Assessing the economic impact of pandemic outbreaks in Portugal: A bibliometric review

Ana Catarina Castelo de Carvalho

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Supervisors: Prof.ª Maria Isabel Craveiro Pedro

Prof Diogo Filipe da Cunha Ferreira

Examination Committee

Chairperson: Prof.ª Tânia Rute Xavier de Matos Pinto Varela

Supervisor: Prof. Diogo Filipe da Cunha Ferreira

Member of the Committee: Prof.ª Teresa Grilo

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Resumo

Esta dissertação tem como objetivo apresentar possíveis cenários que Portugal poderá ter de enfrentar, num espaço de 2 anos, dada a pandemia pela qual está a passar e quais poderão ser os passos a tomar para, minimizar os efeitos da COVID-19 na sua economia. Neste sentido, uma fase introdutória apresentará não só um contexto económico do país, mas também da atual pandemia e do rastro que até agora deixou, de forma a definir o setor e realçar a importância deste estudo para o futuro. Numa segunda fase, foi conduzida uma revisão bibliográfica dos vários métodos adotados para este tipo de estudo no passado, assim como, a melhor forma de o fazer, nomeadamente a melhor forma estruturar a seleção de informação através de um modelo PRISMA. Precedentemente a esta revisão foi conduzida uma análise bibliométrica aos artigos publicados desde 2004 de forma a permitir uma primeira triagem de artigos, por meio do software VOSViewer que permitiu verificar o crescente interesse no aperfeiçoamento de modelos de previsão. Por fim, depois de analisada a literatura foi aplicado um modelo ARIMA com dados quadrimestrais da taxa de crescimento do Produto Interno Bruto (PIB), do Índice de Preços no Consumidor (IPC), que permitirá concluir sobre a inflação, e a taxa de desemprego.

Apesar de serem reconhecidas as limitações que apresenta, os resultados do modelo mostram que após uma rápida queda e recuperação, estes três indicadores irão estabilizar o seu crescimento. É esperado que o PIB cresça quadrimestralmente cerca de 0,5% a partir de 2020 e que o ICP e a taxa de desemprego mantenham valores a rondar os 2% e 7%, respetivamente. Por fim e de forma a reagir a estes valores tentando alavancar a economia portuguesa é recomendado que o país se foque em medidas no setor do conhecimento e inovação, mercado de produtos e mercado de trabalho.

Palavras-chave: ARIMA, projeções económicas, PIB, COVID-19, impacto económico, revisão bibliométrica.

Abstract

The aim of this dissertation is to present possible scenarios that Portugal may face, in 2 years' time, given the pandemic it is currently facing and, which could be the steps to taken in order minimize the effects of COVID-19 on its economy. In this sense, an introduction will present not only an economic overview of the country, but also the current situation of the influenza outbreak, and the trail it has left so far, so as to define the sector and highlight the importance of this study for the future. In a second phase, a bibliographic review of the various methods used for this type of research was included, as well as guide for structuring a selection of information. For this the PRISMA model is addressed. Prior to the review, a bibliometric analysis was carried out on articles published since 2004, in order to allow a first screening of articles. This was done by means of the VOSViewer software that revealed an increase interest on the development of forecasting models. Finally, after analyzing the available literature, an ARIMA model was applied for quarterly data on the growth rate of the Gross Domestic Product (GDP), the Consumer Price Index (CPI), which will allow to conclude about inflation, and the unemployment rate.

Despite recognizing its limitations, the results of the model show that after a rapid decline and recovery, these three indicators will stabilize their growth which goes in accordance with major organizations forecasts. It is expected that GDP will grow by around 0.5% every four months from 2020 onwards, the CPI and the unemployment rates will maintain its values around 2% and 7%, respectively. Finally, in order to react to these values, while trying to leverage the Portuguese economy, it is recommended that the country focuses on measures concerning the knowledge and innovation sector, product market and labor market.

Keywords: ARIMA, forecasting, GDP, COVID-19, economic impact, bibliometric review

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Acronyms

ACF – Autocorrelation Function

ACI – Airports Council International

ANAC – Portuguese Civil Aviation Authority

AR – Autoregressive

ARIMA – Autoregressive Integrated Moving Average

ARMA – Autoregressive Moving Average

BPN – Banco Português de Negócios

BPP – Banco Privado Português

BTL – Lisbon Travel Market

CGE – Computable General Equilibrium

CIP – Confederation of Portuguese Industry

CPI - Consumer Prices Indices

DGS – General Directorate of Health

DSGE – Dynamic Stochastic General Equilibrium

EC – European Commission

ECB – European Central Bank

ECDC – European Centre for Disease Prevention and Control

EFSM – European Financial Stabilisation Mechanism

EU – European Union

GDP – Gross Domestic Product

GNP – Gross National Product

GPI – Genuine Progress Indicator

I – Integrated

ICT - Information and Communications Technology

IHR – International Health Regulations

IMF – International Monetary Fund

IRS – Personal Income Tax

IVA– Value Added Tax

JRC – Joint Research Centre

MA – Moving Average

MAE – Mean Absolute Error

ME – Mean Error

MF – Finance Ministry

MTO – Medium-Term budgetary Objectives

MSE – Mean Square Error

NBER – National Bureau of Economic Research

NIGEM – National Institute Global Econometric Model

NIS – National Institute of Statistics

NPI – Nonpharmaceutical Basic Interventions

OECD – Organization for Economic Co-operation and Development

OPEC – Organization of the Petroleum Exporting Countries

PACF - Partial Autocorrelation Function

PHEIC – Public Health Emergencies of International Concern

PIP - Pandemic Influenza Preparedness

PRISMA - Preferred Reporting Items of Systematic reviews and Meta-Analyses

PRR – Recovery and Resilience Plan

QUOROM – Quality Of Reporting Of Meta-analysis

RMSE – Root Mean Square Error

RW – Random Walk

R&D – Research and Development

SGP – Stability and Growth Pact

SIR – Susceptible, Infectious and Recovered or Removed

SNS – National Health Service

SWT – Short-Term Work

TAP - Portuguese Air Transport

US – United States

USA – United States of America

WHO – World Health Organization

VAR – Vector Autoregressive

1. Introduction

PROBLEM CONTEXTUALIZATION AND MOTIVATION

Portugal's economy has gained a reputation for being unstable, with cyclical contraction and expansion. Despite this concept of economic cycle being very common when discussing a nation's economy (the world economy itself is known for suffering fluctuations), over the last 10 decades this country has faced an unceasing debt problem and continues to be associated with underperformance and low productivity levels. Its lack of technological enhancement over the years made it impossible to accompany the level of growth and progress of the great powers of Europe. In fact, with the arrival of the Great Recession, in 2008, the country suffered major setbacks and was forced to resort to a bailout program to control its situation. During this time, rigid social measures combined with a reinforcement of its focus in its strengths, the tertiary sector, paved the way for a remarkable recovery, reached in 2019, marked by Portugal's first government surplus in decades.

Having just recently recovered from a major crisis and with good prospects for the future, an unpredictable event changed the fate of not only this country but also the world. By the end of 2019, an unexpected pandemic outbreak, labelled SARS-CoV-2 – also known as COVID-19 or coronavirus – originated in China, in the city of Wuhan, put a stop to the economy on a global scale forcing major businesses to close or to enter a layoff period. Since the virus has proven to be easily transmitted, activities requiring personal contact had to be interrupted, nonpharmaceutical basic interventions (NPIs), such as quarantining, had to be imposed and working methods had to be adapted and reinvented. Thankfully, technology facilitated this process, and many jobs were saved by videoconference platforms and teleworking. Notwithstanding, the services sector did not experience the same luck. To point out a few of the more obvious examples, hotels and restaurant suffered a major blow. In 2021, national news stations, announced a loss of about 90% of turnover in these sectors, compared to 2020. Despite having access to platforms of food delivery, it seemed it was still not enough to maintain catering businesses. Subsequently, people who once lived comfortably faced an imminent shortage of money. Equally, hotel owners and workers saw a major fall on revenue as borders were closed and people were reticent to travel. These difficulties combined with the other's sectors, equally or more affected, and the fact that its major trading partner, Spain, suffered the largest decline in Europe contributed to Portugal being the worst performer in 2020, with its GDP contracting 7.6% in that same year according to the National Institute of Statistics (NIS) and Pordata.

Despite the most recent money aids given by the government and the Recovery and Resilience Plan, doubts remain on the predicted future recession: What are the economic scenarios expected and how will Portugal respond under the COVID-19 pandemic? In order to answer this question, this thesis will attempt to analyze in the most thorough way studies previously carried out on economic projections and pandemics and the connections between the two based on previous occurrences. From the outset, not only the controversy arising from this topic is remarkable, since there are many models and combinations of models for this type of study, but also a high degree of uncertainty is

associated with it, since it is a science that strives to predict an environment subjected to risks, which can greatly impact the final expected result. Nonetheless, it is though that if it had been possible to foresee the recent crisis, whose origin is financial, its profound impact on the real economy and social well-being, could have been avoided or in the least diminished (Amado, 2019). Withal, the situation the world finds itself in is very particular, and all the more the amount of research available on Portugal's economic growth and recessions derived from economic shocks is limited. A pandemic of this proportion has not had any precedents to this day in the modern world. Nonetheless, since the beginning of the pandemic several studies have emerged that explore the macroeconomic consequences of COVID-19, future perspectives and policies (Baldwin et al., 2020; Brunnermeier et al., 2020; Baldwin & Mauro, 2020) . This being said, this new research combined with past one has the potential for making this study very compelling, not only for this time being, but also future developments and studies. This research will provide important contributions to the scientific literature. It gives a complete picture of the published studies on the use of the different available forecasting models covering the theoretical background, methodological development, and empirical findings of the research identified. Furthermore, it will provide guidelines for researchers interested in applying a systematic literature review as a research method.

Given the current health crisis, it will be interesting to assess how a country like Portugal, highly dependent on its services sector, will react to a possible lasting economic shock. It is expected that, based on articles published in the past years, trends and economic forecasting models, suitable for comprehending the consequences of this new pandemic on the Portuguese's economic horizon, will be possible to identify. Thus, a thorough literary review of recently published articles will be carried out. The study at hand, will consist of a total of 7 chapters. Following this introduction, there will be a second chapter with a brief description of the economic sector in Portugal, as well as of the history of past pandemics and respective economic impacts, so as to situate the reader while creating a framework for understanding recent research. In a third and fourth chapters, a methodology and a bibliographic review of recent studies on economic forecasting, policies and pandemic analysis will be conducted, followed by a chapter with a possible model for short term economic projections. In a 6th chapter a discussion of the result from the previous one will we presented. Finally, a chapter with conclusions and limitations to this research will be bestowed, as well as suggestions for improvements to be implement in future research.

2. Sector Contextualization

2.1. Portugal's economic evolution - a brief description

When addressing the macroeconomy of a country, it is impossible not to come across the concept of economic cycle (or business cycle). One can briefly describe it as being the fluctuations of the economic activity between periods of expansion and contraction, characterized by growth and recession respectively. The study of these cycles gained a greater importance from the second half of the 19th century, given the world economic crises provoked by the Industrial Revolution, and intensified during the 20th century, and allows economic and monetary decision-makers to formulate policies to alleviate economic impacts.

A variety of key metrics can be used to determine the course of the economy. For instance, from previous experience it is noticeable that expansion is associated, among other criteria, to a period of drop in unemployment. Following the same train of thought, a contraction of the economy is often linked to a decrease in public spending as both money and credit are harder to obtain. Corporations and investors find this information essential as it can have a significant impact on decision making, as they can plan strategically to protect themselves when approaching downturns and position themselves to take advantage of growth periods. Investors find opportunities in technology and energy sectors during expansion, and shift to utilities, financial and health care companies during contraction as these are more likely to thrive during this period (Weinstock, 2020). There is a controversy around what factors contribute to the length of such cycles and its origins. Data shows its duration is volatile and can differ for different countries.

Succinctly, literature recognizes 4 main phases (Figure 1):

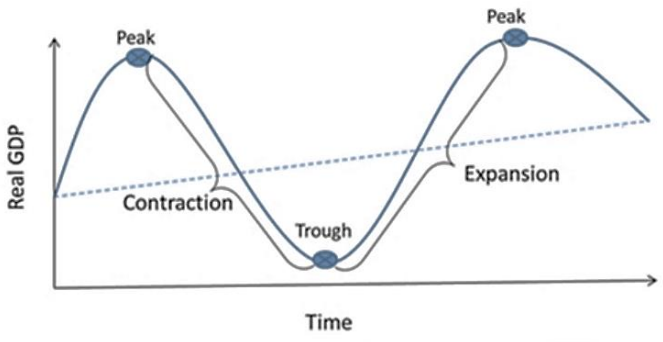

Figure 1 – Graphical characterization of the 4 main phases of the economic cycle (Congressional Research Service, 2020)

- During the **Expansion** period, the economy experiences a rapid growth. Interest rates tend to be low, production increases, and inflationary pressures build.
- The **Peak** is reached once growth is at its maximum rate. It tends to represent a time where imbalances in the economy that need to be corrected.

- These corrections occur during a period of **Contraction** when growth slows, employment falls, and prices stagnate.
- The **Trough** of the cycle is reached when the economy hits a low point and growth begins to recover.

In addition to these 4 stages a fifth one can also be recognized, the **Recovery** where there is an acceleration of growth in a context in which the economy operates bellow full employment and therefore inflation continues to decline. Central banks maintain expansionary monetary policies generated in the recession period. Table 1 identifies the different phases and their duration for Portugal based on quarterly real GDP.

Table 1 – Business cycle chronology in Portugal

Dates		*Duration in months*		
Peak	**Through**	**Contraction**	**Expansion**	**Cycle**
1980 Q2	1980 Q4	2	-	-
1983 Q1	1984 Q1	4	9	13
1992 Q2	1993 Q2	4	33	37
2002 Q1	2003 Q2	5	35	40
2008 Q1	2009 Q1	4	19	23
2010 Q3	2012 Q4	9	6	15
Average		5	20	26

Source: *Banco de Portugal, 2016*

In order to manage the course and effects of the cycle, Governments often use expansionary fiscal policy, involving rapid deficit spending, and contractionary fiscal policy, taxing and running a budget surplus to reduce aggregate spending prevent the economy from overheating during expansions. On the other hand, central banks make use of monetary policy lowering interest rates or implementing expansionary monetary policy to increase spending and investment. During expansion, contractionary monetary policies can be employed by rising interest rates and slowing the flow of credit to reduce inflationary pressures.

Portugal's economic background appears to be one of cyclical contraction and expansion. Dating back to the 1920s, the country faced near bankruptcy ultimately being forced to adopt a corporatist system, in a context of dictatorship and colonial economy. Despite enabling the control of public debt and high inflation rates, economic growth and living standards seemed stagnated. Fast-forwarding to end of World War II Portugal saw its GDP increase as a result of a more outward-looking to the world, increasing trade with wealthy western European markets and shifting from agriculture to light industry, particularly textiles. This growth, however, ceased around 1974, by which time a military coup, the Carnation Revolution, put an end to the colonial wars which were becoming increasingly expensive and politically costly. This milestone profoundly affected this nation's economic basis as it transitioned into a long-awaited democracy. Once again, the decades that followed were accompanied by large levels of both public debt and inflation rate. Eventually, Portugal found a stable way out by joining the European Union in 1986.

In the years that followed, joining the EU proved to be beneficial for its recovery and challenging at the same time, as the change in currency negatively affected its current account (The World Bank 2021). The country was able to slightly compensate its lack of exports with a significant consumer growth which, added to an increasing government spending, contributed to an alarming raising debt. The situation reached a frightful point as the housing bubble that generated the global financial crisis of 2007–2008 stroke this nation. In reality, during this 'boom' Portugal was quite moderate comparing to some of its neighbour countries having a much more realistic supply and demand balance alongside stricter landing by Portuguese banks. Its real problem, apart from its usual underperformance, was where the money was being employed. Compared to the manufacturing sector, there was a high contribution to the tertiary sector, which ultimately made the country less competitive as a lack of technological modernization made a vast percentage of its exports unappealing as well as unnecessary.

As the financial crisis reached Portugal, refinancing for the banks became incredibly expensive as most had invested in government debt through bonds, and they relied on international financial markets with low domestic credit market. The only safe option for Portugal was through financial help. In 2011 the country received €78 billion and with it came years of economic pain and austerity cuts ranging from education spending to the number of bank holidays, enabling the country to control its rising public deficit as well as improve its competitiveness level. As expected, these measures and success came at a cost. By the time Portugal exited its bailouts, unemployment rate reached 16% (Statista 2021; The World Bank 2021) and was higher among the younger population consequently leading to high rates of immigration and therefore significant decline on Portugal's active population. With the later change in government and following discharge of the previous unpopular and rigid measures, concerns were raised regarding Portugal returning to its old habits. Withal, the country was able to put any doubt to rest as 2019 saw its first government surplus in decades (The World Bank 2021).

For further analysis, it is important to note that Portugal's economy has been dominated by services. By 2020, and according to INE, the tertiary sector already represented close to 70% of the employment in Portugal, which judging by recent year will tend to keep growing predominantly because of the tourism spurt experienced in the latest years (Pordata 2021). Despite being the dominant sector for most western European countries, it had been seen as a sector with limited productivity growth. According to Simões, Duarte and Andrade (2019) however, recent research has shown this could be a wrong concept. As pointed out by the author, 'Within the broad services sector there are sub-sectors that contribute relatively more to output growth via productivity increases', known as modern impersonal services. These include communications, banking and business-related services which require high educated workers. This is where Portugal's current fragility lays, as it presents low levels of education, an essential asset to implement technological enhancements that will allow to revive its economy and adapt to global competition.

2.2. SETTLING THE DISCUSSION OF ECONOMIC GROWTH VS. QUALITY OF LIFE

Assessing the behavior of a national economy requires the use of a set of macroeconomic factors that will grant the evaluation and design of economic policies, formulation of judgments, expectations as well as decisions. Among the many indicators, the Gross Domestic Product (GDP) has certainly been the one most resorted to at a global scale, serving not only for monitoring growth, but also, to determine the effect of inflationary trends in production gains and the amount of gross income produced that is used for consumption, investment or savings (Giannetti et al. 2015).

GDP is generally computed on an annual and/or quarterly basis and, as stated by Giannetti et al. (2015), results from the addition of a 'country's individual consumption expenditures, governmental expenses, net exports , and net capital production'. In other words, it is the sum of gross value added by all producers in the economy plus product taxes and minus subsidies not included in the value of the products. It is calculated without making deductions of depreciation of fabricated assets or for depletion and degradation of natural resources (The World Bank n.d.). Despite being the principle mean of comparison between nations, it has been the center of much discussion regarding its interpretation and purpose. Never before have social and sustainability issues had such an important seat at the table when discussing the welfare and progression of an economy. The recent period marked by the COVID-19 pandemic has intensified the importance of health as well as environmental conscience in people's life. Macroeconomic indicators, such as GDP, are being asked to adapt and broaden as the times and necessities change.

GDP has been mistakenly perceived as an appraise for quality of life, however it takes into account marketed economic activities alone. It neglects non-monetary transaction activities, does not distinguish welfare-enhancing and welfare-reducing activities, can disguise social and economic inequities and overlooks environmental costs and depletion rates (Giannetti et al. 2015; Kubiszewski et al. 2013).

GDP can be calculated in three different ways (Lisson & Gasteiger, 2007) where the production, income and expenditure approaches all amounts to the same value:

1. **Production approach**: adds the gross output in different industries and subtracts intermediate outputs. This difference represents the value added and prevents double counting.

2. **Income approach**: measures the income earned by different factors of production, by adding up all the income earned in the economy.

3. **Expenditure approach**: divides the goods and services that are purchased into several categories, a breakdown resulting in an equation called national income identity. The equation states that goods and services can be consumed, invested by the private sector, bought by the government or shipped abroad for foreigners to use. The equation is given by:

$$Y = C + I + G + \mathrm{NX} \tag{1}$$

where *Y* = GDP, *C* = Consumption, *I* = Investment, *G* = Government Purchases and *NX* = Net Export = Export – Import.

GDP within countries are usually calculated by national statistics agencies, by gathering information from a wide range of sources. The calculations of GDP often follow international established standards contained in the System of National Account (Nations, 2010) developed by International Monetary Fund (IMF), the European Commission (EC), the Organization for Economic Cooperation and Development (OECD), the United Nations (UN) and the World Bank.

A recent study conducted by Giannetti et al. (2015) embraces a new index by the name Genuine Progress Indicator (GPI) as an upgrade of GDP giving the possibility to analyze how different factors influence economic welfare. As described in the article 'GPI starts with Personal Consumption Expenditures (a major component of GDP) but adjusts them using 24 different components, including income distribution, environmental costs, and negative activities like crime and pollution, among others'. Moreover, it accounts for the benefits of volunteerism and house work. Previous comparisons between both indicators display a disparity between the two, i.e., late findings show a growing GDP can be accompanied with a lowering GPI. In other words, despite economic activity having increased, welfare has decreased. Although at first glance appearing to be ideal it has been the target of many criticism. Besides the fact that it is not as straightforward to calculate as GDP, its potential ambiguousness regarding the definition of well-being raises doubts about its efficiency and practicality, consequently being vulnerable to political manipulation (Goossens et. al 2007).

Regardless of the potential benefits a GPI analysis could potentially bring, the indicator still needs to be improved therefore, this analysis will be purely economic. Any remarks outside this scope must be consider as a personal assumption or citation of reported facts. Withal, this recent and unexplored indicator should not be discarded for future studies. In fact, this type of analysis should be encouraged, and further enhanced, to provide a more accurate evaluation of a country, accounting for social equity, sustainable production and the environment, which are issues that have been given increasing awareness.

2.3. A DEEPER LOOK INTO THE DEFINITION OF ECONOMIC RECESSION

Economic recessions often imply high levels of unemployment, the decreasing of sales and economic output. As stated by Rodeck and Curry (2021), economist Julius Shiskin quantitatively defined it as 'two consecutive quarters of declining GDP'. Withal, in light of the 2001 global crisis, this characterization ceased to be enough. U.S.'s National Bureau of Economic Research (NBER) understands this concept as a "significant decline in economy activity spread across the economy,

lasting more than a few months, normally visible in real GDP, real income, employment, industrial production, and wholesale-retail sales". Altogether, it can be perceived as a vicious cycle, seen as less sales lead to cutbacks in production and, consequently, jobs and incomes which ultimately extend to various industries and countries, negatively impacting sales and production. The severity of such crisis will highly rely on the behavior of monetary policy, i.e., when the central bank is able to respond, it can offset the effects of the recession, otherwise it is most likely to become unmanageable. Furthermore, complementary to this definition, it is relevant to mention the concept of depression, which, in spite of minor differences within the information available, seems to culminate in the decline of more than 10% of GDP or a recession lasting for more than 3 years (The Economist 2009).

By mere observation of past economic crisis, and as will be exemplified in the next chapter, they often follow periods of expansion and optimism and can rise from errors on behalf of monetary authorities that provide money to an economy. Economic shocks are equally responsible for the rise of recessions. A major shock in any sector will quickly spread to a macroeconomic level given their interconnectedness. Unanticipated events such as wars or epidemics, as the one the world is currently facing, can directly affect demand and production of a country, ultimately weakening its economy.

A concept also vastly discussed when mentioning causes of recessions are inflation and deflation rates. It has been reported that too much of any of them can be harmful. High interest rates depress economic activity and excessive deflation triggers a chain reaction where the depreciation of prices causes a contraction of wages leading to a cut in spending, which in turn will lead to an increase of debt. Table 2 displays the last 5 Portuguese recessions in the last 4 decades shedding light to the main causes and recovery policies.

Although most recessions are brief, recovery periods tend to be quite extent as proven by The Great Recession that hit Portugal in 2008 and dragged on until 2013. Unfortunately, despite many positive prospects, 2019 starred a historic event worldwide resulting from the COVID-19 pandemic, leading to the shut down and/or in some cases decreased workload of major businesses, making almost inevitable the occurrence of an economic collapse, particularly in nations like Portugal where its most profitable sector is the services one. Amid former available studies and data, it is now conceivable to apprise previous pandemics and respective economic recessions, to be used as an outset to forecast a plausible scenario and mitigation strategies for this current influenza outbreak by means of a literary review.

Table 2 – Characterization of past Portuguese economic recessions.

Recession	GDP decline	Causes	Recovery Measures
The 1983 - 1984 Recession	3%	•Oil shock, following a political crisis in Iran, leading to a rise in oil prices.	•International Monetary Fund (IMF) program to help the country to balance its external accounts, to improve the public accounts and economic growth. •Devaluation of the current currency (escudo) by 12%, to increase competitiveness. •Limitation of Bank credit. • Reduced investment by public companies and increased tax burden.
The 1992 - 1993 Recession	1,10%	•Gulf War, which led to a rise in oil prices. •The fall of the Berlin Wall and the unification of Germany, causing a great expansion of public spending in Germany, putting pressure on inflation and generating a rise in interest rates in the rest of Europe. •Devaluation of the shield generated inflationary tensions.	•Restrictive monetary policy, with rising interest rates, and lifted controls on the movement of capital abroad. •Restrictive fiscal policy, with greater containment of the growth of State expenditure and investment, in order to reduce the deficit in the public accounts.
The 2002-2003 Recession	2,90%	•A strong and consistent reduction in interest rates, leading to an increase in the indebtedness of companies and individuals.	•Restrictive fiscal policy. •Cut in public investment and controlling public spending.
The 2008-2009 Recession - The Great Recession	4,40%	•Problems with home loans in the USA that quickly spread to the world economy, with global exports falling by almost 20% between 2007 and 2009. •A stagnant economic growth and falling employment since the beginning of the century in Portugal.	•Public incentives through public works programs, and salary increase of 2.9% to civil workers.
The 2010-2013 Recession - The European debt crisis	6,90%	•High levels of public and private debt and weak economic growth from the past decade.	•Financing package from the European Commission, the European Central Bank and the International Monetary Fund, a group also known as troika, which involved a financial envelope of 78 billion euros.

Source: *Fundação Francisco Manuel dos Santos*, n.d.

2.4. A DEEPER INSIGHT ON HOW PORTUGAL'S POOR PERFORMANCE CONTRIBUTED TO A LONG-LASTING GREAT RECESSION

As previously mentioned, the tertiary sector accounts for 70% of Portugal's workforce. Despite being a substantial number, research stands by the fact it is not necessarily positive since it does not involve high-skill and technological activities. From the point of view of Portugal, where major tertiary sector activities comprise non-tradable services such as hotels, restaurants, public administration etc, it represents a low growing potential. From this statement a fairly realistic picture of the country's economy can be depicted, and its slow evolution and modernization explained. According to data released in 2019 by the *Expresso,* a national newspaper, 45% of the employed population had only completed elementary school in 2018, only 27% had at least a bachelor's degree against 27% that had completed a high school education. The short remaining percentage concern workers with no level of school education. Nonetheless, this article also displays a great progress in the last two decades as the percentage of employed population that had only completed elementary school represented 70% in 2000.

