U.PORTO

MESTRADO
GESTÃO E ECONOMIA DE SERVIÇOS DE SAÚDE

PERFORMANCE OF THE PORTUGUESE PHYSIOTHERAPY PRIVATE PROVIDERS IN TIMES OF BLACK SWAN EVENTS

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M

2023

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FEP FACULDADE DE ECONOMIA
UNIVERSIDADE DO PORTO

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Dissertation

Master in Healthcare Economics and Management

Supervised by

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2023

Acknowledgments

A special thanks to my teacher and supervisor Professora Doutora Susana Oliveira, who through her example and never-ending support, gave me the necessary motivation and the necessary tools, to accomplish the very important personal goal of taking this dissertation to the finish line.

To my teacher and supervisor Professor Doutor César Carneiro, for coming aboard this "train" several months after he had left the station, and by sharing his passion for finding knowledge and meaning in data. His Quantitative Methods classes were the starting point of my newfound interest in data science and in the reconnection with my computer science long forgotten academic background.

To my former teacher Professor Luis Rocha, who with his kindness and support to all his students, in my first brief (and failed) passage through this Faculty in 2012 and latter through Porto Business School in 2020, unknowingly, gave me the necessary motivation to re-enrol in this Master program.

To my family and to my few close friends, for their never-ending love and support, even during periods when some of my choices may not have been the wisest.

Abstract

Background "Black Swan" events such as the global financial crisis of 2008 and the Covid-19 pandemic in 2020, act as "stress tests" to the economy and to the different business sectors. In this study we focused on the performance of the Portuguese physiotherapy private providers and their economic resilience during the 2007-2021 period, in which these two events occurred. ***Objectives*** Our objectives were to investigate how the Portuguese physiotherapy private providers performed in periods of economic downturns, if they performed differently than the rest of the healthcare providers, and if differences in performance between different types of physiotherapy providers were observed. ***Methods*** Economic and financial data was obtained from the SABI Informa database, regarding physiotherapy providers registered with the Portuguese national health regulator (ERS) and also regarding the rest of the private healthcare providers. Economic and financial performance was proxied by Sales, EBITDA, Return on Assets (ROA) and Return on Equity (ROE). A Difference-in-Differences (DiD) approach was used to evaluate the impact of the economic downturns on the performance of the different groups of providers. ***Results*** Our results suggest that physiotherapy providers were less resilient to the recent economic shocks than the rest of the healthcare providers, especially during the Covid-19 recession. Significant differences at α=0,05 were found in the impact of the Covid-19 economic shock in the Sales, EBITDA and in the ROE, with the physiotherapy sector showing an overall inferior performance than the rest of the healthcare providers. Within the physiotherapy sector, providers in the context of Physical Medicine and Rehabilitation (MFR) showed an inferior performance in most of these indicators compared to the non-MFR physiotherapy providers, with significant differences in performance also found in the Covid-19 period. Some minor regional patterns were observed, with a better performance from physiotherapy providers in country regions previously identified as having market competition issues. ***Conclusion*** The physiotherapy sector and especially its MFR providers, underperformed the rest of the healthcare private providers in times of major economic downturns, which suggests that they suffer from greater exposure to economic shocks.

JEL Codes: E32; G01; I11; O49.

Keywords: Physiotherapy; Portugal; Performance; Business cycles; Profitability.

Resumo

Background Eventos como a crise financeira de 2008 ou a pandemia da Covid-19 em 2020, atuam como testes à economia e aos diferentes setores de negócio. Neste estudo focamo-nos na performance económica dos prestadores privados de fisioterapia em Portugal durante o período de 2007-2021, onde estes dois eventos ocorreram. ***Objetivos*** Os objetivos deste estudo foram: investigar a performance dos prestadores privados de fisioterapia em períodos de recessão económica; se nestes períodos de recessão estes prestadores tiveram uma performance diferente da do resto do sector privado da saúde; e se existiram diferenças de performance entre diferentes tipos de prestadores de fisioterapia. ***Métodos*** Indicadores económicos e financeiros foram recolhidos da base de dados SABI Informa, relativamente aos prestadores privados de fisioterapia registados na Entidade Reguladora da Saúde (ERS) e também relativamente aos restantes prestadores privados de cuidados de saúde. A performance económica e financeira foi estimada através da evolução do volume de Vendas, do EBITDA, da Rendibilidade do Ativo (ROA) e da Rendibilidade dos Capitais Próprios (ROE). Uma abordagem Difference-in-Differences (DiD) foi utilizada para avaliar o impacto das recessões económicas na performance destes prestadores. ***Resultados*** Os resultados sugerem que os prestadores privados de fisioterapia foram menos resilientes nos recentes choques económicos do que o resto dos prestadores privados de saúde, especialmente durante a recessão associada à Covid-19. Diferenças estatisticamente significativas foram encontradas durante a recessão de 2020 (α=0,05) no volume de Vendas, no EBITDA e no ROE, com o sector da fisioterapia a registar uma performance globalmente inferior. No sector da fisioterapia, prestadores associados à Medicina Física e Reabilitação (MFR) revelaram uma performance inferior à dos prestadores não associados à MFR nas mesmas variáveis (exceto nas Vendas), com diferenças estatisticamente significativas na recessão de 2020. Foi observado um ligeiro padrão regional, com prestadores de fisioterapia de algumas regiões previamente identificadas como tendo menor concorrência, a revelarem melhor performance em 2020. ***Conclusão*** O sector dos prestadores privados de fisioterapia, em particular os prestadores associados à MFR, mostraram performance inferior aos do resto dos prestadores privados de saúde nos recentes períodos de recessão económica em Portugal.

Códigos JEL: E32; G01; I11; O49.

Palavras-chave: Fisioterapia; Portugal; Performance; Ciclos económicos; Rentabilidade.

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Abbreviations

ADSE – *Instituto de Proteção e Assistência na Doença* – Health Subsystem for Civil Workers

APF – *Associação Portuguesa dos Fisioterapeutas* – Portuguese Association of Physiotherapists

APS – *Associação Portuguesa de Seguradores* – Portuguese Insurers Association

ARS – *Administração Regional de Saúde* – Regional Health Authority

AT – Assets Turnover

BdP – *Banco de Portugal* – Bank of Portugal

BvD – Bureau van Dijk

CAE – *Código de Atividade Económica* – Economic Activity Code

CR – Concentration Ratio

CPI – Consumer Price Index

DiD – Difference-in-Differences

EBITDA – Earnings Before Interest, Taxes, Depreciation and Amortization

EBT – Earning Before Taxes

ECTS – European Credit Transfer and Accumulation System

EPE – *Entidade Publica Empresarial* – Public Business Entity

ERS – *Entidade Reguladora de Saúde* – National Health Regulator

FL – Financial Leverage

GDP – Gross Domestic Product

GHE – Government Healthcare Expenditure

HHI – Herfindahl-Hirschman Index

INE – *Instituto Nacional de Estatística* – National Statistics Institute

IQR – Inter Quartile Range

IHPARA – *Inquérito aos Hospitais Privados, Públicos de Acesso Restrito e das Regiões Autónomas*

MAD – Median Absolute Deviation

MFR – *Medicina Física e Reabilitação* – Physical Medicine and Rehabilitation

N.A. – Not Available

NE – Number of Employees

NHS – National Health System

NI – Net Income

NIPC – *Número Identificação Pessoa Coletiva* – Tax Identification Code

NUTS – *Nomenclatura Comum das Unidades Territoriais para Fins Estatísticos* – Nomenclature of Territorial Units for Statistics

OdF – *Ordem dos Fisioterapeutas* - Portuguese Physiotherapists Association

OECD – Organisation for Economic Cooperation and Development

OLS – Ordinary Least Squares

OOP – Out-of-Pocket

PHE – Private Healthcare Expenditure

PM – Profit Margin

Q1 – First Quartile

Q3 – Third Quartile

ROA – Return on Assets

ROE – Return on Equity

ROI – Return on Investments

RRAS – *Regiões de Referência para Avaliação em Saúde* – Reference Regions for Health Assessment

SABI – Iberian Balance Sheet Analysis System

SAMS – *Serviço de Assistência Médico-Social* – Health Subsystem for Bank Workers

SD – Standard Deviation

SNC – *Sistema de Normalização Contabilística* – Accounting Normalization System

SNS – *Serviço Nacional de Saúde* – Portuguese National Health Service

SPMS – *Serviços Partilhados do Ministério da Saúde* – Health Ministry Shared Services

SRER – *Sistema de Registo de Estabelecimentos Regulados* – Record System of Regulated Units

TA – Total Assets

VHI – Voluntary Health Insurance

WHO – World Health Organization

1. Introduction

Firstly used by Nassim N. Taleb in the risk assessment sector, "Black Swan" is a term used to classify very rare, highly unpredictable and very impactful events (Taleb, 2007). Events like the global financial crisis in 2008 and the Covid-19 pandemic in 2020, are two textbook examples of rare and impactful occurrences that have caused severe social, political, and macro-economic consequences.

From an economic point of view these events place markets, industries, and firms in an environment of uncertainty and financial stress. During these events and in the aftershock of their occurrence, their repercussions act as economic resilience tests, and while some businesses will struggle to survive, others due to their intrinsic characteristics will naturally remain profitable and with good economic performance.

In this context, one of the economic sectors that usually performs better in times of economic downturns is the healthcare sector (Milano, 2017). If we take the Portuguese private healthcare sector as an example, we can verify that during the 2008-2014 period, in which the country suffered severely from the global financial crisis and from an economic bailout intervention by international authorities (with austerity policies and downsizing of resources) (Barros, 2012), the private healthcare sector continued to grow, and remained more profitable than the business sector as a whole (BdP, 2019).

Healthcare needs usually don't diminish during economic downturns (some healthcare needs can even increase) (Eurofound, 2013; Simou & Koutsogeorgou, 2014), healthcare services are price inelastic (Ellis et al., 2017), most of the demand is by referral from healthcare professionals, and if we take into consideration that the user frequently only pays a fraction of the total cost (due to the presence of health insurance), we can easily understand why the sector is prone for stability. However, the healthcare sector as a whole is highly diversified, and naturally some of its firms and markets may not perform as well as the sector as a whole.

In this study we focused on the Portuguese physiotherapy private providers, and their economic performance in times of economic strain. Physiotherapy services are usually not considered as first-aid needs, treatment programs usually range from several weeks to several months increasing the financial burden on the payers and reducing their willingness-to-pay (Fatoye et al., 2020), there is a high competition from professionals such as massage therapists, osteopaths and personal trainers, and the sector is very labour intensive, making

it vulnerable to the Baumol effect (the rise of wages with little or no increase in labour productivity). All of these aspects can potentially lead to a lower economic resilience than in the rest of the healthcare providers.

Portugal, with 182 elders (>65 years) per 100 younger persons (<15 years) is one of the fastest ageing countries in the European Union (EU) (PORDATA, 2023), and is predicted to be the EU country with the oldest population in 2050 (UN, 2015). With the physiotherapy demand following the rising trend of the ageing population (one of the main drivers of the demand in this market) (Landry et al., 2016; Rommel & Kroll, 2017a), and with the rising incidence of chronic diseases requiring physical therapy services (Bernstein et al., 2003; Fries, 2003; Landry et al., 2016), this market is becoming increasingly more attractive to investors. However, the economic literature on this healthcare sector is very scarce, and its economic resilience to economic shocks remains to be explored. To the best of our knowledge, no previous studies have been made addressing the economic resilience of the physiotherapy providers during major economic shocks, and we believe that this type of research can help future investors in this market, at least partially, to better prepare for future periods of economic contraction and uncertainty. In this context, and since there are no studies on the economic behaviour/performance of the physiotherapy sector in Portugal, some questions remain open to explore, namely: Do physiotherapy private providers economically perform like the rest of the healthcare private providers, in times of major economic downturns?; Do the different types of physiotherapy providers perform in a similar way during these economic downturns?.

To better investigate the resilience of the economic performance of the physiotherapy providers, understanding the drivers of their performance is naturally a very valuable information. As of this writing there are no previous studies focused on the drivers of economic performance of these providers. Notwithstanding, some authors studied the financial performance and profitability in other healthcare settings, but mainly in hospitals (Bai & Anderson, 2016; Bai et al., 2022; Burkhardt & Wheeler, 2013; Creixans-Tenas, 2018). Since this information is not currently available for the physiotherapy sector, some questions also remain to be answered: What drives the performance of this type of providers?; What determines their resilience (or the lack of) during economic shocks?; Do the drivers of their profitability remain the same in the different phases of the economic business cycles?.

Taking all these questions into consideration, this study's objectives were:

1) to describe the main characteristics of the Portuguese physiotherapy market,

2) to assess the physiotherapy private providers economic performance in times of major economic downturns,
3) to evaluate if in these periods the physiotherapy private providers perform in a similar way as the rest of the healthcare private providers,
4) to investigate if the different types of physiotherapy providers have different economic and financial performance (since they have different funding characteristics),
5) to investigate if there are regional patterns in the observed performance,
6) and to determine the main drivers of profitability in this economic sector.

Our research hypotheses were that physiotherapy providers could be economically less resilient to economic recessions than the rest of the healthcare providers, that differences in performance between types of providers (MFR vs non-MFR) would be found, and that these differences would vary depending on the cause of the economic downturns (financial crisis vs public health crisis).

Data was collected from the National Health Regulator (ERS) to list all the physiotherapy units and providers in the country, and from the SABI Informa database from Bureau van Dijk (BvD) (Moody's Analytics) to collect economic and financial indicators to investigate the physiotherapy and healthcare providers performance during the 2007-2021 period, in which two "Black Swan" events occurred. Economic and financial performance was proxied by the providers Sales, EBITDA, Return on Assets (ROA) and Return on Equity (ROE). A Difference-in-Differences (DiD) approach was used to evaluate the impact of these major economic downturns on the performance of these providers. Additionally, a Dupont analysis was developed for the assessment of the individual components of the profitability ratios (ROA and ROE), two linear regression models were conducted with multiple explanatory variables to search for the main drivers of the observed profitability from the physiotherapy providers, and a K-Means clustering analysis was performed to search for regional patterns in the observed performance on a major downturn year (2020).

This document is divided in seven sections. It begins with this introduction (section 1), section 2 provides background information, a literature review on the topic, as well as a description of the physiotherapy sector in Portugal. Section 3 details the study's pertinence and its objectives, section 4 presents the study's methodology, section 5 the results, section 6 a discussion of the results, and in section 7 we conclude the main part of the document.

2. Background

Firstly used in the business and risk assessment worlds by Nassim N. Taleb (2007), "Black Swan" is a frequently used term to describe extremely rare and highly unpredictable events. These types of events usually give rise to severe impacts and highly disruptive consequences in the global economy. Even though they can be retrospectively understood, explained, and can even seem predictable, this "predictability" is only perceived after they occur. The 9/11 Twin Towers attack in 2001, the global financial crisis after the United States subprime market crash in 2008, the Covid-19 pandemic in 2020, and the current military conflict in Ukraine are typical examples of these types of events, with obvious social, political, and macro-economic consequences. Due to their current relatively high frequency, we might even say that we are now living in a shock-prone world, where these types of events appear to be more frequent than in the past.

Naturally, some types of markets and business sectors will be economically more vulnerable to these types of events, and while some will still thrive on times of economic downturns, others will suffer and struggle to keep viable in a hardships scenario. The healthcare sector is a particular case of a business sector that is usually more robust and resistant to periods of economic instability. This is mainly due to the fact that most of the consumers, by the presence of health insurance (private, social, or public), only pays a fraction of the total cost of the healthcare services, by the fact that the healthcare services are considered necessity "goods" and are price inelastic (Keegan et al., 2013), by the fact that most of the healthcare decisions are driven by healthcare professional's referral (Gildemeister et al., 2012), and because medical needs do not fluctuate significantly during economic cycles.

Countries like Portugal, with Beveridge inspired national health systems, rely heavily on the public budget for funding, and since they are tax-financed from multiple sources, they are less sensitive to business cycles (Cleeren et al., 2016), and appear to be more resilient than Bismarck health systems that rely on professional/social private insurances, since the funding is not dependent on the citizens employment status (Wagstaff, 2009). But as we have seen in the 2008-2014 period in Portugal, when hard times come, necessary austerity policies may reduce the national health budget, reducing the accessibility and supply from the National Health Service (NHS) (Barros, 2012; Eurofound, 2013; Keegan et al., 2013). These restrictions on the NHS budget, and also the restricted funding of private companies who

work for the NHS (Recio et al., 2022), can force consumers to greater waiting times on the NHS, increase the use of Voluntary Health Insurance (VHI), or greater Out-Of-Pocket (OOP) expenses on the full private sector. Periods of sudden increases in unemployment/underemployment rates due to business cycles downturns and their financial constraints, can also have serious socioeconomical consequences, since they can force some families to catastrophic healthcare spendings, especially in a country like Portugal, with one of the highest percentages of OOP payments in the European Union (Figure 1).

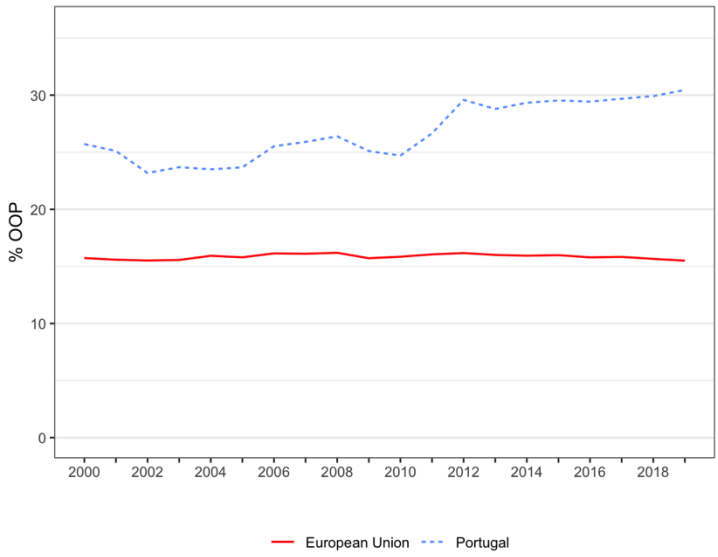


Figure 1. OOP payments as % of current healthcare expenditure in Portugal vs European Union (adapted from WHO, (2022)).

During the global economic crisis of 2008 and the subsequent international monetary intervention in Portugal by the Troika (European Central Bank, International Monetary Fund, and the European Commission) in 2011, co-payments have been increased (Barros, 2012; Eurofound, 2013), wages have been cut, and financial barriers more than doubled the unmet medical needs, especially in the most vulnerable social groups, increasing access inequities (da Costa et al., 2017; Recio et al., 2022). These types of consequences were also seen in other countries like Greece (Simou & Koutsogeorgou, 2014) and Ireland (Burke et al., 2014; Schneider, 2018), also targets of bailout agreements with the Troika. In line with these effects, and in the context of a continuous underbudget of the Portuguese NHS, for those who can afford it, the private healthcare providers become increasingly more appealing from the consumers perspective, but also from the investor's perspective (Eurofound, 2013).

Profitability in this context, is naturally related to the behavior of the healthcare expenditures during the contraction phases of the business cycles. Usually being divided into four phases (expansion, peak, contraction and trough), business cycle is a concept used to describe the expansions and contractions of the economy that cyclically occur over time (Velenyi, 2014). Depending on the development stage, the economic strength, and the health system of the country, the healthcare expenditures can behave pro-cyclically (increase during expansions, decrease during contractions), counter-cyclically (increase during contractions, decrease during expansions), or acyclically (relatively stable during the whole business cycle).

