 *p<0.1;* Coefficients for country and year dummies are not reported

Since our thesis is heavily centered around macroeconomic instability and savings, we have to account for any inflationary changes. Fischer, S. (1993) propounded that inflationary changes are negatively associated with macroeconomic growth. A reduction in macroeconomic growth is a feature of our crisis period. Therefore, higher inflation rates are largely associated with recessionary or crisis periods and therefore augment a household's saving motive. To account for this, we added the inflation rate into our augmented specification. The results in Table 2 feature a positive association between changes in inflation rate and household saving rate. These results are in-line with our model. A 1 percent increase in inflation rate is associated with 0.2 (& 0.3 percent without lagged savings) percent increase in household saving rates.

Lastly, we account for any changes with respect to change in a household's disposable income growth. This is an important determinant as there is a large body of literature dedicated to it in both precautionary saving literature as well as buffer-stock model. Surprisingly, the statistically significant estimates in Table 2 suggest a negative relationship between income growth and household savings. We observe with a 1 percent increase in disposable income growth rate, there is an associated decrease in household saving rates by 0.08 percent (and 0.06 without lagged savings). This negative relationship is contrary to traditional precautionary saving literature. However, Curtin, R. (2016) propounded that consumption aspirations are a direct reflection of changes in income and wealth of a household and are forward looking in nature. Hence, the negative relationship may be a reflection of future expectations in terms of increased consumption aspirations. Households might allocate a larger proportion of income towards future goals as they expect the crisis to fade in the future.

5.2.1 Robustness Check:

The above discussion assumes that the path of causality runs through the three main chosen variables to our dependent variable in question. However, two important aspects to estimate unbiased estimates is the probability of omitted variable bias and the problem of endogeneity.

We account for omitted variable bias via the introduction of all 4 additional control variables (wealth, inflation, credit availability and income growth) are a form of robustness check for our augmented model. The results in column (7) and (8) indicated that the additional controls not only bolster our model but also highlight that our main measures of uncertainty have not significantly changed with the addition and hence remain robust. Further, adding a dynamic savings rate (one-period lagged saving rates) account for any spill-over time effects of past savings on current savings.

On the other hand, we control for the problem of endogeneity and potential reverse causality by running our baseline regression with lags of our regressors. Table 3 illustrates our baseline specification from equation (6) but we now use a one-period lag of our main regressors in *t-1* on household saving rates in period *t.* The null-hypothesis in this case would imply the inclusion of lagged regressors halts the introduction of endogeneity in our model. That would mean if any of our regressors have a statistically significant relationship with household savings, our model has a problem of endogeneity. As observed in the table, all three regressors are statistically insignificant

with respect to their association with household saving rates. As a result, we cannot reject our null hypothesis. Our model is therefore considered consistent and unbiased and fairly robust in nature.

Table 3: Robustness check: baseline specification: with lagged regressors

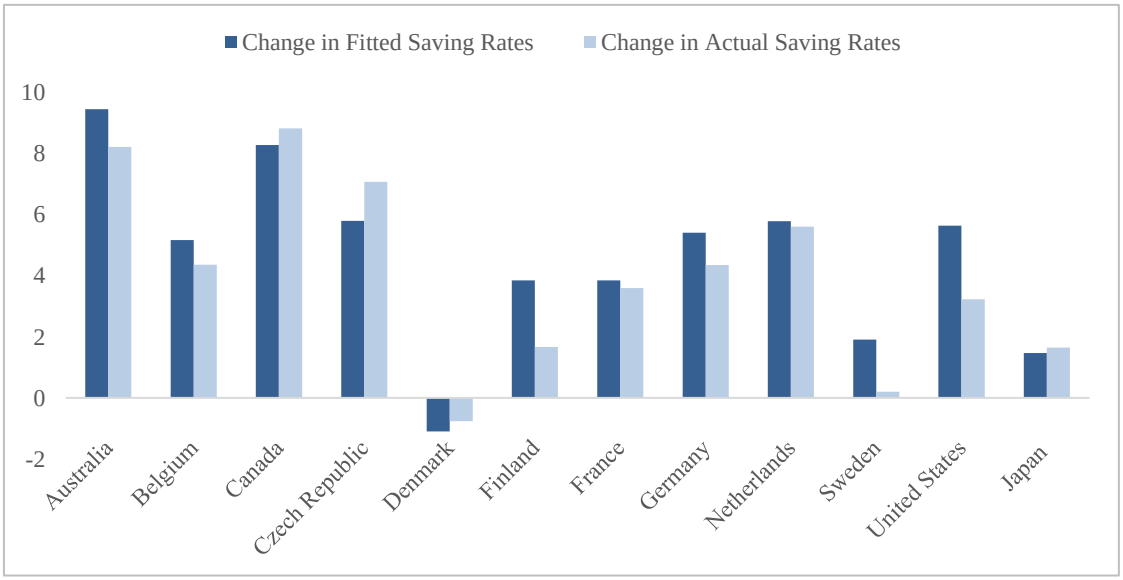
Fixed Effects Regression with Driscoll-Kraay standard errors			
Household saving rate	Coefficient	t-value	P>t
Lagged unemployment rate	0.203	0.106	4.460
Lagged gdp volatility	0.023	0.577	0.108
Lagged SM volatility	0.031	0.457	0.546
Constant	9.680	0.002	3.813
Number of observations = 688			
Number of groups = 27			
Within R-squared = 0.0255			