Anew, Simões, Duarte and Andrade (2019) have called attention to modern impersonal services as these 'take advantage of ICT, globalization and scale economies and thus benefit from higher productivity growth rates.' Services such as real estate, communications, banking, and

insurance are easily and inexpensively transported and have vast growth capacity given the current technological enhancements. Therefore, efforts should be put in continuing to offer the best educational conditions and incentives to enable the creation of more jobs and accompany the innovation of this sector.

By 2009 Portugal's lack of productivity came to prominence with the arrival of the Great Recession, evidencing the country's low progress. In fact, Portugal was one of the countries hardest hit by this crisis. Authors Gertler and Gilchrist (2018) go in accordance with the general assessment as to its origin. Having begun in the USA, it was suggested that a fall in long-term interest rates combined with moderate lending standards and naive optimism concerning the increase in house prices that lead to a boom in house prices as well as housing construction, accompanied by a rise in mortgage lending, were behind the event that triggered the financial collapse, the bankruptcy of the Lehman Brothers bank. Consequently, the decaying of household balance sheets contributed to a decay of house prices and household spending, which had a direct negative impact in economic activity. The writers come to the conclusion that elevated external finance premium and weak balance sheets seem to be the key ingredients regarding economic recession triggers.

This financial crisis quickly spread to other nations. The European Union witnesses a loss of GDP of around 4% from 2008 to 2009. In turn, as result of an intense fall in demand, exports and investments, Portugal saw its first signs of crisis in 2008, as no growth was recorded, and poor monetary policies response took place. A severe credit tightening, a reduction in banks' ability to access the capital markets and the collapse of two banks – *Banco Português de Negócios* (BPN) and *Banco Privado Português* (BPP) – were witnessed. 2009 experienced a fall of roughly 3% followed by a minor increase, possibly due to the European economy recovery plan put it practice. In short, this 2-year plan focused on temporary measures aimed at stimulating demand, highly based in the Keynesian policies[1], and maintaining jobs and longer-term measures to invest in strategical sectors (Reddy 2009). Despite the effort and tight regulations imposed by the Portuguese government, already in the second quarter of 2010 the situation reversed and 2011 took a turn to the worse as GDP suffered yet another hard decrease and the nation entered the euro crisis. Simultaneously, public debt was increasing at a worrying rate having raised 53,4% of GDP from 2008 to 2012 (The World Bank 202; International Monetary Fund 202; Pordata 2021). The amount of pressure the country was under, obligated it to resort to a bailout in April of 2011 of €78 billion made available by the International Monetary Fund (IMF), the European Financial Stabilisation Mechanism (EFSM), and the European Financial Stability Facility (EFSF). By 2013 growth remained negative and unemployment rate reached an all-time high, roughly 16% of labour force. Moreover, although deficit was smaller, government debt was significantly higher (Blanchard and Portugal 2017). To back up and give a broader view on the information so far obtained, Figures 2 and 3 display the variation of the

[1] Keynesian economics were developed by Keynes, 1936, during and after the Great Depression. Keynesian economists argue that aggregate demand is volatile and unstable, consequently, a market economy often experiences inefficient macroeconomic outcomes – a recession, when demand is low, and inflation, when demand is high. Keynesian economics focuses on using active government policy to manage aggregate demand in order to address or prevent economic recessions.

most significant indicators of a country such as GDP growth, public debt, inflation index, unemployment rate and balance of current transactions, since 2008 to 2015.

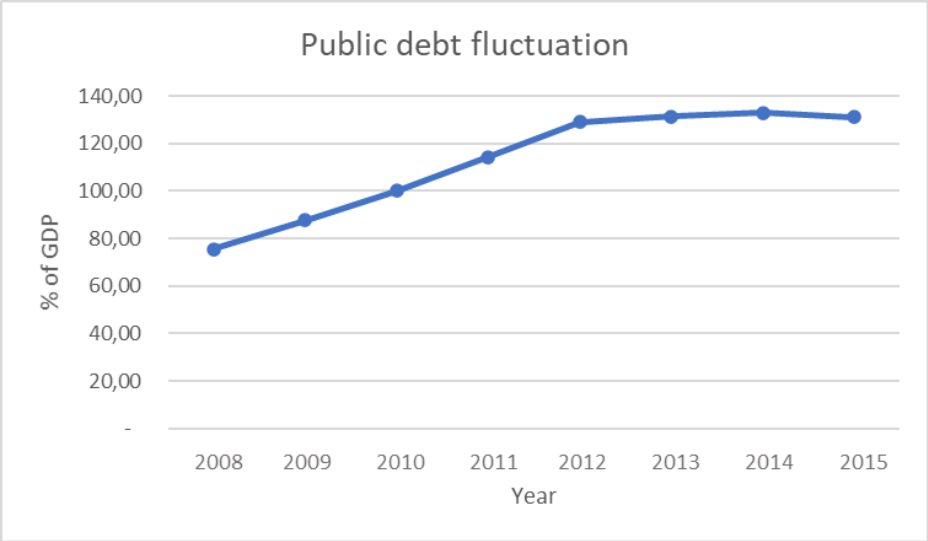

Figure 2 – Graphical representation of Portugal's debt fluctuation (PORDATA; The World Bank)

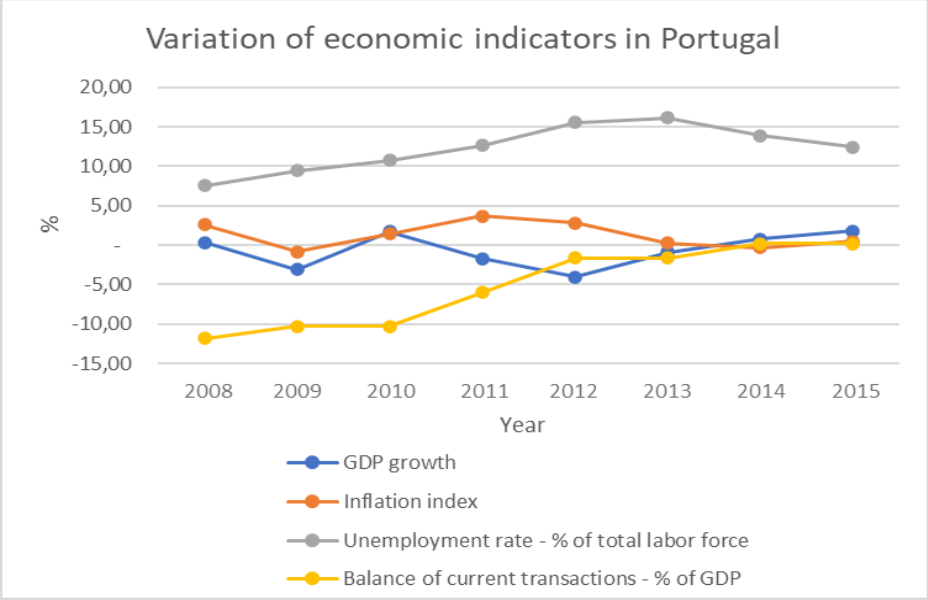

Figure 3 – Graphical representation of the variation of some of Portugal's main economic indicator (PORDATA; The World Bank)

2.4.1. Mitigation measures and economic forecast

Having the previous chapters in consideration, and the characteristics of this country, an economic recovery for Portugal must acknowledge its internal imbalances, with an output below potential, high debt, both public and private, non-performing loans, external imbalances and low productivity growth.

Given these, Blanchard and Portugal (2017) argue the most advantageous policy choices including a higher rate of inflation, as it is suggested that going above 2% would be desirable as an approach to improve price competitiveness. In fact, theoretically, in a case where economy is not running at full capacity, inflation could increase spending and therefore aggregate demand consequently generating more production. Labour market reforms focused on 'employment protection, unemployment insurance, professional training, and retraining' hoping to relocate workers to jobs that contribute to the country's growth, as opposed to an increase of minimal wage, which has proven to be ineffective in 2008. Product market reforms, fiscal consolidation, the right fiscal expansion, infusing more capital in state-run banks, and the treatment of non-performing loans, giving the origin of the Great Recession, were also referred. It is important to note the words 'right fiscal expansion', since there are concerns the government could not choose the adequate investment projects instead of prioritizing education. A recent example of this is the current criticism aimed at the construction of a new bridge in the city of Porto which is set to require €36.9 million. At this point in time, with what it looks like a financial crisis around the corner, many people worry about the timing of this construction and where the government's priorities lie (RTPNotícias 2021).

These of course are nothing but assumptions and suggestions. In 2008 Portugal made use of the European recovery plan. Emphasis, along with €20 billion, were put on strengthening credit institutions given their effect on public debt. In spite of the efforts, towards the end of 2010 no further improvements were made. The BPN wound up being nationalized and the BPP went bankrupt. Given the continuous poor results of its economy and insistent high debt, in April of 2011 Portugal applied for a bail-out program which imposed many authoritarian rules (Caldas 2013). National newspaper Público (2012) displayed the main changes in the economy that allowed for the country to recover. Among them, the Value Added Tax (IVA) increased 1% for all standard, intermediate and reduced rate reaching 21%, 13% and 6% respectively. Taxation of stock market gains came to 20%, income above €150 thousand per year was subjected to a Personal Income Tax (IRS) of 45%. In 2011, as opposed to what was earlier promised, taxes were raised in the form of an extraordinary income tax, equivalent to 50% of the Christmas allowance. Halfway through the same year the price of public transport, IVA, gas and electricity increased and suffered yet another increase in the next year.

Regardless of the general discontent amid these policies, Portugal finally exited the bailout in May 2014 and three years later, GDP rose to 3,5% approximately, the highest growth recorded since 2000. Furthermore, the unprecedented unemployment rates seen in the years prior, urging the younger generation to immigrate, started to undergo a downward trend going form 16%, in 2013, to 11%, in 2016, and with prospects to continue decreasing each year. While reflecting on Portugal's achievements, former Acting Managing Director of the IMF, David Lipton (2019) also pointed out the boom in exports, tourism and the nearly balanced current account and good prospects for the future, adding that debt must continue to be monitored as well as the banking system. Portugal was thought to have been left with a solid foundation for possible future obstacles such as economic shocks.

Forecasts for the future of the economy post the Great Recession pointed to a continuous low growth, of around 1,3% between 2017–2021. According to the data presented by The World Bank

(2021), since 2017 GDP growth has been of around 2 to 3% per year. However the economic shock in the form of the current worldwide pandemic put an end to the accuracy of these forecasts as 2020 suffered a decline of GDP of 7,6%.

Many economists had an optimist prognosis concerning the housing boom that brought about the Great Recession, which translated to the same disbelief by the mass media and society, therefore was seen as unexpected. After underestimating the fewer warnings of financial collapse, rose the need for more rigorous forecasts. Economists often use regression analysis to dictate the relation between independent variables and dependent to predict their behavior. A preliminary research of forecasting models include econometric models, economic base analysis, input-output model, Grinold and Kroner Model and consensus forecasts. Moreover, econometric forecasting models have been increasingly used to explore relationships between variables such as the gross national product (GNP)[2], inflation, exchange rates, among others, and thus, takes into account previous data. In alternative to these theoretical models there are software such as the one utilized by The Organization for Economic Co-operation and Development (OECD), known as the National Institute Global Econometric Model (NIGEM), of the British National Institute of Economic and Social Research. This macro-economic assessment model uses a 'New-Keynesian' framework in that agents are presumed to be forward-looking but nominal rigidities slow the process of adjustment to external events.

2.5. Influenza and pandemic concepts

Commonly known as "the flu", an influenza is the result of contagious influenza viruses provoking a severe respiratory illness, infecting both humans and animals. Subtypes A, B, C and D of these viruses categorize the infectious agents. For instance, subtype A is considered to be the most critical one as it can infect both humans and various animals, while the remaining tend to affect specific animal groups or, in case of subtype D animal alone (World Health Organization 2018). A literature review conducted by Caini et al. (2018) analyzed a total of 47 studies to conclude the causal virus subtype does not seem to be a major determinant of clinical presentation and severity of influenza illness. However, in fact, as a result of its wider range of infection, subtype A can generate greater consequences.

As described by the World Health Organization (WHO) (2018) zoonotic influenza viruses such as avian or swine viruses may be the starting point to mild upper respiratory trac infections, early sputum production and rapid progression to severe pneumonia, sepsis with shock, acute respiratory distress syndrome and even death. The illness usually prevails for 3 to 5 days, and severe outcomes likely emerge on the elderly or people with other medical conditions or weak immune system.

In order to face these threats to human health, the specialized agency of the United Nations (UN), the WHO, operates in about 150 offices worldwide serving as a global link and attempting to facilitate the right communication flow, so as to develop coherent and effective strategies aiming to

[2] Similar to GDP but different metric, the gross national product (GNP), is the value of all finished goods and services owned by a country's residents over a period of time.

provide the best possible health care. In fact, it is required that all nations notify WHO in case of a new influenza virus outbreak at any given site as soon as possible (WHO 2018).

Before being considered a Pandemic, most influenza outbreaks are firstly contemplated as an epidemic given the rapid widespread infectious disease often surfaces in a community at a particular time, independently of sex, age, race or social class. However, the world's impressive technological evolution allows for a much rapid and broad transmission rate. Technological changes take place at a pace never seen before and consequently air and land transportation grant a greater interconnectivity between megacities. This combined with a growing globalization facilitate an increase of contact between people and animals. Certainly, these factors culminate in the unfolding of pandemics (WHO 2018).

The definition of pandemics suggested by WHO appears to be the center of much controversy and adjustment. Kelly (2011) argues that 'an epidemic occurring worldwide, or over a very wide area, crossing international boundaries and usually affecting a large number of people', dismissing immunity, virology, or disease severity, which coincides with the classical epidemiological definition. However, according to Doshi (2011), pandemics can be said to arise in each southern and northern hemispheres, as seasonal epidemics across international boundaries and affect a large number of people. Notwithstanding, these are not contemplated as pandemics and will not be consider as such in the course of this project. Regardless, it most certainly is a source of great lethal proportions as well as a cause of profound demographic, political and economic changes.

2.5.1. Control measures.

The appearance of a new virus translates into an accelerated spread as there is little to no immunity. Nonetheless, it is every nation's intention to cease or at most control its transmission. Having this in mind, WHO has developed, and is constantly perfecting, a Pandemic Influenza Preparedness Framework (PIP Framework) together with Member States and industry's stakeholders. Having all the community in the same page, allows for a greater chance of an effective international response focused on a capable surveillance and emergency response system, a strong laboratory network and health system with competent professionals, together with an efficient and trustworthy communication flow (WHO 2016). Although it has proven to be advantageous over the years, its benefits seems to only reach developed countries. As suggested by Fidler & Gostin (2011) there are no 'norms encouraging developed countries to make specific equity-enhancing contributions to developing countries, such as donating portions of purchased vaccine'. Cooperation to mitigate a disease must be global.

Complementary to this framework, this Organization defined 4 pandemic phases, described in Figure 4, to serve as guidelines for countries to take action consonant to the severity degree each is facing so as to reduce morbidity and mortality[3](Gündüz 2017)

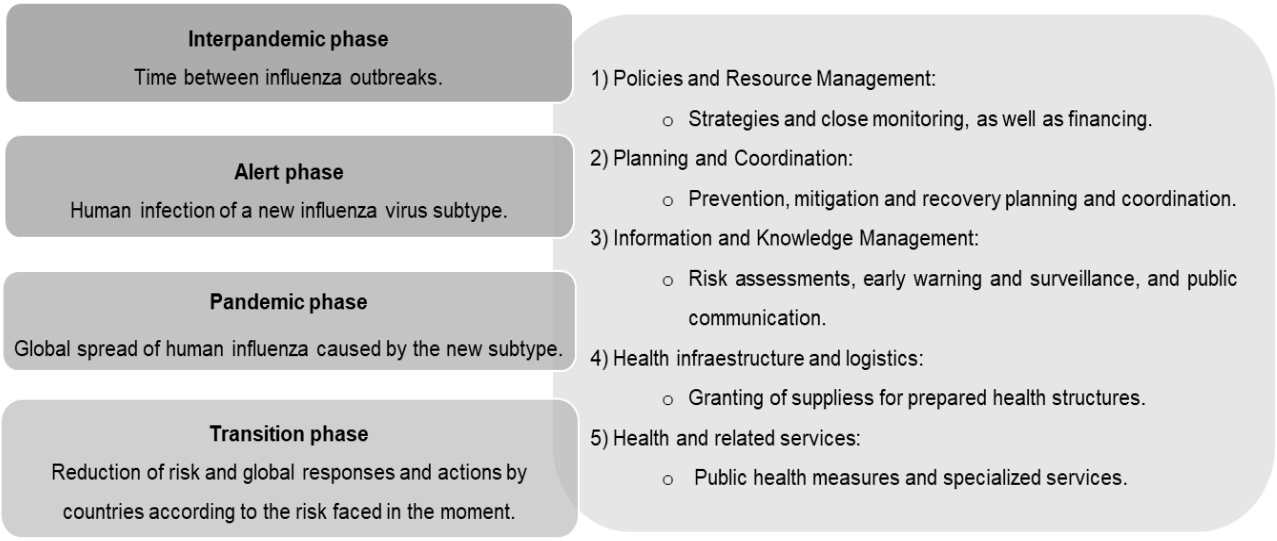

Figure 4 – Pandemic response phases (WHO,n.d)

Thus far, the health community recognizes immunization as the best prevention, being vaccination the most effective mitigation strategy. It can take a long time before a vaccine can be developed and approved for public consumption, however and against all odds the vaccine for COVID-19 broke records by taking slightly over a year to be approved. Despite a rapid respond, the process of vaccinating the entire population still takes time and for the time prior and time being, measures have been taken and are consistently advertised such as the use of masks, social distance, disinfection, among others. These often encourage sensible behavior and slow infection rates down, but at the same time slowed the economy.

A systematic review developed by Rainwater-Lovett, Chun and Lessler (2014) states that NPIs may be useful and essential in early stages of a respiratory transmissible disease, since 'the length of time between reactive vaccination and development of protective immunity, or receipt of antiviral drugs and decreased viral shedding may not be sufficient to produce as rapid a decline in the number of incident infections as NPIs'. A more recent review on several observational studies respecting 16 countries and 6 continents revealed transmission is lower if a physical distance of 1m or more is respected, noting a greater distance implies higher protection. Furthermore, face marks and eye protection are also associated with lower infection (Chu et al. 2020). However, both reviews concluded the impact of these measures should be more thoroughly studied as the data available concerned observational studies. A study amid the coronavirus (COVID-19) outbreak, an infectious

[3] These are concepts that often get confused despite their different meanings. While mortality refers to death, morbidity accounts for the contraction of a disease or symptom of a disease within a population and/or medical problems caused by a treatment.

respiratory disease presenting a similar means of transmission as an influenza, recognized China's control measures. To limit infections, apart from the use of masks, China relied on an early social lockdown followed by quarantine, screening for fever cases along with the screening of close contacts of confirmed cases and suspected cases (Wu et al. 2020). These measures ended up being enforced in most countries in different times according to the evolution of the disease in each one.

2.6 Severity of previous influenza pandemics and respective economic implications

The exercise of the pandemic phases previously displayed, depend on the determination of Public Health Emergencies of International Concern (PHEIC) and 'the declaration of a pandemic based on assessment of the risk associated with the emerging influenza virus'(Gündüz, 2017). These tasks fall on the responsibility of the in-time WHO Director-General. Still, past pandemics have shown different severity levels and health repercussions from country to country, age groups, geographical locations, and over time the intensity of the virus can increase (Caini et al., 2018). Therefore according to each situation strategies should be adapted. Nonetheless, according to WHO (2009) 3 determinants should be considered while assessing a pandemic at a population level: '(i) the pandemic virus and its virological characteristics, as well as the epidemiological and clinical manifestations; (ii) the vulnerability of the population; and (iii) the capacity of the population for response'. Pandemics have occurred in different stages of history and their frequency has been rising since the 2000. According to many researchers, the crisis we are going through was practically inevitable (Garrett, 2007; Keogh-Brown et al., 2008; Fan et al, 2018). The available evidence from prior outbreaks provides information that can help speculate on the implications of COVID-19.

1918

Probably the deadliest pandemic of the 20th century, occurred between the years 1918–1920, in part due to World War I. For some, it has served as a term of comparison to COVID-19 (Ferguson et al., 2020). Thought to have started in a military base in the north of France, its spread quickly took off, and by autumn of 1918 seemingly all parts of the world were experiencing the second, deadliest, wave of the commonly referred to 'Spanish flu'. Winter of 1919 and Spring of 1920 witnessed the final third and fourth waves, respectively. The disease would typically manifest within 1 or 2 days after being in contact with the virus and at the time, the main symptoms documented, concerning the first wave, included typical flu symptoms such as fever, fatigue, headache, and sore throat. By the time of the second wave the symptoms evolved and became more lethal (Radusin 2012). Its transmission occurred through airborne respiratory secretions, having infected around 500 million people, and killed 50 million, translating to a death rate of 2.1 percent (World Economic Forum, 2020). People aged <1 experienced the highest rates followed by young adults ages between 21-35 after which it continuously decreased reaching negative levels (Trilla, Trilla & Dear 2008). Contrary to what happens nowadays, in 1918 there were no effective vaccines or drugs that could cure the flu. Humanity's only hope relied on NPIs, thus, similarly to what happened in the beginning of 2020 with COVID-19, quarantines were imposed, the use of mask was advised, shaking hands was discouraged, and public

areas including schools, churches and theatres were closed up. Undoubtably, the lack of efficient communication, an early lifting of quarantine measures, and the shortage of medical personnel, deriving from both the flu and World War I all culminated in higher number of casualties (Barro, 2020). Hospitals' overburden forced schools, privet homes and other buildings to be transformed into provisional hospitals staffed by medical students (Correia, Luck & Verner 2020) .

The pernicious effects seen in the economy come as no surprise. A large number of nations saw an economic growth during World War I, however, its aftermath combined with the 'Spanish flu' made the perfect recipe for sunk businesses and a symbolical diminished workforce. A research conducted by Barro, Ursúa and Weng (2020) focused on this flu's death rate and consequent economic outcomes – considering a macroeconomic disaster a cumulative decline over one or more adjacent years by 10% or more in real per capita GDP or real per capita consumption. In total, 20 countries experienced this kind of disasters. This pandemic ultimately lead to a 6 and 8 percent declines for GDP and private consumption, respectively. Furthermore, it was concluded that the inflation rates escalated. Dahl et al. (2020) found that the 1918 pandemic resulted in a V-shaped recession [4] leading to a persistent increase in poverty rates and a reduction in the return on capital.

1957

In February 1957, a new pandemic emerged from the then new influenza A (H2N2) virus, provoked by an avian influenza A virus. Its generic designation, 'Asian flu', derived from the fact that its first evidence came from Singapore and Hong Kong around February and April of 1957, respectively. Mostly land and sea routes incited the pandemic wide spread, reaching more than 20 countries from North and South America, Africa and later that year Europe. Similarly to the 'Spanish flu', the 'Asian flu' occurred in consecutive and unpredictable waves having the second one been responsible for a higher number of deaths. As recorded in previous influenza outbreaks this disease manifested itself after a few days, 2 to 5, after being in contact with the virus. Its symptoms were, for the most part, mild. The disease often had 2 to 3 phases, the second being tougher on its victims.

Although it may have infected the same amount of people than the 'Spanish flu', mortality rate was much lower, under 0,2% (Sixty-fourth World Health Assembly 2011), which could be explained by the advances made in between the two outbreaks granting improved health care, vaccination as well as antibiotics. All together is it estimated 1.1 to 4 million people died, a considerably lower number when compared with the 1918 pandemic. Once again, fatality seem to have a greater impact on younger age groups. All throughout the world, including countries in Europe with lower excess mortality, saw that two-thirds of the disease-related deaths were among individuals aged <65, having the age groups <5 and ≥65 suffered minor repercussions (Viboud et al. 2016). As a result of medical development, rather than solely relying on NPIs, people and health professional

[4] A V-shaped recovery is characterized by a quick and sustained recovery in measures of economic performance after a sharp economic decline. Due to the speed of economic adjustment and recovery in macroeconomic performance, a V-shaped recovery is a best case scenario given the recession.

turned to neutralize the disease through vaccination, hospitalization for extreme cases, and antibiotics to treat mild symptoms.

Overall, economic effects were considered moderate as it is estimated a reduction of output of around 1 to 3,5% of GDP (Sixty-fourth World Health Assembly 2011). Countries such as U.S and Canada considered, and quote, that 'probably would not cause a recession and might not be distinguishable from the normal variation in economic activity' and 'the picture that emerges from the 1957 [...] pandemics is of possible very small direct economic impacts and no indirect impacts' (Henderson et al. 2009). Withal, developing countries underwent an, expected, harder hit due to its characteristic large population densities and poverty.

1968

The third influenza pandemic to occur in the 20th century was the 'Hong Kong flu' in July of 1968. This influenza A subtype virus is said to be an evolution of the one observed in 1957, and its high level of contagion, as well as a boost of international air travel, facilitated its spread. After cases reported in Vietnam and Singapore, it rapidly made its way through Europe and the United States. By 1969 Australia, Japan, Africa and South America endured its first cases. There were a total of 2 waves, the second one being the source of most deaths from pneumonia, influenza, and other complications, in the vast majority of the nations affected. This 1968 flu followed the line of the posterior ones concerning its incubation period and symptoms (Rogers 2010).

Again, this pandemics saw a considerably low number of mortal victims, striking nearly 1 million people worldwide. Notwithstanding, there was a shift regarding the age group targeted i.e. fatality seem to strike all age groups among the different nations (Sixty-fourth World Health Assembly 2011). Moreover, mortality patterns were distinct in various countries, for instance in North America, the first pandemic season was more severe than the second, contrary to the pattern seen in Europe and Asia, where the second pandemic season was two to five times more severe than the first. The fact that this disease originated from the 'Asian flu', allowing for immune protection of this virus, combined with an improved medical care and easier availability of antibiotics, allowed for a limited spread and higher control (Gasparini et al. 2012). Thus, its economic effects were only slight in the majority of countries, as a matter of fact the world GDP growth during said time did not suffer any loss (The World Bank 2021).

2009

More recently, in 2009, in addition to an ongoing global economic recession a new influenza outbreak loomed. The Swine flu virus had its earliest appearance in Mexico, rapidly spreading to over 214 countries and manifesting, for most countries, in the course of two waves. Its transmission was alike any seasonal flu. Equivalently, its symptoms were similar to the ones observed in previous influenzas. On the whole, the 2009 H1N1 flu is considered a mild pandemic as a low number of deaths is associated with it. Originally, WHO declared about 18449 confirmed deaths,

yet these merely corresponded to laboratory confirmed cases which afterwards the World Organization itself acknowledged as an underestimate and rectified the number to an interval of approximately 105.000 to 395.000, the mortality being 0,01%. The higher number of mortality during the 2009 influenza period occurred in elderly people, with typically more than 65 years old (Donaldson et al. 2009; Dawood et al. 2012). The cumulative incidence of pandemic influenza infection was reported to be in the range 16%–28% in pre-school aged children, 34%–43% in school aged children and 12%–15% in young adults. Only 2%–3% of older adults were infected (Kelly et al. 2011).