There is a general consensus that the healthcare expenditures tend to behave pro-cyclically (Arze del Granado et al., 2013; Blazquez-Fernández et al., 2016; Cleeren et al., 2016; Liang & Tussing, 2019; Ongaro et al., 2015; Schneider, 2018; Simou & Koutsogeorgou, 2014). Notwithstanding, in developed countries with strong political and economic conditions, the healthcare expenditures (especially Government Healthcare Expenditures (GHE)) can behave counter-cyclically (Burke et al., 2014; Calderón et al., 2016; Cleeren et al., 2016; Darby & Melitz, 2008; Eurofound, 2013; Gildemeister et al., 2012; Keegan et al., 2013; Velenyi, 2014). This seems almost intuitive, since the more economic capacity a country has, the more conditions it has to support the healthcare sector in times of economic downturns, but substantial cross-country variations do exist. The health system characteristics of each specific country also contributes to this variability, and to the specific behavior of the private and governmental healthcare expenditures functions (Clemente et al., 2004). Several of these studies provide us separate trends (from different countries) for the GHE and for the Private Healthcare Expenditure (PHE), but very few of them studied specific markets within the healthcare industry (Table 1), and none to our knowledge studied a specific healthcare market in Portugal.

Table 1. The GHE and the PHE behaviour during the business cycle in specific healthcare markets.

Author(s)	**Country**	**Healthcare Market**	**Results**	**Behaviour**
Blazquez-Férnandez, et al., 2016	Spain	Pharmaceutical	GHE and PHE decrease during recessions, increase during expansions.	Pro-cyclical
Aranha-Rossi et al., 2019	Brazil	Oral health	GHE is relatively stable during recessions. PHE increases during recessions.	Government: Acyclical Private: Counter-cyclical

2.1 The Portuguese healthcare sector in times of Black Swan events

In a Beveridge inspired health system, the Portuguese state acts as a regulator, as a financer, but also as a provider of healthcare services through its NHS, the *Serviço Nacional de Saúde* (SNS). Constitutionally the NHS should be comprehensive, tendentially free, and take care of its citizens "from the cradle to the grave". To achieve this and to improve coverage, some healthcare services are performed by private companies, and paid be the state. The comprehensiveness of the public funded NHS is achieved not only by its own network of providers, but also by returning to the social/private sector, to supply services that are not readily available at public institutions. In this way, a big part of the Portuguese private sector relies on public funding to operate, even though they have other clients such as private insurance companies with voluntary health insurance (VHI) schemes, healthcare subsystems such as the ADSE for civil servants or the SAMS for the banking sector, and completely private individual clients with full OOP payments.

The Portuguese private healthcare sector seems to be particularly resistant in periods of economic recessions. Despite the fact that it followed the trends of the Gross Domestic Product (GDP) growth rate (growing less during recessions), it has been continuously growing in the last decades. The annual growth rate of the market's turnover of the healthcare sector, has been largely positive since 2007, declining to negative numbers only during the Covid-19 pandemic and associated lockdowns, but bouncing right back in 2021 (Figure 2).

Figure 2. GDP growth rate vs Turnover evolution of the private healthcare sector (adapted from BdP, (2022) and PORDATA, (2022d)).

In 2009, Portugal suffered from the global financial crisis and the GDP rate of growth dropped to negative levels has we have seen in Figure 2. During the 2011-2014 period, in the aftershock of this global financial crisis, while under a financial intervention by external institutions, the GDP rate of growth dropped to -4,1% (in 2012). As a consequence of this financial crisis, the Portuguese GDP rate of growth returned to positive levels only in 2013, remaining positive until 2020, when a -8,3% decline occurred due to the Covid-19 pandemic lockdowns and associated economic repercussions.

In spite of these GDP drops, the private healthcare providers continued to be highly profitable in these periods, and the Return on Equity (ROE) (the ratio between net income and equity), has been continuously positive and well above the ROE of the business sector as a whole (Figure 3).

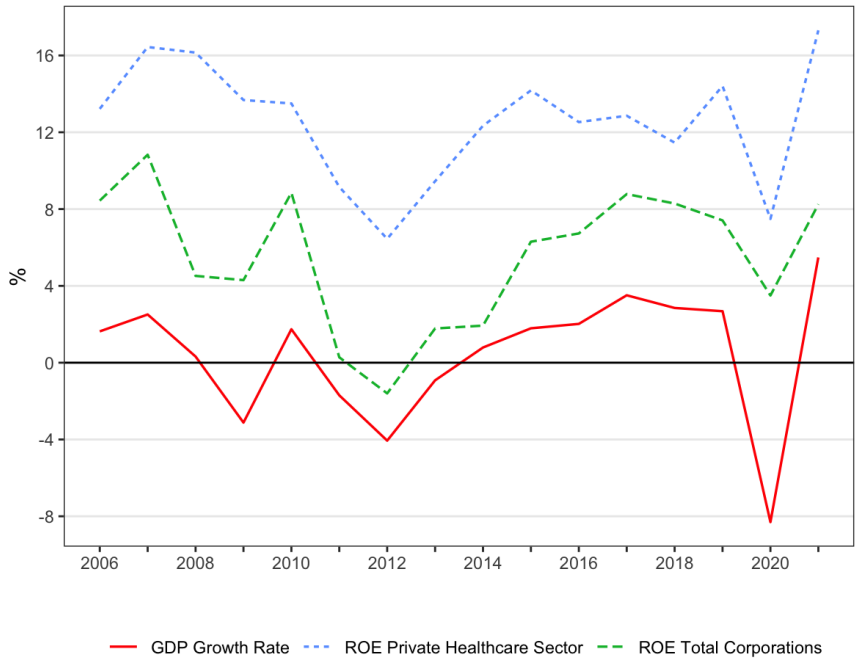


Figure 3. ROE of all corporation's vs ROE of the private healthcare sector (adapted from BdP, (2022) and PORDATA, (2022d)).

This fact is even more relevant, if we take into consideration that 77% of Portuguese consumers reported in 2011, that the economic downturn made them reduce their willingness to spend on healthcare services and products (Deloitte, 2011), and traditionally increase their savings rate during recessions (PORDATA, 2022f) (Figure 4). In line with these facts, the Portuguese healthcare expenditures usually tend to behave procyclically during

economic cycles (government and private healthcare expenditures decrease during economic contractions, and increase during economic expansions) (Cleeren et al., 2016).

Figure 4. GDP growth rate vs Household saving rate (adapted from PORDATA, (2022d, 2022f)).

The procyclical behaviour in GHE, seems more prevalent in developing countries, while developed countries usually assume a more classical Keynesian approach and increase their public expenditure, to accommodate the increased demand for public services during economic crisis, and to stimulate the economy (Cleeren et al., 2016; Keegan et al., 2013). The procyclical behaviour from the GHE observed in Portugal (Figure 5), especially during the global financial crisis and subsequent bailout period, could be related to the country's extremely high sovereign debt and high sovereign debt yields in that period, restricting the country to act counter-cyclically, at least in the short term (Checherita, 2010; Keegan et al., 2013). In contrast, most of the European countries (82%), adopted counter-cyclical healthcare governmental approaches, at least in 2009, to stabilize the economy and to face the increased need for public services, while the PHE remained fairly stable in that period (Keegan et al., 2013). In spite of this, as we can also verify in Figure 5 , during the Covid-19 pandemic, the Portuguese GHE did behave counter-cyclically, mainly because of the specific characteristics of this economic downturn (a global health emergency).

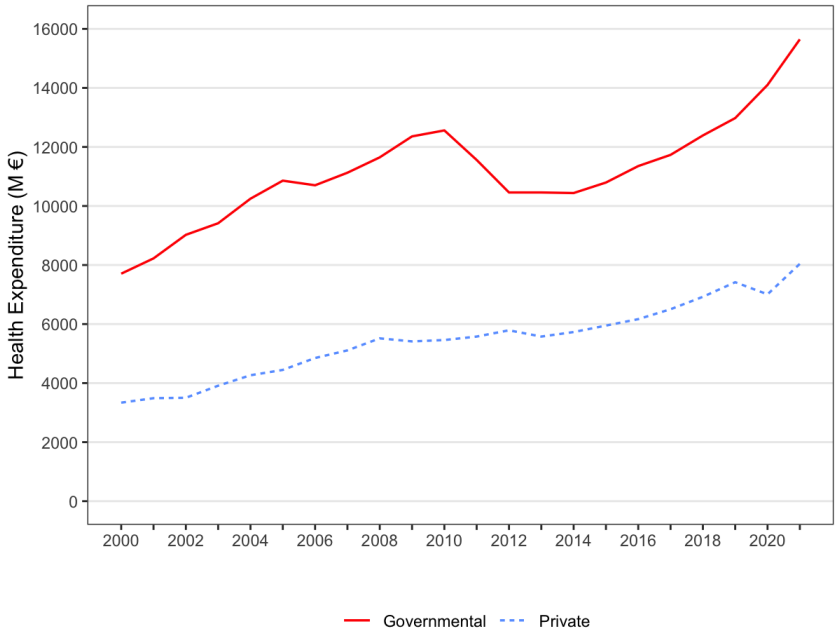


Figure 5. GHE vs PHE (adapted from Conta Satélite da Saúde – INE, (2022a)).

These periods of economic retractions and financial stress are good opportunities to analyse the market's performance, and due to the strain induced in the economy, they can reveal inefficiencies, trends, competition problems, and as some studies suggest, present good opportunities for public authorities to implement some necessary changes to increase the efficiency of the system (Cleeren et al., 2016; Cortès-Franch, 2014; Keegan et al., 2013). But even in this context, the healthcare sector due to its intrinsic structural characteristics, to its political significance, and to diverse social pressures, appears to be stable and less prone to changes, even in economic periods of contraction (Pickens, 2009). Healthcare employment also appears to be particularly resilient during different business cycles (Dillender et al., 2021), and contributing to a more stable business sector in times of economic instability, is the fact that the demand for healthcare services is price inelastic ($\varepsilon<1$) (but very heterogeneous within the healthcare sector) (Ellis et al., 2017), and appears to be income inelastic as well ($\varepsilon<1$) (Di Matteo, 2003; Farag et al., 2012; Getzen, 2000).

However, not all healthcare providers behave as the more diversified ones and as the sector as a whole. There is some evidence that in periods of economic slowdowns, due to the increased economic stress, financial strain, and changes in employment status, consumers may reduce their healthcare services usage (Gildemeister et al., 2012; Macy et al., 2013; Pickens, 2009), especially in services not covered by the NHS, such as dental care (Aranha

Rossi et al., 2019; Cortès-Franch, 2014) or less urgent services like physiotherapy (Thomson, 2009). Some types of healthcare services such as physiotherapy, might have a low priority in times of economic strains, especially when compared to other healthcare sectors. Physiotherapy services are usually not considered as first-aid needs, treatment programs usually range from several weeks to several months increasing the financial burden on the payers and reducing their willingness-to-pay (Fatoye et al., 2020), there's a high competition from other professionals such as massage therapists, osteopaths and personal trainers, and the sector is very labour intensive, making it vulnerable to the Baumol effect. In times of reduced income as in the 2008 and 2020 crisis, or high inflation as in the recent conflict in Ukraine, when consumers net income diminishes, stress will be felt on more vulnerable business areas, especially if access requires some kind of fee, like it did in the Portuguese NHS for a part of the users until 2022, or in the private sector (Legido-Quigley et al., 2016).

This eventual additional economic pressure on some healthcare sectors, should lead investors to design more robust business models, and to prepare some kind of financial buffer zones to bounce back from such periods. In this context, and since there are no studies on the economic behaviour/performance of the physiotherapy sector in Portugal, some questions remain open to explore, namely: Do physiotherapy private providers economically perform like the rest of the private healthcare providers, in times of economic downturns?; Do the different types of physiotherapy providers perform in a similar way during economic downturns?; Does the physiotherapy market entail a higher investment risk and increased vulnerability, and as such deserves a more thorough investment analyses and a more conservative approach to investment?; What are the main drivers of performance in this sector, and do they change according to the different phases of the economic cycles?.

2.2 The Portuguese physiotherapy market

2.2.1 Brief historical review

According to the World Confederation of Physical Therapy, "physiotherapists provide services that develop, maintain, and restore people's maximum movement and functional ability. (…) They can help people at any stage of life, when movement and function are threatened by ageing, injury, diseases, disorders, conditions, or environmental factors." (WCPT, 2022).

The terms physiotherapy and physiotherapist, first appeared in an official Portuguese government document in 1918, in a law related to the creation of an institute to treat the war-wounded ("Decreto nº 3751", 1918). The first health professionals to use the term "physiotherapist" were medical doctors ("Decreto nº 28794", 1938; "Decreto nº 38213", 1951), and physiotherapy was a medical specialty until 1970, when the naming of the medical specialty related to physical therapy was changed to *Medicina Física e de Reabilitação* (MFR) (Physical Medicine and Rehabilitation) and the medical doctor who specialized in MFR, was named physiatrist instead of physiotherapist ("Portaria nº 245/70", 1970). The first trainings in physiotherapy for non-medical doctors occurred in 1966, in the then recently created *Centro de Medicina de Reabilitação de Alcoitão* ("Portaria nº 22 034", 1966). After 1971, along with the first graduates from the *Alcoitão* school, physiotherapy became an independent technical profession ("Decreto-Lei nº 414/71", 1971).

According to the Portuguese law, "a physiotherapist is focused on the analysis and the assessment of body movement and posture, analysing the body structure and function, and using educational and specific therapeutic modalities, essentially based in movement, in manual therapy, and in physical and natural means. (…) He does so with the goal of health promotion, prevention of sickness, handicap, and inadaptation, and to treat, and rehabilitate individuals with physical, mental, and developmental disfunctions, and others such as pain, with the objective of helping them to achieve maximal functionality and quality of life." ("Decreto-Lei nº 564/99", 1999).

Physiotherapy education in Portugal evolved over the years, and currently has a four-year plan study, with 240 ECTS. Only physiotherapists can provide physiotherapy services ("Decreto-Lei nº 320/99", 1999), and after the first professional association in 1960, *Associação Portuguesa de Fisioterapeutas (*APF), the Portuguese government legislated in 2019 the current Portuguese Physiotherapists Association, *Ordem dos Fisioterapeutas* (OdF) ("Lei nº 122/2019", 2019), the first national physiotherapy professional association with regulatory powers, which concluded its implementation period in late 2021. The OdF regulates the professional activity and enrolment is mandatory to practice as a licensed physiotherapist.

Even though physiotherapy is an autonomous profession in Portugal, and private practices like cabinets can be exclusively operated by physiotherapists, in the context of the NHS and paid by the state, physiotherapy services can only be performed in MFR units (in interdisciplinary teams) with a physiatrist as clinical director (mandatory), physiotherapists, and eventually occupational and/or speech therapists.

2.2.2 Current professional status

Currently there are close to 13.500 active physiotherapists in Portugal (WCPT, 2022), but only approximately 10.000 are legally licensed by the OdF (OdF, 2022). This gap is explained by the recent implementation of this association, with around 3.500 active professionals still not registered, and effectively working illegally. Of the active physiotherapists, 1.000 are working in the NHS (APF, 2017). There is a country density of nearly 13 physiotherapists for 10.000 citizens (WCPT, 2022), but only 14 for 100.000 citizens in the NHS (OECD, 2022). The relatively low number in the NHS is partially due to the skill mix in public hospitals, that leads to a professional cohabitation between physiotherapists and rehabilitation nurses, who in some hospitals perform similar tasks in certain types of inpatient settings, and also due to financial constraints in some NHS rehabilitation units.

According to recent data from OdF (2022), there is a higher concentration of physiotherapists working in Lisbon, Oporto, and in the west coast of the country (Figure 6), and the age structure of the profession is very young, with the majority of physiotherapists below the 35 years old age group (Figure 7).

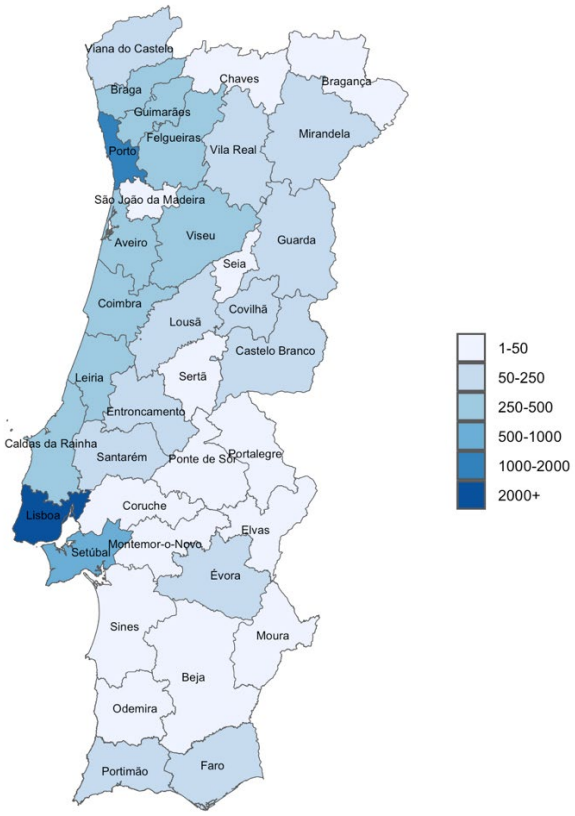


Figure 6. Number of physiotherapists per region of their workplace in continental Portugal (adapted from OdF, (2022)).

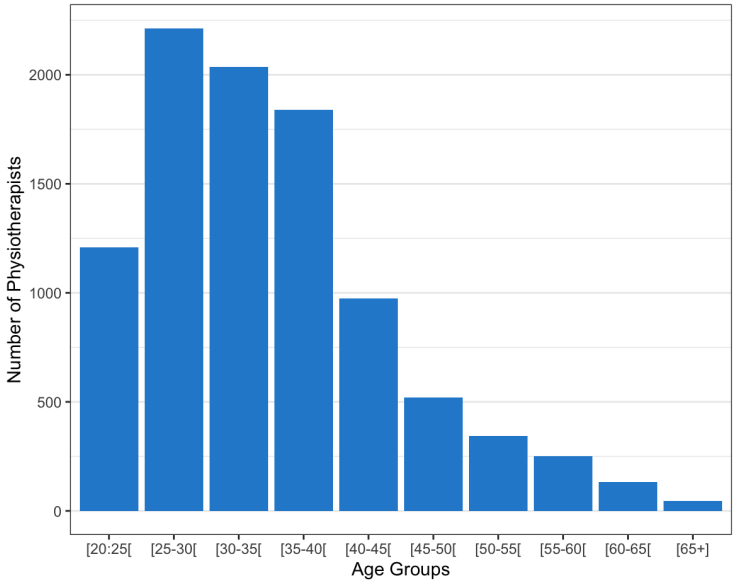


Figure 7. Age structure of the current Portuguese physiotherapy workforce (adapted from OdF, (2022)).

2.2.3 Types of physiotherapy units/providers

The physiotherapy sector is mainly divided in two types of units, the MFR and the non-MFR units/providers. The MFR units/providers can provide services through contracts with the NHS, VHI providers, health subsystems, or to private clients. The non-MFR units/providers can provide services through contracts with VHI providers, health subsystems, to private clients, but due to legal restrictions, not through the NHS. The MFR units are composed of interdisciplinary teams (mainly physiotherapists), with a physiatrist in charge of the clinical direction (mandatory condition to have a contract with the NHS). The non-MFR physiotherapy units provide physiotherapy services without the clinical direction of a physiatrist. These units can have the clinical direction of a non-physiatrist medical doctor (such as an orthopaedic surgeon), or provide services without a medical clinical direction, with physiotherapists providing physiotherapy services on their own.