****p<00.01 **p <0.05 *p<0.1;* Coefficients for country and year dummies are not reported

5.3 The Great Lockdown

As observed in Figure 2, household savings rates across countries ubiquitously rose during any crisis period. The COVID-19 pandemic was no exception. However, many advanced well-functioning economies also observed stagnancy and hence gives us a relatively unchartered time-period to verify our model's traceability and predictive power. The model traces changes in household saving rates moderately well.

Figure 5: Change in Actual and Fitted Saving Rates 2019-2021

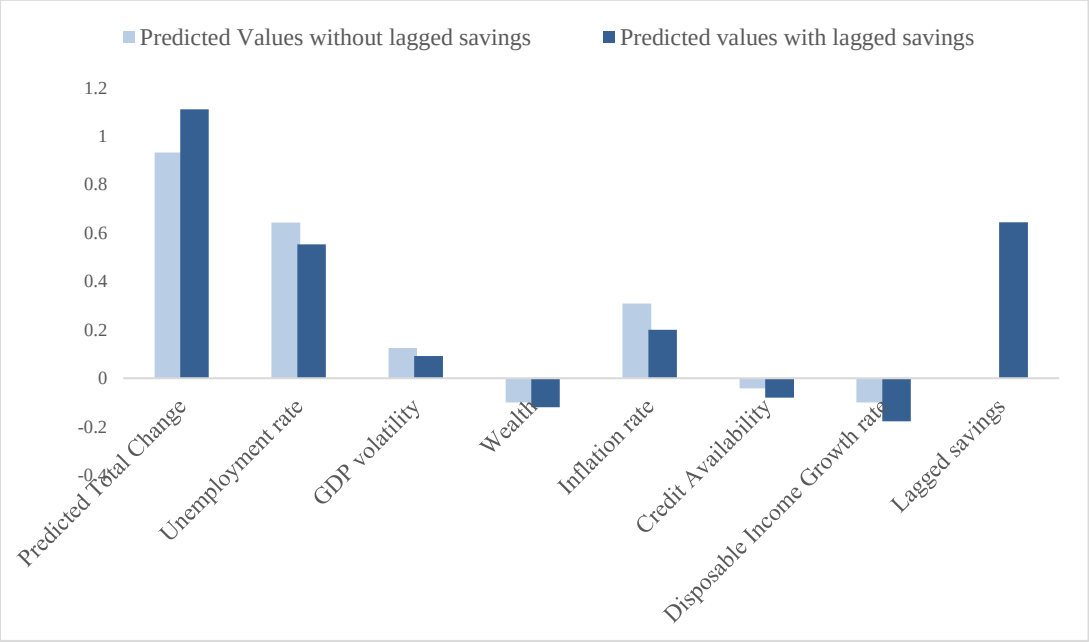


Data source: OECD National Accounts (Actual saving rates)

As Figure 5 displays the change in fitted saving rates for the pandemic period in comparison to the actual values of saving rates for the same period across our sample of advanced economies. In spite of not having perfect proxies to measure uncertainty, the model's prediction of saving rates is moderately representative of the actual saving rates. This statement however, does not hold for all countries, for example, Sweden experienced a much lower savings rate as compared to the predicted saving rate for 2019-2021.