By November of 2009, a vaccine, was already being administrated in order to prevent the disease. Despite being the main mitigation approach, the WHO was under criticism for appearing to be working alongside pharmaceuticals to rise profit from the vaccines instead of solely acting in the best interest of society (Pollard 2010). Nonetheless, this was not the only plan of action to control the number of infections. In addition, it was recommended for people not to travel to the most affected countries, such as EUA and Mexico, unless strictly necessary (World health Organization 2009). Given there was no obligation regarding the closing of borders airlines suffered no major changes. Schools were rarely closed, merely being advised to prepare rooms to isolate ill people and wear masks in case of symptoms as well an easy access to disinfectant. Likewise workplaces were only closed in worst-case scenarios, and allowed for individuals with symptoms to stay home or to care for family members. During the period of the H1N1 virus face masks and quarantine were not generally forced upon, these rules often applied to travelers, and for a few selected countries such as China. Having overlapped with a global economic crisis, it is uncertain of whether the drop of GDP would have still happen, even if in a minor portion, if the pandemic was considered alone.

2019

The new COVID-19 pandemic raised numerous doubts when first appearing. It was initially thought to be similar to previous ones in terms of symptoms, however unknown side effects such as loss of taste and smell and sever shortness of breath, proved to be resistant to the medicine and common treatments of other flus. Thus far, according to the WHO the world mortality rate for this virus is around 0,6% and, according to Fernandes (2020), the evidence suggests there is no correlation between economic impact and mortality rates. In Portugal, to this day 3 waves and 17.023 deaths were registered and, 2 quarantine periods where all population were confined to their homes, were imposed. These quarantines each lasted about 4 months and were followed by a slow revaluation each period of 2 weeks to assess the country's situation and possible release. This constant appraisal was made by means of a risk matrix and were the objective is to stay below the 120 cases for 100 thousand people and the transmissibility index, R(t), which is the number of secondary cases produced by each primary case must be less than 1, and reached over 2 in February of 2021 (the most lethal wave). For many infectious agents, explosive epidemics indicate high transmissibility (Mills, Robins & Lipsitch 2004).

The uncertainty associated with this disease caused a widespread quarantine in the world that has caused unimaginable damage to the economy. The reaction of governments, companies, consumers and media, have created a simultaneous demand and supply shock (Fernandes 2020). The IMF reported that COVID-19 severely impacted developed economies such as France, Italy and Spain. Portugal's economy contracted sharply in 2020 as the spread of the COVID-19 pandemic took a heavy toll on all aspects of social and business activities. Companies had to be closed, tourism suspended, work from home had to be enforced and restaurants were forced to shut. No sector was left untouched. The national airline company alone (TAP) accounted for 365.1 million euros of losses in the first quarter of 2021 and the possibility of insolvency has never been so discussed.

Portugal's GDP is estimated to have fallen by 7,6% in 2020 (Pordata 2021). Service exports and private consumption experienced a steep rise in savings due to a closure of businesses. Contrarily, investment in construction continued to grow, helped by the cycle of EU-funded projects. The hopes of the beginning of a recovery were put down by the resurgence of infections that brought new restrictions towards the end of 2020 weakening GDP growth and adding pressure to businesses that were already hanging by a thread. With the introduction of a more stringent lockdown in mid-January 2021, GDP was projected to fall again in the first quarter of 2021, before starting to hopefully recover as of the second quarter of the year, with a major rebound in the summer months, but risks remain significant due to the country's large dependence on foreign tourism. In full-year terms, GDP is projected to grow by 4.1% in 2021 and 4.3% in 2022 if all goes accordingly. Pent-up consumer demand and the expected surge in business sentiment are projected to drive the economic recovery.

The historical data presented allows to identify aspects all outbreaks have in common which, in turn, allows to conclude that the economic activity is mostly impacted in the short-term by: i) avoidance reaction due to social distancing measures, ii) direct costs (mostly medical), iii) large indirect cost (those linked to production) and iv) subsequent effects (disruption of services)(Roy, 2020). Despite the similarities witnessed, there is a trait, not related to the disease itself, but to the time in which it appeared, that traces the differences between these outbreaks. This is a global pandemic not solely focused on low-middle income countries, and the world is much more integrated. In addition, interest rates are historically low, and the current crisis is provoking spillover effects throughout supply chains as well as aggregate demand and consumption patterns (Fernandes 2020). Higher borrowing and debt levels made short-term shocks more potent compared to previous influenza outbreaks (Boissay and Rungcharoenkitkul, 2020).

2.7 The long-term effects of the pandemic in the various sectors of the economy

According to an article released by the McKinsey Global Institute (Manyika et al., 2021), the business sector overall contributes 72% of GDP in the OECD. The COVID-19 pandemic has hugely impacted this sector and brought changes in the way businesses operate and consumers behave. In turn, these changes are expected to have a direct effect on influence aggregates such as output,

employment and prices – and the relationship between them – in the long term (Jordà et al., 2020). In this section, the impacts on some of the sectors that have more weight in the Portuguese economy will be explored. In order to do so, a survey aimed at 72 leading non-financial euro area companies split around 60% to 40% between "industrial" and "services", respectively, published by the ECB (Eduardo & Morris, 2020) concerning how leading euro area firms perceive the long-term impact of the COVID-19 pandemic on their business, will be taken into account.

This survey reported that more than 40% increased the use of "home office" and almost as many accelerated the adoption of digital technologies. Close to 1/5 of respondents recognized a permanent reduction in business travel and increase virtual meetings. Both situations are likely to change the way companies operate in the long term. To their understanding, changes in living and working habits brought about by the pandemic, especially the increased conduct of business and consumption online and a reduction in travel, will become embedded. Again, around 1/5 highlighted that measures taken to mitigate the pandemic impact would make their business more resilient, efficient, and flexible in the long term. A great majority acknowledged that productivity levels would not only not go down, but in many cases, would increase, however, most foresee a negative impact on employment. A significant share of inquired cited reduced demand and changes in the structure of demand as concerns. The pandemic was seen as changing consumer behavior in the long term, likely leading to increased market concentration, while having much less impact on supply chains.

Although the survey presented concerns companies in different countries in the EU, Portugal will certainly not escape this trend. To deepen this analysis the most directly affected sector, the aviation, oil industry, tourism and health sectors will now be outlined. The impact that each sector has on the others will be visible as well as how a tension can encompass a large part of the economy (Brodeur et al., 2020).

Aviation Sector

Airports Council International (ACI) World determined that there would be a fall of around 2 billion airline passengers globally in the second quarter of 2020, and a reduction of around 4.6 billion passengers for 2020. The fall in airport revenues globally is determined to be $39.2 billion in the second quarter of 2020 and around $97 billion for the entire 2020. According to ANAC (2020), in Portugal alone, the civil aviation sector suffered losses of 1.5 billion euros in 2020. The various divisions within the airline industry were included in this loss, namely passenger airlines, cargo airlines, aircraft manufacturing companies, airport managing companies, and catering and service providing companies. Aircraft manufacturing companies may also be affected as a result of the pandemic due to cancellation of airplane orders.

The various steps taken by airlines in order to mitigate the losses include reduction of capacity, parking or retiring aircrafts that have become old, reducing compensation paid to executives and taking measures regarding voluntary leave or early retirement programs for employees, reduction in new employee hiring, minimizing non-essential spending, closing airport lounges, pausing real

estate projects, limiting food and beverage served onboard, stalling the delivery of aircrafts, minimizing non-aircraft capital outflow, applying for both secured and unsecured loans for cash flow requirements, selling shares, selling or loaning aircrafts, engines as well as other assets and stopping repurchase of shares and dividend payments.

Oil Industry

The shock from COVID-19 pandemic and disruptions in negotiations between Organization of the Petroleum Exporting Countries (OPEC) and its associates resulted in a fall in oil prices. Galp, a leading multinational energy corporation, headquartered in Lisbon, registered a fall of 5% in the first quarter of 2020 in its operating results due to the contraction caused by the COVID-19 pandemic and the confinement measures in the Iberian Peninsula, which caused the price of oil to fall and caused sharp drops in demand for energy by businesses and consumers.

The dual shock of COVID-19 and fall in oil prices are interlinked, yet different. The demand portion of oil shock is related to a fall in consumption of oil as a result of safety practices to curb the spread of coronavirus. This has occurred due to 'stay-at-home' orders which has caused severe slowdown to the global economy. Rystad Energy[5] has determined a fall in the consumption of oil by 10% since 2019 due to fall in air and road transport. But the supply part of oil shock is expected to stay and cause oil prices to stay low for a greater period of time. In order to determine the effect of oil prices on global economy, economists differentiate between supply and demand driven oil shocks. Demand driven shocks are interlinked with worldwide demand and do not have a standalone impact on the economy. In comparison, supply driven shocks are determined to have a standalone impact on the economy. This might not be true in the case of COVID-19 pandemic, as the fall in oil prices have resulted in fluctuations in the market for bonds, equities and non-oil commodities.

Tourism industry

On a worldwide basis, as a result of COVID-19 pandemic, a few countries are striving to recover from extensive lock-downs, while other countries have the stay at home order in place to curb the spread of coronavirus. The COVID-19 pandemic will have a long standing effect on worldwide tourism, and it is still uncertain if tourist destinations in Europe or North America will have sufficient tourists to maintain the local industries. In Portugal, Neoturis, a strategic and business consulting company, that monitors the tourism, entertainment and leisure sector estimates that the loss of revenue from tourist developments in Portugal has reached around 6 billion euros since March 2020. The sector is responsible for 18.6% of total jobs in the country, taking into account the direct, indirect and induced effects. In places like the Algarve, Madeira and the Azores, tourism represents more than 20% of GDP and local jobs. The year before the pandemic Portugal reached 70 million

[5] We are an independent energy research and business intelligence company providing data, tools, analytics and consultancy services to clients exposed to the energy industry across the globe. It is the biggest independent energy consultancy in Norway, and a world-leading analysis company for the oil and gas industry.

tourist overnight stays, yet in 2020 and 2021 combined this number was no more than 63 million. In pre-pandemic times this sector was expected to grow 4% in 2020 and 2021 each.

The tourism sector has always been severely affected by pandemics and macroeconomic shocks. Historically, the tourism industry has been heavily burdened by various pandemics including Black Death (1346-1353), Spanish Flu (1918-1920), SARS (2002-2004), H1N1 Swine Flu (2009-2010) and Ebola Virus (2014-2016). The Spanish flu created travel restrictions for four months, the Swine Flu led to an economic downturn in the Mexican tourism industry and led to a loss of a million international tourists in a period of five months, and the industry lost approximately $2.8 billion. The tourism industry both increases the spread of virus while also suffering as a result of virus spread. The COVID-19 pandemic is turning people away from popular tourist spots as they fear the spread of the virus.

Hugo et al., (2021) assume that in a recovery model limited by recurring episodes translate into a slow recovery where pre-pandemic levels of domestic and international tourism will only return in 2023 and 2024, respectively, for Portugal. To accelerate the recovery process, this sector must prepare itself to become even more competitive , innovate in intersectoral collaboration as well as within the sector , and promote a different way of thinking about tourism, for instance, it is expected that second home tourism, culture and adventure will recover faster than many others. Given that consumers' personal savings are at an unprecedented level, it might make sense that stakeholders collaborate and develop world-class travel experiences in the entire Iberian Peninsula.

Healthcare sector

In the past, healthcare has not been much affected by crisis and economic slowdown. Regardless of whether the economic conditions are favorable or unfavorable, people need healthcare, however the COVID-19 pandemic control measures encouraged people to stay at home under lock-down. This measure turned out to have an unexpected and never-before-seen effect, in which people tried to refrain from going to medical centers as they fear risk of infection and longer waiting times as healthcare workers are busy treating COVID-19 patients, and delayed non-essential medical procedures such as imaging services, elective surgeries, filling of prescription drugs among others. Derived from this phenomenon, clinics and hospitals faced a reduction in other patients. So, it is not likely that the healthcare sector will recover from the crisis it faces unless the COVID-19 situation is addressed. As a result of the pandemic one of the most popular measures to mitigate this effect was digital health and telehealth.

Many health professionals have since been laid off, and those who remained employed went through salary reductions. Moreover, the pandemic has caused immense pressure on medical centers and hospitals due to a shortage in medical supplies and testing capacity. Improvement in technology, reduction in healthcare costs and ensuring more healthcare access will be primary constituents of healthcare developments following the COVID-19 pandemic. Non liquidity and pressure on administration is caused delay in payments to healthcare workers. The increase in the

number of COVID-19 positive cases disrupted the supply chain of pharmaceutical products. After the COVID-19 curve flattens and communities begin to return to pre-covid phase, the impact of coronavirus will most likely continue in medical, economic and recruitment disruptions.

3. The Evolution of COVID-19 in Portugal

Ahead of discussing the different methodologies targeted at forecasting a country's macroeconomy, the course and impact of the Coronavirus in Portugal must be understood, as well as the policies conjectured meanwhile, both economic and healthcare wise. This look into the pandemic will allow for an initial perception of the cumulative impact this virus had on Portugal's economy over the last two years. The information bellow is a compilation of some of the major events publicly listed by the SNS following a chronological order (all the information in this chapter was authored by DGS). Since this is an unknown virus, decisions were made day after day in correlation with the progression of the disease, taking into account both the number of infections and death.

On the 14th day of January 2020, the SNS issued the first press release reporting 59 cases of pneumonia in Whuan, China. It stated that a new coronavirus had been detected as the etiological agent of the disease on 41 of the cases, including one death. Despite being caught by surprise, and unknowing neither its origin nor its severity, the WHO followed a protocol previously developed, bearing in mind this type of phenomenon, initially suggesting the following measures:

- Avoid close contact with people suffering with acute respiratory infections;
- Wash hands frequently;
- Avoid contact with animals;
- Adopt respiratory etiquette measures such as: covering one's nose and mouth when sneezing or coughing with a tissue, or one's arms, and washing one's hands whenever one blows, sneezes or coughs.

Shortly after, citizens were informed that the laboratory-confirmed cases in China had risen and the first ones outside the country were identified, 2 in Thailand and 1 in Japan and South Korea, all linked to the city of Wuhan. Moreover, it was around this time that these cases were linked to a food and live animal market that had already been cleaned and closed after raising suspicions in early January. Given these new findings, it was reinforced that travelers staying in Wuhan, who show symptoms suggestive of respiratory disease, should seek medical attention and provide their travel history.

By the second half of the month, the cases showed no sign of slowing down and the USA had already reported one case and the ECDC manifested a greater concern regarding the appearance of cases in the EU, a possibility that until then had been underestimated. On January 23rd all flights and public transport with destination to and within the city of Wuhan were cancelled, and spaces with a concentration of people such as cinemas were closed. In addition, health screening measures for travelers leaving the country at airports, ports and land borders were implemented. Based on the information published by the WHO, which did not recognize any evidence of person-to-person transmission outside China, the DGS provided guidelines and procedures for the support of health professionals, as well as the distribution of posters and informational leaflets, a strengthening of the Medical Support Line, and update and validation of information.

The 25th saw the first 3 EU cases coming out of France. With the increasingly aggravated news accounting for already 9836 infections confirmed, 18 in countries outside of China including 8 cases of person-to-person transmission, the WHO met with the IHR Emergency Committee and decided to declare an international emergency of international scope. Only by March 3rd the first case of infection was detected in Portugal. Two days later the BTL was postponed and eventually cancelled so as other events, from sporting to cultural, including all summer music festivals were. This date was also marked by the decision of TAP Air Portugal to cancel more than a thousand flights in March and April, canceling and suspending salaries and place employees on unpaid leaves.

Naturally, the positive diagnosis continued to grow and the locations holding the largest number of cases saw its schools, leisure and cultural establishments, public installations, such as gyms, libraries, swimming pools and cinemas, closed and hygiene measures, previously mentioned, reinforced. Once infections reached 39, the Minister of Internal Affairs announced the suspension of all flights to or from areas severely affected by Covid-19 in Italy, where numbers skyrocket ate the time. In addition, the shutting down of open spaces with more than 5.000 people and closed places that could hold more than 1.000 was recommended. Hotel reservations were cancelled by 60% in the following months across the country, and tourism fell to almost zero. A few days later, the Superior Council of Magistracy determined courts of first instance could carry through procedural acts and measures related to fundamental rights. Most sporting modalities were likewise suspended. From March 12th Portugal registered a number of shut downs and restrictions. Classes at all schools and levels of education were suspended, nightclubs closed, restaurants and shopping centers were imposed a maximum capacity, cruise passengers were not allowed to disembark, the Portuguese Football Federation announced the suspension of all national competitions, and religious ceremonies followed the same faith. Monuments and national palaces were closed to the public, sporting activities by the ocean were prohibited and events could go up to only 100 people.

It was by the 16th of March that the first death was recorder and air traffic between Portugal and all Europe was interrupted. The country's President declared a state of emergency for 15 days, from which public establishments closed and telework was widespread. The end of this month was heavily marked by the phenomenon that seemed to be determinant for number of deaths, outbreaks in nursing homes. Compared to previous days, there were twice as many deaths and those infected reached 1,280. Consequently, a large amount of complaints due to lack of safety equipment forced Portugal to purchase around 4 million euros worth on masks to China.

Moreover, credit lines were announced to support companies' treasury by the amount of 3,000 million euros, and tax payments were postponed. As fear installed in the population, Ebola and Malaria medicine started to be used, without proper prior testing. This 'solution' was later discredited.

On March 26, the government approved the suspension, until September, of the payment of housing credits and company credits. In addition, Banco de Portugal estimates that the GDP would fall by 3.7% in a base scenario and 5.7% in an adverse scenario, in 2020 due to the pandemic. The unemployment rate was expected to rise above 10%. The end of this month is usually associated with high levels of tourism, however this sector was practically closed, and people were stopped from

national travelling during Easter Holidays. Moreover the emergency state was prolonged 15 more days.

Having to adapt to this scenario, a rectification of the initial simplified lay-off diploma was published by the government consisting of simplified "lay-off" (Castanheira, 2020). In short, this measure allowed companies to temporarily reduce their normal working hours or suspend their employment contract, as part of the COVID-19 disease pandemic. Companies or establishments whose total or partial closure had been decreed by decision of the political or health authorities could access this new type of lay-off. Equally, companies that had to, completely or partially, stop their activity due to the interruption of global supply chains, or the suspension or cancellation of orders could adhere to the measure. Companies with a drop of at least 40% in turnover compared to the previous month or the same period of the previous month could also have access to the simplified lay-off. Companies that joined reduced the wages of their workers, following the general rules provided for in the Labor Code for lay-off situations, with this remuneration being financed 70% by Social Security and 30% by the employer. In case of suspension of the contract, workers were entitled to receive two-thirds of their regular gross salary, with a guarantee of a minimum amount equal to the national minimum wage (635 euros) and with a maximum limit corresponding to three minimum wages (1,905 euros). In situations of reduced hours, the salary is guaranteed, calculated in proportion to the hours of work. By April 4th more than 100 thousand companies applied for this "lay-off" regime.

Despite having saved many companies, the nationalization of the airline company TAP was contemplated due to the large amount of "lay-off" it had to endure to survive. Galp had to announce the suspension of activity at the Sines refinery for not selling the products and the automotive market dropped 84,6% in April compared to the same month the previous year. Despite the emergence of these measures Government estimates pointed to an annual GDP fall of 6,5% for every 30 working days the economy was paralyzed due to COVID-19 and the European Commission forecasts a recession of 6.8% for the country and an increase in the unemployment rate to 9.7%.

On April 30th, the Government approved in the Council of Ministers a plan to transition from a state of emergency to a situation of calamity with phased application of deconfinement measures. Public spaces were slowly opening still obeying several limitations, schools were opened only for high school students and homeworking was maintained.

By the end of May, the Institute for Employment and Professional Training announced that the number of unemployed people continued to increase in April, 22.1% more, compared to the same month last year. According to the sector association, the consumption of gasoline in April fell 61.3% and diesel consumption by 44.6%, compared to April 2019. Also due to COVID-19, hotels in the Algarve in April had an average occupancy rate of 1 %. The Minister of Health said that around 540,000 medical specialty consultations and 51,000 surgeries were left unanswered until April. The end of May saw flights and high level sporting competitions being resumed accompanied by measures such as the use of masks and the prohibition of public in the case of sport events. Theaters and cinemas were scheduled to partially reopen by June, and it was made known by the Direção-Geral do Orçamento that the pandemic had an impact of 680.2 million euros on the accounts of Public

Administrations until April 2020. In the same line, the Banco de Portugal made public that restaurants and retail trade lost 354.4 million euros and 316.3 million euros in April, compared to the value in the same month of 2019. According to a survey conducted by the CIP more than 40% of companies wanted to suspend or cancel investments and 82% planned to use capitalization instruments. Requests from companies for support lines launched by the Government reach 10.5 billion euros. Furthermore, the Government approves the extension of the simplified 'lay-off' until the end of July and the financial support for companies until the end of the year. On May 27, the European Commission presented a proposal for economic recovery of 750 billion euros, praised by Portugal.

With the significant decrease of infections and mortality during the wormer months, public spaces continued to gradually open. In August it was finally announced the reopening of schools for all ages with the mandatory use of masks and specific circulation rules.

Given the approach of Christmas and New Year's festivities measures tightened once more. To prepare for this time, a mandatory curfew was established for the weekends. All commerce and restaurants were shut down from 1pm. Many restaurants chose to either not open during those two days of the week given the time limitation, or to solely take advantage of online food and delivery platforms, or adapted their menus to suit meal other than lunch and dinner. Despite the new measures a new state of emergency was renewed on November 20th. Little did the country know it would last until March of 2021.

The month of December was marked by the purchase of 22million vaccine doses by the Portuguese government, with the purpose of distributing them free of charge and arbitrarily. Along with the vaccines a vaccination plan was presented. People over 50 years of age with associated pathologies, residents and workers in nursing homes, and health and essential service professionals were identified as priority groups. This first phase represented around 950,000 people. In a second phase of vaccination 1.8 million people over the age of 65 could be vaccinated, and about 900,000 people with associated pathologies and over 50 years. In a third and final stage the rest of the population should be vaccinated. The order of the remaining age groups were organized from oldest to youngest given the evolution of the pandemic. Although the vaccine moderates the effects of COVID-19, and was able to decrease mortality, the number of infections remained high and therefore the administration of 3 doses of the vaccine was approved. It is possible that the administration of this vaccine will be similar to the flu vaccine, which is advised to be taken annually (SNS, 2020).

The remaining days of the month of December were crucial for the unroll of the mortality and infection on the following month. Together with the national ministry of health, the Portuguese government decided that circulation between municipalities would be allowed between December 23rd and 26th. In addition, restaurants were able to function at Christmas, however New Year's celebrations were entirely shut down. In the meantime, new bans on driving on weekends in high-risk counties were applied. Close to these dates, the government decreed restrictions on the entry into Portugal for passengers on flights from the United Kingdom, with the exceptions of people with Portuguese nationality or legally residents, due to a new variant, highly transmissible, detected in the country.

Shortly after, and still in the same month, the Pfizer-BionNTech vaccine was approved and by the 27th the vaccination plan was initiated.

The new year brought with it the approval of a new vaccine Moderna's against COVID-19. In spite of the uplifting news, the country was on the verge of entering the worst COVID-19 period to date. It would be misleading to not pin point the festivity season as the turning point. The easing of measures made people more comfortable to go about their daily lives and to reunite with family as is typical for this time of year, under normal circumstances. Of course this had a direct impact on the increased transmissibility of the disease and increasing rate of infection. New records of deaths and infections were being reached every day, hospitals collapsed, and ambulances were forced to stand at the emergency door due to lack of space for patients. It was around such time, Portugal became the country in the world with the highest number of cases of infection according to statistical websites. Given its critical situation, the possibility of hiring doctors and nurses trained abroad was later approved. By the end of January, the Government had closed senior universities, day and social centers, schools, courts, restaurants, leisure shops and prohibited the circulation between municipalities. Moreover, with the emergence of new strains of the virus in countries such as the United Kingdom, South Africa and Brazil, borders had to be temporarily closed once again. Despite the additional strains, it was a common understanding between the health community that the virus was losing strength and symptoms were milder. On January 29, the European Medicines Agency approves the administration of another vaccine, AstraZeneca. Figure 4 displays the cumulative incidence of confirmed cases at 7 days per 100.000 population provided by DGS's daily report.

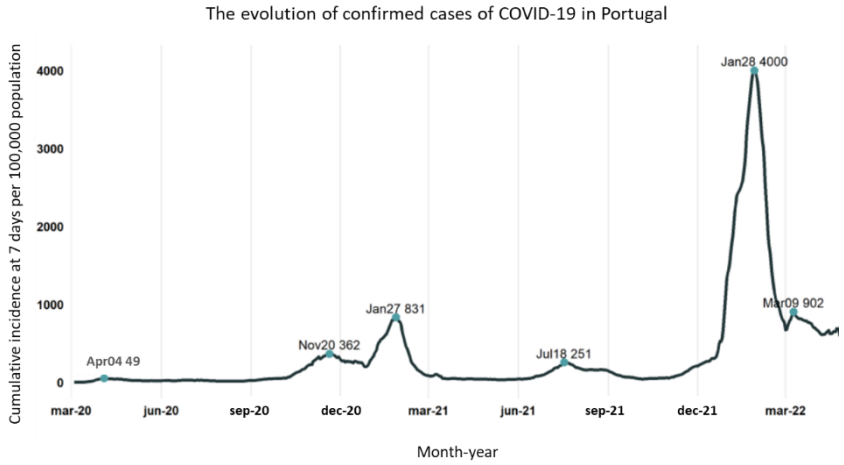

Figure 5 – Graphical representation of the evolution of confirmed cases of COVID-19 in Portugal (DGS, 2022)

It was decided classes would resume by February 8th in an online regime and all further restrictions should be maintained for an additional 15 days. On January 29, the European Medicines Agency approves the administration of another vaccine, AstraZeneca. About a month later, the General Director of Health announces that close to 250.000 Portuguese have already received two doses of the vaccine for COVID-19. The number of new deaths and infections dropped significantly. On March 11th the Prime Minister announced a plan for a gradual deconfinement. Until that date, the

state of emergency was maintained. Gradually, the country and the world have recovered their general functioning, but without a doubt the pandemic left its marks on several levels.

Still in 2020, the National Preparedness and Response Plan for this epidemic was made public. It was based on the guidelines of the WHO and the European Center for Disease Prevention and Control (CEPCD) and included information regarding this disease, namely its pathogenic behavior and transmissibility potential. The objectives of this plan were to minimize serious illness and death, as well as minimize social and economic impacts adjacent to this public health threat. In this sense, alert and response levels were developed and the response phase includes three levels and six sub-levels (Table 3), according to the risk assessment for COVID-19 and its impact for Portugal (Correia et al., 2020).