The physiotherapy providers market in Portugal can be further divided into three sectors, the public, the social, and the private. The public sector includes public hospitals with MFR units, and some primary care units with non-MFR physiotherapy services. The social sector is organized in non-profit social entities, the biggest one being *Santa Casa da Misericórdia*, with MFR units all over the country, and some other entities with MFR and non-MFR physiotherapy units. The private sector is divided in MFR and in non-MFR units (physiotherapy solo units, and diversified healthcare units providing physiotherapy services).

2.2.4 Private and public hospital MFR activity

Physiotherapy services in all public and in the majority of private hospitals in Portugal are provided in the context of MFR settings. These providers are naturally extremely diversified, and physiotherapy services is clearly not their core business. Data from the INE IPHARA hospital survey (INE, 2022c) regarding the number of MFR appointments and the number of MFR treatments performed each year, is the best available proxy of the physiotherapy operational performance on all Portuguese hospitals. MFR medical appointments relates not only to physiotherapy, but also to occupational therapy, speech therapy, and physiatry medical consultations with no therapy associated. Notwithstanding, this data is the best available option to proxy the demand and operational performance of physiotherapy services in hospital providers. Data from the IPHARA hospital survey shows clear opposite trends in the public and in the private hospitals operational performance regarding the MFR activity since 2011 (Figure 8). Private hospitals have progressively increased their number of MFR appointments and performed services, contrasting to the progressive decline in the public sector. The expansion of the Portuguese private hospitals network of providers and their operational performance is in line with the increased usage of VHI and with the progressive ageing of the Portuguese population (one of the main drivers of physiotherapy services), factors that could naturally be contributing to the observed trends.

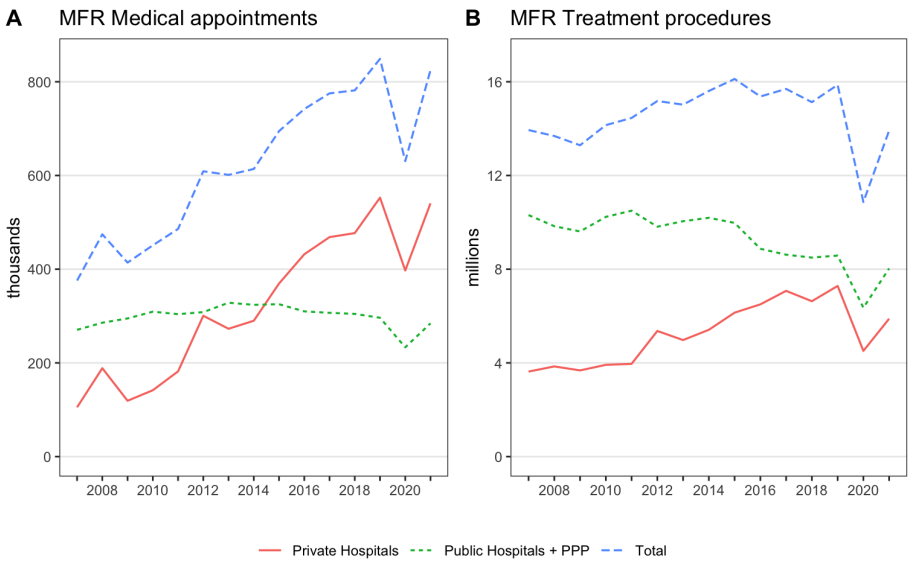


Figure 8. MFR appointments and treatment procedures in public and private hospitals (Adapted from the INE IPHARA survey data).

Contrary to the clear upward trend in the MFR operational activity in private hospitals, the public hospitals MFR activity has been slowly declining. Since there are no signs or publicly available information that points to a reduction on the supply side of these services in public institutions (the IPHARA data even points to an increase in the number of physiatrists in public hospitals in recent years), the observed reduction in operational activity could be the result of some sort of access constraints or a shift in the patients preferences toward the private sector. The Portuguese public hospital MFR waiting times for non-priority patients, that can range from 17 days in *Centro Hospitalar Médio Tejo EPE* up to 387 days in *Unidade Local de Saúde do Nordeste EPE*, (SPMS, 2023b) can eventually contribute to this phenomenon.

According to these trends in operational hospital activity and to the increasing number of MFR services in NHS contracted providers (SPMS, 2023a), increases in the demand for MFR and physiotherapy services appear to be channeled to the private sector, and progressively further away from public physiotherapy providers.

2.2.5 Access to physiotherapy services

There are essentially three ways to access physiotherapy services in Portugal. Through the NHS, through VHI or health subsystems, and through private access with full OOP payments.

Access via the NHS has a gatekeeping mechanism, where the primary care physician or a hospital physiatrist, acts as a gatekeeper, and the patient requires a referral to have access to the service. If the gatekeepers recognize the need for this type of treatments, they can refer the patient to an MFR unit in a public institution, or to a social/private MFR unit contracted by the NHS to perform services in their behalf. This type of access was partially free until 2022, and totally free since 2022 ("Decreto-Lei nº 37/2022", 2022). Before 2022, a relatively small number of citizens, mainly due to economic reasons, were not exempt from access fees and had to pay a user charge to access. These charges were implemented to control access and were not intended as direct funding mechanisms.

VHI schemes have been increasing their popularity in Portugal in the last decade (APS, 2022) (Figure 9), and have their own network of contracted physiotherapy providers, with MFR and non-MFR physiotherapy units (MFR - with physiatrist, non-MFR - without

physiatrist). This type of access can be totally or partially free, depending on the clinical situation, the VHI scheme characteristics, and the insurers policies.

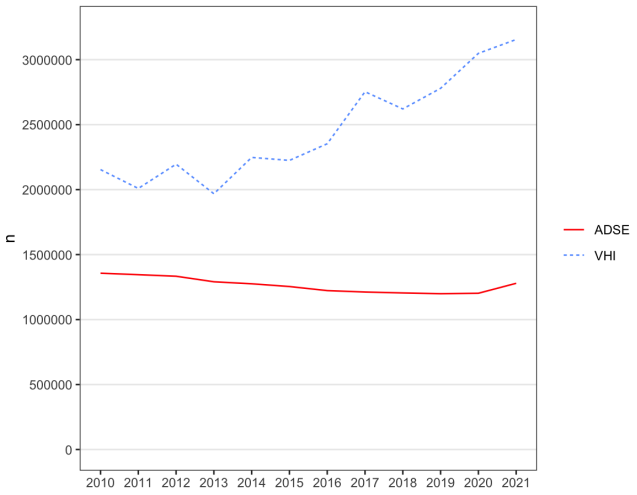


Figure 9. Number of VHI policyholders and ADSE beneficiaries (adapted from APS, (2022) and PORDATA, (2022b)).

Direct access via full OOP payments allows clients to have full freedom to access physiotherapy services at their will in private providers, directly paying the full-service fees. They can do so in a MFR setting or in a non-MFR physiotherapy unit/cabinet, as they wish.

In 2008, in a national study focused on the access to MFR units, the national health regulator *Entidade Reguladora da Saúde* (ERS) concluded that accessibility to these specific type of units was 94% nationwide, with only 6% of citizens living in a place more than 30 minutes away from an MFR unit (ERS, 2008b). Regional access iniquities were observed, especially in the rural regions of the country. The low number of physiatrists and the almost complete shutdown by the state of new contracts with the NHS since 2000, were identified as the main barriers to the expansion of this network of providers. They reiterated the need to allow new contracts between the NHS and new MFR providers, and even the possibility to develop physiotherapy home-based services, to improve accessibility without the need for new physical infrastructures (ERS, 2008a). At this moment, new contracts with the NHS remain hard or even impossible to obtain, but the total NHS expenditure with these types of MFR services/contracts continues to spiral (Figure 10).

Before 2014 the market was highly homogeneous and dominated by units within the NHS umbrella. This market characteristic was reported by the ERS in 2011, identifying that

more than 80% of the private MFR sector, had a contract with the state or with some kind of health subsystem, and admitting the existence of effective entry barriers to new players (ERS, 2011).

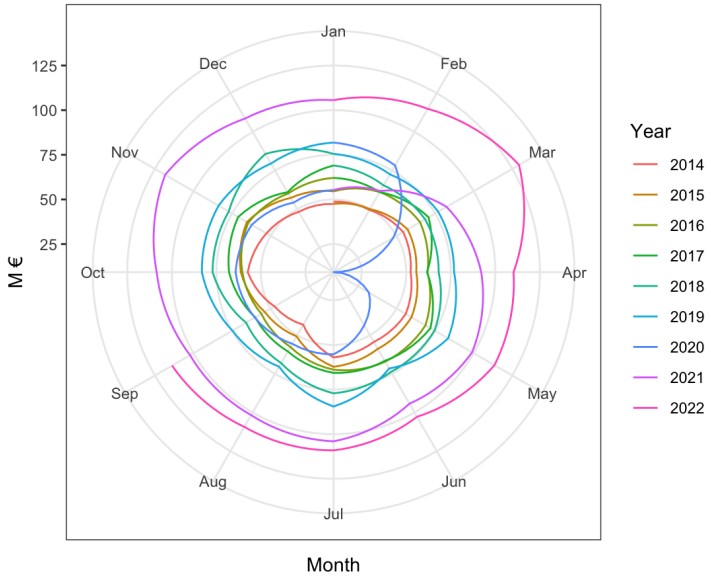


Figure 10. Total NHS expenditure in contracted MFR services (adapted from Portal da Transparência do SNS – SPMS, (2022)).

2.2.6 Historical market structure

A market study focused on MFR units has been made by the ERS in 2011, using the Herfindahl-Hirschman Index (HHI) and the CR_2 concentration ratio (CR), and dividing the country in 37 market regions (ERS, 2011). In 2010 there were 813 MFR units in the country, 48% of their workers were physiotherapists, 32% medical doctors, and the remaining were nurses, occupational and speech therapists, etc. (ERS, 2011).

The HHI is a measure of firm concentration and is the sum of the all squared market shares (firm output/total output) of the firms in the market (Ferguson, 1994).

$$HHI = \sum_{i=1}^{n} {S_i}^2$$

(${S_i}^2$ = square of the market share of the *i*th firm, n = number of firms in the market)

Equation 1. Herfindahl-Hirschman Index (HHI).

When the HHI is close to 0, the market is composed by a large number of firms with similar size, the closer to 1 the more concentrated the market is, and if HHI equals 1 that would reflect a situation of complete monopoly (Church, 2000).

The X-firm Concentration Ratio measures the cumulative market share of the largest X firms. When this ratio in close to 0, the X largest firms have a cumulative low share of the market, and if the ratio is equal to 1 that would reflect that they're the sole providers.

$$CR_x = \sum_{i=1}^{x} S_i$$

(S_i= market share of the *i*th firm, x = number of firms)

Equation 2. X-firm Concentration Ratio (CR_x).

In this ERS study the market structure was measured (only) by the seller concentration and market share, underemphasising the importance of other dimensions such as barriers to entry and service differentiation. These latter dimensions are usually more difficult to quantify, but should not be neglected when characterizing the market structure (Lipczynski, 2017). In 2011, 20 regions were classified as having a high concentration of MFR units according to their respective HHI, and in seven of them, the CR_2 ratio was 100%, meaning that the two units with the highest market shares were the only providers, dominating the entire region (Figure 11). In 14 of these 20 regional markets, dominant positions from MFR units were observed (ERS, 2011). Unfortunately, in this report the market studied didn't include the non-MFR physiotherapy units, and the CR_2 and HHI were calculated using the number of employees per provider as a proxy for market share, a questionable and limited approach. After 2014, and due to changes in the regulatory and licensing process, the market became more heterogeneous with a proliferation of private units, MFR and non-MFR ones, mainly without contract with the NHS, funded by VHI companies, healthcare subsystems, and by private users. The 2018 survey by the APF reflected this new reality (APFISIO, 2018), but as of this writing, no actual comprehensive study has been made to investigate these changes in the market's structure.

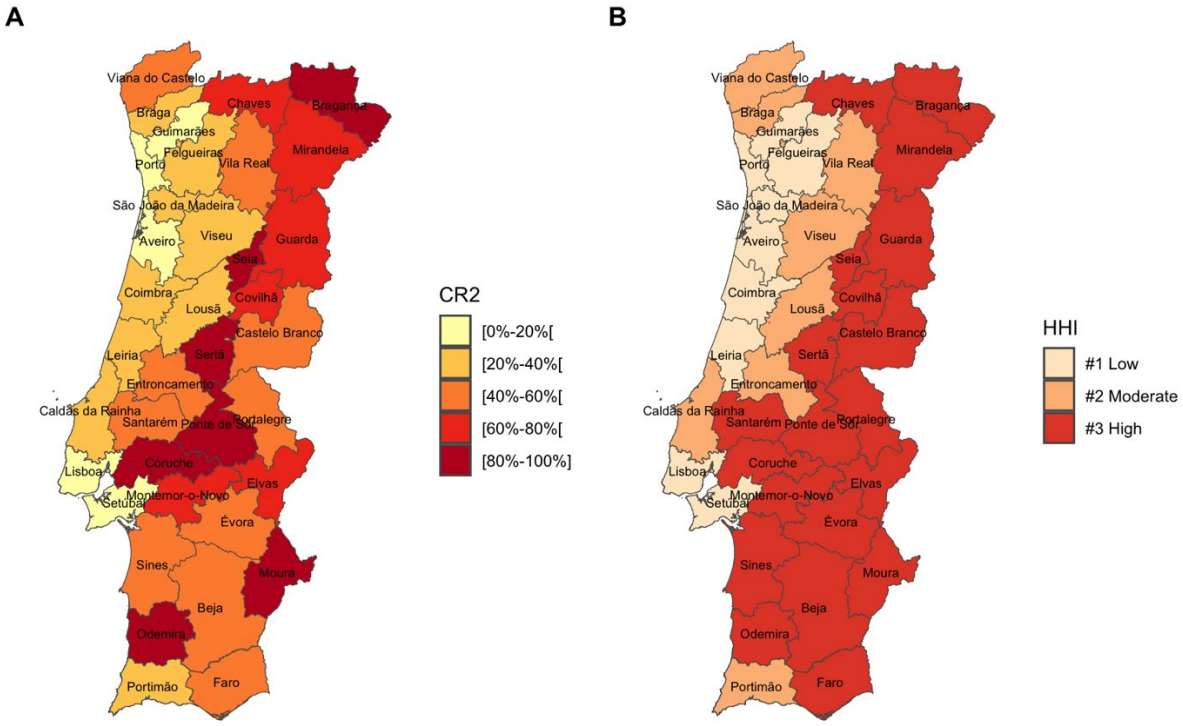


Figure 11. MFR units CR_2 (A) and HHI (B) concentration ratios per country region in 2010 (adapted from ERS, (2011)).

2.2.7 Entry barriers

In 2007, according to the ERS (2008b), there were two main entry barriers to new MFR units: the limited number of physiatrists, and the impossibility of new contracts between the NHS and new MFR providers. There were 482 physiatrists, for a total of 617 MFR units (ERS, 2008b). Considering that by law an MFR unit must have as clinical director a physiatrist, and that he can only direct one unit (in very specific conditions, two) ("Decreto-Lei nº 500/99", 1999), we can easily conclude that in 2007, there was a shortage of physiatrists, and several of them were in charge of two units. Currently there are 735 physiatrists (OM, 2022) for more than 735 MFR units, so the shortage of these specific human resources persists, and the impossibility of new contracts with the NHS remains an effective barrier, with no developments in this regard. As we have seen in Figure 7, the age structure of the physiotherapy workforce is very young, and no shortages of physiotherapists appears foreseeable in the near future. However, other possible entry barriers do exist, such as the necessary capital expenditure investment, and the associated sunk costs regarding the construction or adaptation of a physical structure to the requirements of a physiotherapy

unit. These infrastructures can go from a small medical office with an open space room, to large premises with several rooms for different kinds of therapy settings, and an assortment of physical therapy equipment. MFR units are under more legal requirements to operate than non-MFR units concerning the physical structure of the unit and require a higher initial investment. For all physiotherapy units, a registry in the national health regulator and its respective annual fees are also mandatory, as well as several insurance policies. Nevertheless, since most of the physiotherapy treatments consist in manual therapy, therapeutic exercises and simple electrotherapy treatments, not all these investments constitute high entry barriers, especially to new non-MFR units.

2.2.8 MFR NHS contracts

According to the Portuguese health system base law ("Lei nº 95/2019", 2019), the public system should be universal and comprehensive, but the private and social sector could be used by the NHS to improve its coverage and to complement some public services. This is achieved by a special type of contract, in what is called "*convenções*" ("Decreto-Lei nº 97/98", 1998; "Decreto-Lei nº 139/2013", 2013). In this way, from the user perspective, the public (free) physiotherapy services can be accessed directly at a public institution, or at a social/private MFR unit contracted by the state, as long as there is a referral from an NHS medical doctor/physician as we discussed previously. The social and private sector without these contracts with the NHS, can be accessed only through VHI schemes and health subsystems in MFR and non-MFR contracted institutions, or directly by the user in a full private manner (with no restrictions attached, not even a medical prescription).

New contracts with the NHS are almost impossible to obtain by the social/private sector since 2000 (ERS, 2008a), and the licencing process for new physiotherapy units, was very bureaucratic and difficult to comply until 2013, a factor that protected the market share of the providers already in business. After 2013, changes in the organization of the licencing process simplified these procedures and it became easier to open an MFR or a non-MFR physiotherapy unit ("Decreto-Lei nº 127/2014", 2014). However, the competition problem remains (especially in MFR providers), with the impossibility of new contracts with the NHS still in place. Despite the lack of new contracts with the NHS, the number of MFR appointments by referral from the NHS, and the number of associated therapeutic treatments performed in contracted MFR units, has been progressively increasing since 2014

(SPMS, 2023a). Considering this reality, the NHS continues to be a major client and an increasingly important payer/funder of the NHS contracted MFR physiotherapy providers.

Since the different types of physiotherapy units have different funding mechanisms, with the non-MFR units being legally deprived of the possibility of contracts with the NHS, this distinctive characteristic creates a potential competitive disadvantage for the non-MFR type of providers and for newly created MFR providers. The fact that new physiotherapy providers are deprived of contracts with the NHS, can also have a detrimental effect for the users and for the society. These effects can easily be observed *in-loco*, with the lack of innovation and limited implementation of new treatment modalities observed in these contracted institutions (in comparison with recent non-MFR units with much more differentiated services).

Recent musculoskeletal therapeutic modalities such as AlterG therapy, pulsed signal therapy, shockwave therapy, isokinetic assessment, isoinertial training, TECAR therapy, ultrasound-guided physiotherapy, percutaneous electrolysis therapy, among others, are not specifically covered by NHS MFR contracts, and are usually performed in providers with more market power, such as the non-MFR providers, or MFR providers without contract with the NHS. These recent treatment modalities fall into the same payment categories as much cheaper (although limited and sometimes outdated) treatment alternatives, not being paid accordingly to their true costs. As an example, muscular strengthening can be performed with just some free weights that can cost as few as 10-20 €, or with advanced isoinertial equipment that can cost several thousands. In spite of this, in a NHS MFR contract the payment for this treatment technique (muscular strengthening exercises) is exactly the same. This limitation is present in all treatment modalities. They have a fixed price in NHS contracts, independently from their technical differentiation or investment costs. Even when the treatment technique is technically similar, the delivered value (as assessed by Patient-Reported Outcome Measures - PROMS) can be substantially different across settings due to price constraints. The treatment technique "lymphatic drainage massage", a very specific form of massage frequently used after a mastectomy in oncologic patients, should usually be performed in around 45-60 minutes, but since the fixed NHS price is below the real cost for the technical recommended protocol, it is usually performed in 15-20 minutes in most NHS MFR providers. The value delivered to the patient will obviously be very different.