We now take a look at what the predicted values of saving rate encompass in terms of contributions per component (Figure 6). We broke-down the increase in predicted values of household savings rate obtained through our model's predictions. The components are broken down according to our augmented model found in Table 2 column (7) and column (8), that is, the specification including controls without lagged savings and with lagged savings variables. We however did not include stock market volatility in this figure, as it was statistically insignificant across all specifications and variations thereof. As illustrated in Figure 6, by and large unemployment rate and GDP volatility contribute to significantly to a change in saving rate. An increase in unemployment rate and GDP volatility single-handedly contribute about 60 percent of the projected increase in household saving rate with the addition of a one-period saving rate.

Figure 6: Componental breakdown of change in fitted saving rate values 2019-2021



We observed a relatively substantial reduction in household net-worth across a majority of samples, this propelled an increase in the saving rate. Furthermore, a similar reduction was also noted in disposable income growth, specifically for our 2019-2021 time period. We believe that this reduction in household net worth solidifies the incentive to restore household wealth and therefore reinforce the precautionary saving motive during the COVID-19 Pandemic crisis.

The increase in inflation rate had a significantly larger contribution to increased fitted saving rate without the inclusion of the one-period lag of the household saving rate in comparison to the predicted values with the one-period lag. The decline in credit availability however contributed only moderately to raise predicted saving rate, contrary to our expectation as financial tightening would ideally accelerate household saving rates.

We can deduct from our econometric results that it is improbable to assume household saving rates will return back to pre-pandemic (or before crisis) levels in the short run. Households are yet to adjust to the new normal completely and hence continue to consume conservatively. Furthermore, with the persistence of economic uncertainty around the globe we expect consumption rates to be muted. With the rising inflationary pressure and high-likelihood of the onset of a recession, navigating to a recovery will require uncovering alternative sources of demand paired with policy initiatives directed to rebuild confidence and minimize uncertainty.

Conclusion

Building on the substantial academic precautionary saving literature, through this thesis we have undertaken an analysis saving response in times of uncertainty spanning across multiple advanced economies. From the results, we can conclude that our model holds through various specifications. We can confidently infer that household savings tend to increase in the face of economy-wide uncertainty for advanced economies. Further, the impact on savings rates is largely accounted to any change in labor income and variability in growth rates of economies as opposed to changes in the financial stock markets.

We then applied our econometric model to identify whether the heightened saving rates during the COVID-19 pandemic period can be attributed to the onset of income uncertainty. The results indicate that about 60 percent of the increase in household saving rates is directly associated with an increase in GDP volatility and unemployment risk. Further, household savings rates also increase following a drop in household wealth and an increase in inflationary pressures.

While we did try to include a variety of controls to act as our robustness check, future research can build on this model further. For instance, we could not include any age metrics into our model due to the unavailability of data, however, it is a valuable control measure to add into a savings and uncertainty model. Hence, this study does have to potential to be further developed to include more elements and variables.

Through our model, we have come to understand that it would take a while for households to go back to pre-pandemic levels of consumptions. Households are still reeling in from the pandemic and will continue to consume conservatively whilst navigating through this “new normal”. With the onset of a new-recession coming our way, this study showcases the importance of navigating through periods of uncertainty will require uncovering alternative sources of demand paired with policy initiatives directed to rebuild confidence and minimize uncertainty.