Table 3 – Levels of the response phases in Portugal

Response Phases	Pandemic status
1. Containment	. Existence of sustained transmission of coronavirus capable of causing serious health problems in humans, outside Portugal, with international spread. . Imported cases in Europe.
2. Extended Containment	. Presence of transmission chains in Europe. . Presence of imported cases in Portugal, without secondary chains.
3. Mitigation	. The transmission chains of COVID-19 are already established in Portugal, in the case of an active epidemic/pandemic situation. . Comunity transmission.

Source: DGS, 2020

On the economic front, and keeping in mind the pre-pandemic goals and construction of a stable future, Portugal's government drafted a Recovery and Resilience Plan, which according to the Planning Minister, Nilson de Souza will include the:

- Creation of 35 new mobile units for primary health care to cover low density regions;
- Extension of the National Continuing Care Network with 5,500 new inpatient beds;
- Extension of the National Palliative Care Network, with 400 less complex hospital beds by 2024;
- Requalification or adaptation of 326 buildings to increase efficiency, comply with contingency plans and / or guarantee accessibility, safety and comfort for users and professionals;
- Extension of the network of equipment and social responses to the level of children, the elderly and people with disabilities (28,000 posts in interventional social responses);
- Support of 26 thousand households with decent housing;
- Creation of 15,000 new jobs created, and increase spending (public and private) on R&D to at least 2% of GDP by 2025.

4. Methodology for conducting a Literature Review

The preparation of macroeconomic forecasts is an essential aspect of policy making. As organizations seek to minimize risks and maximize utilities, they turn to forecast for decision making and planning (Hyndman, 2011 & Petropoulos et al., 2022). The variety of forecasting applications asks for a diverse set of methods to face real-life challenges. Several studies list a step-by-step method to conduct economic forecasting exercises. In general the basic steps are similar, and so a research of this sort should contain:

1. **Problem definition and scope**: being the most defiant step, defining the problem carefully requires an understanding of how the forecasts will be used, who requires the forecasts, and how the forecasting function fits within the organization requiring the forecasts. A forecaster needs to spend gathering data, and maintaining databases.
2. **Literature review**: given the relevance of this step, the next chapter will dive deeper in this topic, as the reader might benefit from understanding how to properly carry out this stage taking into account the pace and quantity at which new studies are generated. Past literature reviews in this field show that commentary from sources with summary-level perspective, such as the IMF and OECD, helps with identifying key economic trends, issues and risks. Additionally, it can help the forecaster with their own assumptions while also giving them other forecasts to compare against.
3. **Obtain data inputs**: gathering relevant historical data on key economic variables is crucial. Particular care should be put into ensuring that the sources are reliable. Thus, it is recommended not only to analyze the data sources chosen by authors in the past, but also to make a comparison between them to validate the ultimate decision. There are at least two kinds of information required:
    a. Statistical data;
    b. The accumulated expertise of the people who collect the data and use the forecasts. Through the searching process it might be difficult to obtain enough historical data to be able to fit a good statistical model. However, occasionally, very old data will not be so useful due to changes in the system being forecast.
4. **Determine historical relationships**: historical data is used to determine the relationships between one or more independent variables and the dependent variable under study, often by using regression analysis. For this step, graphing the data it is often suggested as way to easily spot possible trends, patterns, verify seasonality and/or business cycle and realize the level of relationships among the variables selected.
5. **Model:** the historical previously collected will be used to employ or in some cases develop an econometric model, which typically apply a computation to a series of

inputs to generate an economic forecast for one or more variables. Authors stress that the model should be chosen based on the availability of historical data, the strength of relationships between the forecast indicators, and the way the forecasts are to be used. It is common to compare two or three potential models.

At last, once a model/s has been selected, and its parameters estimated, the only step left is to make the forecast and evaluate the results. The performance of the model can only be properly evaluated after the data for the forecast period have become available.

4.1 The purpose of a literature review

The aim of the literature review is to clarify the method to be followed in order to carry out a rich analysis directed towards Portugal's economic forecasting giving emphasis to GDP projections. This research will, therefore, allow for a comprehension of recent work done on economic forecasting models, and scenario building, which will in turn serve as a starting point for testing in a posterior chapter.

Literature reviews are the basis for research in nearly every academic field. The amount of research and the rate at which it has been emerging in the present-day, have made this type of study a fundamental element for gathering updated information, to pave the way for new studies. Amid the recent COVID-19 pandemic alone, more than 550 NBER working papers have presented pandemic-related research[6]. Systematic reviews, focus on a given sector, theme or discipline and carefully examine and synthesize selected articles and prior studies in order to identify all that has been concluded thus far, as well as the methods and key theories applied, allowing for the detection of knowledge gaps, ambiguities, and consequently the formulation of new theoretical frameworks (Elsevire n.d; Paul & Criado 2020). In other words, it can ordinarily be described as research on research. Thus, the quality and reliability of the sources while writing an article review has never been more important.

4.2. Types of literature reviews

Recent studies conducted by Palmatier, Houston and Hulland (2018), Paul and Criado (2020) and Donthu et. al (2021) shed light to 3 main categories of systematic literary reviews. The articles point out domain-based, theory-based and method-based reviews, while also referring to a 4th additional category – the meta-analytical – which has been increasingly popular.

[6] 4 The list of NBER working papers can be accessed here: https://www.nber.org/wp_covid19.html

4.2.1. DOMAIN-BASED

Domain-based reviews seem to be the most prevalent in published articles regardless of the field of study and, essentially, reexamine and synthetize the available literature in a particular domain. Within this research category there have been developed many methodologies such as **structured reviews** whose focal point fall over broadly used methods, theories and constructs, allowing for the coordination and understanding of past research. For instance, Rogers, Ahad and Murphy (2007) made use of this type of research to review the literature over a period of 5 years to identify papers reporting outcomes using patient self-competed questionnaires and group these into themes, adopting a tabulated summary in order to facilitate the identification of deficit in the literature. Likewise, although in a different discipline, Akbari, M (2018) provided a structured literature review with the purpose of giving insight into logistics outsourcing research so as to identify gaps in knowledge and incite future research.

Framework-based reviews fall in the same category. Authors employ either known frameworks, such as ADO (Antecedents, Decisions and Outcome), our new ones such as the 6 W Framework developed by Callahan (2014) comprised of – Who, When, Where, How, What, and Why – for structuring their review (Paul & Criado 2020).

A **bibliometric review**, in turn, examines collections of knowledge within and across disciplines. It uses statistical tools to establish trends and citations and/or co-citations regarding a chosen sector, by year, country, author, journal, method, theory, and research problem. Citation analysis focuses on the quantitative assessment of citation patterns within the literature. Randhawa, Wilden & Hohberger (2016) combined two complementary bibliometric methods of co-citation analysis and text mining on 321 journal articles regarding Open Innovation enabling the understanding of key information and concepts on the subject. A second example covers an article where authors, universities, and countries that publish the most in International Business Review are singled out, as well as the most cited papers and articles of the journal (Rialp et al. 2019). Much more examples can be found as there has been a clear trend of increase in the use of this type of study. Donthu et. al (2021) was able to quantify this trend and found that there was an average of 1021 publications in the last decade using bibliometrics, due to a constant growth of scientific research. Indeed, the bibliometric methodology has been applied in a variety of fields such as business research, including business strategy (Kumar et. al 2021), finance (Bui et. al 2020; Xu et. al 2018), management (Fahimnia, Sarkis & Davarzani 2015; Mishra et. al 2018), and marketing (Samiee & Chabowski 2012; Nicolas, Valenzuela-Fernández & Merigó 2020; Backhaus, Lügger & Koch 2011).

A study on bibliometric reviews written by Barker (2013) analyzed several papers to deduce the following advantages and disadvantages of this method. Bibliometric methods facilitate examination of large data sets and thus can facilitate examination of trends in subject areas, decision making and the examination of the sociology of science. On the other hand, citation analyses may encounter measurement and technical problems including changes in citation databases over time, language biases or problems with the journal impact factor. Sampling problems can also rise, and citations can occur for nonscientific reasons. Authors may also reference work that is more commonly

used databases, more easily available or written in a familiar language. For this particular study, and with the support of the methods that will be described in the following chapters, this will be the most suitable research to pursue since the objective will be to collect relevant information from recent years in the area of macroeconomics and economic crises and shocks, in order to detect trends that may occur regarding possible errors and data, that will enable to conclude about the future of the Portuguese economy after the pandemic, and measures that proved to be effective in the fight against an economic crisis.

A **hybrid review** might originate more conclusive results as it can integrates both a framework and narrative-oriented literature review or, combine a bibliometric and structured review, which combines systematic literature review and bibliographic network analysis. A clear example that takes advantage of this category is a research conducted by Comerio and Strozzi (2019) that combined a systematic and bibliometric literature review which helped granting a panorama of the most developed areas of study concerning tourism.

Finally, in review aiming for theory development, new models and/or propositions, or propositions are developed. For instance Paul and Mas' (2019) article on 'Toward a 7 P framework for international marketing' displays this type of work.

4.2.2. Theory-based

This type of study aims at gathering already existent theories in a subject area/field in order to establish relationships between them and asses the level at which the same have been investigated, as a means to develop new hypotheses to be tested. Lebek et. al (2014) compiled a total of 113 published articles with the objective of providing a panorama of theories developed in the field of workers' information systems security behavior over the last decade. Furthermore, a systematic review was conducted to identify publications from January 2009 to March 2013 referring to the implications of the economic crisis on both health and healthcare in Greece (Simou & Koutsogeorgou 2014). This category has algo gained popularity within the marketing theory area, for instance, a Rindfleisch and Heide's (1997) review of research in marketing using transaction cost economics has been cited more than 2200 times (Paul & Criado 2020; Palmatier, Houston & Hulland 2018).

4.2.3. Method-based

Method-based review articles synthetize and extend a body of literature that uses an underlying methodology (Paul & Criado 2020; Palmatier, Houston & Hulland 2018). There are not many published works that adopt this type of review, particularly in the business area, however an evident illustration of such method comprises the 'Event study methodology in the marketing literature: An overview' (Sorescu, Warren & Ertekin 2017) which reviews the applicability of event studies in the marketing literature and condensates the current knowledge available to serve as a guideline to future research.

4.2.4. META ANALYTICAL

Meta analytical reviews have been increasingly popular as a quantitative technique. Through it, one can assess available data from numerous quantitative studies to 'identify directions and effect sizes based on prior studies with the help of weighted average techniques, and contextualize the relationships by considering moderator variables' (Paul & Criado 2020). As the previous categories it provides recommendations and guidance for future research. Lim (1999) developed a meta analytical review composed by 70 articles chosen considering the basis of their t-statistics, standard errors, F-statistics, and sample sizes. The purpose of said analysis was to draw conclusions from major published empirical studies regarding the relations between international tourism demand and income, transportation costs, and tourism prices. Following the same train of thought, an analysis of 28 data sets examined age differences in emotion recognition across four modalities: faces, voices, bodies/contexts, and matching of faces to voices, was facilitated through a meta-analytical review process (Ruffman et. al 2008).

Although this being a serious contender, seen as it can handle large amounts of studies, similar to bibliometric reviews, the papers considered are most likely to be less diverse and the heterogeneity of existing studies and the existence of publication bias can invalidate the results, therefore confirming the decision of applying a bibliometric analysis (Donthu et. al 2021).

4.3. QUANTITATIVE VS. QUALITATIVE RESEARCH

The field of economics is greatly extensive. The amount of information and data available make it possible to distinguish 3 different methodologies applied to accompany its evolution – qualitative, quantitative and mixed-methods.

Bibliometric methodology encapsulates the application of quantitative techniques on bibliometric data. Qualitative research in economics had been considered unreliable and inaccurate compared to quantitative one. In order to achieve a given conclusion information gathering may encompass relatively flexible discussions, whereas quantitative research compiles predetermined reported data and are more suitable for measuring, ranking, identifying patterns and making generalizations. For the purpose of this dissertation, as an analysis of Portugal's prospects for its future economy after the COVID-19 pandemic, a quantitative research will be utilized where the aims and scope will be defined, appropriate techniques will be chosen, data will be collected and finally the bibliometric analysis and findings will be run.

In addition to these two, the Cochrane Handbook for systematic reviews of interventions adapted to different fields other that the medical one, three main ways a mix-method research can be conducted (Higgins 2019). A first procedure could be to perform an early exploratory and qualitative phase to later design a quantitative phase so as to generalize results. Another option would be to firstly evaluate administrative records or formal experiments followed by a qualitative research to

support. And, finally, a third would be to analyzing and interpreting the data derived from both types of research simultaneously , where insights into unexpected results from one method can be gleaned from results of the other.

4.4. Collection and treatment of papers

4.4.1. PRISMA model

The process of gathering information is crucial in systematic reviews. Whatever the topic at hand, search strategies must be designed to determine all articles and studies that address a specific question. With the constant growth of publications, a suitable paper collection and treatment has never been more vital.

The biggest concern and risk to consider in a literature review concerns the inclusion and exclusion criteria, therefore it must be clearly established in advance, as papers with important information could be left out. According to Nightingale (2009) a review protocol must clearly define: 1) the aims and objectives of the review; 2) the inclusion and exclusion criteria for studies; 3) the way in which studies will be identified; and 4) the plan of analysis.

In order to undertake the reporting of this type of analysis, the QUality Of Reporting Of Meta-analysis (QUOROM), was published in 1999. The QUOROM group consisted of 30 clinical epidemiologists, clinicians, statisticians, editors, and researchers who settled the items to be included in a checklist of standards that one may elaborate a quality review while transparently reporting the methods used and results. Having been increasingly employed and delivered highly positive results, in 2009 this Statement was updated to the Preferred Reporting Items of Systematic reviews and Meta-Analyses (PRISMA), which was able to able to address several conceptual, methodological and practical advances (Tao et al. 2011).

For a rigorous data collection the PRISMA statement has been widely used. It was created by an international network of healthcare-based collaborators, seeking to strengthen and streamline the methodological rigor and quality of systematic literature reviews. It may be useful for critical appraisal of published systematic reviews, however it is not a quality assessment instrument to gauge the quality of a systematic review (Hutton, Catalá & Moher 2016). It allows readers to assess strengths and weaknesses, permits replication of review methods and a structure and format for the realization of the review. It is expected to improve the reporting of a systematic review and grant a transparent selection process of articles, as it consist of a checklist and flowchart, which depicts the flow of information while mapping out the number of records identified, included and excluded, and the reasons for exclusions.

There are numerous studies over the years that have made use of PRISMA, particularly health related articles. For instance, Glonti et al. (2015) made use of PRISMA flowchart and manage to retrieve 22, from a total of 14.584, that met the eligibility criteria in order to execute a systematic review to examine evidence from longitudinal studies on factors influencing resilience for health

outcomes or health behavior among the general population living in countries exposed to financial crises. Notwithstanding, it is broadly applicable, Nosratabadi et al. (2020) wrote 'Data science in economics: Comprehensive review of advanced machine learning and deep learning methods', a systematic literature review, through the PRISMA guidelines using a diagram displaying the systematic selection, evaluation, and quality control of the database. Mardani et al. (2019) performed a review 175 published articles appearing in 55 scholarly international journals between 1995 and 2017, haven been categorized by the author name, the year of publication, data duration, types of techniques, data analysis method, the name of indicators, country, scope, journals, results, and outcome in which they appeared. This way, and using the same tool, the review demonstrated that the relation between CO2 emissions and economic growth gives reasons for policy options that have to reduce emissions by imposing limiting factors on economic growth as well.

As QUOROM required updating, PRISMA suffered from the same necessity. Since its first conception advances have been made in systematic review methodologies and terminology, technological advances have enabled the use of natural language processing and machine learning to identify relevant evidence, new methods have been developed to assess the risk of bias in results of included studies. In this sense, a new reporting guidance that reflects advances in methods to identify, select, appraise, and synthesize studies, the PRISMA 2020 has been developed (Page est al. 2021).

4.4.2. Information mapping

As previously mentioned, a quantitative approach will be applied in this study so as to understand the economic background of Portugal, the research done so far on economic shocks and crisis as well as prediction models and effective mitigation measures. The ultimate goal of the research will be to understand what the country will have to face in the coming years at a macroeconomic level and what measures could alleviate a possible financial crisis. Along these lines and to make this research process clearer, the upcoming steps must be settled.

Simultaneously to the quantitative method, a collection of data will be conducted. For this purpose, existing data will be gathered from evidence available in reliable sources such as DataBank (The World Bank). This platform consists of an analysis and visualization tool containing a plethora of graphics that display the evolution of economic indicators worldwide as GDP growth and unemployment rate. With the same purpose in mind, and to confirm the values obtained, a second source will be used, through data extracted from the UN as well as the OECD Data and IMF. For a more specific analysis of Portugal the INE and Pordata databases will be contemplated. Both identify themselves as a database producing official quality statistical information in an impartial manner, concerning multiple areas of Portugal's society, having the latter one additional information on European countries. Additionally, to obtain the most updated facts regarding the current pandemic figures as well as past pandemics the WHO will be the most suitable as it is the great pillar of health worldwide manages and maintains a wide range of data collections related to global health and well-being.

Having the economic area as a baseline, the most prestige journals that will be taken into consideration include The Quarterly Journal of Economics, which broadly covers this discipline, specializing in microtheory and macroeconomics, and The Journal of Political Economy, which specializes in monetary theory, fiscal policy, labor economics, development, micro and macroeconomic theory, international trade and finance, industrial organization, and social economics. The Journal of Finance, American Economic Review and Econometrica are also among those with the highest reputation attracting high-quality research with a high number of references and citations (Scimago Journal & Country Rank 2020; Iconomics 2021). In order to access these journals and potentially more, complementary research will be made using platforms such as Web of Science and Scopus give relevant information concerning the publish year, key words, citations and references in order to easily sort the pertinent articles. Suitable articles written in Portuguese will not be excluded.

The posterior phase regarding the treatment of information will be conducted following the PRISMA 2020 guidelines. The approach to be taken will highly depend on the amount of articles relevant to the field are available (Snyder 2019). The ideal scenario would be to read each article in full, however if a considerable amount of studies emerge this process can be very time-consuming and unproductive. For this reason, the expected approach will have to, in a first stage, make use of a software tool for constructing and visualizing bibliometric networks, such as VOSViewer. In a second stage, on the reading and interpreting of each paper's abstract in order to select a first group. It will allow to compile studies on scenario building after economic crisis or shocks, the economic impact of past pandemic (given the amount of emerging research COVID-19 recently released papers will be included) as well as recession and, economic forecasting models, being the biggest interest the GDP indicator . A final analysis can then be conducted through a full-text reading of the previously selected articles for a final inspection. After making sure they fit the inclusion criteria a summary of the results reached, and theories used will be provided. Subsequently, and having collected a substantial amount of information, tendencies and gaps should be identified to helpfully enable the creation of a new theory and depict future prospects for Portugal and make a great contribution to this research field. In sum, the approach is demonstrated in Figure 6.

4.4.3. Bibliometric Network

Firstly, a brief analysis to Scopus' data base was conducted, through a search applied to the title, abstract and keywords of the various articles. Hence, through the words 'economic' and 'forecast', or 'COVID-19' or 'influenza outbreak' or 'ARIMA' and 'forecasting models' and limiting the research to articles and reviews published since 2004 the results are as shown in Figure 7. Results show a clear majority of articles compared to reviews (98,3% and 1,7%, respectively) and a peak of publication in 2020, which is indicative of the surge of COVID-19 and consequently the urge to prepare for the future. There can also be observed a peak in 2012 which can also suggest that economic forecasting started to be a subject of interest after The Great Recession.

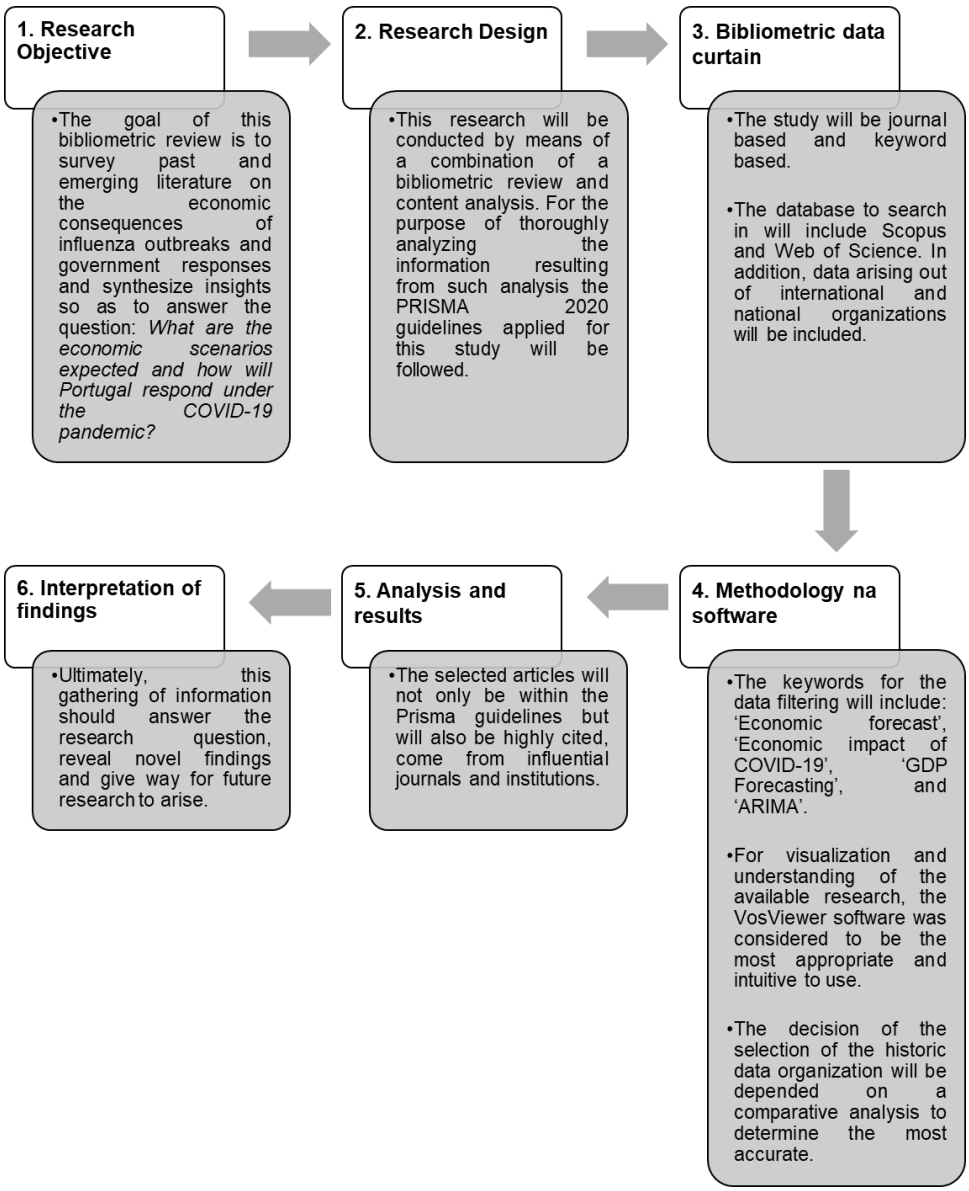

Figure 6 – Bibliometric approach for the present thesis

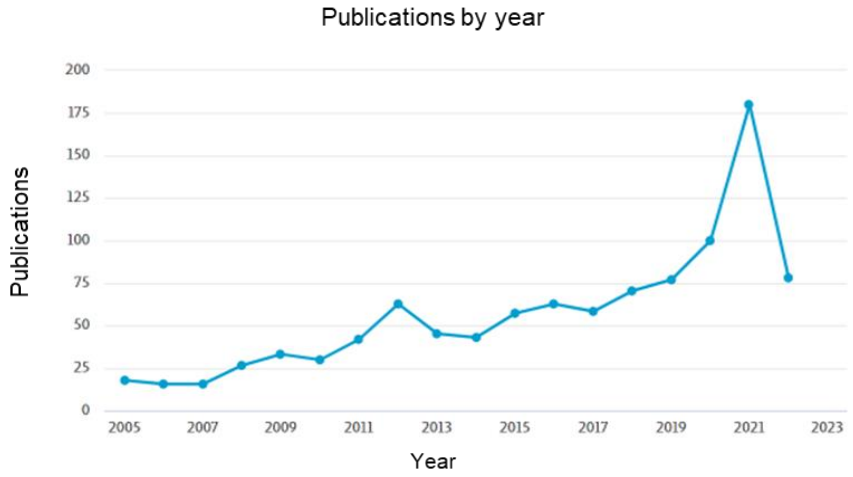

Figure 7 – Scopus publications per year from 2004 until March 2022

A similar analysis was made concerning information arising out of Web of Science. The keywords searched were 'economic forecast', and 'economic impact of COVID-19', and 'GDP forecasting', or 'ARIMA'. Again, the date range considered was from 2004 to 2021 and only articles and reviews where accounted for. From the 25 categories initially identified, Economics appears as the second most relevant with 149 published documents. So as to taper the search even further, the analysis was limited to this category. In turn, these 149 publications are divided into 20 categories shown in Table 4. Following the category 'Economics', 'Management' and 'Business' are the categories with the most associated articles, 41 and 13 respectively. It is important to note that the same article can be classified under more than one category, which may impair partial and total statistics.

Table 4 – Number of publications by category (2004-2021).

Web of Science Fields	Record Count	%of 149
Economics	149	100%
Management	41	27,50%
Business	13	8,70%
Enviornmental Studies	8	5,40%
Energy Fuels	7	4,70%
Enviornmental Sciences	6	4%
Mathematics Interdisciplinary Applictions	5	3,40%
Hospitality Leisure Sport Turism	4	2,70%
Transportation	4	2,70%
Business Finance	3	2%
Health Policy Services	3	2%
International Relations	3	2%
Social Sciences Mathematical Methods	3	2%
Transportation Science Technology	3	2%
Agricultural Economic Policy	2	1,30%
Engineering Civil	2	1,30%
Operations Research Management Science	2	1,30%
Forestry	1	0,70%
Hitory	1	0,70%
History of Social Sciences	1	0,70%

Source: *Web of Science data base, 2022*

Figure 8 illustrates the annual trends in publications on this topic generated from the sample of 149 articles. The peaks observed in the graphic follow the same tendency registered of the ones in Figure 7, as well as the number of citations.

The VOSViewer software was used in a following step with the objective of identifying and analyzing the most frequently used keywords to classify the 149 articles that are part of the sample (Figure 9). It was defined that of the 3523 keywords found 60 where to have 10 occurrences or more to be relevant. For each of the 60 terms, a relevance score was calculated. Based on this score, the most relevant terms were selected. The default choice was to select the 60% most relevant terms. From this analysis, the topics arising more often in the analyzed area stand out. The map presented in Figure 9 groups the keywords into 6 clusters. The main keyword per cluster are 'model' (red cluster), 'forecast' (green cluster), 'series' (dark blue cluster), 'production' (yellow cluster), 'price' (purple

cluster), and ‘effect’ (light blue cluster). The keyword ‘model’ registered 455 occurrences and ‘forecast’ account for 88. Thus, the map highlights, further, that forecasting models appear to be the direction the research is taking and where research opportunities might arise. This is reinforced by the link strength between the two and the strong link between ‘model’ and ‘forecasting accuracy’ which has always been the major weakness of these studies.