Having a contract with the NHS, despite its apparent competitive advantage (due to the large pool of NHS users), comes with a drawback. Units and providers in this context,

are truly price takers in these NHS contracted services, since payments by treatment procedures and their overall limits are defined by the payer (the state through its NHS), independently of their real service costs. NHS contracts provide a stable income for MFR contracted providers in times of economic stability, but with eventual shorter profit margins, they can limit the profitability, the resilience, and the freedom to adapt to new economic scenarios (and to the increasing demand for better quality services).

2.2.9 Determinants of performance

To the best of our knowledge, there are no previous studies focused on the economic or the financial performance of the private physiotherapy providers. As such, the drivers of the performance of these healthcare providers remain unclear. Notwithstanding, some authors studied the financial performance and profitability in other healthcare settings, but mainly in hospitals (Bai & Anderson, 2016; Bai et al., 2022; Burkhardt & Wheeler, 2013; Creixans-Tenas, 2018).

Widely used measures of performance are profitability ratios such as the Return on Assets (ROA), the Return on Equity (ROE) and Profit Margin (PM). ROA measures the return a firm earns on its assets, ROE the return a firm earns on its equity, and PM the profit over a certain period of time. While evaluating the drivers of profitability in hospitals, several characteristics have been studied and used as explanatory variables, namely: ownership (investor owned vs government owned vs not-for-profit), location, size (number of beds), teaching status, critical access designation (critical access vs noncritical access), and urban or non-urban location (Turner et al., 2015); and also short-term solvency, indebtedness, business size, GDP per capita, and population density (Creixans-Tenas, 2018). Alas, some of these performance determinants don't apply to private physiotherapy providers and lack a solid theoretic support for this specific economic sector.

To better understand the behaviour of the economic performance of the physiotherapy providers, to know the drivers of their performance is naturally a very valuable information. Unfortunately, as of this writing, this information is not readily available, and some questions remain open to explore: What drives the performance of this type of providers?; What determines their resilience (or the lack of) during economic shocks?; Are the drivers of their profitability the same in the different phases of the business cycles?.

3. Research motivation and objectives

To the best of our knowledge, there are no previous economic studies based on the current reality of the Portuguese physiotherapy private providers, and no studies focused on the performance of these providers in times of major economic downturns. Such analysis has some obvious obstacles to overcome. The market characteristics makes it difficult to separate the physiotherapy as a solo business market from other healthcare businesses, especially because physiotherapy services are available in units that offer other healthcare services as well, and some micro businesses and individual providers don't have public financial accounting, making their economic and financial performance impossible to assess. In spite of these market characteristics, due to the pertinence of this topic, such analysis appeared to be useful, even in the presence of such relevant drawbacks.

In order to study the impact of the last two major economic shocks in the performance of the Portuguese physiotherapy private providers, this study's objectives were:

1) to describe the main characteristics of the current Portuguese physiotherapy market,
2) to assess the physiotherapy private providers economic performance in times of major economic downturns,
3) to evaluate if in these periods the physiotherapy providers performed in the same way as the rest of the healthcare private sector,
4) to investigate if the physiotherapy MFR and non-MFR private providers had different economic performances, since they have different funding characteristics,
5) to investigate if there were regional patterns in the observed performance,
6) and to determine the main drivers of performance/profitability in this type of healthcare providers.

The pertinence of this study is to fill an obvious gap of knowledge, gathering and creating information/knowledge that can allow a better understanding on how these specific healthcare providers perform in different economic cycles, and to help future investors to make better informed decisions and design robust business models as preparation for future periods of uncertainty.

4. Methodology

To achieve this study's objectives, we developed a retrospective observational study. We studied the economic performance of the private physiotherapy providers with units listed in the Record System of Regulated Units (SRER) of the ERS, as providing physiotherapy services in MFR and non-MFR settings. This list of registered and regulated units and providers is publicly available at the ERS website. Due to the large heterogeneity of the private physiotherapy units and providers, the inclusion and exclusion of units/providers for our sample is thoroughly detailed in section 4.1.

Section 4.2 and section 4.3 detail the chosen performance indicators and assessment methodology, partially adapted from a similar study (Ríos, 2022). Economic and financial data was collected for the 2007-2021 period, from the SABI Informa database from Bureau van Dijk (BvD). This period was chosen to capture the economic downturns associated with the external financial intervention in Portugal during the 2011-2014 period, the following economic upturn, and the downturn associated to the Covid-19 pandemic in 2020-2021.

4.1 Physiotherapy units/providers selection

The physiotherapy private units and providers included in this study are publicly listed in the ERS website as providing physiotherapy services through integrated MFR units, as well as providing physiotherapy services without the integrated approach of an MFR unit. This includes all registered physiotherapy units in continental Portugal but excludes all units from the autonomous regions of Madeira and Azores, because they operate in political autonomous regions, each with a specific health regulator, unique market characteristics, and are outside the scope of the continental ERS and NHS.

The SRER units and providers search engine, available at the ERS website (https://www.ers.pt/pt/prestadores/servicos/pesquisa-de-prestadores/), was used to list all units with physiotherapy services. A search in the ERS search engine was conducted for units with MFR (n=1087) and non-MFR physiotherapy services (n=3885). After listing these 4972 records, duplicates and closed records (n=413 and n=531, respectively) were removed, culminating in 4028 records of unique active physiotherapy units. Duplicates were records of units that appeared listed in both search queries and old versions of already updated

records, and closed records were inaccessible records of inactive units, etc. Figure 12 summarises the entirety of the sample selection process.

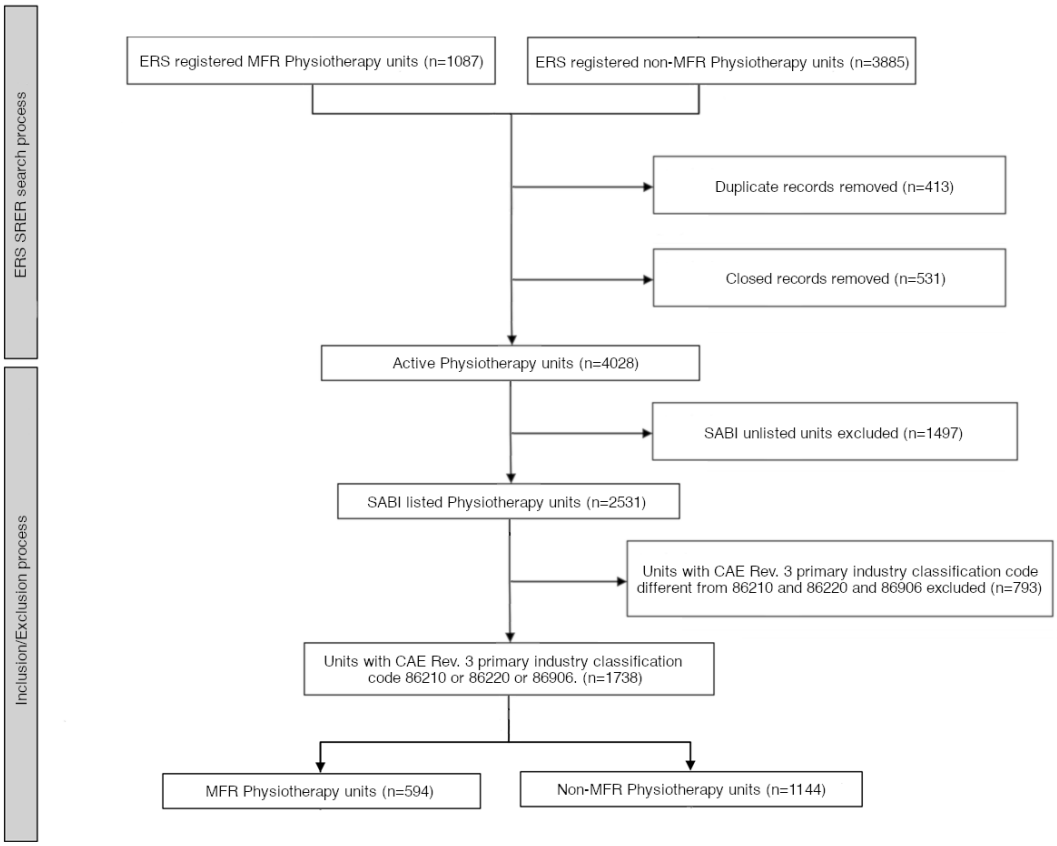


Figure 12. Physiotherapy units inclusion/exclusion diagram.

Information from the 4028 listed units, such as name of the unit, ownership/provider, Provider Tax Identification Code (NIPC), postal code, type of physiotherapy setting (non-MFR vs MFR), was collected with the use of an R script (Appendix A). Units with a contract with the NHS were identified from NHS providers lists, publicly available in the different regional health authority's (*Administração Regional de Saúde* - ARS) websites.

In this study the units and providers were identified as being part of different RRAS market regions (*Regiões de Referência para Avaliação em Saúde*). These geographical regions were defined by the regulator, and they divide the country into 37 areas of effective competition, usually with 2.000-4.000 km^2, 25 km radius and within a 30-minute trip from their centre (ERS, 2008b). The demand for healthcare services is naturally determined by the

geographical distance to the providers, and the longer the distance, the higher the direct costs, but also the opportunity costs related to the travel time. If the disutility generated by these costs is higher than the utility generated by the healthcare service, there will be no incentive in using the service. In line with this, the option for utilizing the RRAS region system, instead of the commonly used Nomenclature of Territorial Units for Statistics (NUTS), seemed more appropriate for this analysis. The RRAS system was developed by the ERS, based on the NUTS III 2002 system. Larger NUTS III regions were divided into smaller catchment areas, to represent regions of effective competition between existing service providers. Appendix B can be used for a visual comparison between the current NUTS III 2013 and the RRAS regions used in this study.

Most physiotherapy services are provided in multidisciplinary units and institutions, who also provide other healthcare services, culminating in a highly heterogeneous market. In order to include units and providers closely related to physiotherapy services and exclude those whose main activity is clearly not physiotherapy, a preliminary analysis of the characteristics of these units was performed. After collecting information from the physiotherapy units from the SRER database (n=4028), their listing status in the SABI database was analysed, and the providers main economic activity code (CAE Rev. 3) was obtained. From the 4028 units listed as active physiotherapy units (MFR and non-MFR) in the SRER database, 1497 were found not to be listed in the SABI database (Figure 13-A).

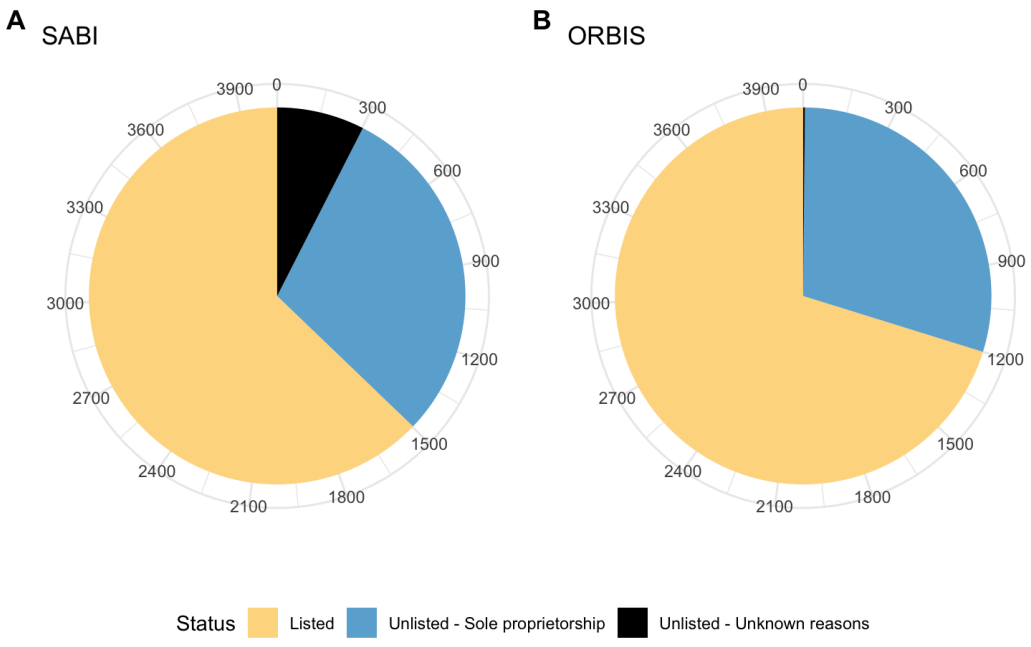


Figure 13. SABI BvD (A) and ORBIS Global BvD (B) listed and unlisted physiotherapy units.

Appendices C and D details the regional distribution of the physiotherapy units listed and unlisted in the SABI database.

To track additional information from these unlisted units, a search was performed in the ORBIS Global database (also from BvD). ORBIS shares SABI data sources but has different data processing characteristics and different historical record (Figure 13-B).

As can be seen in Figure 13-A, there were nearly 1500 units unlisted in the SABI database, 300 for unknown reasons and around 1200 due to ownership characteristics (sole proprietorship units don't have publicly available accounting). Almost all of the 300 unlisted units for unknown reasons in the SABI database were found to be listed in ORBIS, but no actual economical or financial information was available. Despite the large scope of these databases and the large amount of information available, some issues with the lack of coverage and representativeness from databases from BvD are known to exist (Bajgar, 2020; Gal, 2013; Kalemli-Özcan, 2022; Liu, 2020). Sometimes providers listed in SABI have no financial information at all, in other cases data from some variables is not available, and coverage varies over time. The same has been observed in ORBIS (Kalemli-Özcan, 2022). The reasons for this lack of coverage in BvD databases are multiple. There is a reporting gap of up to two years on recent data, firms are erased from the database if not reporting for some time, and efforts from BvD to improve coverage have been implemented progressively throughout the years, making longitudinal coverage more volatile (Kalemli-Özcan, 2022).

Almost 1200 unlisted units are units with a sole proprietorship. This type of legal ownership does not oblige owners to have publicly available accounting, and due to this fact, they are not listed in any financial or economic statistics database, being impossible to track and analyse. The remaining 2531 units were analysed regarding their providers CAE Rev. 3 primary economic activity code (Figure 14).

As can be seen in Figure 14, the physiotherapy market is highly heterogeneous, and this type of service is performed in a variety of providers, with very different primary economic activity codes. More than 50% of the units are from providers with primary economic activity code 86906 (Other human health activities (non-specified)). From the CAE Rev. 3 healthcare division list of codes (Table 2), 86906 is the code for "non-specified" healthcare activities such as physiotherapy services, but physiotherapy units in conjunction with other medical activities such as the case of MFR units, can be included in codes 86210 (General medical practice activities) or 86220 (Specialist medical practice activities). All units from providers with different primary activity codes, such as 86100 (Hospital activities),

86230 (Dental practice activities), 87300 (Residential care activities), or 93130 (Fitness facilities) are in a setting in which physiotherapy is clearly not the primary economic activity.

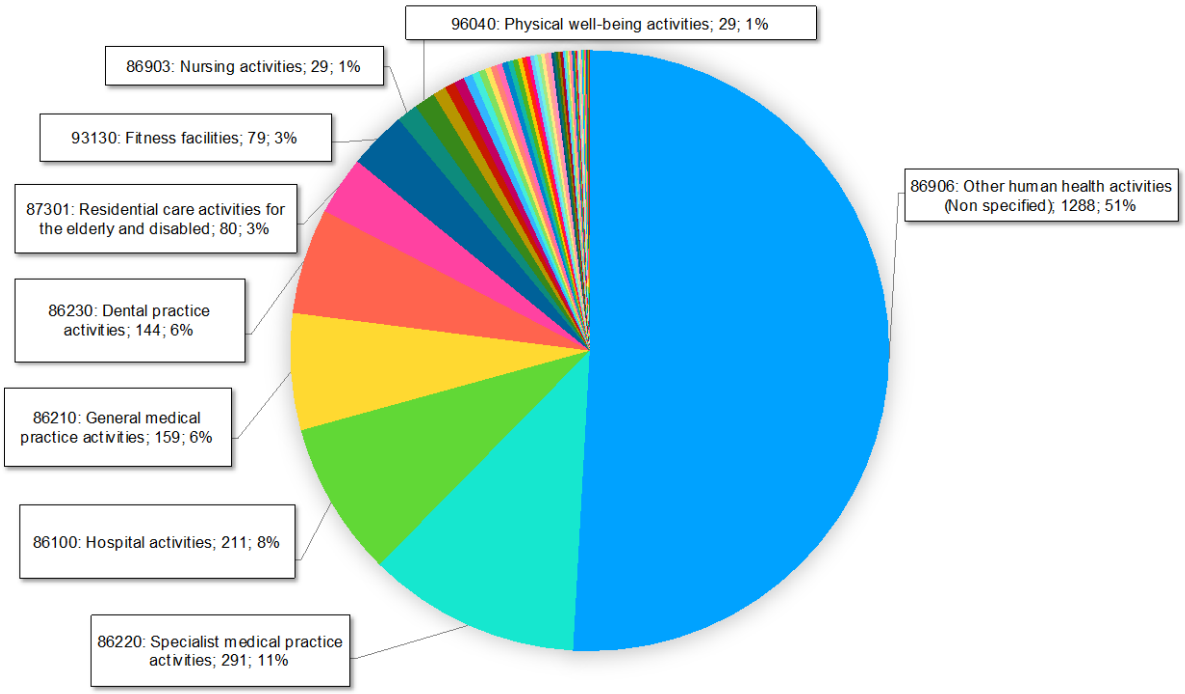


Figure 14. SABI listed physiotherapy units/providers CAE Rev. 3 main activity code.

Table 2. CAE Rev. 3 list of codes for healthcare activities (division 86) (adapted from INE, (2007)).

Division	Group	Class	Subclass	Description
86				Human health activities
	861	8610	86100	Hospital activities (with inpatient services)
	862			Medical and dental practice activities (outpatient)
		8621	**86210**	General medical practice activities (outpatient)
		8622	**86220**	Specialist medical practice activities (outpatient)
		8623	86230	Dental practice activities
	869	8690		Other human health activities
			86901	Clinical analysis laboratories
			86902	Emergency response activities
			86903	Nursing activities
			86904	Organ collection and organ storage banks
			86905	Geothermal therapeutic activities
			86906	Other human health activities (non-specified) (Physiotherapy, speech therapy, acupuncture, massage, homeopathy, osteopathy, psychology, optometry, etc.)

Taking this into consideration, and to analyse a more homogeneous group of physiotherapy providers, better aligned with the physiotherapy market, this study includes physiotherapy units and providers who simultaneously meet the following entry criteria:

- Active units and providers listed in the SRER database in the ERS website, as providing physiotherapy services (in MFR or in non-MFR physiotherapy settings) (MFR units have a physiatrist as clinical director, while non-MFR units are medical units with physiotherapy services (but no physiatrist), and other settings such as physiotherapy units run exclusively by physiotherapists).
- Units and providers listed in SABI database with the following CAE Rev. 3 primary economic activity code: 86210 (General medical activities) or 86220 (Specialist medical activities) or 86906 (Other human health activities).