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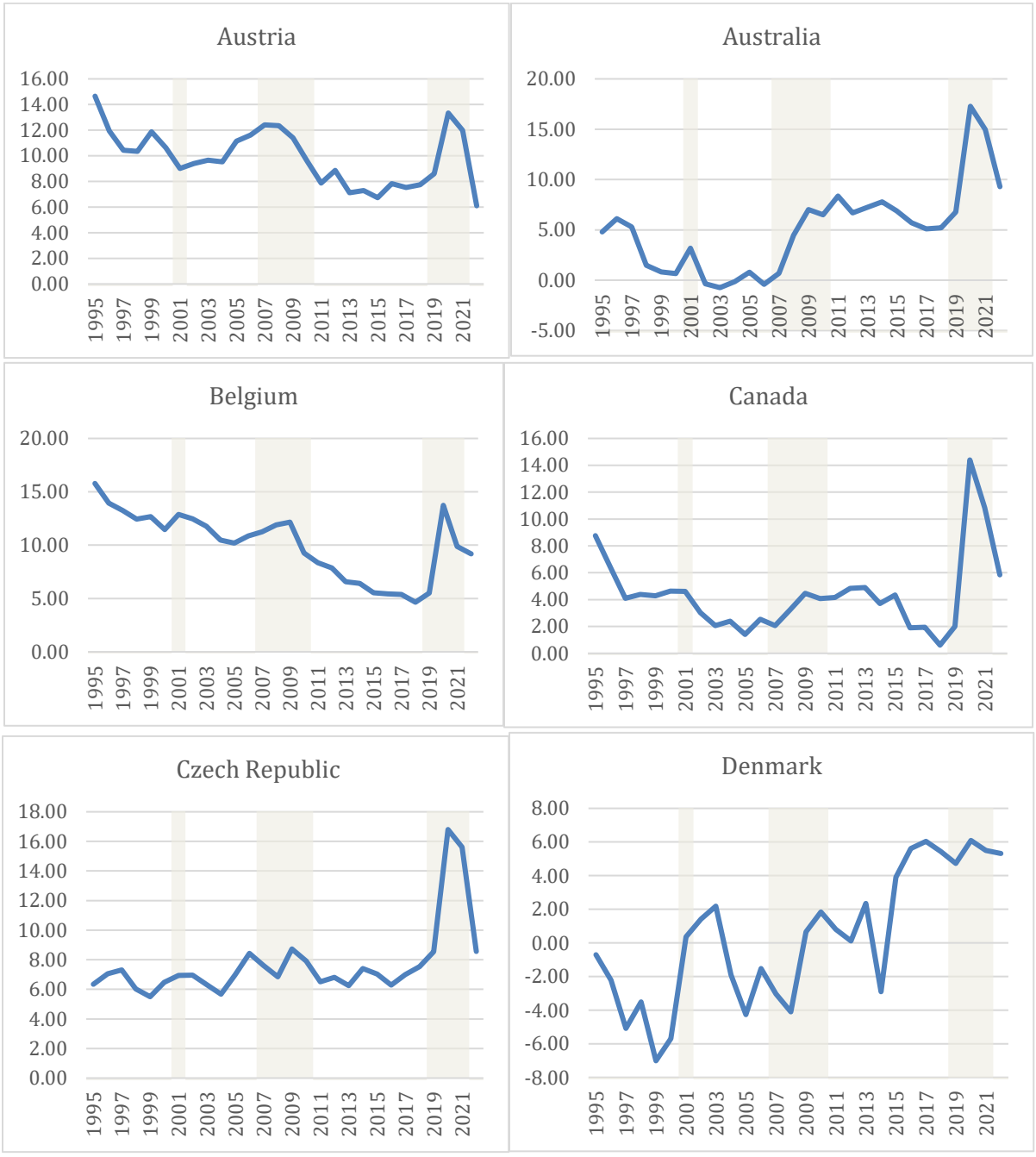
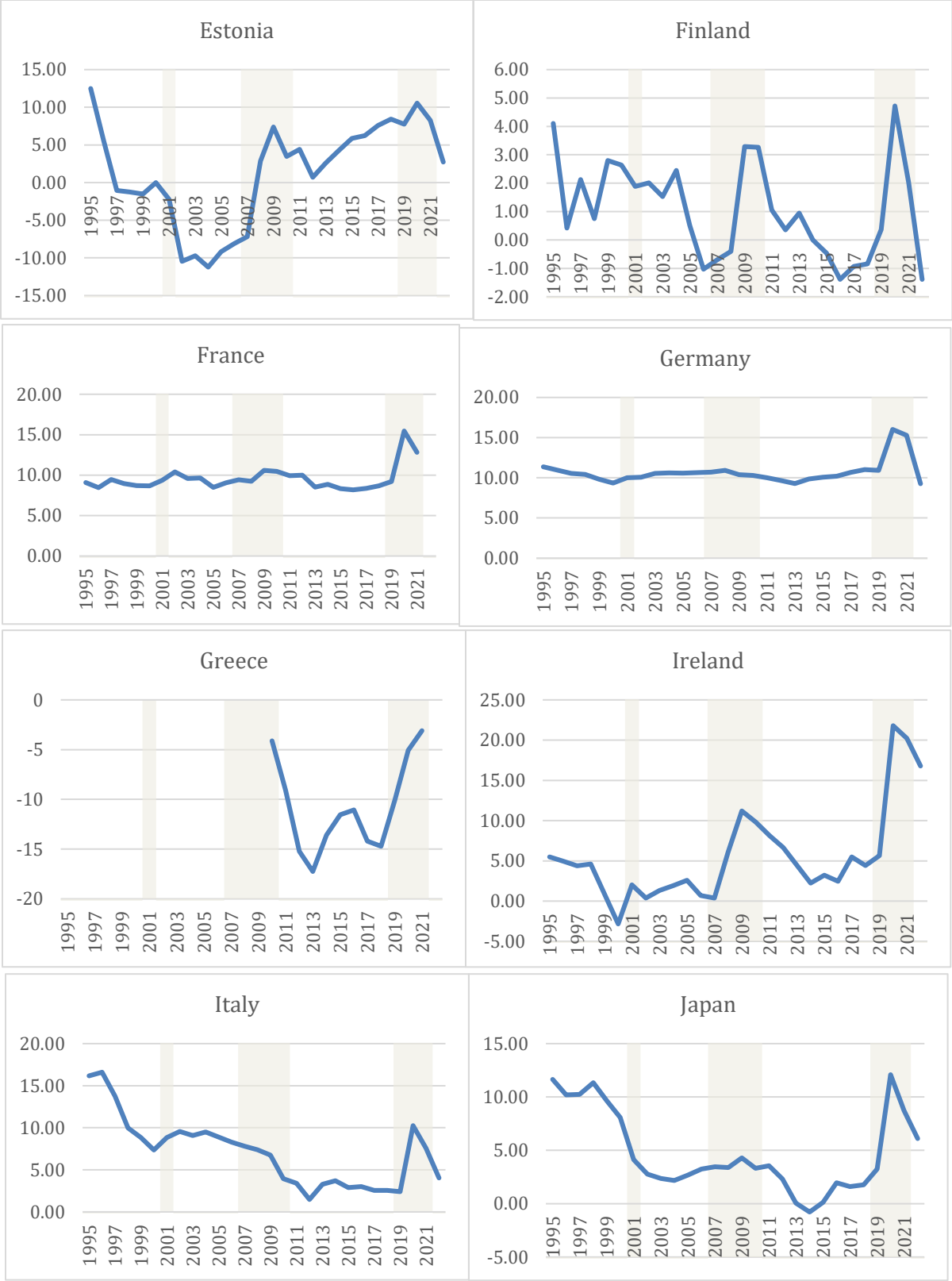
Appendix