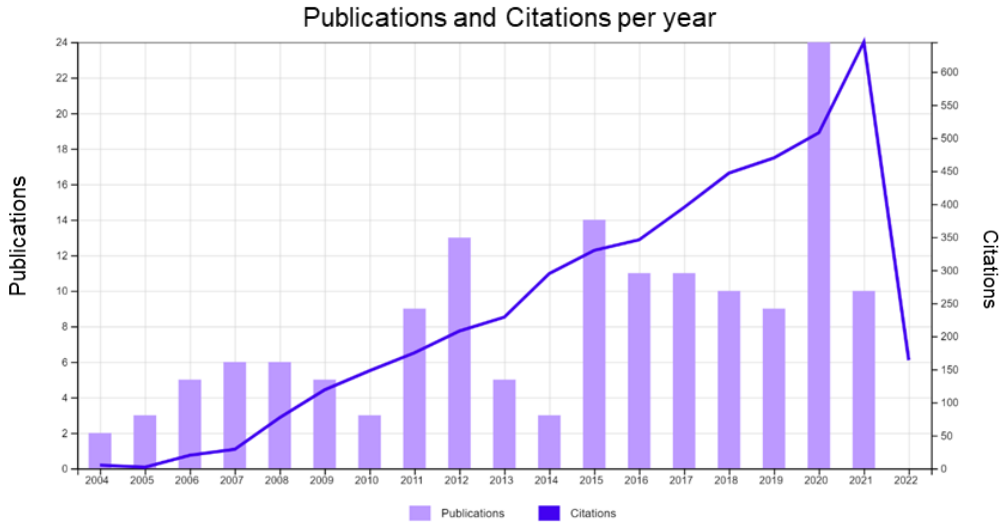

Figure 8 – Web of Science publications per year from 2004 until 2021

Note that the fact that two terms have a strong link strength does not mean they have very high citation. To conclude this analysis, it is also important to mention that when researching ‘GDP forecast’

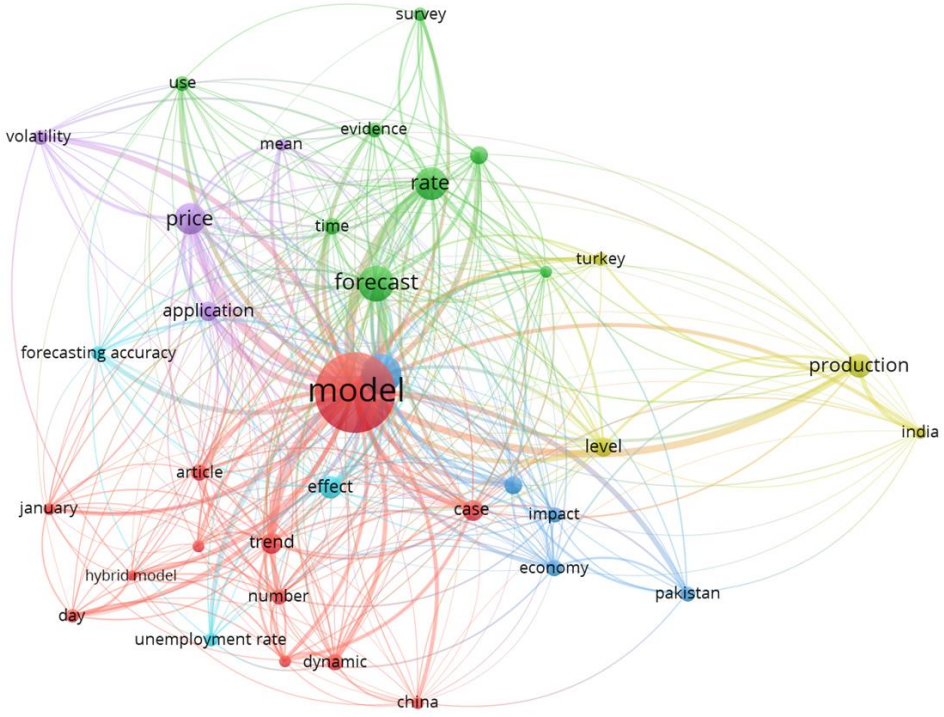

Figure 9 – Network Visualization of 149 publications of Web of Science

and ‘Economic impact of COVID-19’, no results were obtained. Just as zero results were produced when specifying one of the most used models, ‘ARIMA’ and the ‘Economic Impact of COVID-19’, which from the outset indicates a gap.

Having reached these results, a literature review will take place in the next chapter.

5. Literature Review on Economic Forecasting

This chapter will focus on the relationship between the macroeconomic indicators that most reflect the state of a country's economy, the tools most used to predict some of these same indicators by global and national organizations and verified in previous and recent studies. Lastly, the construction of economic forecast scenarios will also be addressed, in order to serve as a starting point for the construction of possible scenarios that can reflect the future of the Portuguese economy given the recent COVID-19. Several authors have already tried to anticipate recessions derived from pandemics. By means of historical comparison, Barro et al. (2020) estimated that a death rate of 2.1 for COVID-19 (the same registered during the Spanish Influenza) corresponds to a 6% decline in GDP and 8% fall in private consumption. On the other hand, Jonung and Roeger (2006) predicted that a global pandemic would lead to a drop of 1.6% in GDP for the EU.

Forecasting models

Clements and Hendry (2004) defined forecast as being any statement about the future. 'Such statements may be well founded, or lack any sound basis; they may be accurate or inaccurate on any given occasion, or on average; precise or imprecise; and model-based or informal'. Elliott & Timmermann (2008) define economic forecasting as the process of attempting to predict the future condition of the economy using a combination of extensively followed indicators. Many authors have made this their focal point of study (Chen & Yang, 2004; Becker et al., 2007; Pesaran, 2014; Salisu et al., 2022). It often implies building statistical models with indicators as outputs, in order to bring forth a future GDP growth rate. It has a variety of purposes. Government and businesses, for instance, take advantage of this to layout strategies, multi-year plans and budgets for the next year. Forecasting represents the first step towards creating and implementing fiscal and monetary policies. So as to minimize the degree of uncertainty associated with economic cycles and make decisions more effectively, the most suited indicators for this type of exercise, and therefore the ones that will be monitored in this paper, comprehend economic growth (GDP and its components), inflation, wages, unemployment rates, interest rates, consumer confidence, worker productivity and industrial production.

Literature acknowledges the uncertain nature of this type of study. Economic agents fluctuate unpredictably hence the complexity of the economy, as it is dependent on many external factors (Patrícia & Santos, 2020). It must be depicted as a flawed science. In fact, past crises have been neglected either because of outside pressure or because of personal beliefs and judgment and theory conceptions from forecasters (Clements & Hendry, 2012). On that account, it would be plausible to associate a probability to an economic forecast. An objective assessment, must consider 3 fundamental principles: unbiased forecasts, efficient forecasts and correlation of forecast errors equal to zero. The quality of any prediction should be evaluated by the Mean Error (ME), Mean Absolute Error (MAE) and the Mean Square Error of Forecast (MSE) or its square root (RMSE), these being some of the leading indicators among the existent literature (Harvey et al., 2017; Hyndman & Koehler, 2006; Buturac, 2021).

As these studies cite, there are two types of uncertainties 'the one we don't know that we don't know and the one we know we don't know', this to emphasize the importance of a careful interpretation following this type of research (Patrícia & Santos, 2020). Errors in macroeconomic forecasts tend to be systematic, and certain indicators can be more easily predicted than others, for instance, authors Blix et al. (2001) stand by the fact that inflation is easier to predict than GDP.

There were distinguished two types of forecasting methods: Qualitative forecasting and quantitative forecasting. Qualitative forecasting methods include the Delphi Method, Market Surveys, Executive Opinion and Sales Force Composite. It is not the preferred approach within the professional community as it is typically more opinionated and, as a result, more subjective. It relies heavily on historic data to predict the future and encounter trends and relationships. On the other hand, within quantitative forecasting leans on univariate and multivariate models.

A univariate model is understood as the modeling of evolutionary or historical patterns identified in a single time series while the multivariate model focuses on modeling the evolutionary or historical patterns of several time series (Garcia, 2020). The most prominent univariate models include the Random Walk (RW) model - assumes that in each period the variable takes a random step away from its previous value, and the steps are independently and identically distributed in size, for instance, it suggests that changes in stock prices have the same distribution and are independent of each other – and the autoregressive (AR), which gives rise to the ARMA and ARIMA models (Brooks, 2008). Several articles display studies applied to GDP forecasting that favor the use of the ARIMA model. Yang et al. (2016) and Abonazel and Abd-Elftah (2019) argue that this model is more effective and accurate, therefore producing the most objective forecast of GDP. Wei et al., (2010) employed the ARIMA (1,2,1) model to a set of data records from 1952 to 2007 to predict Shaanxi's GDP. 2016 studies by Wabomba et al. and Yang et al. focused on predicting GDP for Kenya and China respectively, claim that the ARIMA (2,2,2) model is more accurate and robust in short term forecasts. Lhano et al., (2021) used the model to understand the evolution of the economy and predict GDP, until 2031, of Portugal and Germany using ARIMA (1,0,1) and ARIMA (4,0,0) respectively. Dritsaki (2015) made GDP projections for 3 years for Greece, using ARIMA(1,1,1). Paul et al., (2013) tried to determine the suitable ARIMA model and used the average market price of data series for Square Pharmaceuticals Limited for forecasting. Their investigation showed that ARIMA (2, 1, 2) is the appropriate model for their forecasting (Paul, Hoque, & Rahman, 2013).

Contrariwise, Amado (2019), makes reference to multivariate models including the Solow model, which makes GDP depend on the total productivity of the factors and quantities used from the factors of GDP, capital and labor. In addition, there is the widely known VAR model whose main obstacle is the proliferation of coefficients. Of course, given the evolution of technology that can process increasingly more information, this problem has its days numbered. In the Bridge model, GDP is modeled as a function of past values and values available on a monthly basis and a transformation can be applied to change to quarterly data (Mariano and Murasawa, 2004), which in turn can be used for "real-time" forecasting allowing to update the projections as soon as data becomes available. More than that, it also contributes to "nowcasting", that is, the estimation of the current value of series

whose official values will only be known later (Kitchen and Monaco, 2003; Lahiri and Monokroussos, 2012). Opposite to a short term reasoning, Hausmann & Hidalgo (2012), developed the economic complexity index calculated from information on the diversity of production in each country and on the ubiquity of that production in the world. This model suggests that a country that does not produce goods that many other countries produce will have a less complex economy and, therefore, will have fewer growth possibilities in the future.

The Oxford Handbook of Economic Forecasting Clements & Hendry (2012), offers a detailed look into the most influential forecasting macroeconomic models used through the years. It recognizes the vector autoregressive (VAR) model as one of the most popular for the last 30 years. Dynamic factor models, which can analyze information sets consisting of large numbers of macroeconomic, financial, and sectoral variables, where the potential number of variables is far in excess of the number of observations. It synthesizes the relationships between a set of macroeconomic variables of interest and their lags (Stock e Watson, 2001; Viegi, 2010). Switching-regime models, simpler compared to VAR and factor models, are either univariate or single-equation models which puts into question whether nonlinearity improves forecast accuracy. This book also references the well-known Dynamic Stochastic General Equilibrium (DSGE) models which are constructed on the basis of explicit micro foundations with optimizing agent, and regardless of being originally used for policy analysis, these models have been used for forecasting, producing similar results to the ones of VAR models. Finally, it features a nontraditional approach to predicting economic activity that presumes that the variable of interest can be decomposed into a number of unobserved components including a trend (seasonal or cyclical) and an irregular component. It is shown how a careful modeling of these components as unobserved stochastic processes may enhance forecasts (of the aggregate) (Christiano et al., 2018).

Amado (2019) compiled in the form of a literature review the most popular models used for GDP projections. In this research, 5 different models were tested to analyze the Portuguese economy. Conclusions demonstrated that Solow's neoclassical models were the finest and the VAR models displayed the worst results in terms of accuracy. Firstly, the paper analyses the Holt method, which assumes that the forecast represents the weighted average of the variable's past values, with the weight decreasing exponentially as time passes. Secondly, the ARIMA method, and thirdly, the Solow method, that allows to predict convergence of countries to a steady state that depends on certain parameters, creating an additional source of uncertainty seen as there is the need to predict the variables. Following, Thirlwall's model suggests that the GDP growth rate can be written as a function of the real growth rate of exports and the real exchange rate growth rate, and lastly the VAR model.

Overall, there is a necessity of accompanying the exercise of forecasting with one or a combination of intricate econometric methods. Elliot & Timmermann (2008), recognize the difficulty of using a single model that works effectively. Regarding the models' suitability, Ericsson (2017) finds that simple dynamic models offer more accurate results than static economic models despite the latter one including economic theory. Besides the more scientific models, Turner (2016), admits a diversity of models, linear and non-linear, that analyze past patterns without assuming that the present will

repeat itself and at the same time identify patterns that repeat or are constant. Economic literature has grown rapidly amid COVID-19, and economic models have been linked with epidemiological models (Atkenson, 2020; Alvarez et al., 2020). Daron Acemoglu, Victor Chermozhukp & Ivan Werning (2020), introduced multiple risk groups into the SIR [7] model given the significant differences in both hospitalization and fatality between age groups. After, the trade-off between prioritizing saving lives and improving economic outcomes had to be addressed. The paper concluded that opting for safety-focus policies, limiting mortality rate to more than 0,2%, would account for economic losses of 37,3% of one year's GDP. Contrarily, if economic losses are limited to be no more than 24,8% of one year's GDP, the mortality rate would reach 1,05%. Lastly, it is noteworthy to refer that conclusions favor target policies, e.g., different lockdowns for groups with different risk. Since the elderly seem to be more affected by the disease, a more aggressive lockdown could be applied. Eichenbaum et al. (2020), studied the interaction between economic decisions and epidemics by once again extending the SIR model. It considers that an epidemic has both aggregate demand and aggregate supply effect. The latter one rises as workers reduce their labor supply given the exposition to the virus. In the same way, consumers react to this risk by reducing consumption. These effects together are likely to generate a large and persistent recession. Glover et al. (2020), further adapt the epidemiological model in which economic activity and disease progression are jointly determined to reach a similar conclusion, older generations have the most to gain from slowing virus diffusion whereas younger generations have most to lose. The study concluded that modest shutdowns would be optimal when redistribution creates tax distortion, and shorter but harder shutdowns could be preferable due to the appearance of vaccines.

The crisis that comes from the pandemic, however, brings a particularity that has never been seen in recent times, a widespread business shut down. Lockdown measures imply a downward shift in labor demand and the reduction in output and its associated demand and supply leads to falling investment via liquidity problems for firms. The pandemic shocks are associated with supply and demand disruptions, restrictions on labor input and consumption. Economists have argued that while monetary policies will play an important role, the European Central Bank (ECB) should not be expected to be the only life safer, governments must play a role in the process of recovery through generous loans and support programs to prevent mass bankruptcies as well as direct fiscal measures to support demand when lockdowns are lifted (Bénassy-Quéré et al. (2020), Lane (2020)). Information collected by Pfeiffer et al. (2020), highlights some of the policies studied thus far. According to the authors, traditional stimulus are less effective in a scenario where sectors are shut down. It was found that unemployment insurance benefits favor borrowers, whereas unconditional transfers favor savers. Liquidity assistance programs seem to be effective in case the goal is stabilizing employment in the affected sector. This same study considered two outlines. A shock absent of liquidity constraints predict a V-shaped recession on the premise that higher capacity utilization partly offsets a delayed response of the labor inputs, which, however, remains limited as it is assumed a partial short-run complementarity between capital and labor. Furthermore, investment should not suffer a big impact as

[7] A SIR model is an epidemiological model that computes the theoretical number of people infected with a contagious illness in a closed population over time.

investors are expected to foresee the temporary effects of the shock. On the other hand, firm liquidity constraints are expected to lead to a deeper and more U-shaped recession characterized by an increased share of liquidity-constrained firms and generation of a sizable contraction in private investment. The impact from liquidity constraints amplifies the deflationary demand effects. Once the lockdown is lifted, higher capacity utilization and recovering consumption lead to an increase prices. GDP growth falls by 13% below the no-shock path, compared to -8% in the absence of the liquidity constraints. Having this established and given the sharp fall in the gross operating surplus, liquidity constraints substantially prolong the recession, if not addressed appropriately.

As displayed in the interview with David Hendry conducted by Ericsson (2017), organizations such as OECD, IMF and EC are worldwide known for performing economic predictions. However, these rarely produce the same results either because different models are put to use or different knowledge concerning the same country. Literature seems to agree the disparities between the institution's projections are not standard and that, reinforcing what has already been mentioned above, none of the institutions produces perfect forecasts, which could very possibly be directly related to the electoral cycles. Between the institutions previously brought up, FMI seems to be the one producing the most accurate results while MF is the most suitable for foreseeing Portugal's economy.

Despite the different proportions, every national and international institution seem to be in line with the fact that 2021 will witness a Growth in GDP:

Table 5 – Annual %GDP growth projections

	Year	2020	2021	2022	2023
		%Real GDP growth rate			
Organization	OECD	-8,4	4,8	5,8	2,8
	IMF	-8,4	4,9	4	2,1
	EC	-8,4	4,9	5,5	2,6
	MF	-8,5	5,4	4	2,1

Source: Projections EC, 2020-2023, Santos, 2021, Imprensa, 2021

The differences between forecasts (Table 5) reveal differences in the statistical information available at the time of their publication and notably the degree of uncertainty regarding the evolution of this disease. Regarding domestic demand, both national institutions expect greater growth in public consumption and a smaller recovery in investment, compared to the Government scenario. On the other hand, the MF forecasts an external financing capacity of 2.1% of GDP, higher than expected by other national institutions. All institutions are in agreement with this growth tendency throughout 2022.

Errors associated with forecasting include the availability and manipulability of the starting point information as well as intentional errors related with potential incentives. For instance, Martins and Correia, 2013, gathered that national entities tend to be optimistic regarding economic forecasting. Errors can also derive from the model itself, according to an interview with David Hendry[8]

[8] David Hendry has made major contributions to economic forecasting. He has developed a taxonomy of forecast errors and a theory of unpredictability that have yielded valuable insights into the nature of forecasting. He has

conducted by Ericsson (2017) flaws can come from unobserved terms, observed stochastic variables, and/or deterministic terms. Each of these three components are subjected to three potential problems: estimation uncertainty, mis-specification, and change in the GDP's parameter values.

Scenario building and mitigation measures

Coming back to the DSGE models, they have a number of advantages over large-scale, an important one being the ability to avoid the problem deriving out of the Lucas Critique[9]. Not only they incorporate a role for monetary policy, making them appealing to central banks, but also can make use of the powerful solution methods of nonstructural models, given their decision rules are usually well approximated by linear rules (Fernández-Villaverde, 2010). Within the area of scenario building several authors, namely Alexandr & Mourre (2010), refer to the DSGE model, QUEST. As explained by the European Commission, this global macroeconomic model is suitable for macroeconomic policy analysis and research (Varga et al., 2021; Pfeiffer et al., 2020). It is a structural macro-model in New-Keynesian[10] tradition with rigorous microeconomic foundations with full dynamics, whose equations are explicitly derived from intertemporal optimization under technological, budgetary and institutional constraints. It also features nominal and real frictions, as well as financial frictions in the form of liquidity constrained households. Additionally, it incorporates semi endogenous[11] growth features and accumulation of human capital.

There are different versions of the QUEST model used for specific purposes. Model variants have been estimated using Bayesian methods, where probability is used to represent all uncertainty within the model (regarding both input and output), jointly with the Commission's Joint Research Centre (JRC). These dynamic models are used for shock analyses and shock decompositions to access, for instance, the main drivers of growth and imbalances. Many of the main applications deal with fiscal and monetary policy interactions and either use a one-sector model or models that explicitly distinguish tradable and non-tradable sectors. Other model variants also include housing and collateral constraints, and a banking sector. All model versions are employed using different country disaggregation, focusing on the euro area or EU as a whole, and other global regions, or on individual member states.

Making use of this model and prior to the pandemic Alexandr & Mourre (2010), attempted to assess the strategy to guide the EU out of the economic crisis, to ensure macroeconomic stability, and

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also provided new perspectives on many existing forecast techniques, including mean square forecast errors, add factors, leading indicators, pooling of forecasts, and multi-step estimation. In addition, David has developed new forecast tools, such as forecast encompassing; and he has improved existing ones, such as nowcasting and robustification to breaks (Ericsson, 2017).

[9] Lucas 1976 stresses that often some model parameters are unlikely to be invariant under policy change, and therefore the model is unable to assess the effects of a policy change. The argument also applies to other unprecedented changes in environment, making most model forecasts ineffective as there is almost always some change in policies or environment that affect current expectations and behavior (Don, 2001).

[10] The new Keynesian theory attempted to address, among other things, the slow behavior of prices and its cause, and how market failures could be triggered by inefficiencies and might justify government intervention. The benefits of government intervention remain a flashpoint for debate. New Keynesian economists made a case for expansionary monetary policy, arguing that deficit spending encourages saving, rather than increasing demand or economic growth.

[11] The endogenous growth theory holds that investment in human capital, innovation and knowledge contribute significantly to economic growth. The long-term growth rate of an economy depends on policy measures.

put in place a structural reform agenda and ultimately demonstrate the benefits policy measures envisioned under Europe 2020 could bring. Such measures enclose the introduction of reforms with a medium- to long term horizon that focus on promoting the sustainability of public finances, enhancing potential growth. The study places Portugal and most European countries in the economic cycle after having recently emerged from The Great Recession, therefore, illustrates what would be the expected scenario for Portugal's economy if the pandemic had not happened.

For such analysis, several stylized scenarios were constructed. As a starting point, a baseline scenario was presented to best assess the relations between economic indicators in the case of inexistent regulation or policy action. Of course, this does not mean that no change will take place, since the economy will change even in the absence of regulation. This scenario embeds the adverse impact of the crisis on potential output and assumes an increase in financing costs due to a protracted resolution of financial sector troubles. Potential growth would be expected to decline given the crisis and gradually return to pre-crisis level by 2020, the increases in the cost of capital due to the real economy effects of balance-sheet adjustments in the financial sector and the restructuring of banks, even in the presence of large recapitalization packages. Employment growth would become negative during the crisis, recover to pre-crisis level in the middle of the coming decade and decline again to close to zero, reflecting the demographic ageing taking its toll. As a result, potential productivity growth, which would fall significantly during the crisis because of the level of labor hoarding, would increase very slowly to reach 2% in 2020 in the baseline scenario. In practice this means that the budget deficit is cut by an additional 0.5% of GDP every year so as to ensure gradual convergence to the level of deficit or surplus recommended in the MTO[12]. Henceforth, productivity becomes the sole driver of growth.

This being established, the remaining scenarios assume the following characteristics (Primiceri & Tambalotti, 2020):

- More ambitious fiscal consolidation – considers a far stronger fiscal consolidation of 1% of GDP annually.

- Limited structural reform – due to the constrained budgetary resources, reform efforts focus on measures with no budgetary costs (e.g. increasing competition, reducing administrative burden or limited budget-neutral tax reforms).

- Medium reform – the momentum reforms gained across all the policy areas, leads to important increases in knowledge-oriented expenditures and significant reforms in product and labor markets.

- Advanced reform – brings the highest gains, with very advanced reforms carried out across the board. It generally assumes a 1/2 reduction in the gaps with the best performers which, for example, means reductions in mark-ups or in risk premia on intangible capital to the US levels.

[12] All EU countries are expected to reach their medium-term budgetary objectives (MTOs), or to be heading towards them by adjusting their structural budgetary positions at a rate of 0.5% of GDP per year as a benchmark.

The results presented by this study show that a fiscal consolidation going beyond the minimum requirement prescribed by the SGP[13] is crucial to rein in the increases in public debt, which would approach 100% of GDP by 2020 in the baseline scenario. Hence, it is crucial that consolidation efforts are accompanied by growth-oriented structural reforms, so as to sustain fiscal consolidation and return debt levels to a declining path. Progress in implementing structural reforms under the main priority areas of EU2020 can generate significant gains in terms of increasing output and creating jobs. These conclusions are susceptible to change due to the uncertainty surrounding it. Proof of this is COVID-19 that affected the world and but a stop to Europe's recovery which was set reach an almost full recovery by 2020. It remains to be seen whether this will be a crisis of rapid recovery given the nature of business losses, have the same trend as that observed in The Great Recession.

Pfeiffer et al. (2020), bring another take and analysis on this same model. The macroeconomic model appraised the transmission of the disease and its associated lockdown to ultimately establish the effects of the economic policy response. The model is a two-region TANK model based on the QUEST III model. Firstly, a set of scenarios mirrored the economic characteristics of the pandemic capturing the dynamic adjustment of the economy to supply shock through precautionary measures and shortfalls in consumer demand. Secondly, the paper focuses on the advantages of short-term work (STW) allowances and government guarantees.

While building their projections, the Stability Program (2020), not only used the macroeconometric model of the Ministry of Finance / GPEARI for the short and medium term, allowing to capture the effects of the cycle, but also made use of the QUEST III R&D model calibrated for the Portuguese economy as it is suited for capturing the long-term effects of supply impacts, a central element of the PRR.

Authors such as McKibbin & Fernando (2021) build their research on previous disease outbreaks such as HIV/AIDS, SARS, and pandemic influenza. The HIV/AIDS virus, for instance, affected households, businesses and government, shifting supply and demand behaviour, increasing business costs and public expenditure on health. The macroeconomic effects have been previously analyzed by the World Bank (2006), Freire (2004) and Over (2002), where several Computable General Equilibrium (CGE) macroeconomic models were applied. This virus however is far less contagious than COVID-19. Past studies, focused on SARS (Chou et al., 2004; Lee and McKibbin 2004a, 2004b), found that despite the low mortality associated with this type of virus, economies are highly impacted by the significant reduction in consumption of many goods and services and increased business operating costs.

Through a hybrid of DSGE models and CGE models, McKibbin & Fernando (2021) created a set of filters that convert the shocks into economic shocks and built 7 different possible outcomes. Results lead to the understanding that the pandemic originated a sharp drop in consumption and investment, and a drop in aggregate demand that together with risk shocks cause a sharp drop in equity markets. In addition, equity markets are expected to decline due to the rise in risk, as well as

[13] The Stability and Growth Pact (SGP) is a set of rules designed to ensure that countries in the European Union pursue sound public finances and coordinate their fiscal policies.

the expected economic slowdown and the fall in expected profits. Every scenario proposed had in common the prediction of a V-shaped recovery, with the exception of the unlikely scenario where the pandemic will be persistent and occur every year.