Units and providers who meet at least one of the following criteria were excluded:

- SABI unlisted units/providers (e.g., sole proprietorship providers don't have public accounting records and are not listed in the SABI database).
- Units and providers who are listed in the SABI database with a primary economic activity code different from those defined in the inclusion criteria (≠86210 and ≠86220 and ≠86906). The main activity of these providers is clearly not physiotherapy (e.g., hospital activities, dental practice activities, fitness facilities, residential care activities, etc.).
- Public units/providers (e.g., CAE Rev. 3 84100 and Public Business Entities (EPE)).

After applying the entry and exit criteria, 1738 units were included in this study. Figure 15 details a bit further the set of 1738 units included by CAE Rev. 3 primary code, and Figure 16 by type of physiotherapy setting and service provided.

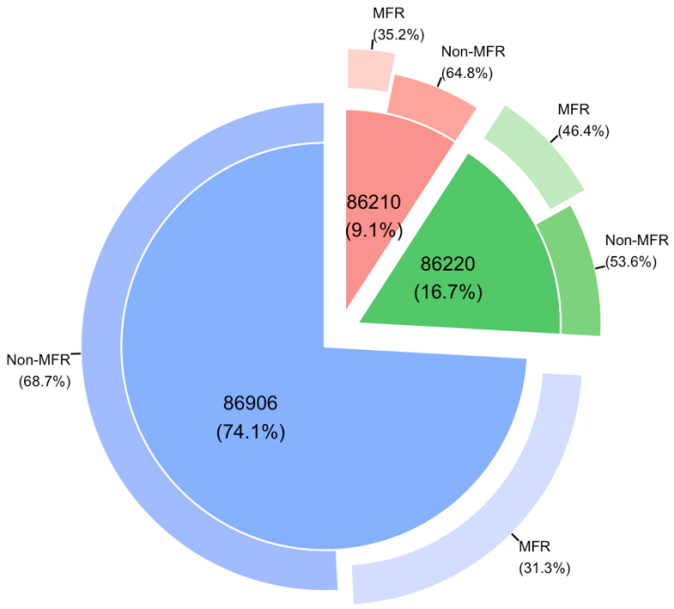


Figure 15. Units included in the study classified by CAE Rev. 3 primary activity code, and by type of physiotherapy setting (%).

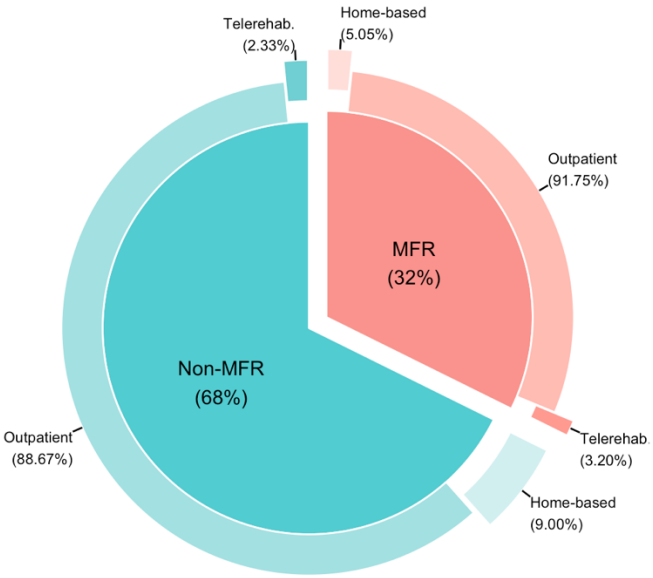


Figure 16. Included units classified by type of physiotherapy setting and by type of service (Home-based/Outpatient/Telerehabilitation).

As can be seen in Figure 16, some of the units included in the study are registered as home-based units (mobile units with no physical address assigned) or as telerehabilitation units. After close inspection of all the units included, it became apparent that several units belong to the same provider. There are cases in which the same provider has several

outpatient units in different RRAS regions, and cases in which home-based and telerehabilitation units belong to the same provider of an outpatient physical unit. Since the SABI database is organized by provider (each with a unique NIPC identification code), and that units belonging to the same provider naturally share the same NIPC code, it is impossible to separate the economic and financial information for each specific unit, and as such, performance was assessed by provider and not by individual unit. The number of providers analysed is consequentially inferior to the number of units included (Table 3). Appendix E details the regional distribution of these providers.

Table 3. Number of units vs providers.

	MFR	**Non-MFR**	**Total**
Units	594	1144	1738
Providers	471	932	1403

A subgroup of the included physiotherapy providers was defined, including providers whose company name includes at least one of the following terms: "Fisi", "Physi" or "Reab" (n=515). This subgroup was used for control purposes and includes providers that clearly suggest in their company's name, that their main focus is physiotherapy and/or physical rehabilitation services (MFR or non-MFR).[1] The focus of this subgroup analysis was to assess if a stricter selection process regarding the physiotherapy providers group, would lead to different conclusions, since physiotherapy services are usually performed in providers who also provide other healthcare services (Perreault et al., 2014).

[1] Due to the holistic nature of human health, healthcare services are usually performed in units and providers with multidisciplinary approaches and services. This intrinsic characteristic of the healthcare sector is especially present in the physiotherapy providers market. As seen in Figure 14, these services are performed by providers with very heterogeneous economic core activities. In this study we defined the inclusion/exclusion criteria, to study a homogeneous group of providers, excluding those whose main economic activity was clearly not physiotherapy. Notwithstanding this approach, we recognize that to align with the multidisciplinary nature of the physiotherapy providers, we've included units/providers that provide additional services outside the boundaries of physiotherapy *per se*, e.g., specialized medical services, occupational therapy, speech therapy, etc. We've done this conscientiously, but we recognize that this fact will be reflected in the providers economic and financial performance indicators, since accounting records are usually not segmented by function. Taking this into consideration, we've decided to also study a subgroup of our set of included providers, with a stricter inclusion criteria. The units in this subgroup, utilizing physiotherapy related terms in their company's name, seem clearly more focused on physiotherapy services *per se*. In our opinion they don't reflect the true heterogeneous characteristics of the physiotherapy providers market, but we studied them specifically nonetheless, to investigate if a stricter selection process would lead to different results and conclusions.

4.2 Performance indicators

Performance in this study was proxied by the providers annual Sales, EBITDA (Earnings Before Interest, Taxes, Depreciation and Amortization), and profitability ratios (ROA and ROE), mainly because growth and profitability are key factors in determining the providers capacity to survive during economic downturn periods, and their resilience to future economic shocks.

The rationale behind the choice of these indicators is that the annual Sales evolution of a sector of economic activity is a classical measure of its growth, and through the EBITDA, we can circumvent some accounting normalization issues associated with the Net Income, namely the different individual approaches to depreciations and amortizations, and the return owed to foreign stakeholders (lenders through financial interests and the state through taxes). We believe that the ROA provides a very valuable information, because a provider must generate an ROA above its financing costs to increase value, and that the ROE (focusing on Equity return) is also a key measure, due to the fact that shareholders must have a proper return on their investments, and because it is through equity growth that a provider can increase its debt capacity to finance more growth and to sustainably increase its assets (equity-funded or through borrowed funds).

Financial profitability was proxied by the Return on Equity (ROE) ratio. ROE can be defined as the ratio between Net Income and Equity (Equation 3), usually being used as an indicator of the return on own funds. Economic profitability was proxied by the Return on Assets (ROA) ratio. ROA is a variant of Return on Investments (ROI), which excludes the impact of financial costs from the calculation, being defined as the ratio between Net Income and Total Assets (Equation 4). It is an indicator of a providers effectiveness to take advantage of its own assets to generate profits (Chang et al., 2014; Ríos, 2022).

$$ROE = \frac{Net\ Income}{Equity}$$

Equation 3. Return on Equity (ROE).

$$ROA = \frac{Net\ Income}{Total\ Assets}$$

Equation 4. Return on Assets (ROA).

For a deeper analysis using the DuPont framework, these ratios were broken down into three components as performed by Ríos (2022): Profit Margin (PM), Assets Turnover (AT) and Financial Leverage (FL) (Bai et al., 2022; Turner et al., 2015).

According to the DuPont equation, ROE is dependent of PM, AT, and FL, and ROA is dependent on PM and AT (Equation 5). With such decomposition we can study the contribute of each component, to the global profitability ratio as done previously in the healthcare industry (Bai et al., 2022; Turner et al., 2015). In a DuPont analysis, PM is an indicator of profitability related to the revenue, AT is an indicator of efficiency in assets utilization, and FL is an equity multiplier related to the capital structure (Chang et al., 2014; Turner et al., 2015).

$$ROE = PM * AT * FL \qquad ROE = \frac{Net\ Income}{Turnover} * \frac{Turnover}{Total\ Assets} * \frac{Total\ Assets}{Equity}$$

$$ROA = PM * AT$$

Equation 5. DuPont equation.

$PM = \frac{Net\ Income}{Turnover}$	$AT = \frac{Turnover}{Total\ Assets}$	$FL = \frac{Total\ Assets}{Equity}$

Equation 6. Profit Margin (PM), Assets Turnover (AT) and Financial Leverage (FL) equations.

4.3 Economic and financial data collection and statistical analysis

Economic and financial data collected, spans from 2007 to 2021, and was obtained from the SABI database using as reference the NIPC code of the included physiotherapy providers. This data was used for comparisons between the private physiotherapy providers and the rest of the private healthcare providers (CAE Rev. 3 primary activity code 86), and between MFR providers and non-MFR physiotherapy providers.

The following annual economic and financial data was obtained from SABI database for all the providers included in the study: Number of Employees (NE), Sales, EBITDA, ROE, ROA, Net Income (NI), Turnover (Operational Revenue), Total Assets (TA) and Equity. Components of the profitability ratios (PM, AT, and FL) were calculated for a DuPont analysis. For comparison purposes, these same indicators were collected from the

SABI database for the rest of the healthcare providers (CAE Rev. 3 code 86, excluding EPE's and Public Private Partnerships (PPP)). Due to the relatively long time span (15 years), Sales and EBITDA were converted to constant prices (base 2007) to adjust for the inflation effect. The INE Consumer Price Index (CPI) for the healthcare sector was used for these adjustments (Appendix F).

Descriptive statistics were used and analysed for each studied group. These statistics were used to analyse outliers, number of Not Available (N.A.) values, and the distribution characteristics of the variables. The commonly used Tukey boxplot rule for outliers detection (Shevlyakov et al., 2013; Torgo, 2016) was used for outliers detection within each variable and year.

To compare the impact of the economic downturns between sectors and types of physiotherapy providers, a Difference-in-Differences (DiD) method was used, as described by Fredriksson (2019). In a DiD approach a combination of before-after (some event or intervention) and studied-control group comparison is performed, calculating the before-after difference in outcomes in the studied group, and subtracting from this the before-after difference in the control group (Equation 7) (Fredriksson, 2019; Goodman-Bacon, 2021).

$$\hat{\delta}_{kU} = \underbrace{\left(\bar{Y}_k^{\,post(k)} - \bar{Y}_k^{\,pre(k)}\right)}_{\Delta\, k} - \underbrace{\left(\bar{Y}_U^{\,post(U)} - \bar{Y}_U^{\,pre(U)}\right)}_{\Delta\, U}$$

$\hat{\delta}$ = DiD estimate.
k = group 1 (studied group).
U = group 2 (control group).
$\bar{Y}$ = outcome variable mean.
post ( ) = post-intervention period.
pre ( ) = pre-intervention period.

Equation 7. DiD estimator formula (Goodman-Bacon, 2021).

One of the main assumptions required for this approach is the existence of "parallel trends" between groups in the "before" period. This assumes that the studied group would have followed the same trend as the control group, if no treatment or event had occurred. The parallel trends assumptions can be tested formally through "placebo regressions" as suggest by Fredriksson (2019) and performed by Schnabl (2012). In a placebo regression test, a DiD analysis is performed on the "before" period of the main analysis (naturally at least

two "before" periods must be available to perform this test). If no significant differences are encountered when comparing the outcomes between groups in the "before" period, parallel trends can be assumed, and the main DiD results can be accepted. From the time span of the study (15 years), two four-year periods (2010-2013 and 2018-2021) were chosen for between groups comparisons (using the DiD approach). These periods encompassed two years before the two biggest GDP drops in the analysed period (2012 and 2020) and the two subsequent years. In the first shock, we chose to consider the aftershock period beginning in the year with the most economic impact, 2012. We chose to do this, because the external intervention with its major austerity policies didn't impact the country immediately in 2011, but in the following year, because the national government budget for 2011 was already approved and in practice in 2011. Regarding the second shock, the aftershock period began in 2020, since the impacts of the Covid-19 recession were felt immediately in 2020.

Two multiple regression models using the Ordinary Least Squares (OLS) approach (one for explaining the ROA and one for the ROE) were estimated, to search for the profitability determinants of the physiotherapy providers. A year from an upturn period (2019) and the year with worst economic recession (2020) were chosen for data analysis. To obtain the best possible models, a backward stepwise selection of variables was used to select from the available explanatory variables, the most relevant ones for each specific model. For comparative purposes, we prioritized the selection of variables obtained from the stepwise selection using the 2019 data and used that selection of variables in the subsequent 2020 model.

In the absence of previous studies regarding the profitability drivers of the physiotherapy providers, we used theoretical and empirical knowledge to choose possible explanatory variables, assuming that they could be related to the observed profitability. These variables were: **1)** being an MFR provider (dichotomous variable) (as we have seen they have different funding characteristics, which can have a differential impact on profitability); **2)** the number of employees (NE) of the provider (possible structure size effect on profitability); **3)** Sales (possible sales volume effect on profitability); **4)** percentage of payments to staff dedicated to self-employed workers (some providers may rely more on self-employed workers instead of contracted employees, influencing their profitability); **5)** labour-intensiveness of the provider (percentage of total costs dedicated to payments to staff) (the degree of labour-intensiveness could influence the providers profitability); **6)** owning their business premises (dichotomous variable) (the presence or absence of owned premises in the

non-current assets can potentially influence the ROA); **7)** being located in a rural civil parish (dichotomous variable) (INE, 2014) (some rural regions have competition issues while others very low population density, which can lead to abnormal profits or reduced demand/supply, respectively) (Carter & Rizzo, 2007; Freburger & Holmes, 2005; Goode et al., 2013); **8)** the municipality ratio between the number of primary and secondary activity sector employees vs the tertiary sector (PORDATA, 2021) (a higher number of employees in the primary and secondary sector can increase the demand for physiotherapy services due to an increased risk of physical injuries); **9)** the municipality aging index (PORDATA, 2020) (the older the population is, the higher the demand for physical therapy services) (Rommel & Kroll, 2017b); **10)** the municipality average monthly income (INE, 2020b) (the higher the income, the higher the demand for healthcare and physiotherapy services) (Freburger & Holmes, 2005; Rommel & Kroll, 2017b; Siqueira et al., 2005); **11)** the municipality yearly number of road accidents with injuries (INE, 2020a) (the more accidents with injuries, the higher the need for physical rehabilitation services); **12)** having a contract with the NHS (dichotomous variable) (SPMS, 2023a) (empirically the NHS is regarded as a high volume "client", but a bellow average "payer"); **13)** having a contract with the ADSE health sub-system (dichotomous variable) (ADSE, 2023) (an alternative funder available to civil workers); and **14)** having a public hospital with MFR services in the region (dichotomous variable) (SPMS, 2023b) (a natural substitute for the physiotherapy private sector).

Explanatory variables 2-6 were obtained from the SABI database (more detail further ahead), while variables 7-14 were obtained from different external sources as referenced.

A K-Means clustering analysis was performed to search for regional patterns within the observed performance indicators. The K-Means partitioning algorithm, initiating with an assigned number of groups/clusters with randomly allocated observations, through an iterative reallocation process, commonly using the Euclidean distance as a distance function, seeks to maximize the inter-cluster dissimilarity and intra-cluster similarity, to achieve the best possible cluster grouping allocation (Mussabayev et al., 2023; Torgo, 2016). An agglomerative hierarchical clustering algorithm was also used to serve as a reference point to the outcomes obtained from the K-means analysis, using the "complete linkage" merging method. This process starts with all the cases available, and at each iteration the cases that are most similar are grouped together, resulting in a hierarchical dendrogram (Torgo, 2016).

MS Excel 16.67 was used for database and spreadsheet processing, and R 4.2.2 and RStudio 2022.07.2+576 for statistical and data processing analysis.

5. Results

In the next sections we present the results from our data analysis. Section 5.1 details the missing data and our approach to outliers. In section 5.2, we provide a brief description of the included physiotherapy providers, including their geolocation, their structure by number of employees, and their share of the sales volume within the private healthcare sector. In section 5.3, we describe our results focusing on the impact of the two biggest recent economic shocks. In section 5.4, we report the results from our DuPont analysis, in section 5.5 the results from the regression models regarding the drivers of profitability of the physiotherapy providers and in section 5.6 of our K-Means cluster analysis.

5.1 Data

5.1.1 Missing data

Missing data in the SABI database is classified as N.A. (Not Available). This data is absent for several unspecified reasons (lack of coverage in some particular years, periods before the providers birth, etc.). SABI data, contrary to other databases from BvD such as ORBIS, is not pre-processed and includes raw values without any kind of filtering, consequentially increasing the amount of available data, but also the disproportionate number of outliers that might affect the robustness of the computed indicators of performance. Data was analyzed using the available cases, and as such, the number of observations will vary from year to year, and between variables.

5.1.2 Outliers

All the data from the different variables was analysed and the outliers and anomalies were inspected. In the case of the profitability ratios and of growth rates, there were numerous cases of extreme values. Most of these values were cases when the denominator of the ratios or the base period for the growth rates was extremely low. There were several cases of Total Assets and Equity below 100 euros, and many of them with just a few cents, resulting in extremely high or extremely low profitability ratios. After careful inspection and

consideration, all far outliers were removed on a yearly analysis for each of the variables.[2] The rationale for this approach was that a large part of these values were anomalies that didn't represent robust indicators of performance and were the result of the limitations in how ratios and growth rates are calculated. To use a standard criterion, only the values considered far outliers[2] were removed from the analysis. Positive profitability ratios obtained from dividing a negative numerator by a negative denominator were classified as N.A.

5.2 Brief description of the physiotherapy providers

5.2.1 Geolocation

Portuguese physiotherapy professionals and providers tend to be more concentrated in the coastal side of the country and in the two biggest metropolitan areas (Oporto and Lisbon). Our sample of physiotherapy providers followed this pattern. As can be seen in Figure 17, most of the included providers are located in the Oporto and Lisbon regions, in line with the country pattern of physiotherapists geographical distribution (Figure 6).

5.2.2 Number of employees

Using the number of employees (NE) by provider in 2021 (with outliers included), we observed that the physiotherapy sector is largely (83%) composed by micro providers (≤9 employees) (Figure 18-A). Small and medium providers (10-249 employees) have a relevant position in the physiotherapy sector (17%), but minimal in the healthcare sector (3%). The number of large providers (≥250 employees) is residual in both sectors (<1%), being virtually absent in the physiotherapy sector as we described it.

The used staff headcount for the classification of micro, small & medium, and large providers, was defined in the EU recommendation 2003/361 (EU_Commission, 2003). Since most healthcare and physiotherapy providers are micro providers (≤9 employees), we further divided this group in categories more focused on micro providers (Figure 18-B).

[2] All values outside the rule-of-thumb interval [Q1 – 3 x IQR; Q3 + 3 x IQR] were considered far outliers and were removed. The following analysis doesn't include these outliers, unless stated otherwise.