FIGURES:

A.1: Trajectory of housing saving rates during periods of crisis:

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Finland
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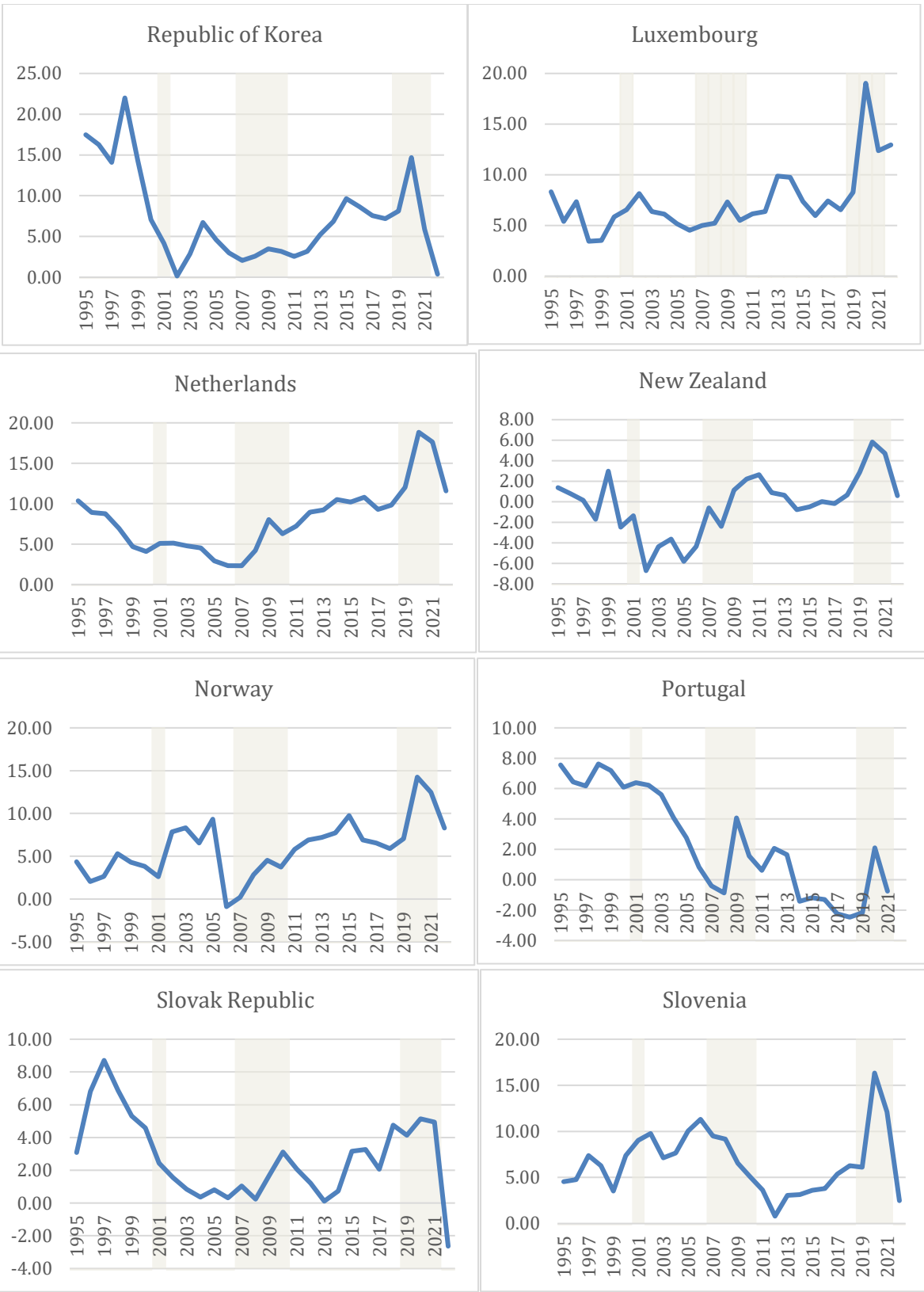
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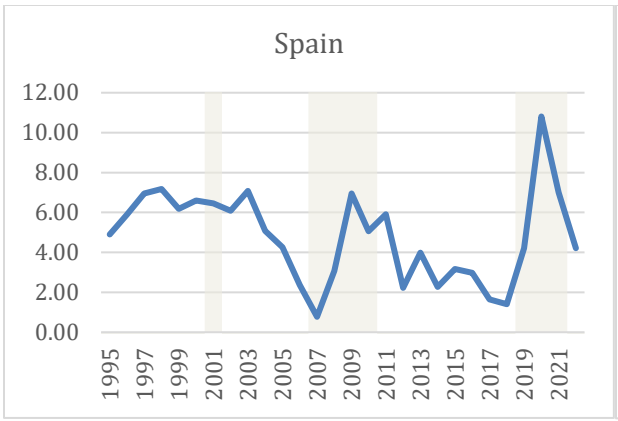
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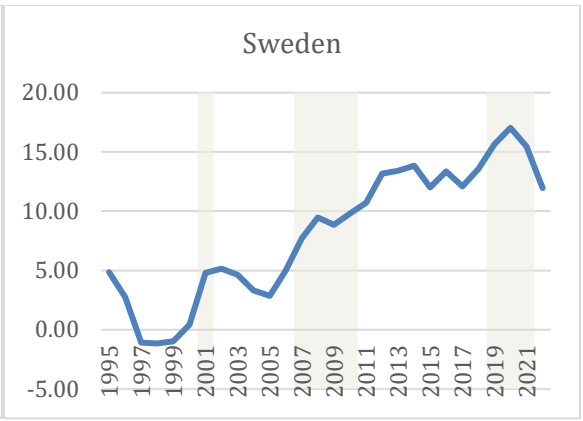