In agreement with previous studies, McKibbin & Fernando (2021), admit a variety of policy responses. In the short term, Central Banks would need to guarantee the disrupted economies continue to function. There is also a fundamental role played by the government as the pandemic will most likely require monetary, fiscal and health policy responses. It is also recognizes that more simple actions such as social distancing and good hygiene can be effective and low cost ways to reduce contamination and therefore economic costs. It is also emphasized that longer-term responses will wind up being the most impactful as this type of diseases will continue to pose a threat to the world economy hence global cooperation is essential.

According to the Stability Program (2020), the future holds much uncertainty. Economic recovery will most likely vary between countries depending on the magnitude of the impact of the pandemic on the disruption of economic activity and the relative weight of the sectors most vulnerable to restrictions on mobility. Recent projections provided by the main international institutions point to a significant recovery of the world economy in 2021. OECD expects world GDP growth to increase 5,6% and 4% in 2021 and 2022, respectively. ECB estimates that the euro area's GDP will grow approximately 4% in both 2021 and 2022, and will continue moderately do so for the upcoming years. As for Portugal, the country experienced a sharp drop in external demand together with a decline in imports, however, it is expected to undergo a robust recovery in 2021 as result of the implementation of investment and reforms foreseen in the Recovery and Resilience Plans (2021-26) and the Multiannual Financial Framework(2021-27).

The Recovery and Resilience Plan is structured in 3 dimensions – Resilience, Climate Transition and Digital Transition – which were though out to go hand in hand with Portugal´s 2030 Strategy and the Strategic Vision for the Economic Recovery Plan of Portugal 2020-2030. It comprises 37 reforms and 82 investments, totaling 16.643 million euros, from which about 80% will be financed through grants and the remaining through loans.

Short term results depict and increase in the GDP growth rate and also show that it's growth is 3.5% higher than it would be without the PRR. In the medium term, Portugal's GDP is predicted to have a growth of 4% and resume its previous growth trajectory forecasted in pre-pandemic times. Domestic demand and private consumption seem to be main drivers for this growth. The projections for unemployment suggest a rise to 7,3% in 2021, as a result of the increase of active population, make a recovery in 2022 and continue a downward trajectory as was predicted before the pandemic. Likewise, exports are expected to rise by 8,7% in 2021 reflecting not only the increase in global external demand but also the recovery of tourism which in turn could very well be a reflection of the positive effects of the vaccination process. Finally, the improvement in the confidence of economic agents foresees an acceleration of investment and the reforms provided in the Resilience Program will do the same for public consumption.

6. Forecasting Models Applied to Portuguese GDP

6.1. Methodology

Based on the literature review previously carried out, it is understood that a first approach could be done through one of the most popular models in the area is the ARIMA model. New variants of the model will be presented throughout this chapter that will make it possible to analyze the percentage of growth of real Portuguese GDP in the short term, and to measure the impact that COVID-19 will continue to have on the country, which will in turn allow to conclude on recovery strategies.

The ARIMA model can be understood by explaining each of its components (Lisson & Gasteiger, 2007):

1. **Autoregression (AR)**: is a representation of a type of a random process, and has generally been applied to time-varying events in economics, including stock market forecasting and macroeconomic forecasting. It specifies that the output variable depends linearly on its previous values and a stochastic term, representing a stochastic difference equation. In other words, s one where Yt depends only on its own lags. That is, Yt is a function of the 'lags of Yt'. The notation AR(p) indicates an autoregressive model of p order, and may be expressed as:

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} + \epsilon_{\ 1} \quad (2)$$

where, Yt-1 is the lag1 of the series, β_1 is the coefficient of lag1 that the model estimates, and α is the intercept term, also estimated by the model.

2. **Integrated (I)**: represents the differencing of raw observations to allow for the time series to become stationary. Data values are replaced by the difference between the data values and the previous values.

3. **Moving average (MA)**: incorporates the dependency between an observation and a residual error from a moving average model applied to lagged observations. It is one where Yt depends only on the lagged forecast errors.

$$Y_t = \alpha + \epsilon_{\ t} + \phi_1 \epsilon_{t-1} + \phi_2 \epsilon_{t-2} + \ldots + \phi_q \epsilon_{t-q} \quad (2.1)$$

where the error terms are the errors of the autoregressive models of the respective lags. The errors $\epsilon_{\ t}$ and ϵ_{t-1} are the errors from the following equations :

$$Y_t = \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_0 Y_0 + \epsilon_{\ t} \quad (2.1.1)$$

$$\mathrm{Y_{t-1}} = \beta_2 \mathrm{Y_{t-2}} + \beta_3 \mathrm{Y_{t-3}} + \ldots + \beta_0 \mathrm{Y_0} + \epsilon_{\mathrm{t-1}} \quad (2.1.2)$$

The three combined originate the ARIMA model equation:

$$Y_t = \alpha + \beta_1 Y_{t-1} + \beta_2 Y_{t-2} + \ldots + \beta_p Y_{t-p} \epsilon_{\mathrm{t}} + \phi_1 \epsilon_{\mathrm{t-1}} + \phi_2 \epsilon_{\mathrm{t-2}} + \cdots + \phi_{\mathrm{q}} \epsilon_{\mathrm{t-q}} \quad (2.2)$$

In words, the predicted value of Y is equal to a constant and/or a weighted sum of one or more recent values of Y and/or a weighted sum of one or more recent values of the errors. The lags of the stationarized series are called **autoregressive** terms, while lags of the forecast errors are called **moving average** terms, and a time series which needs to be differenced to be made stationary is said to be an **integrated** version of a stationary series. Random-walk and random-trend models, autoregressive models, and exponential smoothing models are all special cases of ARIMA models

The ARIMA model constitutes a method for forecasting or predicting future outcomes based on historical data. It is based on the statistical concept of serial correlation, where the past influences the future. The data is differenced in order to make it stationary. A stationary series has no trend, its variations around its mean have a constant amplitude, and it variates in a consistent fashion. Most economic and market data display trends and so the aim of differencing is to remove any trends or seasonal structures as they could negatively affect the regression model. The latter condition means that its autocorrelations remain constant over time.

ARIMA models are based on the assumption that past values have some residual effect on current or future values, however, this is not always the case. For example, in the years prior to The Great Recession, most investors were not aware of the risks. Once it became public knowledge that many financial institutions were at risk of imminent collapse, investors suddenly became less concerned with these stocks' recent prices and far more concerned with their underlying risk exposure. Therefore, the market rapidly revalued financial stocks to a much lower level, a move that would have utterly confounded an autoregressive model (Hayes, 2021).

The general non-seasonal notation ARIMA (p, d, q) indicates a p order of the AR part, d degree of first differencing and q order of the MA part:

- **p**: the number of lag observations in the model.
- **d**: the number of times that the raw observations are differenced.
- **q**: the size of the moving average window

In a linear regression the number and type of terms are included. A 0 value of a parameter would mean that such component should not be used in the model. Hence, the ARIMA model can be constructed to perform the function of an ARMA model, or even simple AR, I, or MA models.

In order to make an appropriate selection of these parameters an analysis to the partial autocorrelation function (PACF) and to the autocorrelation function (ACF) must be conducted in order to determine 'p' and 'q', respectively. The autocorrelation function (ACF) is a statistical technique that we can use to identify how correlated the values in a time series are with each other. The ACF lays out the correlation coefficient against the lag, which is measured in terms of a number of periods or units. A lag corresponds to a certain point in time after which we observe the first value in the time series. The correlation coefficient can range from -1 (a perfect negative relationship) to +1 (a perfect positive relationship). Partial autocorrelation captures the correlation between two variables after controlling for the effects of other variables. A coefficient of 0 means that there is no relationship between the variables. The values will depend on the examination of the spikes at each lag to determine whether they are significant as shown in Tables 6 and 7 (Brockwell & Davis, 2016).

Table 6 – Interpretation of ACF function

ACF	
Pattern	**Conclusion**
Large spike at lag 1 that decreases after a few lags.	An autoregressive term in the data. Use the partial autocorrelation function to determine the order of the autoregressive term.
Large spike at lag 1 followed by a decreasing wave that alternates between positive and negative correlations.	A higher order autoregressive term in the data. Use the partial autocorrelation function to determine the order of the autoregressive term.
Significant correlations at the first or second lag, followed by correlations that are not significant.	A moving average term in the data. The number of significant correlations indicates the order of the moving average term.

Source: Minitab 18, 2022b

Table 7– Interpretation of PACF function

PACF	
Coluna1	**Coluna2**
Pattern	Conclusion
Large spike at lag 1 that decreases after a few lags	A moving average term in the data. Use the autocorrelation function to determine the order of the moving average term.
Large spike at lag 1 followed by a damped wave that alternates between positive and negative correlations.	A higher order moving average term in the data. Use the autocorrelation function to determine the order of the moving average term.
Significant correlations at the first or second lag, followed by correlations that are not significant.	An autoregressive term in the data. The number of significant correlations indicate the order of the autoregressive term.

Source: Minitab 18, 2022a

6.2. Practical Example

Before employing the ARIMA method it must be confirmed that the time series is stationary. To be stationary, a time series must have a constant mean, a constant variance and a constant covariances where the value of the covariance between the two time periods depend on the lag between the two time periods and not on the time at which the covariance is computed. A stationary time series will have the same mean, variance and covariance, these properties are time invariant meaning the series will have no predictable patterns in the long-term. The need to confirm this comes from the fact that if the series is not stationary, each period of the time series will have a distinct behavior and it is not possible to predict or generalize for future time periods. A stationary time series will tend to return to its mean value. The fluctuations around this mean will have a constant magnitude, thus, a stationary time series will not drift too much from its mean value because of the finite variance. One example of a stationary time series is White Noise. Is inherent stationarity makes it unpredictable in the long term.

Having established that the ARIMA models work best on large data sets, projections of quarterly growth rates of real GDP were made for the years 2021 and 2022, following said model. GDP is the most used indicator to test the economic health of a country and from its conclusions can be drawn regarding the remaining relevant macroeconomic indicators. The historic data was harvested from the OECD data base (OECD.Stat, 2020). Within the major economic data organizations it was considered the best option since, typically, it presents the most pessimistic scenarios, according to the research carried out in the literature review chapter. What is more, the Lucas Critique states that future development is influenced by projections because expectations are accomplished, therefore, to manage expectations a safer route is to consider modest values. Finally, regarding the observed data, and since the pandemic has shown the unpredictability of the world, it will be analyzed on a quarterly basis so as to obtain results that are as close to reality as possible, as a result of recurrent monitoring (Buturac, 2021).

Because ARIMA models are elaborate and work best on very large data sets, computer algorithms and machine learning techniques are used to compute them. By way of the XLSTAT[14] tool, quarterly values were run since the year 1980, which allows for the inclusion of a relevant number of current samples that include past economic shocks and, therefore, contribute to a faithful forecast of the percentage of economic growth in GDP.

For this study , first, the ACF and PACF functions were analyzed using the following graphs, where a 95% confidence interval was considered:

[14] XLSTAT is an Excel data analysis add-on that allows to analyze, customize and share results within Microsoft Excel.

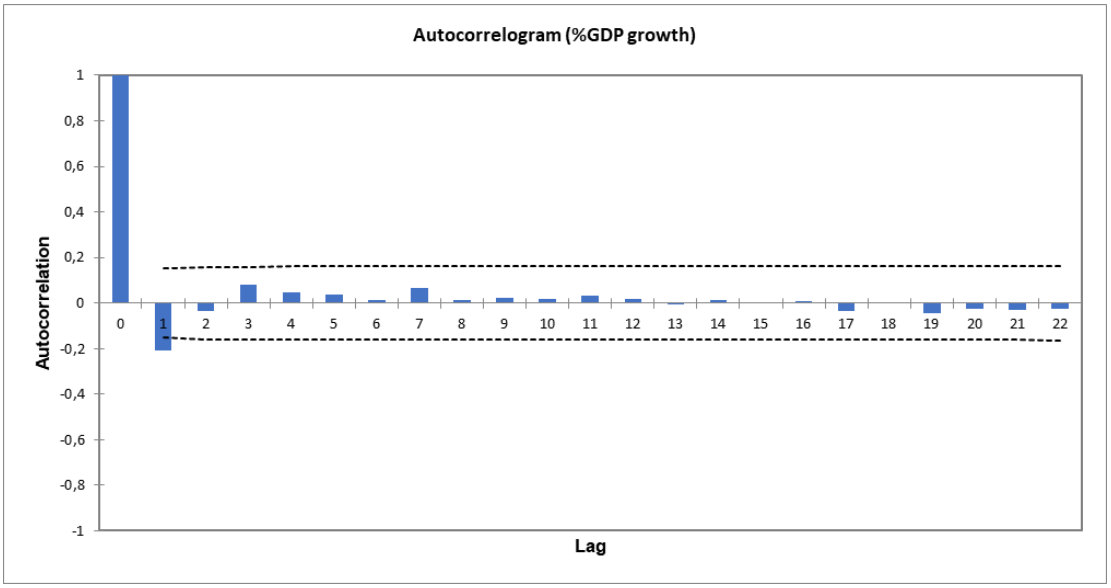

Figure 10: Autocorrelogram of the % of GDP growth of Portugal from 1980 to 2020.

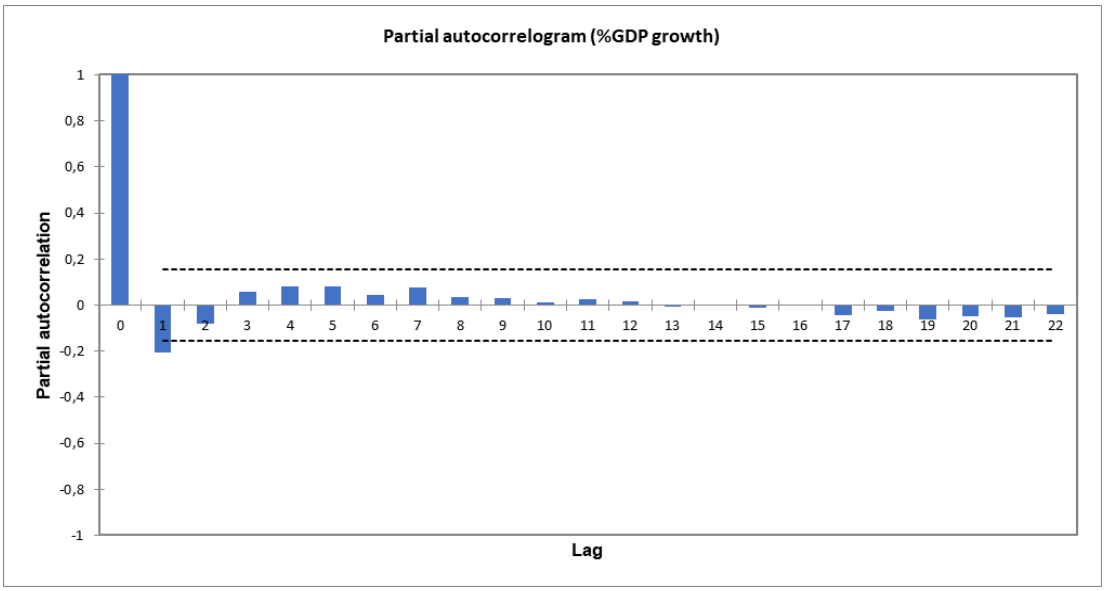

Figure 11: Partial autocorrelogram of the % of GDP growth of Portugal from 1980 to 2020.

Autocorrelation measures the relationship between a variable's current value and its past values. The close to zero values in each of the graphical representation (Figures 10 and 11) indicate low relation between them. From the example below, the PACF plot has significant spikes at lag 1 because of the significant PACF value. For everything within the doted lines, we don't have evidence that it's different from zero. Also, we could try for 'p' other values of lag that are outside of the dotted lines if there were any. Hence, the AR model parameter 'p' will in this case be equal to 1. Similar to selecting p for the AR model, in order to select the appropriate 'q' order for the MA model, all spikes higher than the dotted line must be analyzed. Consequently, the best value for parameter 'q' is also 1. Finally, for this test the 'd' parameter will be equal to 0 given the p-value presented in the descriptive

analysis is considerably lower than 1, the data does not need to be differentiated to be made stationary.

The final model to be teste will then be ARIMA(1,0,1). The period of the series was set to 8, as a result of an examination made to the economic cycle of Portugal (Table 1). It corresponds to an average of the duration of an economic cycle in the country. The results of the model are as follows:

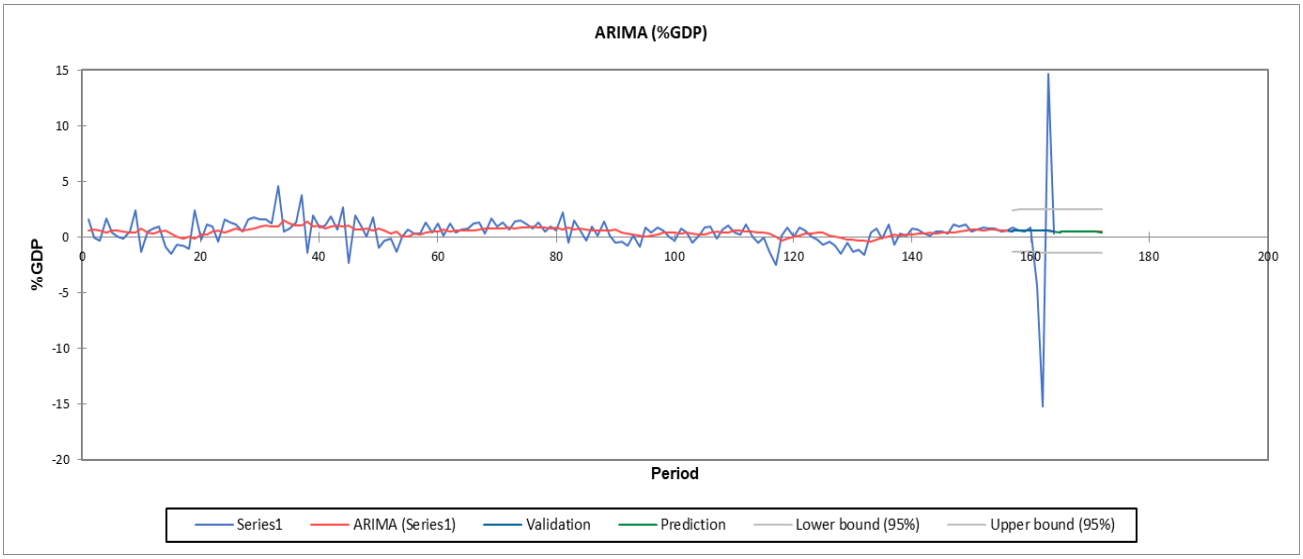

Figure 12: ARIMA (1,0,1) model – graphical representation for GDP growth rate

Table 8 – ARIMA model real GDP growth rate projections

Quarter	ARIMA (%GDP growth)
Q1-2021	0,535
Q2-2021	0,538
Q3-2021	0,533
Q4-2021	0,527
Q1-2022	0,525
Q2-2022	0,522
Q3-2022	0,520
Q4-2022	0,517

Additionally, the results present a MSE and RMSE value of 0,9 and 0,95, respectively.

The same process was followed for projecting unemployment rates for the same period, however OECD only had available data starting from 1983:

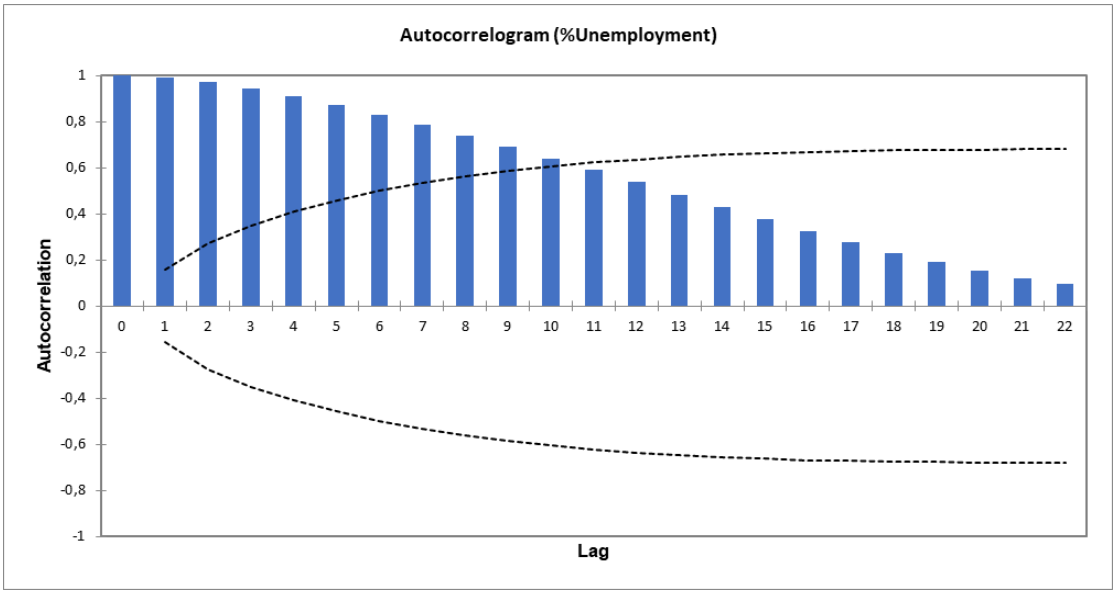

Figure 13: Autocorrelogram of the %Unemployment of Portugal from 1983 to 2020

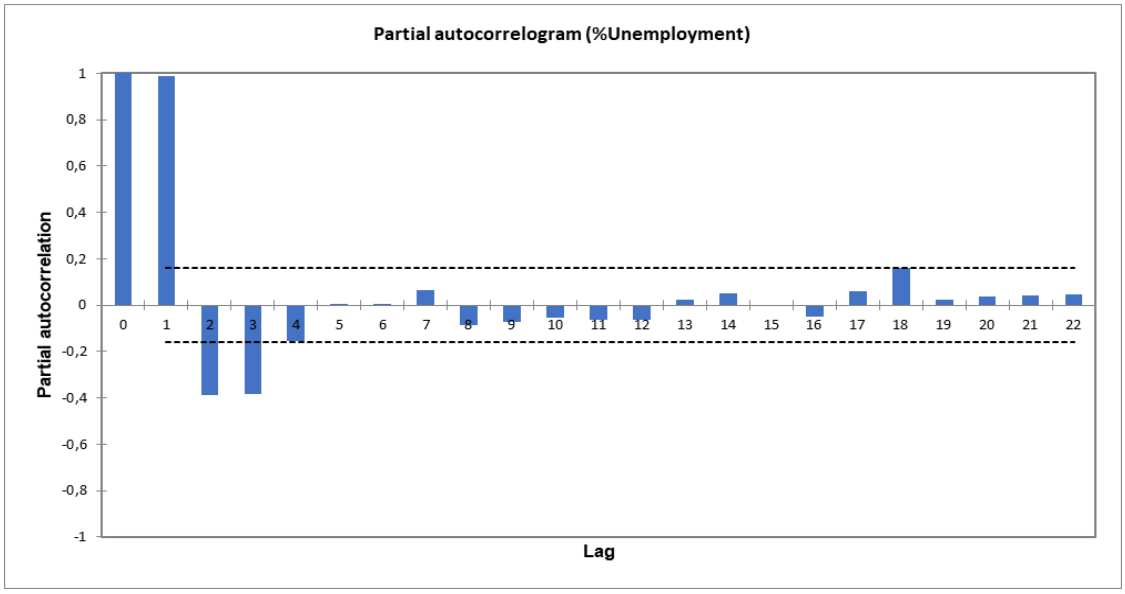

Figure 14: Partial Autocorrelogram of the %Unemployment of Portugal from 1983 to 2020

From Figures 13 and 14 an appropriate ARIMA model can again be selected: ARIMA(3,0,10):

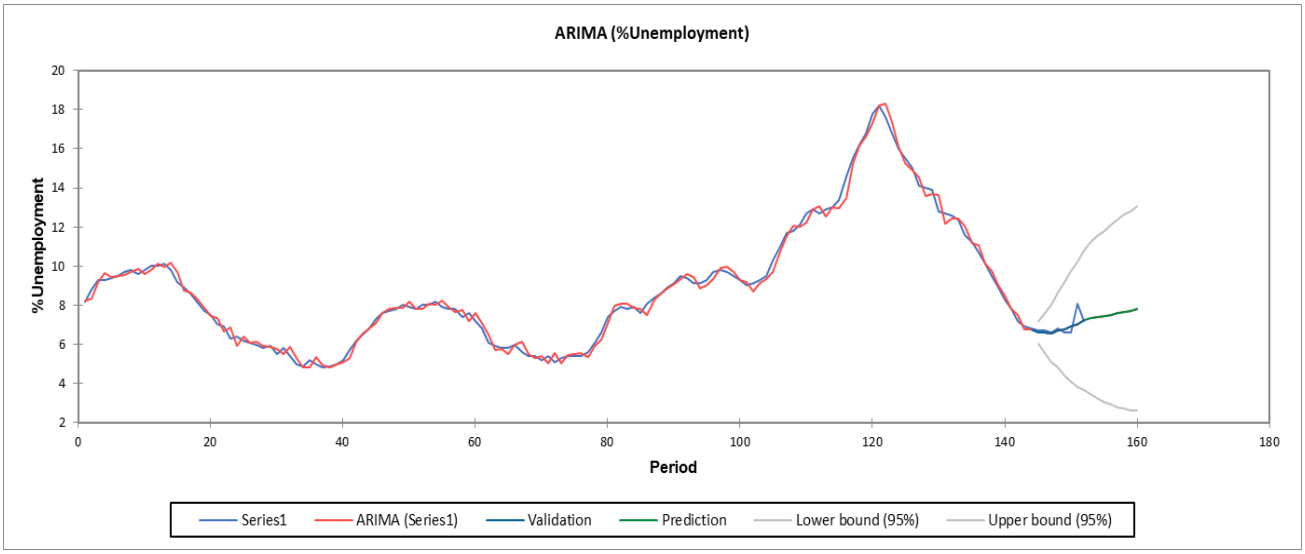

Figure 15: ARIMA (3,0,10) model – graphical representation for unemployment rate

Table 9 – ARIMA model Unemployment rate projections

Quarter	ARIMA (%Unemployment)
Q1-2021	7,323
Q2-2021	7,384
Q3-2021	7,424
Q4-2021	7,513
Q1-2022	7,576
Q2-2022	7,664
Q3-2022	7,701
Q4-2022	7,820

Results present a MSE and RMSE value of 0,08 and 0,29, respectively.

Finally, the ARIMA model will be applied to Consumer Prices Indices (CPI) rate. This measure is often used to examine inflation. Inflation is the decline of a given currency's purchasing power over time characterized by a rise in prices. A quantitative estimate of the rate at which the decline in purchasing power occurs can be reflected in the increase of an average price level of a basket of selected goods and services in an economy over some period of time (CPI).