As can be seen in Figure 18-B, more than half of the physiotherapy private providers have less than four employees. This characteristic is especially present in the non-MFR physiotherapy providers, with 69% of them with three or less employees.

Our findings on the size structure of the private healthcare sector for 2021, are almost identical to the ones reported by Bank of Portugal for 2017 (BdP, 2019), and indicator of the stability of the sector's structure in recent years.

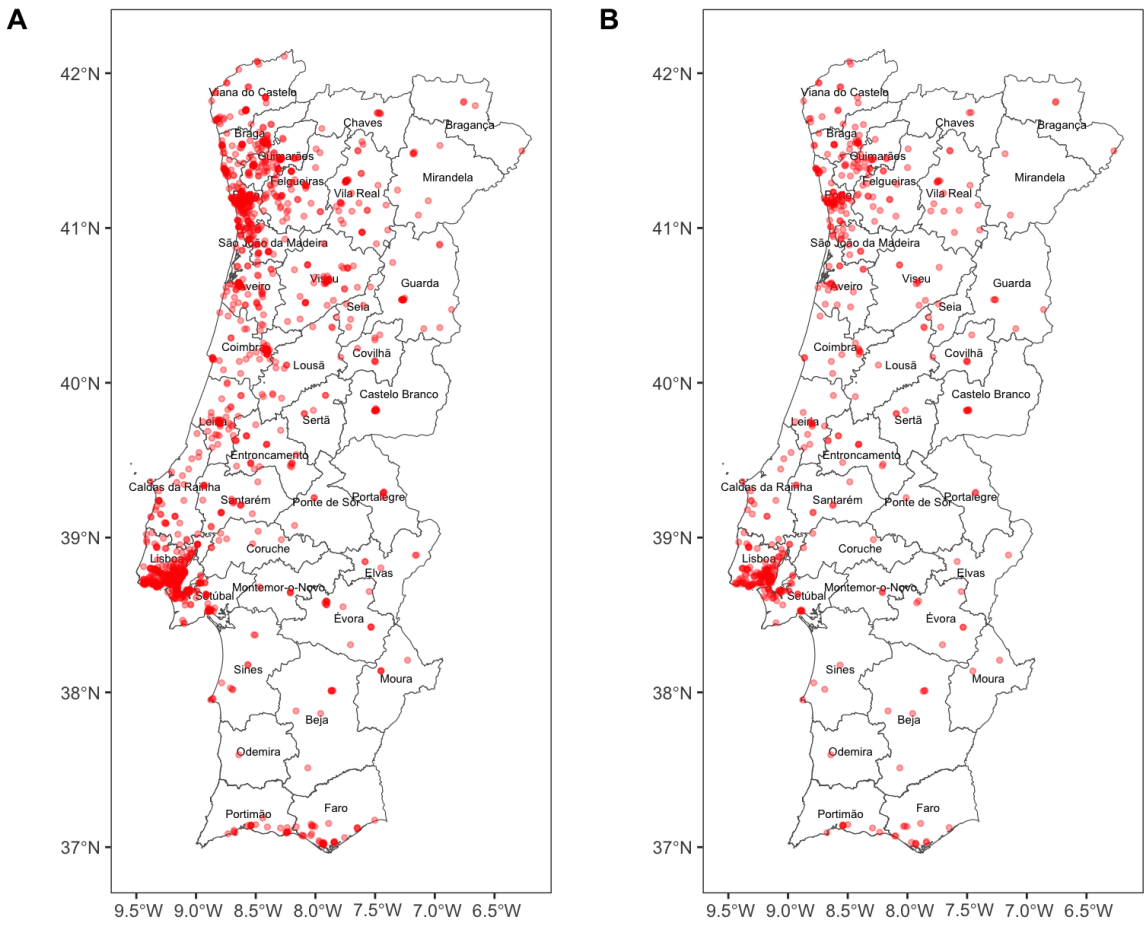


Figure 17. Spatial location of the providers in the physiotherapy main group (A) and in the physiotherapy restricted subgroup (B).[3]

[3] Each dot represents a provider's headquarter location. Physiotherapy units are more numerous than providers since some providers own several units. Dots may be overlapped, and darker ones represent multiple providers due to graphical spatial proximity.

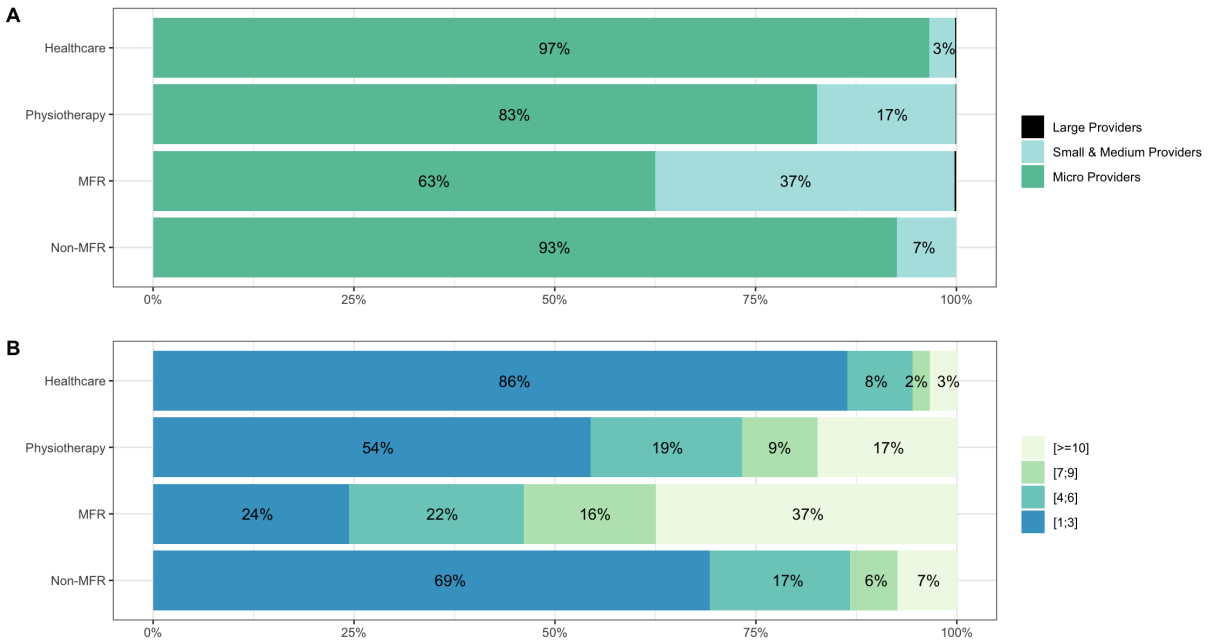


Figure 18. Size structure of the healthcare/physiotherapy sectors and by type of physiotherapy provider (by number of employees in 2021).

5.2.3 Sales volume

The services provided by the healthcare and physiotherapy private sector have been progressively increasing over the last years, as can be seen by the Sales evolution on Figure 19. Bank of Portugal reported for 2017 5,6 billion € in sales for the whole healthcare private sector (physiotherapy providers included) (BdP, 2019), a higher amount than our findings for that particular year (4,75 billion €), a difference mostly related to the fact that BdP included PPP's in their definition of private sector, and also to the fact that we've used constant 2007 prices in our approach. There were some downward periods in the worst recession periods (2012 and 2020) in both sectors, but an overall upward trend is clearly visible. Within the physiotherapy sector, there appears to be a similar trend in the MFR and in the non-MFR providers (Figure 19-B). The physiotherapy providers were responsible for 6,0% of the overall sales volume of the entire healthcare sector (physiotherapy included) in 2007, increasing their share to 7,5% in 2021. Our data suggest that the physiotherapy sector has been growing in recent years in size (by Sales volume), but also in economic relevance within the broad healthcare sector.

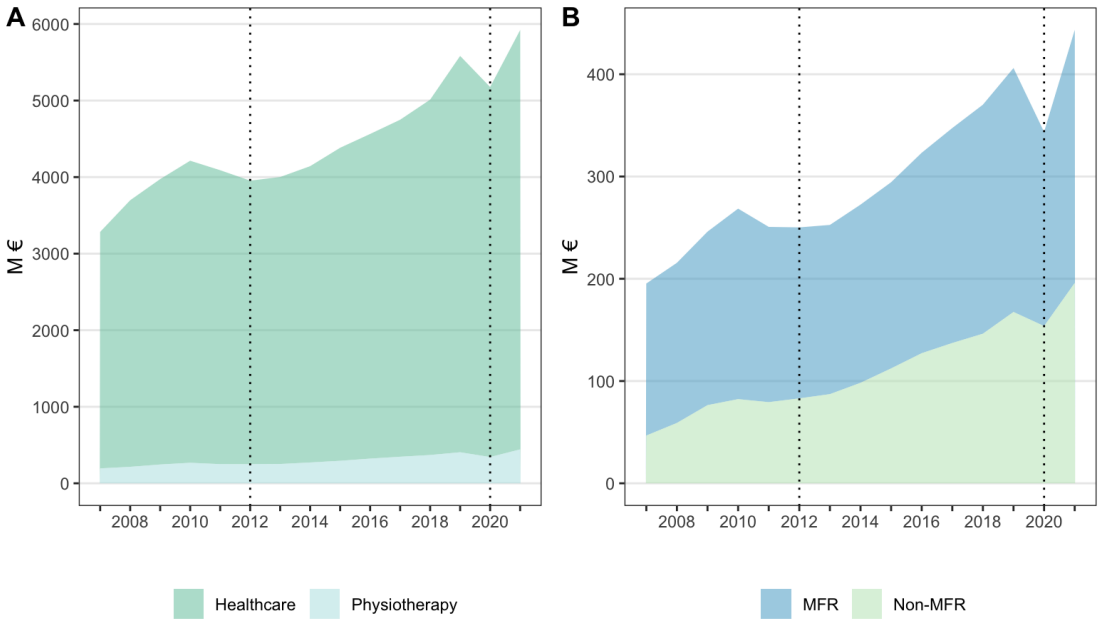


Figure 19. Sales volume in constant 2007 prices by sector (A) and by type of physiotherapy setting (B) (A and B with different y-axis scales, and with no overlapping layers).

5.3 Analysis of shocks

5.3.1 DiD analysis description

Equation 7 described the DiD estimate as capturing the combination of before-after and studied-control group effects. To estimate this joint effect, we considered a regression model with dummy variables for group membership and for pre- and post-intervention (Equation 8). The DiD estimate is obtained as the coefficient of the interaction between these two dummy variables. In our analysis we estimated four DiD regression models by OLS for each indicator analysis (20 DiD models in total). Two models used as studied group the physiotherapy sector and as control group the rest of the healthcare sector (for the two analysed economic shocks), and two models used as studied group the physiotherapy MFR providers and as control group the physiotherapy non-MFR providers (for the two analysed shocks). In the DiD OLS regression model, the coefficient of the interaction between the two dummy variables (for group membership and time) provides us with the DiD estimate (the difference between the differences from the pre- and post-intervention in the studied group and the differences from the pre- and post-intervention in the control group), as well as the respective p-value. In our case the "intervention" were the two economic shocks. If

the p-value was below the defined significance level (e.g., α=0,05), the DiD estimate was considered statistically significant.

$$Y_{gt} = \alpha + \beta D_g + \gamma\, post_t + \delta D_g \times post_t + \varepsilon_{gt}$$

Y_{gt} = dependent variable.

D_g = dummy variable for group membership. 1 = studied group, 0 = control group.

$post_t$ = dummy variable for time. 1= post-intervention period, 0 = pre-intervention period.

$D_g \times post_t$ = interaction between group and time.

ε_{gt} = regression residual.

δ = DiD estimate (interaction coefficient).

Equation 8. DiD estimator model using the OLS regression method and dummy variables (Cunningham, 2021).

For the estimates of the DiD approach to be valid, a "parallel trend" assumption must be verified for each model. This assures that the two analysed groups had parallel trends before the "intervention", and that the studied group trend would have followed the trend of the control group, if no "intervention" or event had occurred. To test this assumption, we performed "placebo regressions", using the DiD OLS regression model approach in the pre-intervention period (2010 vs 2011 for the first shock, and 2018 vs 2019 for the second) using the same groups as before (for all the DiD tests). If the p-value associated with the coefficient of the interaction term was above the significance level (α=0,05), the "parallel trend" assumption was verified (no significant differences were encountered) and the DiD estimates were considered valid.

5.3.2 DiD analysis results

Despite the heterogeneity of the physiotherapy providers and the different healthcare services that can be provided in their units, our results points to a lower resilience to economic shocks than in the rest of the healthcare providers. The reasons for this findings are probably multiple and can only be hypothesized. This topic is discussed in more detail further ahead, but the non-emergency characteristic of this type of services, the economic burden associated with prolonged treatment programs, the higher competition from substitute services, and the larger dependency on contracts with the NHS in the MFR type of providers (with prices determined by the payer) can help to explain this phenomenon. The

non-MFR providers appear to be more similar to the rest of the healthcare providers, and as such, were more resilient to the analysed economic shocks in almost all the performance indicators. Table 4 summarizes the DiD analysis results, highlighting the comparative negative performance of the physiotherapy sector and of its MFR providers.

Table 4. DiD analysis results.

	DiD				"Parallel trend assumption" placebo regression
	DiD Estimate	Comparative impact	Studied group (dummy =1)	p-value	p-value
NE					
Physiotherapy vs Healthcare					
Shock 1	0,044	+	Physiotherapy	0,551	0,960 #
Shock 2	-0,601	-	Physiotherapy	<0,001 ***	0,902 #
MFR vs non-MFR					
Shock 1	0,078	+	MFR	0,661	0,613 #
Shock 2	-1,293	-	MFR	<0,001 ***	0,465 #
Sales					
Physiotherapy vs Healthcare					
Shock 1	-11,041	-	Physiotherapy	0,006 ***	0,769 #
Shock 2	-6,675	-	Physiotherapy	0,018 **	0,737 #
MFR vs non-MFR					
Shock 1	-10,664	-	MFR	0,271	0,659 #
Shock 2	-9,407	-	MFR	0,179	0,947 #
EBITDA					
Physiotherapy vs Healthcare					
Shock 1	-1,664	-	Physiotherapy	0,227	0,378 #
Shock 2	-3,665	-	Physiotherapy	<0,001 ***	0,881 #
MFR vs non-MFR					
Shock 1	-2,946	-	MFR	0,297	0,360 #
Shock 2	-8,757	-	MFR	<0,001 ***	0,145 #
ROA					
Physiotherapy vs Healthcare					
Shock 1	-0,339	-	Physiotherapy	0,675	
Shock 2	-0,995	-	Physiotherapy	0,183	0,027 **
MFR vs non-MFR					0,310 #
Shock 1	-1,708	-	MFR	0,170	0,030 **
Shock 2	-2,092	-	MFR	0,106	0,739 #
ROE					
Physiotherapy vs Healthcare					
Shock 1	0,059	+	Physiotherapy	0,970	0,002 ***
Shock 2	-2,598	-	Physiotherapy	0,058 *	0,762 #
MFR vs non-MFR					
Shock 1	-3,108	-	MFR	0,252	0,181 #
Shock 2	-7,779	-	MFR	0,004 ***	0,484 #

(Shock 1 – 2010+2011 vs 2012+2013; Shock 2 – 2018+2019 vs 2020+2021; * - significant differences at α=0,1; ** - significant differences at α=0,05; *** - significant differences at α=0,01; # - "Parallel trend" assumption verified at α=0,05)

5.3.3 Employment

During the analysed period (2007-2021), the employment in the physiotherapy sector (by mean NE per provider) was consistently higher than the one in the healthcare sector (Figure 20-A). The mean number of employees of the healthcare sector providers reduced progressively throughout the analysed period from 2,0 in 2007 to 1,5 in 2021. The physiotherapy sector shared this trend until 2019 but declined more abruptly in 2020 from 3,5 to 2,4 employees per provider. The fact that physiotherapy providers have more employees than the healthcare sector, could have posed higher economic pressures due the higher fixed costs with staff. This effect, especially in 2020 where providers remained closed for long periods of time due to the Covid-19 lockdowns and restrictions, can partially explain the lower resilience of the employment of the physiotherapy sector in the Covid-19 shock, and the more abrupt NE decrease in 2020. A shift to the use of self-employed workers could also be at play.

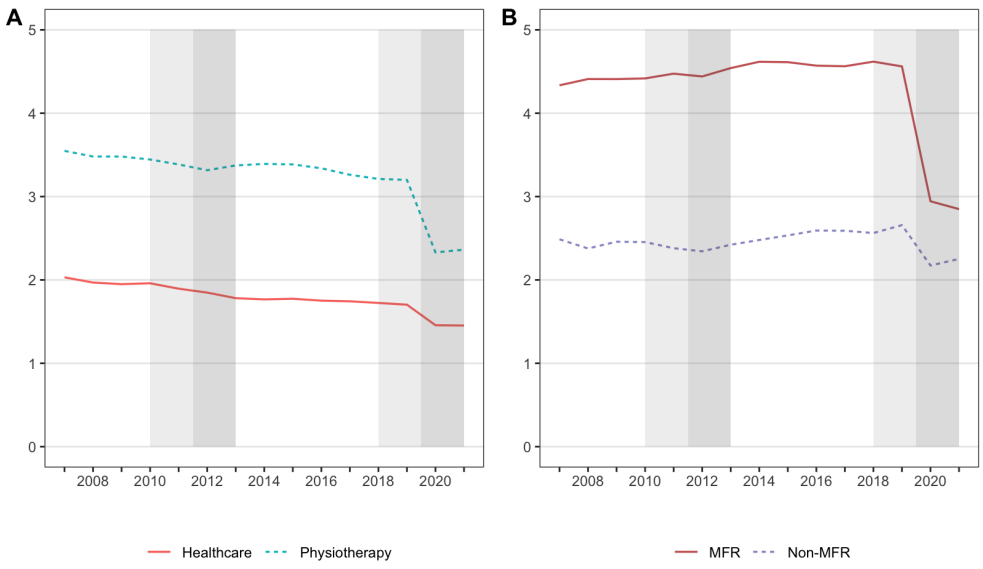


Figure 20. Mean NE by sector (A) and by type of physiotherapy setting (B).

The healthcare and physiotherapy providers workforce appeared to have been resilient in the 2012 recession, with no significant differences between groups in the DiD analysis (p=0,551), despite a slight positive DiD estimate towards the physiotherapy sector. The NE has been slowly declining since 2007, slightly faster after 2010, but not abruptly in

any sector in 2012/2013. On the other hand, the 2020 Covid-19 recession had a pronounced and significant negative impact in the physiotherapy providers NE ($p<0,01$) compared to the rest of the healthcare providers. The MFR providers appeared to be predominantly responsible for this decline in the NE of the physiotherapy sector (Figure 20-B), since the NE of the non-MFR providers remain relatively stable during the entirety of the analysed period with a mean around 2,5. There were no significant differences between MFR and non-MFR providers in the first analysed recession ($p=0,661$) (with a slight positive DiD estimate towards the MFR providers), but the second recession had a more pronounced and significant negative impact in the MFR providers ($p<0,01$), with a steeper reduction in their mean number of employees in 2020, following a slight positive trend during the upturn years. This behaviour in the MFR providers can be the result of an effective reduction in the providers workforce, but also a shift from the usage of employees with permanent contract, to the use of self-employed workers and part-time employees. Unfortunately, employment data from the SABI database only accounts for the number of employees with permanent contract and consequentially does not truly reflect all of the workforce of each provider. Additionally, the NE doesn't reflect the real service capacity, since the number of hours that each employee works may differ within and between providers. In Section 5.5 we will use the providers fees with staff and with self-employed workers as a percentage of their total costs, to better proxy the labour-intensiveness of the physiotherapy providers, and its relation to the observed performance/profitability.