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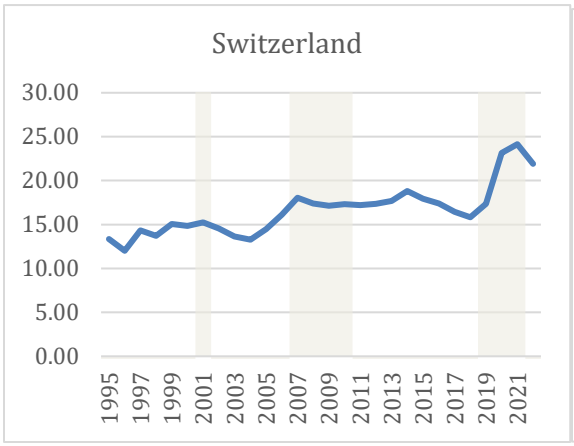
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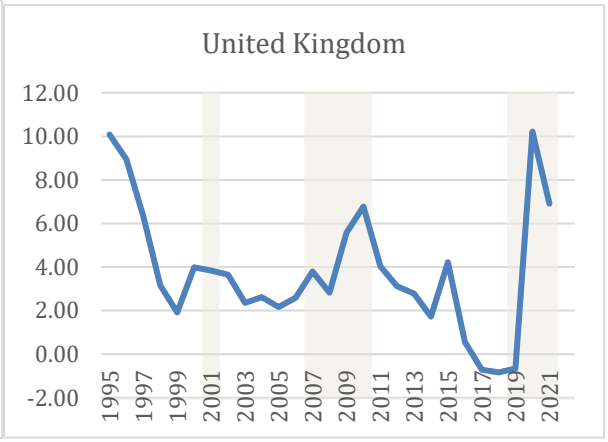
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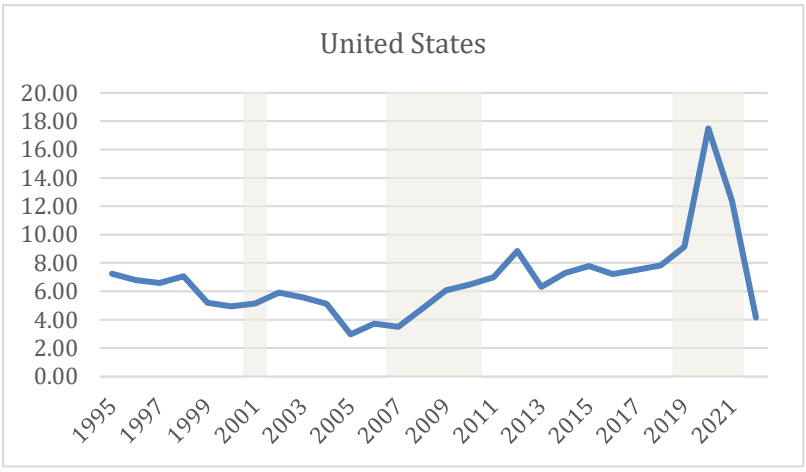
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A. TABLES:

Table A : Selected sample and associated time periods:

Country	Periods
Austria	1995-2022
Australia	1995-2022
Belgium	1995-2022
Canada	1995-2022
Czech Republic	1995-2021
Denmark	1995-2022
Estonia	1995-2021
Finland	1995-2022
France	1995-2021
Germany	1995-2021
Greece	1995-2021
Ireland	1995-2021
Italy	1995-2021
Japan	1995-2021
Korea, Republic of	1995-2021
Luxembourg	1995-2021
Netherlands	1995-2021
New Zealand	1995-2021
Norway	1995-2021
Portugal	1995-2021
Slovak Republic	1995-2021
Slovenia	1995-2021
Spain	1995-2021
Sweden	1995-2021
Switzerland	1995-2021
United Kingdom	1995-2021
United States	1995-2022

Table B: Variable definitions and data sources:

Variables	Source	Link
Household savings rate	OCED National Accounts	OECD Household accounts
Unemployment Rate	IMF's World Economic Outlook	IMF WEO Database
gdp volatility	Real GDP growth data: IMF World Economic Outlook; *measure of GDP volatility as calculated using GARCH(1,1) model of estimation*	IMF WEO Real GDP Growth
SM Volatility	S&P 500 historical data; *Calculated volatility measure on daily returns over a period of 2 years using GARCH(1,1) model of estimation*	Historical data S&P 500
Wealth	Proxied by Household net worth; data source: OECD National Accounts	OECD Household accounts
Inflation rate	IMF's World Economic Outlook	IMF WEO Inflation Rate Data
Credit availability	Proxied by Household debt; data source: OECD National Accounts	OECD Household accounts
Disposable Income Growth	Proxied by One-period ahead Real Disposable Income growth; data source: OECD National Accounts	OECD Household accounts

Table C : Selected Periods of Crisis:

Periods of Crisis	Start	End
Recessions		
Asian Financial Crisis	1997	1997
Dot Com Bubble	1998	2001
Financial crisis	2007	2009
European debt crisis	2009	2011
Pandemics		
Swine Flu	2009	2011
COVID-19 Pandemic	2019	2021

Table D: Summary Descriptive Statistics:

Variable	Obs	Mean	Std. Dev.	Min	Max
Country	729	14	7.794	1	27
Year	729	2008	7.794	1995	2021
Household saving rate	714	5.77	5.558	-17.25	24.14
Lagged saving rate	687	5.596	5.465	-17.25	23.14
Real GDP growth	728	2.315	3.182	-14.6	25.2
Unemployment Rate	729	7.417	4.015	1.7	27.5
GDP Volatility	729	10.513	4.924	3.907	49.064
Stock Market Volatility	729	10.502	4.924	3.907	49.064
Wealth	602	433.096	110.916	228.01	988.77
Credit Availability	698	124.568	61.837	7.18	339.78
Inflation rate	728	2.156	2.193	-1.7	29
Real Disposable Income Growth	292	.784	2.24	-12.34	6.23
Lag Unemployment Rate	702	1.889	.483	.531	3.314
Lag GDP volatility	702	10.329	4.792	3.907	49.064
Lag Stock Market volatility	702	10.329	4.792	3.907	49.064

Table E : GDP volatility GARCH(1,1) Model estimates:

Real GDP Growth	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]
Real GDP arch L1	.315***	.037	8.46	0	.242	.388
Constant	1.473***	.167	8.81	0	1.145	1.801
Real GDP arch L1	-.074***	.027	-2.70	.007	-.128	-.02
Absolute Real GDP arch L1	.216***	.036	6.03	0	.146	.286
Real GDP garch L1	.932***	.022	42.29	0	.889	.975
Constant	.208***	.058	3.55	0	.093	.322

Mean dependent var	2.267	SD dependent var	3.204
Number of obs	701	Chi-square	71.602
Prob > chi2	0.000	Akaike crit. (AIC)	3509.873

**** p<.01, ** p<.05, * p<.1*

Table F : Fixed-Effects Regression of savings rate on individual independent variables:

Fixed Effects Regression baseline specification

Household saving rate	A	B	C
Unemployment rate	0.386***		
	[3.55]		
GDP volatility		0.156***	
		[4.88]	
Stock Market volatility			0.08**
			[2.26]
Constant	7.849	8.578	5.200
Number of obs =	714	714	714
Number of groups =	27	27	27
within R-squared =	0.3109	0.3127	0.2012

Fixed Effects Regression baseline specification with lagged savings

Household saving rate	A	B	C
Unemployment rate	0.120***		
	[3.55]		
GDP volatility		0.174***	
		[4.88]	
Stock Market volatility			0.03
			[0.10]
Lagged savings	0.761***	0.762***	0.771***
	[3.08]	[3.08]	[3.08]
Constant	7.849	8.578	5.200
Number of obs =	714	714	714
Number of groups =	27	27	27
within R-squared =	0.3109	0.3127	0.2012