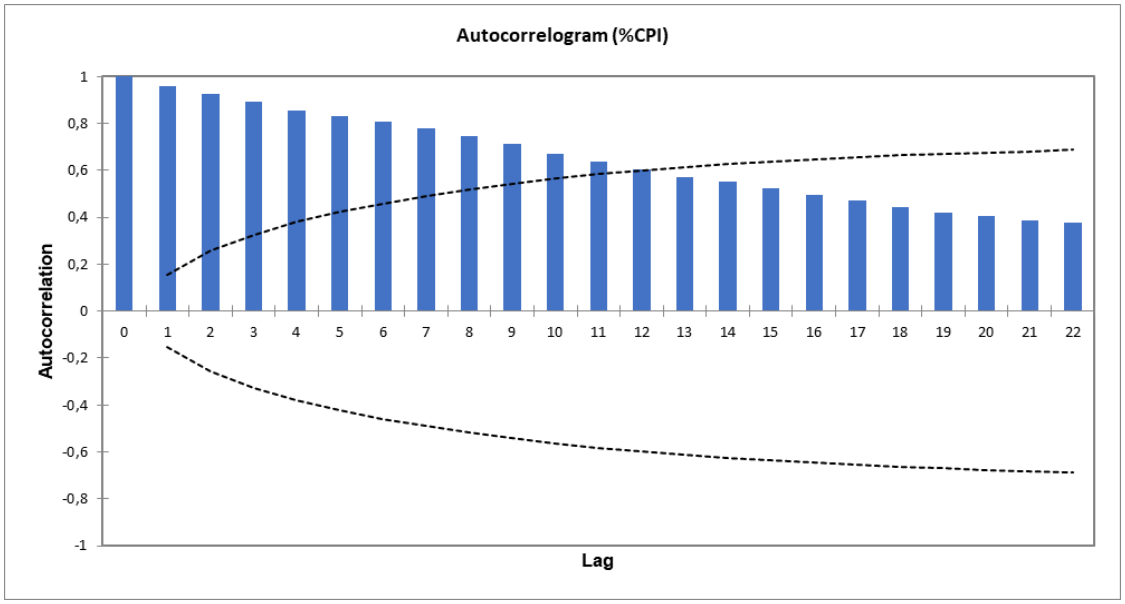

Figure 16: Autocorrelogram of the %CPI from Portugal from 1980 to 2020

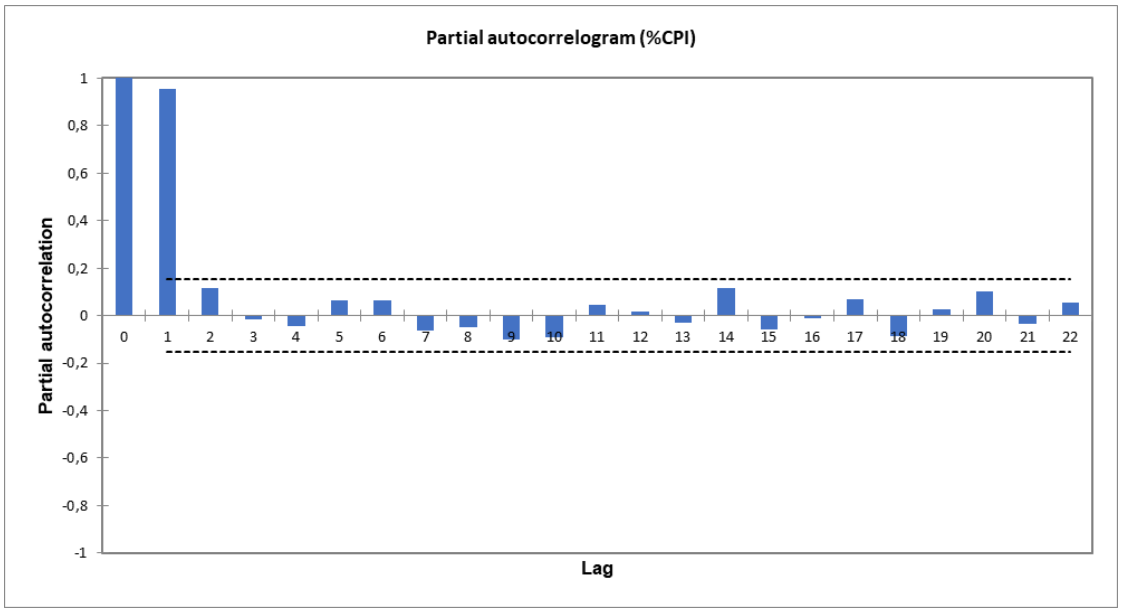

Figure 17: Partial Autocorrelogram of the %CPI of Portugal from 1980 to 2020

It can then be established the ARIMA(1,0,11):

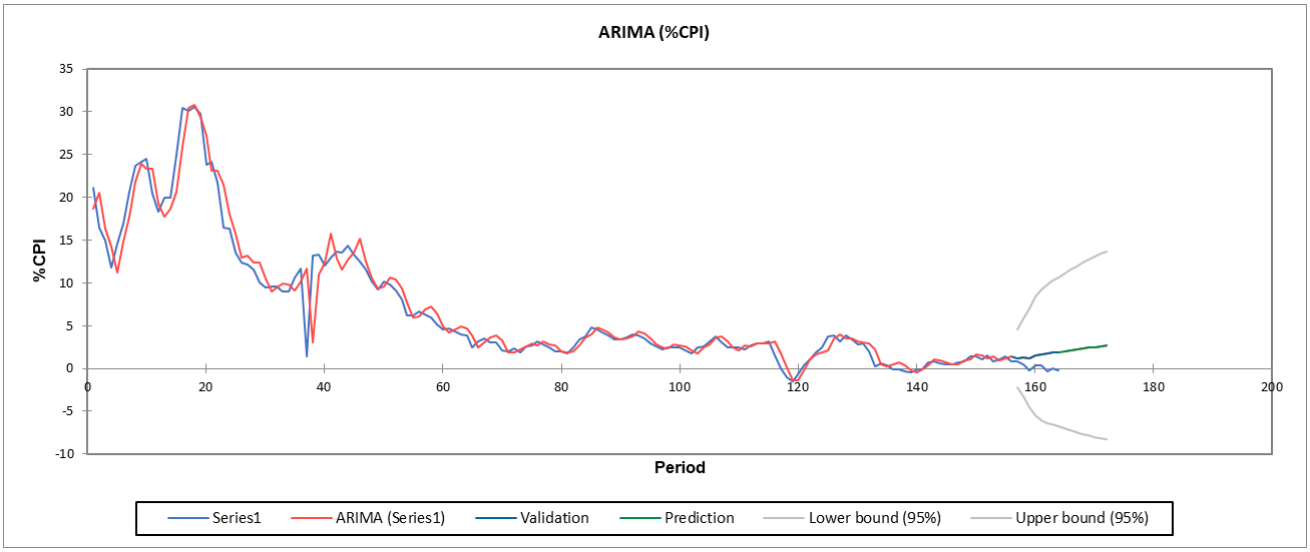

Figure 18: ARIMA (3,0,8) model – graphical representation for CPI rate

Table 10 – ARIMA model %CPI projections

Quarter	ARIMA (%CPI)
Q1-2021	2,040
Q2-2021	2,139
Q3-2021	2,218
Q4-2021	2,326
Q1-2022	2,422
Q2-2022	2,516
Q3-2022	2,611
Q4-2022	2,694

Results present a MSE and RMSE value of 2,97 and 1,72, respectively.

6.3 Discussion

The first thing that stands out, is the fact that the model, as expected, is not able to predict the increase and decline peaks caused by the pandemic and reacts differently for different measures, being the unemployment rate the most reliable. This reveals once again the importance of monitoring this indicator in the short term and the uncertainty associated with these projections. Not devaluing all the mathematical work applied to the models developed so far, one can say the only certainty in this type of analysis should be the degree of uncertainty. This is also reflected in the high value of errors

(MSE and RMSE) of %Unemployment and %GD growth. Nonetheless, the values presented in Tables 8, 9 and 10 will be taken as a baseline for potential scenarios.

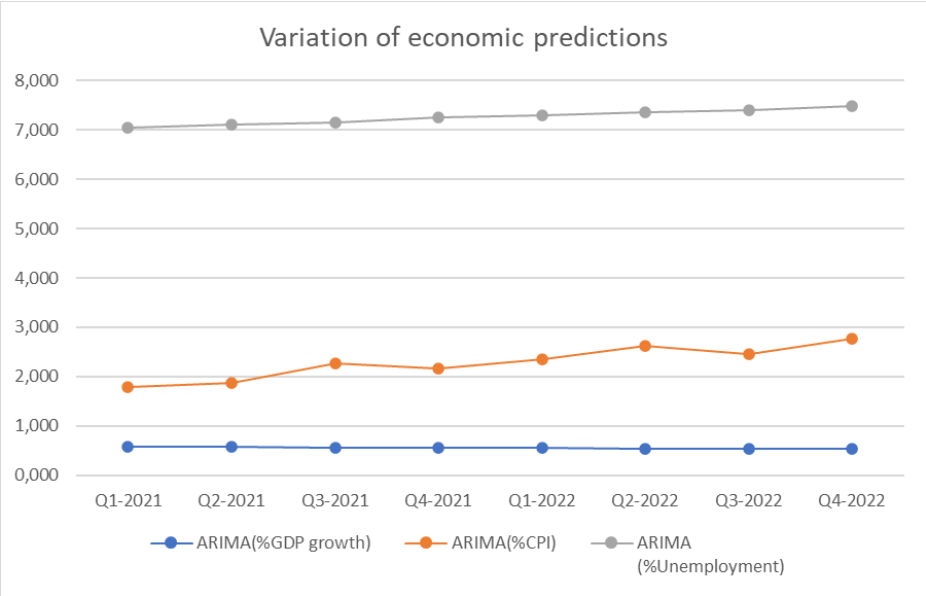

Figure 19: Graphic representation of the quarterly variation of the predictions resulting from the ARIMA models from 2021 to 2022

Before assessing the possible scenarios, it is of great relevance to define the relationship between the GDP growth and other economy primary factors such as the **unemployment rate** and **inflation**. Figure 19 displays this same relationships (similarly to Figure 3), despite being a plausible scenario, reality is often not so black and white.

Arthur Okun (Wen & Chen, 2012) developed a law, Okun's law, that establishes how much a country's GDP may be lost when the unemployment rate is above its natural rate. Succinctly, the logic behind this is that being output dependent on the amount of labor used in production, there is a positive relation between output and employment. In accordance, total employment equals the labor force minus the unemployment, implicating a negative relation between output and unemployment. The model states that when unemployment decreases by 1%, GDP rises by 3%. Another version of the law shows that GDP falls 2% when unemployment increases by 1%. This law has proven to not always being correct. During the Great Recession that for every percentage point that year-over-year growth exceeded the trend rate—between 2.3% and 2.6%—unemployment dropped by half a percentage point. Despite the complexity of the inputs and the uncertainty that goes with running economic regressions, Okun's law may not be entirely accurate, but it predicts that growth slowdowns typically coincide with rising unemployment. Although this relationship appears linear, it is important to note that when employment reaches a substantially low value it could be more costly for the economy. In this situation prices will rise, as aggregate demand will increase faster than supply and companies will be forced to raise wages due to the competitive labor market ultimately leading to a rise in prices for consumers.

The relationship between inflation and economic output (GDP) can be more complex. For instance, if GDP is declining or steady, most companies will not be able to increase their profits.

However, too much GDP growth is also dangerous, as it will most likely come with an increase in inflation, which erodes stock market gains by making money less valuable. Most economists today agree that 2.5 to 3.5% GDP growth per year is the most that the economy can safely maintain without causing negative side effects (Sánchez & Liborio, 2012). The effects of inflation are not linear. Over time, the growth in GDP causes inflation which could escalate to hyperinflation quickly becoming cyclical. If more money is spent because people know it will be less valuable in the future, GDP will increase in the short term which will in turn bring further price increases.

For the time being and this particular study, the greatest uncertainty is the fact that no prediction can mirror what consumer behavior will be like. This economic shock caused by the COVID-19 pandemic caused an abrupt closure of many businesses and consequently employment. That being said the course of pandemic will highly depend on what the consumer decides to do, and the levels of confidence shown. After 2020 saw a 'boom' in GDP due to the lifting of many restrictions and quarantine this study predicts that is clearly not going to last forever. The previous projections predict that economic growth will decelerate and return to pre-pandemic levels, assuming that the country will not suffer new restrictions, the pandemic remains under control and other external factors/shocks do not influence the course of the economy. This supports the concept that the pandemic gave rise to a "V" shaped recession, clearly visible in the graphs above, in which a sharp decline was followed by a sharp rise in GDP making it incomparable to that of the Great Recession.

However, in an attempt to anticipate another possible scenario, the possibility of the effects of the pandemic becoming seasonal, with a strong incidence in the 1st and 4th quarter of the year (winter months) could be considered despite being extremely unlikely given the vaccination advances already made. This second scenario is a global slowdown with sectors such as aviation and hotels, restaurants and tourism heavily affected, including the summer season. , and the other sectors to recover until the end of the second quarter. In this case there would be a sharp drop in stock markets , with a severe impact on the economy in a "U" shape instead of a "V" shape , which implies more time in the reversal on the way to recovery. Consumers would see a slow recovery of confidence and the straightening of global production chains would follow the same path. Global GDP would reflect an international recession, growing less than projected.

6.3.1 Mitigation measures

As for the policies planned to help mitigate the effects of a possible crisis, based on past experiences and the necessities of the country, 3 major groups can be identified:

- **Knowledge and innovation**: the country should not lose focus on this sector and get carried away by uncertainty. Above all, and thinking about technological advances and the creation of new and more jobs attention and investment should be faced towards education spending, not only physical expenses but most importantly increasing effectiveness and quality. In fact, during this time it has never been more critical as many students couldn't have access to education during the pandemic lockdown. Portugal's weakness could be said to be this one for many years now and with the arise of home office working less, but more specialized and

prepared, people will be given job opportunities, therefore this matter shouldn't be disregarded. Additionally, there should be policies to boost private R&D through tax incentives and subsidies on wages of R&D workers.

- **Product markets**: encourage higher competition through the services sector (e.g. professional services, network services, retail) since it is such a vital sector for the country's economic health. In addition, improved business environment, including free entry in market and more efficient exit and reductions and facilitation in administrative and regulatory procedures and certification, making the relationship between companies and the Public Administration more flexible. So far, the Portuguese government has offered monetary aid to maintain the liquidity of many companies whose business abruptly shut down. This quick response from governments and banks are essential to face this type of shock. Some of these measure are:
  - Facilitating the payment of taxes and Social Security contributions and providing access to credit lines that allow companies to remain in operation and fulfill their commitments;
  - The creation of a credit line of 600 million euros for small, medium companies;
  - A credit line for the tourism sector of about 200 million euros;
  - 1,3 million euros for a credit line for the textile sector and extractive industry;
- **Labor markets**: reforms of tax-benefit systems such as reductions in the generosity of long-run unemployment benefits and eligibility conditions. Fixing aggregate wage targets compatible with macro productivity developments, price stability and external competitiveness and, finally, tax system reforms aimed at reducing distortions and disincentive effects for low-skilled/wage earners.

7. Conclusions

In an unprecedented moment of contemporary history, many economists wonder what the consequences of COVID-19 will be for macroeconomic variables over time and when will the economy be able to bounce back. Conducting an economic forecast has proven to be a challenging task, especially when the amount of available information is so overwhelming. It becomes increasingly important to make the correct selection of relevant articles and methods that can bring value to further investigations. A comparative review has been made of the rich variety of forecasting methods. It is recognized that there are many different types of forecasting problems, requiring different treatment. As a result there is no direct or certain answer for the title of the paper. The choice of most appropriate method for a particular situation depends on a variety of considerations, of which forecasting accuracy is only one relevant criterion. In fact, more or less, models will always be faced by external factors that will make them deviate from reality. This is also why a shorter-term and consistently frequently analysis should be put ahead of long-term ones.

As in many other countries, Portugal has experienced an unprecedented social situation. Social distancing reduced the consumers' confidence by keeping consumers at home, wary of discretionary spending and pessimistic about the long-term economic prospects, which in turn caused a reduction of consumption of goods and services. People have developed new habits as consumers, workers, students, citizens and as family members. Some of these transformations will be transient, while others may persist. The Pandemic experience provides an opportunity to accelerate desirable changes, for instance many companies now behold the opportunity of saving costs by maintaining teleworking . This infectious disease will also most likely cause household wealth will fall, savings to increase, and consumption spending to decrease further. Supply-side disruptions are also a consequence of COVID-19. It has kept production halted, while negatively impacting supply chains, labor demand, and employment, leading to prolonged periods of lay-offs and rising unemployment.

Previous pandemics, such as the 1918 Spanish Influenza, the 1958 Asian Influenza, the 1968 Hong Kong Influenza, and the 2002 SARS outbreak, have shed light to possible outcomes. During said diseases, economies have experienced 'V-shaped' recoveries, whereby aggregate output is displaced and quickly recovers to its pre-crisis path. However, the COVID-19 economic recovery is not expected to be straightforward. This time preventive measures will prevail for a much longer time. Probably, even if no containment measures were implemented, a recession would occur anyway, fueled by the precautionary and/or panic behavior of households and firms faced with the uncertainty of dealing with a pandemic as well as with an inadequate public health response.

The ARIMA model, being a model that takes into account past values, provided with a good estimate of the future. After a fast recovery, it predicts that the economy will continue to grow but at a much moderate state, considering the effects of the pandemic residual. International organizations as OECD, World Bank and MF have access to more developed tools to make this type of projections. Despite not being identical, it is clear that the trend of the projections is the same, that is, a deceleration in growth after a V-shaped recovery. Only time will be able to tell the level of accuracy of

each forecast. Nonetheless, future research could focus on the comparison of the different tools available to appraise the fitness of each. In addition and because of the fact the world's view of the measure of a country's well-being is changing, research could be conducted on a broader indicator, such as the GPI. It is not yet fully developed, and it has some limitation, but it could represent a great evolution from GDP to characterize a country.

The chain impact provoked by such event proved once more that the modern economy is a complex web of interconnected parties: employees, firms, suppliers, consumers, and financial intermediaries. Everyone is someone else's employee, customer, lender. There is a huge degree of inter-connectiveness and specialization of productive activities, a breakdown in the supply chains and the circular flows will have a cascading effect: households do not get paid and, hence ,reduce their consumption and savings levels. The decrease in savings reduce investment ultimately diminishing the capital stock. Households reduce their demand for imports, which in turn reduces income for the rest of the World, and hence the country's exports decrease. The demand/supply shocks cause disruption in domestic and international supply chains. All of the previous shocks and disruptions lead to a fall in output – causing reductions in the usage of the factors of production.

Ultimately, the intensity of the shock is determined by the underlying epidemiological properties of COVID-19, consumer and firm behavior in the face of adversity, and public policy responses. The biggest task at hand for the government will be related to managing the reopening of the economy and society. Public authorities need to set clear rules on health and safety in the workplace, take steps to minimize the risk of contagion, and adopt rules and regulations to increase trust in face-to-face business transactions. Measures should be reviewed and adapted as events unfold. In addition the economic and social tensions derived from COVID-19 will have to be addressed by the government and in the process hopefully seize the beneficial changes. More equitable and sustainable policies will help to increase public trust in institutions. Politicians and policymakers will also be able to learn lessons from the pandemic experience in order to make the economy and society more inclusive and sustainable. Frequent and open communication with citizens, transparency, well-founded policies, social dialogue and institutional cooperation have led to great adherence and acceptance by the population of containment measures, during the recovery this behavior must be maintained. It could be a great opportunity for the country to show its value and strength.

7. Annex

ANNEX A – PRISMA 2020 GUIDELINES (PAGE EST AL. 2021)

Title	• Must identify the work as a systematic review.
Abstract	
Introduction	
Rationale	• Describe the purpose for the review considering existing knowledge.
Objectives	• Explicitly provide the objective(s) or research question(s) to be addressed.
Methods	
Eligibility criteria	• Specify the inclusion and exclusion criteria for the review as well as how studies were grouped for the synthesis.
Information sources	• Specify all sources of search consulted and date when each source was searched.
Search strategy	• Declare the full search strategies for the databases, registers and websites, including any filters and limits used.
Selection process	• Explain the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently. • If applicable, provide details of automation tools used in the process.
Data collection process	• Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators. • If applicable, details of automation tools used in the process.
Data items	• List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought, and if not, the methods used to decide which results to collect. • List and define all other variables for which data were sought. • Describe any assumptions made about any missing or unclear information.
Study risk or bias assessment	• Mention the methos used to assess the risk of bias concerning the articles included. • Include details of the tools, how many people will examine each paper and automation tools used.

Effect measures	• Specify the effect measures used in the sysnthesis or presentation of results.
Synthesis methods	• Describe any methods required to prepare the data for presentation or synthesis.
Reporting bias assessment	• Describe any methods used to assess risk of bias due to missing results in a synthesis.
Certainty assessment	• Describe any methods used to assess certainty.
Results	
Study selection	• Describe the results of the search and selection process.
Study characteristics	• Cite each included study and present its characteristics.
Risk of bias in studies	• Clarify assessments of risk of bias for each included study.
Results of individual studies	• For each study present a summary statistics for each group and the effect estimate and its precision.
Results of synthesis	• For each synthesis, briefly summarize the characteristics and risk of bias among contributing studies. • Present results of all investigations of possible causes of heterogeneity among study results and results of sensitivity analysis.
Reporting biases	• Present assessments of risk of bias due to missing results.
Certainty of evidence	• Present assessments of certainty.
Discussion	• Provide a general interpretation of the results as well as any limitations and implications of the results for the future.
Other information	
Registration and protocol	• Provide registration information for the review. Indicate where the review protocol can be accessed and describe and explain any amendments to information.
Support	• Describe sources of financial or non-financial support for the review.
Competing interests	• Declare any competing interests of review authors.
Availability of data, code, and other materials	• Report which of the materials used in the review are publicly available and where they can be found.

ANNEX B – ECONOMIC PROJECTIONS VS. PAST DATA OF GDP GROWTH RATE FROM 1980 TO 2020

Period	% GDP growth	ARIMA(%GDP growth)	Residuals	Standardized residuals	Standard error	Lower bound (95%)	Upper bound (95%)
Q1-1980	1,574	0,555	1,019	1,076			
Q2-1980	-0,026	0,722	-0,748	-0,790			
Q3-1980	-0,342	0,556	-0,898	-0,949			
Q4-1980	1,671	0,417	1,253	1,324			
Q1-1981	0,447	0,618	-0,171	-0,181			
Q2-1981	0,081	0,578	-0,498	-0,526			
Q3-1981	-0,171	0,493	-0,664	-0,702			
Q4-1981	0,487	0,392	0,094	0,100			
Q1-1982	2,426	0,363	2,064	2,180			
Q2-1982	-1,345	0,769	-2,113	-2,232			
Q3-1982	0,459	0,443	0,016	0,017			
Q4-1982	0,811	0,344	0,466	0,492			
Q1-1983	0,923	0,489	0,434	0,458			
Q2-1983	-0,895	0,575	-1,469	-1,552			
Q3-1983	-1,500	0,360	-1,860	-1,965			
Q4-1983	-0,652	0,056	-0,709	-0,749			
Q1-1984	-0,771	-0,134	-0,637	-0,673			
Q2-1984	-1,034	0,041	-1,075	-1,136			
Q3-1984	2,404	-0,170	2,574	2,718			
Q4-1984	-0,232	0,233	-0,465	-0,491			
Q1-1985	1,089	0,192	0,897	0,947			
Q2-1985	0,974	0,456	0,518	0,547			
Q3-1985	-0,374	0,581	-0,955	-1,009			
Q4-1985	1,587	0,384	1,203	1,271			
Q1-1986	1,321	0,559	0,762	0,805			
Q2-1986	1,128	0,741	0,387	0,409			
Q3-1986	0,535	0,576	-0,041	-0,044			
Q4-1986	1,601	0,688	0,912	0,963			
Q1-1987	1,805	0,743	1,063	1,123			
Q2-1987	1,601	0,911	0,690	0,729			
Q3-1987	1,547	1,062	0,486	0,513			
Q4-1987	1,197	0,972	0,225	0,238			
Q1-1988	4,557	0,971	3,586	3,787			
Q2-1988	0,455	1,498	-1,043	-1,102			
Q3-1988	0,763	1,235	-0,473	-0,499			
Q4-1988	1,319	1,071	0,248	0,262			
Q1-1989	3,766	1,027	2,739	2,893			
Q2-1989	-1,414	1,409	-2,823	-2,981			
Q3-1989	1,973	0,919	1,054	1,113			
Q4-1989	0,833	1,030	-0,197	-0,208			
Q1-1990	1,017	0,767	0,250	0,264			
Q2-1990	1,870	0,994	0,876	0,926			
Q3-1990	0,699	1,063	-0,364	-0,385			
Q4-1990	2,659	0,920	1,739	1,837			
Q1-1991	-2,331	1,001	-3,332	-3,519			
Q2-1991	1,963	0,725	1,238	1,308			
Q3-1991	1,074	0,719	0,354	0,374			
Q4-1991	0,024	0,806	-0,783	-0,827			
Q1-1992	1,769	0,605	1,164	1,230			
Q2-1992	-0,919	0,773	-1,692	-1,787			
Q3-1992	-0,346	0,545	-0,891	-0,941			
Q4-1992	-0,160	0,287	-0,447	-0,472			
Q1-1993	-1,319	0,467	-1,785	-1,886			
Q2-1993	0,050	0,040	0,010	0,011			
Q3-1993	0,696	0,081	0,615	0,649			
Q4-1993	0,335	0,277	0,059	0,062			
Q1-1994	0,339	0,197	0,142	0,150			
Q2-1994	1,296	0,386	0,910	0,961			
Q3-1994	0,452	0,521	-0,069	-0,073			
Q4-1994	1,202	0,474	0,728	0,769			
Q1-1995	0,175	0,707	-0,533	-0,562			
Q2-1995	1,179	0,504	0,675	0,713			
Q3-1995	0,434	0,572	-0,138	-0,146			
Q4-1995	0,678	0,579	0,098	0,104			
Q1-1996	0,790	0,562	0,228	0,241			
Q2-1996	1,199	0,572	0,627	0,662			
Q3-1996	1,357	0,701	0,656	0,693			
Q4-1996	0,282	0,733	-0,451	-0,476			