There are several possible reasons for the inferior resilience observed in the MFR providers in the Covid-19 shock. Their value chain requires more professionals (by definition ate least one more, the physiatrist), with the subsequent higher fixed costs (and higher exposure to the effects of the lockdowns on the pandemic); 40% of their units have contract with the NHS, that dramatically reduced its non-Covid-19 related activity and subsequent clinical referrals in 2020; and the fact that prices per treatment procedure in NHS contracts are determined by the payer, can limit the investment in innovation and in more advanced treatment modalities (as can be seen in non-MFR providers), limiting the attractiveness of this type of providers for clients with VHI or for those with higher purchasing power. Appendix G provides additional visual and statistical analysis related to the NE variable.

5.3.4 Sales

As can be observed in Figure 21-A, the mean Sales of the physiotherapy and of the healthcare sector providers behaved in a similar way during the analysed period. The trends for both sectors were very similar, but the mean Sales of the physiotherapy providers was always higher when compared to the rest of the healthcare providers. However, the gap reduced over the years, ranging from 76.100 € in 2008, to 38.100 € in 2020. Within the physiotherapy sector, the MFR providers had constantly higher mean Sales than the non-MFR ones, a difference that was at a maximum of 103.900 € in 2021, and at a minimum of 80.100€ in 2013. The mean Sales of the MFR providers had an upward trend between the 2013-2019 period, contrasting to the downward trend of the non-MFR providers in this period (Figure 21-B). Despite this fact, in the recession periods, the physiotherapy sector (especially its MFR providers) had a sharper decrease in their mean Sales.

The physiotherapy sector had higher mean Sales than the healthcare sector during the analysed period but declined more abruptly in 2012 and 2020. There were significant differences between sectors in the impact of the first ($p<0,01$) and second recession ($p<0,05$), with a negative DiD estimate towards the physiotherapy sector. Before 2012 both sectors had downward trends (following the 2008 crisis). The healthcare providers stabilized their mean Sales after 2013, but the physiotherapy sector mean Sales continued to decline since 2010 at least until 2020.

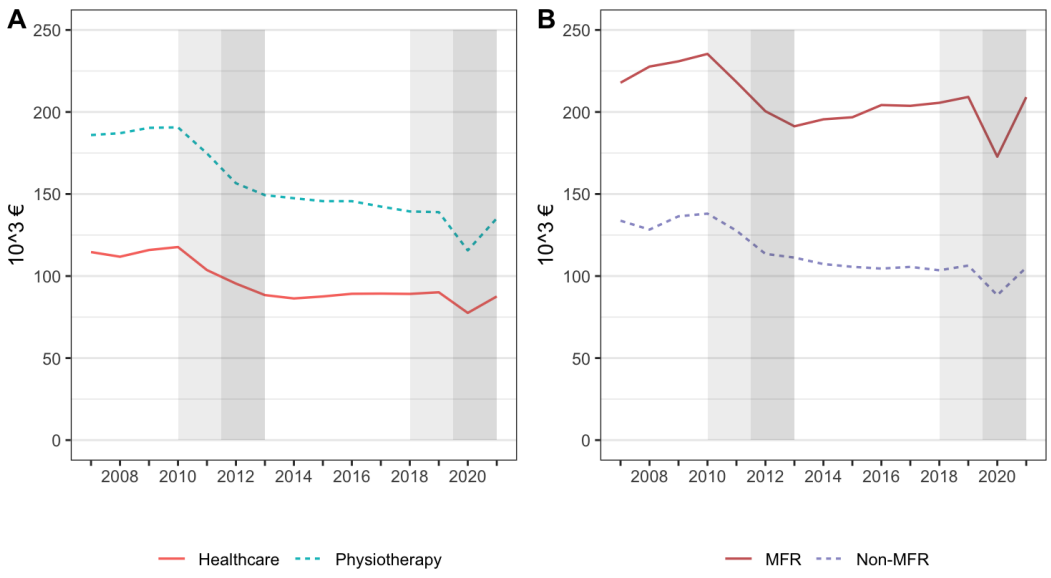


Figure 21. Mean Sales by sector (A) and by type of physiotherapy setting (B).

This overall negative trend in the Sales performance from the physiotherapy sector in the downturn years, was driven mainly by the performance of the non-MFR providers, as can be seen in Figure 21-B. Despite the sharper decline in their mean Sales in the downturn periods, the MFR providers increased their mean Sales in the 2013-2019 upturn period, contrasting to the decline in the non-MFR providers. There were no significant differences in the impact of the first shock between types of physiotherapy providers (p=0,271) (with a negative DiD estimate towards the MFR providers), neither in the impact of the second economic shock (p=0,179), but again with a more pronounced negative impact in the MFR providers. However, the Sales from the MFR physiotherapy providers was consistently superior to the one from the non-MFR providers in the entirety of the analysed period.

Comparatively, the physiotherapy median provider had three times more NE and almost two times more Sales than the median healthcare provider in 2012 but only two times more NE in 2020 (Figure 22-A and 22-B). The MFR providers had four times the median number of employees and more than two times the median Sales from the healthcare sector in 2012. The differences in NE reduced (due to the more abrupt decline in NE in the MFR providers in 2020) when comparing the data from 2012 to the one from 2020, the two years with the highest GDP drops in Portuguese recent history (Figure 22-A and B). The observed negative trend in the mean Sales since 2010, associated with the fact that the total Sales of the sector has been growing in the last decade (Figure 19), is a clear indicator of an increase in the number of physiotherapy providers. Appendix H provides additional statistical data related to the Sales variable analysis.

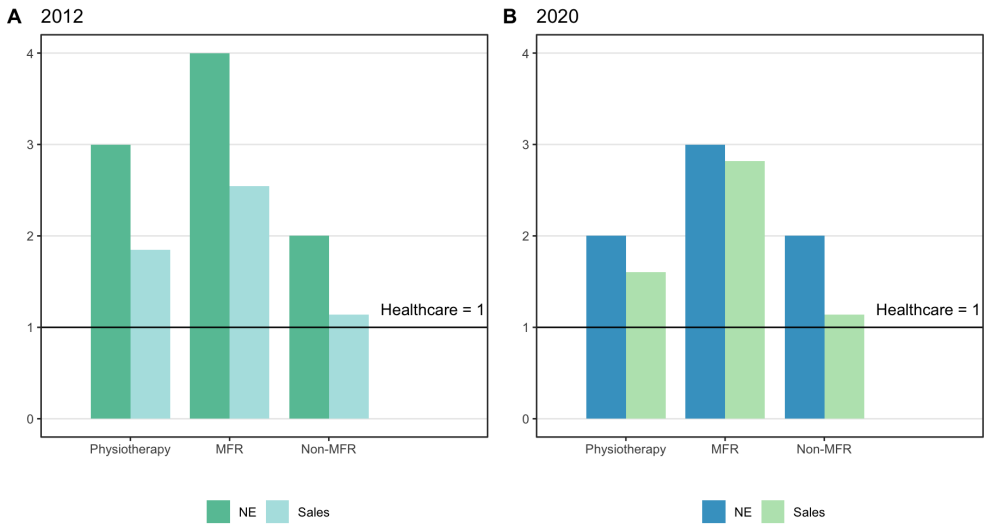


Figure 22. Median NE and median Sales: ratio between the physiotherapy and the healthcare sector in 2012 (A) and 2020 (B).

5.3.5 EBITDA

Regarding the comparative impact of the two analysed shocks on the EBITDA of the physiotherapy providers, we observed that the healthcare and the physiotherapy sector shared similar trends, but in the case of the physiotherapy sector the declines in 2012 and 2020 were more pronounced (Figure 23-A). There were no significant differences between sectors in the impact of the first shock (p=0,227) (with a negative DiD estimate towards the physiotherapy sector), but significant differences were found in the impact of the second shock (p<0,01), with a more pronounced negative impact on the physiotherapy sector. Within the physiotherapy sector, in the main recession periods (2012 and 2020), the MFR providers appeared to have been less resilient than the non-MFR providers, with a harder decline in their EBITDA, especially in 2020 (Figure 23-B). There were significant differences in the impact in the second economic shock (p<0,01), with a more pronounced negative impact in the MFR type of providers, but none in the first shock (p=0,297) (despite the negative DiD estimate towards the MFR providers). The mean EBITDA from both sectors continued from a downward trend in the first shock, but in 2020 there was an inversion starting from a stable/upward trend. This lower resilience from the MFR providers during the Covid-19 shock in 2020, can be related to the lockdowns and lay-offs during the pandemic, and the higher structural fixed costs in the MFR providers. As could be seen in Figure 18, the MFR providers are composed by 37% small and medium providers, 30 p.p. more than the non-MFR ones, which are composed almost entirely (93%) by micro providers. The non-MFR providers tend to have less employees (probably a more flexible cost structure) but also more freedom to adjust prices, a possible advantage when facing long periods of inactivity or diminished demand.

Except in a few years, the EBITDA growth rate for both sectors remained negative during all the analysed periods. The mean EBITDA from both sectors providers has been clearly declining since 2009. Despite this fact, in 2020 (the year with the lowest GDP growth rate), around 60% of the physiotherapy sector providers remained with positive EBITDA, approximately 15 p.p. below the providers in the healthcare sector (Figure 24-B). The percentage of providers with positive EBITDA growth was very similar (at around 30%) between sectors in 2012 and in 2020. Appendix I provides additional visual and statistical analysis related to the EBITDA variable.

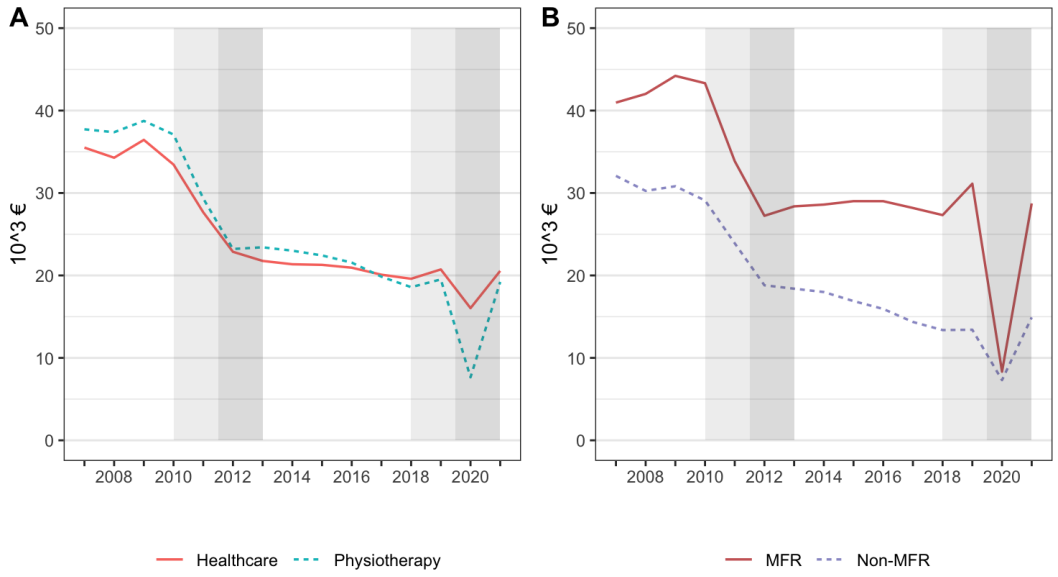


Figure 23. Mean EBITDA by sector (A) and by type of physiotherapy setting (B).

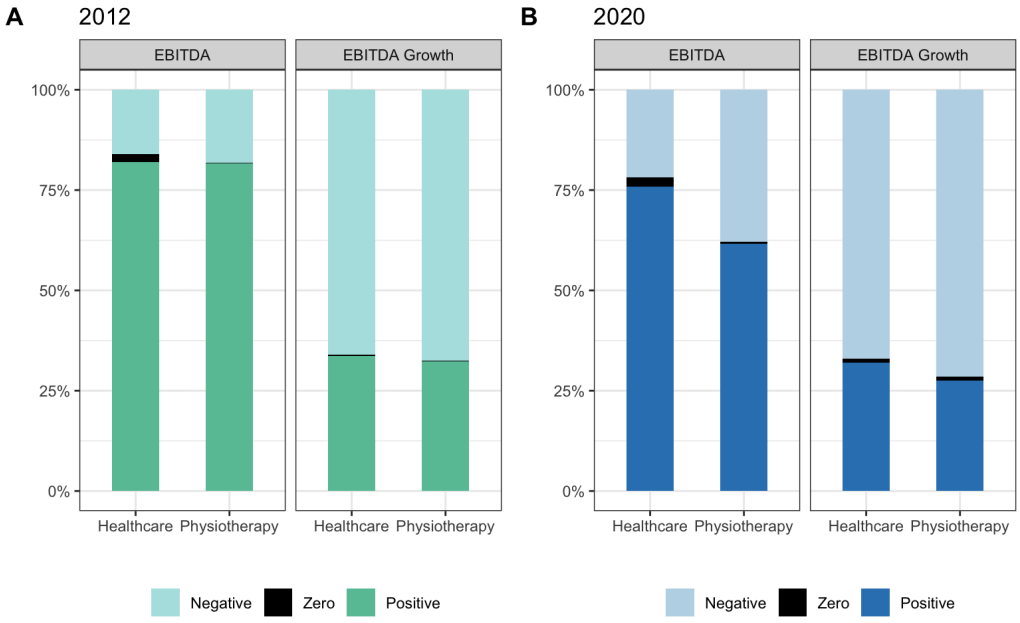


Figure 24. Percentage of providers with positive EBITDA and with positive EBITDA growth by sector in 2012 (A) and 2020 (B).

5.3.6 Profitability ratios

Profitability ratios from SABI database are calculated using Net Income before taxes (Earnings Before Taxes (EBT)), contrary to the Bank of Portugal approach that calculates profitability ratios using Net Income after interest and taxes. This different approach from

BvD in SABI benefits economic cross-country comparisons, excluding the different tax policies from each specific country, while including debt costs.

5.3.6.1 Return on Assets (ROA)

The ROA of the physiotherapy sector in the analysed period, followed the trend of the healthcare sector, but from a lower level (Figure 25-A). The decline in 2012 and 2020 were sharper and more pronounced in the physiotherapy sector, reaching a negative ROA in 2020 (-0,1%), but with no significant differences in impact between sectors in both economic shocks (p=0,675 and p=0,183 respectively) (in both cases with a negative DiD estimate towards the physiotherapy sector). The sharper declines from the physiotherapy sector when compared to the healthcare sector, were compensated by sharper rebounds. The non-MFR providers, were more profitable (according to the ROA) in the recession years than the MFR ones, never reaching negative ROA's, unlike the MFR providers who decreased their ROA to -2% in 2020 (Figure 25-B). However, no significant differences between these providers were identified in both analysed shocks (p=0,170 and p=0,106) (in both cases with a negative DiD estimate towards the MFR providers). In spite of this, a large part of the physiotherapy providers had positive ROA throughout the years (Figure 26). Appendix J provides additional visual and statistical analysis related to the ROA variable.

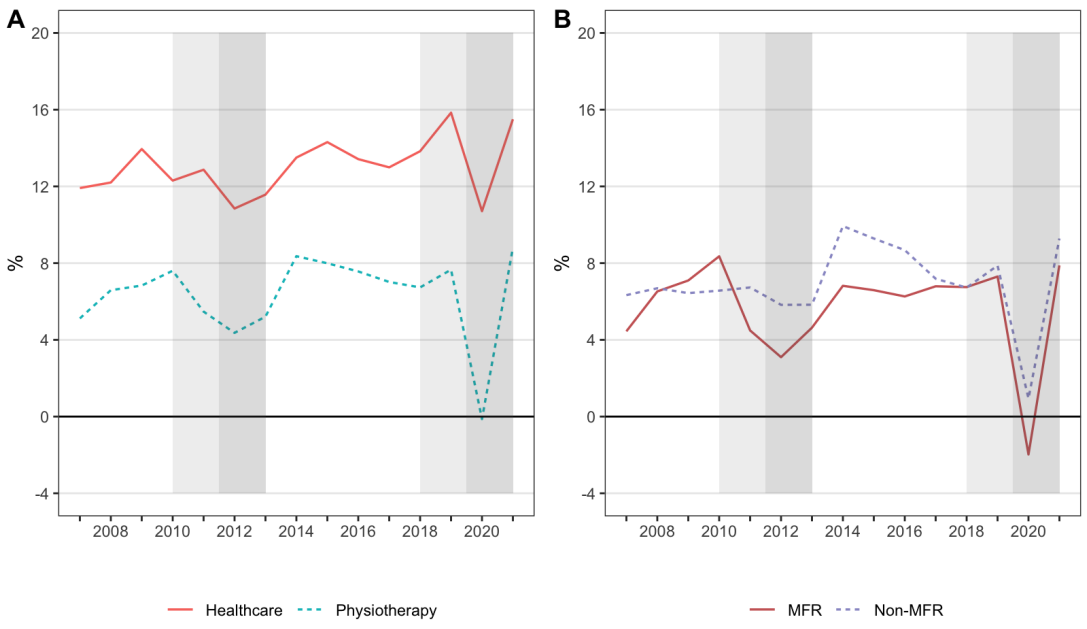


Figure 25. Mean ROA by sector (A) and by type of physiotherapy setting (B).

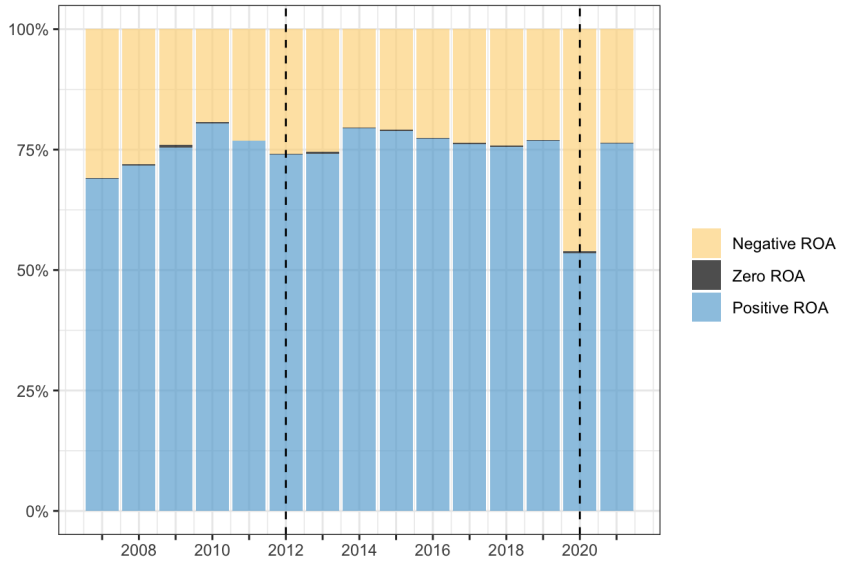


Figure 26. Physiotherapy providers with positive ROA by year.

5.3.6.2 Return on Equity (ROE)

The ROE behaviour of the healthcare and physiotherapy sector appeared to be quite similar to the one from the ROA in the downturn years (Figure 27). The physiotherapy sector ROE followed the trend of the healthcare sector, on a lower level (approximately 10-15% p.p. less, depending on the year), with sharper declines in the recession years, but never crossing the 0% threshold (Figure 27-A). A significant difference between sectors was visible in the impact of the second shock with a more pronounced negative impact in the physiotherapy sector ($p<0,1$), but none on the first one ($p=0,970$) (with a slight positive DiD estimate in the physiotherapy sector). Bank of Portugal reported consistently lower ROE for the healthcare sector than our findings (BdP, 2022), possibly due to the usage of Net Income after taxes in their calculations and inclusion of PPP's in their calculations.