Q1-1997	1,645	0,726	0,918	0,970			
Q2-1997	0,909	0,767	0,142	0,149			
Q3-1997	1,301	0,795	0,506	0,534			
Q4-1997	0,672	0,841	-0,169	-0,178			
Q1-1998	1,448	0,773	0,675	0,713			
Q2-1998	1,536	0,823	0,713	0,753			
Q3-1998	1,109	0,900	0,208	0,220			
Q4-1998	0,753	0,940	-0,187	-0,198			
Q1-1999	1,329	0,819	0,510	0,538			
Q2-1999	0,522	0,885	-0,363	-0,384			
Q3-1999	0,980	0,780	0,200	0,211			
Q4-1999	0,574	0,816	-0,241	-0,255			
Q1-2000	2,225	0,705	1,521	1,606			
Q2-2000	-0,528	0,901	-1,430	-1,510			
Q3-2000	1,465	0,668	0,797	0,842			
Q4-2000	0,669	0,801	-0,131	-0,139			
Q1-2001	-0,313	0,708	-1,021	-1,079			
Q2-2001	0,967	0,579	0,388	0,410			
Q3-2001	0,146	0,602	-0,455	-0,481			
Q4-2001	1,399	0,550	0,849	0,896			
Q1-2002	0,178	0,572	-0,394	-0,416			
Q2-2002	-0,464	0,645	-1,109	-1,171			
Q3-2002	-0,454	0,363	-0,817	-0,863			
Q4-2002	-0,746	0,296	-1,042	-1,101			
Q1-2003	0,105	0,197	-0,092	-0,097			
Q2-2003	-0,889	0,152	-1,041	-1,099			
Q3-2003	0,887	0,059	0,828	0,875			
Q4-2003	0,378	0,161	0,217	0,229			
Q1-2004	0,903	0,261	0,642	0,678			
Q2-2004	0,572	0,448	0,124	0,131			
Q3-2004	0,039	0,451	-0,411	-0,434			
Q4-2004	-0,296	0,423	-0,719	-0,760			
Q1-2005	0,769	0,289	0,480	0,507			
Q2-2005	0,369	0,423	-0,054	-0,057			
Q3-2005	-0,472	0,338	-0,810	-0,855			
Q4-2005	0,133	0,240	-0,107	-0,113			
Q1-2006	0,817	0,226	0,591	0,625			
Q2-2006	0,965	0,372	0,594	0,627			
Q3-2006	-0,113	0,496	-0,609	-0,643			
Q4-2006	0,712	0,432	0,280	0,296			
Q1-2007	1,052	0,417	0,635	0,671			
Q2-2007	0,443	0,551	-0,108	-0,114			
Q3-2007	0,206	0,557	-0,351	-0,370			
Q4-2007	1,118	0,472	0,646	0,682			
Q1-2008	0,008	0,531	-0,524	-0,553			
Q2-2008	-0,493	0,447	-0,939	-0,992			
Q3-2008	-0,083	0,371	-0,454	-0,479			
Q4-2008	-1,292	0,277	-1,569	-1,657			
Q1-2009	-2,517	0,023	-2,539	-2,682			
Q2-2009	0,089	-0,284	0,374	0,395			
Q3-2009	0,882	-0,141	1,024	1,081			
Q4-2009	0,048	0,013	0,035	0,037			
Q1-2010	0,823	0,108	0,715	0,755			
Q2-2010	0,552	0,279	0,274	0,289			
Q3-2010	0,084	0,336	-0,252	-0,266			
Q4-2010	-0,194	0,371	-0,566	-0,597			
Q1-2011	-0,661	0,364	-1,024	-1,082			
Q2-2011	-0,429	0,099	-0,528	-0,558			
Q3-2011	-0,781	0,016	-0,796	-0,841			
Q4-2011	-1,478	-0,034	-1,445	-1,526			
Q1-2012	-0,546	-0,237	-0,309	-0,326			
Q2-2012	-1,348	-0,201	-1,147	-1,211			
Q3-2012	-1,129	-0,291	-0,838	-0,886			
Q4-2012	-1,580	-0,320	-1,261	-1,332			
Q1-2013	0,416	-0,396	0,813	0,858			
Q2-2013	0,758	-0,233	0,991	1,047			
Q3-2013	-0,139	-0,006	-0,134	-0,141			
Q4-2013	1,095	0,068	1,027	1,084			
Q1-2014	-0,642	0,211	-0,853	-0,901			
Q2-2014	0,333	0,160	0,173	0,183			
Q3-2014	0,095	0,217	-0,122	-0,129			
Q4-2014	0,809	0,262	0,547	0,578			
Q1-2015	0,645	0,275	0,369	0,390			
Q2-2015	0,298	0,323	-0,025	-0,027			
Q3-2015	0,114	0,385	-0,272	-0,287			
Q4-2015	0,479	0,301	0,179	0,189			
Q1-2016	0,467	0,425	0,041	0,044			
Q2-2016	0,300	0,402	-0,102	-0,108			
Q3-2016	1,174	0,409	0,765	0,808			
Q4-2016	0,932	0,504	0,428	0,452			
Q1-2017	1,171	0,554	0,617	0,651			
Q2-2017	0,505	0,655	-0,149	-0,158			
Q3-2017	0,695	0,641	0,054	0,057			
Q4-2017	0,825	0,606	0,219	0,232			
Q1-2018	0,727	0,650	0,078	0,082			
Q2-2018	0,780	0,649	0,131	0,138			
Q3-2018	0,526	0,612	-0,086	-0,091			
Q4-2018	0,609	0,592	0,017	0,018			
Q1-2019	0,882	0,568	0,314	0,332	0,947	-1,288	2,423
Q2-2019	0,565	0,597	-0,033	-0,035	0,958	-1,279	2,474
Q3-2019	0,462	0,584	-0,121	-0,128	0,967	-1,311	2,478
Q4-2019	0,825	0,560	0,264	0,279	0,974	-1,349	2,469
Q1-2020	-4,400	0,563	-4,963	-5,242	0,980	-1,358	2,484
Q2-2020	-15,200	0,553	-15,753	-16,639	0,985	-1,378	2,485
Q3-2020	14,700	0,550	14,150	14,945	0,990	-1,389	2,490
Q4-2020	0,300	0,542	-0,242	-0,255	0,993	-1,405	2,488
Q1-2021		0,535			0,994	-1,412	2,482
Q2-2021		0,538			0,995	-1,413	2,489
Q3-2021		0,533			0,997	-1,421	2,487
Q4-2021		0,527			0,998	-1,430	2,484
Q1-2022		0,525			1,000	-1,434	2,485
Q2-2022		0,522			1,001	-1,439	2,483
Q3-2022		0,520			1,001	-1,443	2,483
Q4-2022		0,517			1,002	-1,447	2,481

ANNEX C – ECONOMIC PROJECTIONS VS. PAST DATA OF CPI RATE FROM 1980 TO 2020

Period	%CPI	ARIMA(%CPI)	Residuals	Standardized residuals	Standard error	Lower bound (95%)	Upper bound (95%)
Q1-1980	21,100	18,621	2,479	1,439			
Q2-1980	16,400	20,533	-4,133	-2,399			
Q3-1980	14,900	16,374	-1,474	-0,856			
Q4-1980	11,800	14,296	-2,496	-1,449			
Q1-1981	14,600	11,246	3,354	1,947			
Q2-1981	16,900	14,867	2,033	1,180			
Q3-1981	20,600	17,698	2,902	1,684			
Q4-1981	23,700	21,873	1,827	1,061			
Q1-1982	24,100	23,889	0,211	0,122			
Q2-1982	24,500	23,335	1,165	0,676			
Q3-1982	20,400	23,350	-2,950	-1,713			
Q4-1982	18,300	19,249	-0,949	-0,551			
Q1-1983	19,900	17,728	2,172	1,261			
Q2-1983	20,000	18,685	1,315	0,763			
Q3-1983	25,000	20,603	4,397	2,552			
Q4-1983	30,500	25,887	4,613	2,678			
Q1-1984	30,100	30,482	-0,382	-0,221			
Q2-1984	30,600	30,800	-0,200	-0,116			
Q3-1984	29,700	29,386	0,314	0,183			
Q4-1984	23,800	27,214	-3,414	-1,982			
Q1-1985	24,100	23,080	1,020	0,592			
Q2-1985	21,700	23,049	-1,349	-0,783			
Q3-1985	16,400	21,492	-5,092	-2,956			
Q4-1985	16,300	17,959	-1,659	-0,963			
Q1-1986	13,500	15,724	-2,224	-1,291			
Q2-1986	12,400	12,917	-0,517	-0,300			
Q3-1986	12,100	13,181	-1,081	-0,628			
Q4-1986	11,500	12,368	-0,868	-0,504			
Q1-1987	10,000	12,415	-2,415	-1,402			
Q2-1987	9,400	10,469	-1,069	-0,621			
Q3-1987	9,600	8,981	0,619	0,360			
Q4-1987	9,600	9,478	0,122	0,071			
Q1-1988	9,000	9,960	-0,960	-0,558			
Q2-1988	9,000	9,810	-0,810	-0,470			
Q3-1988	10,600	9,132	1,468	0,852			
Q4-1988	11,700	10,182	1,518	0,881			
Q1-1989	1,400	11,664	-10,264	-5,958			
Q2-1989	13,200	3,050	10,150	5,892			
Q3-1989	13,300	10,995	2,305	1,338			
Q4-1989	12,000	12,334	-0,334	-0,194			
Q1-1990	12,900	15,798	-2,898	-1,682			
Q2-1990	13,700	12,790	0,910	0,528			
Q3-1990	13,500	11,530	1,970	1,143			
Q4-1990	14,300	12,707	1,593	0,925			
Q1-1991	13,300	13,562	-0,262	-0,152			
Q2-1991	12,500	15,166	-2,666	-1,547			
Q3-1991	11,600	12,494	-0,894	-0,519			
Q4-1991	10,100	10,518	-0,418	-0,242			
Q1-1992	9,200	9,305	-0,105	-0,061			
Q2-1992	10,200	9,524	0,676	0,392			
Q3-1992	9,800	10,593	-0,793	-0,460			
Q4-1992	9,100	10,397	-1,297	-0,753			
Q1-1993	8,100	9,397	-1,297	-0,753			
Q2-1993	6,200	7,740	-1,540	-0,894			
Q3-1993	6,200	5,970	0,230	0,133			
Q4-1993	6,700	6,027	0,673	0,390			
Q1-1994	6,300	6,866	-0,566	-0,329			
Q2-1994	5,900	7,259	-1,359	-0,789			
Q3-1994	5,100	6,377	-1,277	-0,742			
Q4-1994	4,500	4,863	-0,363	-0,211			
Q1-1995	4,700	4,166	0,534	0,310			
Q2-1995	4,300	4,606	-0,306	-0,178			
Q3-1995	4,000	4,899	-0,899	-0,522			
Q4-1995	3,900	4,621	-0,721	-0,418			
Q1-1996	2,500	3,888	-1,388	-0,806			
Q2-1996	3,200	2,469	0,731	0,425			
Q3-1996	3,500	3,057	0,443	0,257			
Q4-1996	3,000	3,647	-0,647	-0,375			

Q1-1997	3,000	3,809	-0,809	-0,470			
Q2-1997	2,100	3,242	-1,142	-0,663			
Q3-1997	2,000	1,925	0,075	0,044			
Q4-1997	2,300	1,876	0,424	0,246			
Q1-1998	1,900	2,260	-0,360	-0,209			
Q2-1998	2,600	2,552	0,048	0,028			
Q3-1998	2,700	2,971	-0,271	-0,157			
Q4-1998	3,100	2,695	0,405	0,235			
Q1-1999	2,800	3,166	-0,366	-0,213			
Q2-1999	2,500	2,856	-0,356	-0,207			
Q3-1999	2,000	2,663	-0,663	-0,385			
Q4-1999	2,000	2,037	-0,037	-0,021			
Q1-2000	1,800	1,927	-0,127	-0,074			
Q2-2000	2,500	1,986	0,514	0,298			
Q3-2000	3,400	2,724	0,676	0,392			
Q4-2000	3,700	3,659	0,041	0,024			
Q1-2001	4,800	3,993	0,807	0,469			
Q2-2001	4,600	4,813	-0,213	-0,124			
Q3-2001	4,200	4,518	-0,318	-0,185			
Q4-2001	3,900	4,242	-0,342	-0,198			
Q1-2002	3,400	3,653	-0,253	-0,147			
Q2-2002	3,400	3,336	0,064	0,037			
Q3-2002	3,600	3,523	0,077	0,045			
Q4-2002	4,000	3,756	0,244	0,142			
Q1-2003	3,900	4,310	-0,410	-0,238			
Q2-2003	3,500	4,086	-0,586	-0,340			
Q3-2003	2,900	3,563	-0,663	-0,385			
Q4-2003	2,600	2,798	-0,198	-0,115			
Q1-2004	2,200	2,501	-0,301	-0,175			
Q2-2004	2,500	2,352	0,148	0,086			
Q3-2004	2,400	2,762	-0,362	-0,210			
Q4-2004	2,400	2,727	-0,327	-0,190			
Q1-2005	2,100	2,631	-0,531	-0,308			
Q2-2005	1,800	2,149	-0,349	-0,202			
Q3-2005	2,500	1,813	0,687	0,399			
Q4-2005	2,600	2,497	0,103	0,060			
Q1-2006	3,200	2,852	0,348	0,202			
Q2-2006	3,700	3,593	0,107	0,062			
Q3-2006	3,000	3,763	-0,763	-0,443			
Q4-2006	2,500	3,115	-0,615	-0,357			
Q1-2007	2,400	2,403	-0,003	-0,002			
Q2-2007	2,500	2,126	0,374	0,217			
Q3-2007	2,200	2,644	-0,444	-0,258			
Q4-2007	2,700	2,621	0,079	0,046			
Q1-2008	2,900	2,967	-0,067	-0,039			
Q2-2008	2,900	2,959	-0,059	-0,034			
Q3-2008	3,100	2,978	0,122	0,071			
Q4-2008	1,500	3,132	-1,632	-0,947			
Q1-2009	0,000	1,735	-1,735	-1,007			
Q2-2009	-1,100	0,103	-1,203	-0,698			
Q3-2009	-1,500	-1,423	-0,077	-0,045			
Q4-2009	-0,700	-1,420	0,720	0,418			
Q1-2010	0,300	-0,181	0,481	0,279			
Q2-2010	1,000	1,082	-0,082	-0,047			
Q3-2010	1,900	1,696	0,204	0,118			
Q4-2010	2,400	1,883	0,517	0,300			
Q1-2011	3,700	2,143	1,557	0,904			
Q2-2011	3,800	3,532	0,268	0,156			
Q3-2011	3,200	4,010	-0,810	-0,470			
Q4-2011	3,900	3,538	0,362	0,210			
Q1-2012	3,400	3,532	-0,132	-0,076			
Q2-2012	2,800	3,116	-0,316	-0,183			
Q3-2012	2,900	3,056	-0,156	-0,091			
Q4-2012	2,000	2,945	-0,945	-0,549			
Q1-2013	0,200	2,225	-2,025	-1,175			
Q2-2013	0,600	0,448	0,152	0,088			
Q3-2013	0,300	0,277	0,023	0,013			
Q4-2013	-0,100	0,425	-0,525	-0,305			
Q1-2014	-0,100	0,651	-0,751	-0,436			
Q2-2014	-0,300	0,308	-0,608	-0,353			
Q3-2014	-0,500	-0,193	-0,307	-0,178			
Q4-2014	-0,100	-0,451	0,351	0,204			
Q1-2015	-0,100	-0,097	-0,003	-0,002			
Q2-2015	0,700	0,335	0,365	0,212			
Q3-2015	0,800	1,031	-0,231	-0,134			
Q4-2015	0,600	0,973	-0,373	-0,217			
Q1-2016	0,500	0,751	-0,251	-0,145			
Q2-2016	0,500	0,438	0,062	0,036			
Q3-2016	0,700	0,458	0,242	0,141			
Q4-2016	0,800	0,893	-0,093	-0,054			
Q1-2017	1,400	1,068	0,332	0,193			
Q2-2017	1,400	1,630	-0,230	-0,133			
Q3-2017	1,100	1,525	-0,425	-0,246			
Q4-2017	1,500	1,225	0,275	0,159			
Q1-2018	0,800	1,393	-0,593	-0,344			
Q2-2018	1,000	0,910	0,090	0,052			
Q3-2018	1,400	1,191	0,209	0,121			
Q4-2018	0,800	1,411	-0,611	-0,355			
Q1-2019	0,800	1,172	-0,372	-0,216	1,723	-2,204	4,548
Q2-2019	0,500	1,302	-0,802	-0,466	2,321	-3,246	5,851
Q3-2019	-0,200	1,228	-1,428	-0,829	2,922	-4,499	6,954
Q4-2019	0,300	1,486	-1,186	-0,688	3,556	-5,484	8,456
Q1-2020	0,400	1,596	-1,196	-0,695	3,912	-6,071	9,264
Q2-2020	-0,300	1,729	-2,029	-1,178	4,129	-6,364	9,823
Q3-2020	0,000	1,889	-1,889	-1,096	4,305	-6,548	10,326
Q4-2020	-0,200	1,917	-2,117	-1,229	4,447	-6,799	10,633
Q1-2021		2,040			4,626	-7,026	11,107
Q2-2021		2,139			4,789	-7,248	11,526
Q3-2021		2,218			4,949	-7,482	11,917
Q4-2021		2,326			5,106	-7,682	12,334
Q1-2022		2,422			5,246	-7,860	12,703
Q2-2022		2,516			5,372	-8,012	13,044
Q3-2022		2,611			5,489	-8,148	13,370
Q4-2022		2,694			5,600	-8,281	13,669

ANNEX D – ECONOMIC PROJECTIONS VS. PAST DATA OF UNEMPLOYMENT RATE FROM 1983 TO 2020

Observations	%Unemployment	ARIMA(%Unemployment)	Residuals	Standardized residuals	Standard error	Lower bound (95%)	Upper bound (95%)
Q1-1983	8,200	8,219	-0,019	-0,064			
Q2-1983	8,800	8,358	0,442	1,520			
Q3-1983	9,300	9,173	0,127	0,435			
Q4-1983	9,300	9,642	-0,342	-1,176			
Q1-1984	9,400	9,419	-0,019	-0,066			
Q2-1984	9,500	9,475	0,025	0,085			
Q3-1984	9,700	9,530	0,170	0,583			
Q4-1984	9,800	9,726	0,074	0,254			
Q1-1985	9,600	9,860	-0,260	-0,892			
Q2-1985	9,800	9,573	0,227	0,781			
Q3-1985	10,000	9,829	0,171	0,588			
Q4-1985	10,000	10,100	-0,100	-0,343			
Q1-1986	10,100	9,988	0,112	0,385			
Q2-1986	9,800	10,152	-0,352	-1,209			
Q3-1986	9,200	9,681	-0,481	-1,654			
Q4-1986	8,900	8,754	0,146	0,501			
Q1-1987	8,600	8,635	-0,035	-0,119			
Q2-1987	8,200	8,359	-0,159	-0,546			
Q3-1987	7,700	7,856	-0,156	-0,535			
Q4-1987	7,500	7,459	0,041	0,140			
Q1-1988	7,000	7,326	-0,326	-1,121			
Q2-1988	6,900	6,648	0,252	0,868			
Q3-1988	6,300	6,844	-0,544	-1,871			
Q4-1988	6,400	5,943	0,457	1,572			
Q1-1989	6,200	6,394	-0,194	-0,668			
Q2-1989	6,100	6,078	0,022	0,075			
Q3-1989	6,000	6,115	-0,115	-0,397			
Q4-1989	5,800	5,898	-0,098	-0,337			
Q1-1990	5,900	5,888	0,012	0,041			
Q2-1990	5,500	5,758	-0,258	-0,886			
Q3-1990	5,800	5,501	0,299	1,029			
Q4-1990	5,400	5,856	-0,456	-1,569			
Q1-1991	5,000	5,313	-0,313	-1,074			
Q2-1991	4,900	4,825	0,075	0,257			
Q3-1991	5,200	4,830	0,370	1,273			
Q4-1991	5,000	5,344	-0,344	-1,181			
Q1-1992	4,800	4,925	-0,125	-0,431			
Q2-1992	4,900	4,847	0,053	0,183			
Q3-1992	5,000	5,001	-0,001	-0,003			
Q4-1992	5,200	5,062	0,138	0,475			
Q1-1993	5,700	5,318	0,382	1,313			
Q2-1993	6,200	6,157	0,043	0,146			
Q3-1993	6,500	6,546	-0,046	-0,157			
Q4-1993	6,800	6,810	-0,010	-0,036			
Q1-1994	7,300	7,082	0,218	0,750			
Q2-1994	7,600	7,615	-0,015	-0,050			
Q3-1994	7,700	7,789	-0,089	-0,306			
Q4-1994	7,800	7,855	-0,055	-0,190			
Q1-1995	8,000	7,864	0,136	0,469			
Q2-1995	7,900	8,159	-0,259	-0,891			
Q3-1995	7,800	7,824	-0,024	-0,083			
Q4-1995	8,000	7,800	0,200	0,688			
Q1-1996	8,000	8,060	-0,060	-0,205			
Q2-1996	8,200	8,030	0,170	0,584			
Q3-1996	7,900	8,237	-0,337	-1,158			
Q4-1996	7,800	7,897	-0,097	-0,333			
Q1-1997	7,800	7,679	0,121	0,415			
Q2-1997	7,400	7,765	-0,365	-1,254			
Q3-1997	7,600	7,191	0,409	1,406			
Q4-1997	7,200	7,596	-0,396	-1,361			
Q1-1998	6,800	7,104	-0,304	-1,044			
Q2-1998	6,100	6,507	-0,407	-1,398			
Q3-1998	5,900	5,694	0,206	0,707			
Q4-1998	5,800	5,770	0,030	0,102			
Q1-1999	5,800	5,501	0,299	1,027			
Q2-1999	6,000	5,954	0,046	0,157			
Q3-1999	5,600	6,123	-0,523	-1,797			
Q4-1999	5,400	5,527	-0,127	-0,437			
Q1-2000	5,400	5,269	0,131	0,450			
Q2-2000	5,200	5,421	-0,221	-0,760			
Q3-2000	5,400	5,022	0,378	1,298			
Q4-2000	5,100	5,566	-0,466	-1,602			

Q1-2001	5,300	5,040	0,260	0,895			
Q2-2001	5,400	5,447	-0,047	-0,161			
Q3-2001	5,400	5,505	-0,105	-0,360			
Q4-2001	5,400	5,546	-0,146	-0,500			
Q1-2002	5,600	5,349	0,251	0,863			
Q2-2002	6,100	5,904	0,196	0,672			
Q3-2002	6,600	6,217	0,383	1,315			
Q4-2002	7,400	7,073	0,327	1,124			
Q1-2003	7,700	7,948	-0,248	-0,851			
Q2-2003	7,900	8,063	-0,163	-0,559			
Q3-2003	7,800	8,077	-0,277	-0,952			
Q4-2003	7,900	7,869	0,031	0,106			
Q1-2004	7,600	7,834	-0,234	-0,805			
Q2-2004	8,100	7,474	0,626	2,152			
Q3-2004	8,400	8,269	0,131	0,452			
Q4-2004	8,600	8,592	0,008	0,028			
Q1-2005	8,900	8,865	0,035	0,119			
Q2-2005	9,100	9,085	0,015	0,051			
Q3-2005	9,500	9,358	0,142	0,489			
Q4-2005	9,400	9,572	-0,172	-0,591			
Q1-2006	9,100	9,423	-0,323	-1,112			
Q2-2006	9,100	8,882	0,218	0,748			
Q3-2006	9,300	9,035	0,265	0,912			
Q4-2006	9,700	9,358	0,342	1,175			
Q1-2007	9,800	9,903	-0,103	-0,354			
Q2-2007	9,700	9,970	-0,270	-0,930			
Q3-2007	9,500	9,724	-0,224	-0,770			
Q4-2007	9,300	9,275	0,025	0,085			
Q1-2008	9,000	9,151	-0,151	-0,519			
Q2-2008	9,100	8,683	0,417	1,434			
Q3-2008	9,300	9,126	0,174	0,598			
Q4-2008	9,500	9,346	0,154	0,529			
Q1-2009	10,300	9,676	0,624	2,144			
Q2-2009	11,000	10,761	0,239	0,821			
Q3-2009	11,700	11,529	0,171	0,589			
Q4-2009	11,800	12,053	-0,253	-0,869			
Q1-2010	12,100	12,033	0,067	0,229			
Q2-2010	12,700	12,238	0,462	1,589			
Q3-2010	12,900	12,915	-0,015	-0,051			
Q4-2010	12,700	13,075	-0,375	-1,290			
Q1-2011	12,900	12,555	0,345	1,184			
Q2-2011	13,000	13,003	-0,003	-0,011			
Q3-2011	13,400	12,929	0,471	1,620			
Q4-2011	14,600	13,465	1,135	3,899			
Q1-2012	15,500	15,235	0,265	0,912			
Q2-2012	16,200	16,144	0,056	0,193			
Q3-2012	16,800	16,601	0,199	0,682			
Q4-2012	17,800	17,305	0,495	1,700			
Q1-2013	18,200	18,217	-0,017	-0,059			
Q2-2013	17,600	18,329	-0,729	-2,505			
Q3-2013	16,800	17,357	-0,557	-1,914			
Q4-2013	16,000	16,099	-0,099	-0,339			
Q1-2014	15,500	15,257	0,243	0,836			
Q2-2014	15,000	14,873	0,127	0,436			
Q3-2014	14,100	14,510	-0,410	-1,408			
Q4-2014	14,000	13,605	0,395	1,356			
Q1-2015	13,900	13,708	0,192	0,660			
Q2-2015	12,800	13,645	-0,845	-2,905			
Q3-2015	12,700	12,142	0,558	1,919			
Q4-2015	12,600	12,420	0,180	0,619			
Q1-2016	12,400	12,417	-0,017	-0,060			
Q2-2016	11,600	12,061	-0,461	-1,585			
Q3-2016	11,200	11,189	0,011	0,037			
Q4-2016	10,700	11,056	-0,356	-1,223			
Q1-2017	10,100	10,111	-0,011	-0,039			
Q2-2017	9,500	9,755	-0,255	-0,875			
Q3-2017	8,900	9,000	-0,100	-0,345			
Q4-2017	8,300	8,490	-0,190	-0,653			
Q1-2018	7,800	7,818	-0,018	-0,060			
Q2-2018	7,200	7,501	-0,301	-1,036			
Q3-2018	6,900	6,745	0,155	0,534			
Q4-2018	6,800	6,778	0,022	0,074			
Q1-2019	6,700	6,618	0,082	0,282	0,291	6,048	7,188
Q2-2019	6,700	6,581	0,119	0,409	0,523	5,555	7,607
Q3-2019	6,600	6,566	0,034	0,116	0,754	5,089	8,044
Q4-2019	6,800	6,736	0,064	0,218	0,990	4,796	8,677
Q1-2020	6,600	6,787	-0,187	-0,641	1,226	4,383	9,190
Q2-2020	6,600	6,929	-0,329	-1,131	1,454	4,078	9,780
Q3-2020	8,100	7,027	1,073	3,689	1,642	3,807	10,246
Q4-2020	7,200	7,214	-0,014	-0,048	1,823	3,641	10,787
Q1-2021		7,323			1,978	3,446	11,199
Q2-2021		7,384			2,115	3,238	11,530
Q3-2021		7,424			2,237	3,040	11,808
Q4-2021		7,513			2,345	2,917	12,109
Q1-2022		7,576			2,442	2,790	12,362
Q2-2022		7,664			2,529	2,708	12,620
Q3-2022		7,701			2,601	2,603	12,799
Q4-2022		7,820			2,666	2,595	13,044

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