The MFR providers had consistently lower ROE's than the non-MFR providers during all the analysed years, with a negative mean ROE in 2020 (-1,9%) (Figure 27-B). The impact was no different between providers on the first economic shock ($p=0,252$) (with a negative DiD estimate towards the MFR providers), but significant differences were found in the second one with an inferior performance from the MFR providers ($p<0,01$). Appendix K provides visual and statistical analysis related to the ROE variable.

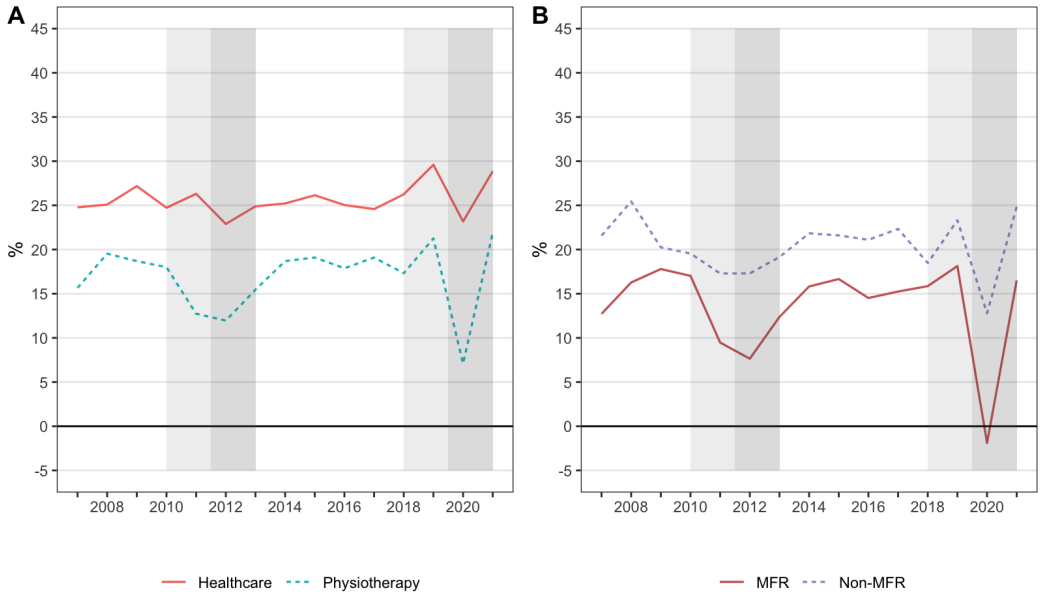


Figure 27. Mean ROE by sector (A) and by type of physiotherapy setting (B).

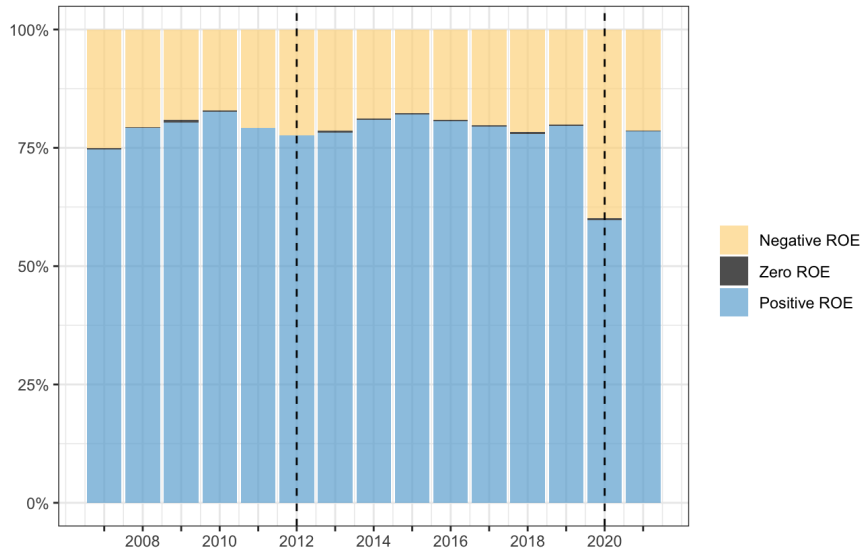


Figure 28. Physiotherapy providers with positive ROE by year.

The lower profitability from the physiotherapy sector, especially in the MFR group of providers, can be related to eventual lower profit margins, to the higher labour-intensiveness of these type of healthcare providers, the higher number of employees. This topic will be further developed in section 5.5.

5.4 DuPont analysis

Using the DuPont framework as performed by Ríos (2022), we observed that the main driver of economic profitability in the physiotherapy sector (proxied by the ROA) was the Profit Margin (Figure 29-B). With the exception of 2019 where the Assets Turnover/Rotation effect was higher than the Margin effect, in all other years the Margin effect was the primary component influencing the ROA behaviour. The Profit Margin is an indicator of the earnings of the providers in relation to their revenue (operating efficiency), where the Assets Turnover (also named Rotation) reflects the ability of the providers to generate revenue in relation to their own assets (asset efficiency).

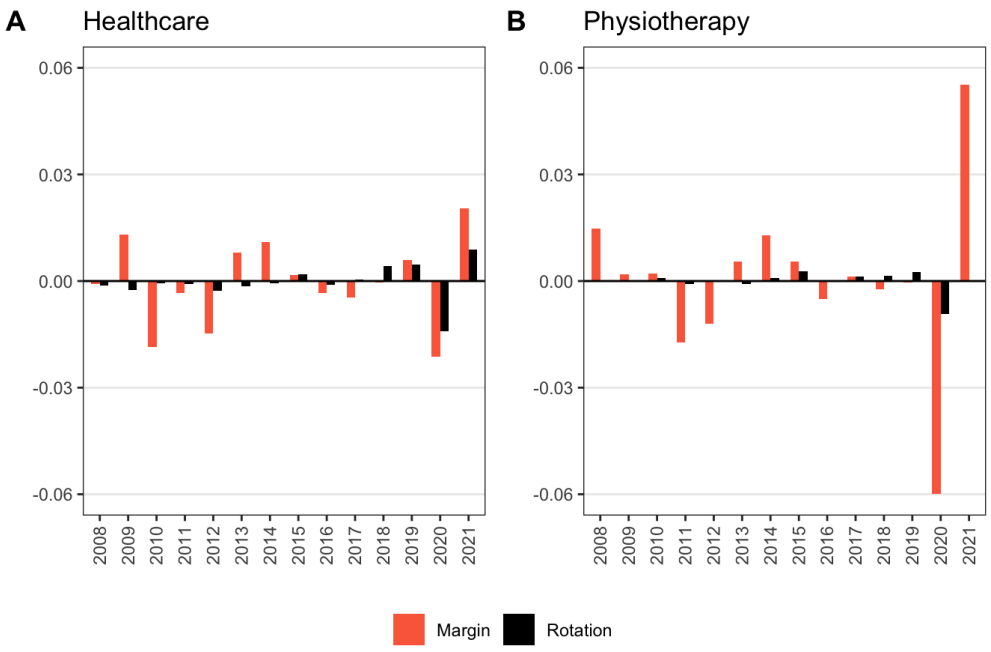


Figure 29. Margin and Rotation effect on the ROA of the physiotherapy sector.

We observed that the profitability behaviour of the physiotherapy providers, like in the rest of the healthcare providers, relies more on their Profit Margin than on their Assets Turnover, making them strongly dependent on their operational results. Since physiotherapy services are very labour-intensive, and that usually there is not a great amount of regular investment in state-of-the-art equipment in most of these providers (with some equipment being used for decades without being replaced for newer models), improvements in productivity may be more limited than in other business areas. This sector can also be particularly sensitive to the Baumol effect, due to its degree of labour-intensiveness.

Regarding the financial profitability of the sector (proxied by the ROE), we observed that the main driver of the ROE was the ROA component (PM * AT) rather than the Financial Leverage (also named Equity Multiplier) (Figure 30-B). The Leverage effect was always inferior to the ROA effect during the analysed time period. The Financial Leverage is an indicator of a provider's debt to finance its assets. Our results suggest that the Leverage effect has a limited influence on the physiotherapy sector's performance behaviour, but also on the rest of the healthcare sector. Appendix M contains additional data and the formulas used in this DuPont analysis.

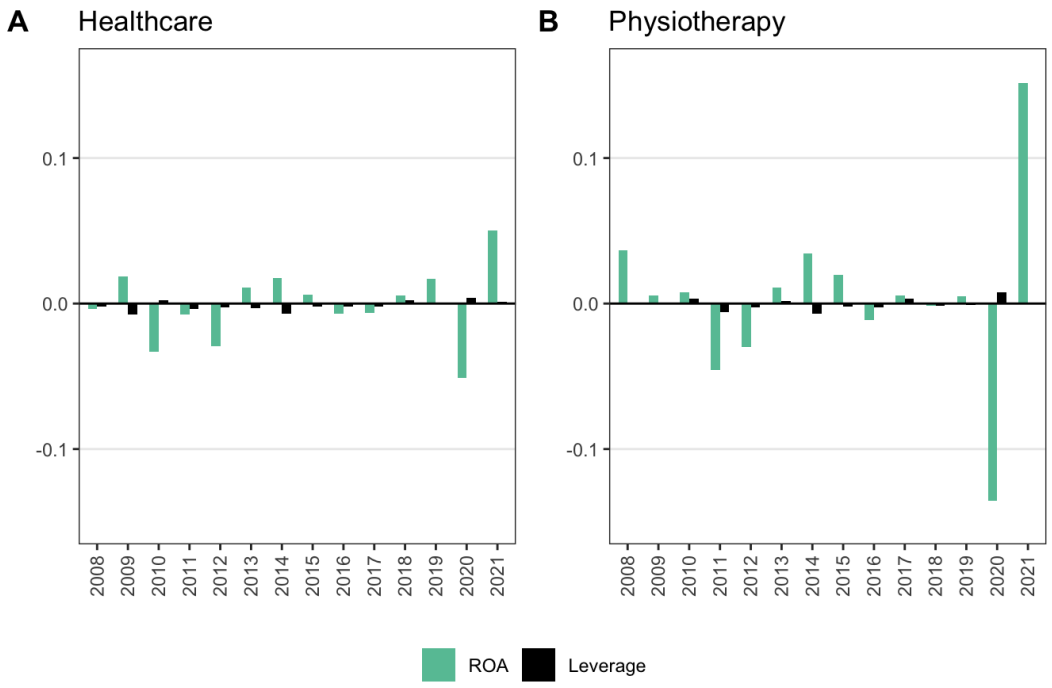


Figure 30. ROA and Leverage effect on the ROE in the physiotherapy sector.

5.5 Determinants of profitability

In an effort to explain the profitability drivers of the physiotherapy providers, we estimated rwo OLS regression models (one for explaining the ROA and the other for explaining the ROE). Data from a year unimpacted by the effects of economic shocks (2019), and data from the year with the worst recession in recent history (2020) was used to model the observed profitability. We used as the response variables the ROA and ROE observed in 2019 and 2020, and as explanatory variables: **1)** being an MFR provider or not; **2)** the number of employees (NE); **3)** Sales; **4)** percentage of payments to staff dedicated to self-

employed workers; **5)** labour-intensiveness; **6)** having owned premises or not; **7)** being located in a rural civil parish or not; **8)** municipality ratio between the number of employees in the primary and secondary sector vs the tertiary sector; **9)** municipality aging index; **10)** municipality average monthly income; **11)** municipality yearly number of road accidents with injuries; **12)** having a contract with the NHS or not; **13)** having a contract with the ADSE subsystem or not; and **14)** having a public MFR hospital in the municipality or not.

To remove non-relevant explanatory variables, we used a backwards stepwise selection approach to reach the best possible models with the available variables. Appendix N provides a more detailed description of the explanatory variables, as well as auxiliary plots from the regression models residuals and models without the stepwise selection of variables.

In table 5 and table 6 we can verify that we obtained statistically significant models for both analyzed years in both profitability ratios (F-statistics with $p<0,05$), but with extremely low adjusted R^2's for both the ROA (2,61% in 2019, 4,82% in 2020) and ROE models (1,30% in 2019, 4,72% in 2020).

The explanatory variables explain an extremely low percentage of the variance observed in the profitability ratios, but significant relationships were found between the profitability ratios and some explanatory variables.

In the ROA regression models (Table 5), we can verify that being an MFR provider is related to an -3,803 p.p. decrease in the ROA of the provider in 2019 ($p<0,05$), and that having a contract with the NHS is related to a 4,644 p.p. increase ($p<0,05$). The positive effect of having a service contract with the NHS on the ROA (which implies being an MFR provider), is largely absorbed by the negative effect of being an MFR provider. In 2020, being an MFR provider was related to a -3,198 p.p. decrease in the ROA ($p<0,05$), but unlike in 2019, having a contract with the NHS had a significant (but negative) impact on the ROA (-4,739 p.p.). Having a contract with the NHS appears to have a positive effect on the ROA in an upturn year (2019), but a negative effect in a downturn year such as 2020, where the NHS had limited clinical activity. A curious finding that we discuss in more detail further ahead. This can be related to the positive effect of a steady flow of patients from the NHS (a below average "payer", but a high volume "client") under regular conditions, but to a problematic reliance under exceptional conditions (as seen in 2020), in which the NHS dramatically decreased its surgical and medical activity in the non-Covid related NHS services, and reduced referrals to NHS contracted providers due to financial constraints (as previously seen in 2012).

Table 5. OLS regression model for explaining the ROA of the physiotherapy providers (after backwards stepwise selection).

Formula	ROA ~ MFR + NE + NHS_Contract + Owned_Premises + Labour_Int + Sales				
	Estimate	Std. Error	t-value	p-value	
Coefficients (2019)					
(Intercept)	12,494	1,900	6,577	<0,001	***
MFR	-3,803	1,406	-2,705	0,007	***
NE	-0,113	0,068	-1,665	0,096	*
NHS_Contract	4,644	1,873	2,479	0,013	**
Owned_Premises	-4,862	1,219	-3,989	<0,001	***
Labour_Int	0,053	0,037	1,440	0,150	
Sales	0,001	0,001	1,751	0,080	*
Multiple R^2					3,21 %
Adjusted R^2					2,61 %
F-statistic (p-value)					<0,001 ***
Coefficients (2020)					
(Intercept)	9,166	1,678	5,462	<0,001	***
MFR	-3,198	1,311	-2,438	0,015	**
NE	-0,042	0,060	-0,691	0,490	
NHS_Contract	-4,739	1,754	-2,702	0,007	***
Owned_Premises	-3,906	1,130	-3,456	<0,001	***
Labour_Int	0,005	0,034	0,140	0,889	
Sales	0,001	0,001	0,846	0,398	
Multiple R^2					5,44 %
Adjusted R^2					4,82 %
F-statistic (p-value)					<0,001 ***

(* - significant differences at α=0,1; ** - significant differences at α=0,05; *** - significant differences at α=0,01)

Regarding the ROE regression models (Table 6), we verified that being an MFR provider is also related to a profitability decrease (in both analyzed years), in this case -8,487 p.p. in the ROE for 2019 and -9,236 p.p. for 2020 ($p<0,05$). Having a contract with the NHS was related to a 9,231 p.p. increase in the ROE of the provider in 2019, compensating completely the impact of being an MFR provider, but to a -10,922 p.p. decrease in 2020 ($p<0,05$). The negative impact of being an MFR provider on the profitability is in line with our previous findings, and while having a contract with the NHS appears to increase the providers profitability in an upturn year (2019), it was related to a decrease in a recession year such as 2020 (a recession year during a pandemic).

Having owned premises was significantly related to a decrease in both profitability ratios in the two analyzed years ($p<0,05$). This finding can be related to the increased Total Assets of the providers with owned premises (increasing the denominator in the ROA, since leased assets may not appear on the assets in the balance sheet), and/or eventual higher

financial costs related to the funding of the premises with external sources (decreasing the numerator in both profitability ratios).

Table 6. OLS regression model for explaining the ROE of the physiotherapy providers (after backwards stepwise selection).

Formula	ROE ~ MFR + Income + Accidents + NHS_Contract + Owned_Premises + Labour_Int				
	Estimate	Std. Error	t-value	p-value	
Coefficients (2019)					
(Intercept)	35,983	10,169	3,539	<0,001	***
MFR	-8,487	3,279	-2,588	0,009	***
Income	-0,014	0,009	-1,614	0,107	
Accidents	0,004	0,003	1,597	0,111	
NHS_Contract	9,231	4,293	2,150	0,032	**
Owned_Premises	-6,439	2,824	-2,280	0,023	**
Labour_Int	0,129	0,086	1,502	0,134	
Multiple R^2					1,91 %
Adjusted R^2					1,30 %
F-statistic (p-value)					0,005 ***
Coefficients (2020)					
(Intercept)	26,588	9,945	2,673	<0,001	***
MFR	-9,236	3,264	-2,830	0,005	***
Income	-0,007	0,009	-0,797	0,425	
Accidents	0,005	0,005	1,088	0,277	
NHS_Contract	-10,922	4,272	-2,556	0,011	**
Owned_Premises	-8,777	2,801	-3,134	0,002	***
Labour_Int	-0,033	0,083	-0,398	0,691	
Multiple R^2					5,33 %
Adjusted R^2					4,72 %
F-statistic (p-value)					<0,001 ***

(* - significant differences at α=0,1; ** - significant differences at α=0,05; *** - significant differences at α=0,01)

Interestingly, the regional aging index, the regional average monthly income, the regional number of accidents, all possible determinants of the demand for physical therapy services, were not statistically associated with any of the profitability ratios, neither the labour-intensiveness of the provider, its location, or its employment structure.

As with all the data retrieved from SABI, the profitability ratios (response variables) were presented at the firm/providers level, and not at the individual units level that each provider owns. As such, when matching some of the explanatory variables to the providers profitability ratios, the data used concerns the location of the providers headquarters. This aspect could have caused some distortion in the results, because in some cases the providers profitability ratios are the result of the performance of multiple units located in different

locations, and the regional explanatory variables were only linked to the location of the providers headquarter. To test if this distortion could impair the main conclusions obtained, the regression models were also performed excluding the data from the providers with multiple physical units (~10%). The results obtained were slightly different, but the main conclusions remained valid. A few explanatory variables gained statistical significance (NE, Sales, among a couple of others), but their impact on the profitability ratios was always extremely limited. For comparative purposes, the stepwise variable selection process was only performed using the 2019 data. The 2020 models were performed using the explanatory variables obtained for the 2019 models. A stepwise selection process for the 2020 models using the 2020 data (performed as a test), obtained a slightly different set of variables (with marginally better R^2's for 2020), but the main drivers of profitability remained unchanged.

5.6 Cluster analysis

A cluster analysis was performed at the RRAS regions level and using the main performance indicators from the physiotherapy providers regarding 2020 (Figure 31).

The reason and the objective for this analysis was to identify eventual regional patterns related to the observed performance in the worst recession year. In the 2011 ERS report regarding the competition in the MFR providers (ERS, 2011), dominant positions from physiotherapy providers were found in 14 of the 37 RRAS regions. This could have led to abnormal profits and/or higher profitability ratios in these specific regions of the country.

Each variable was scaled (to have mean 0 and standard deviation 1) and a K-Means clustering algorithm was applied using the optimal number of clusters of two (Appendix O.1), with the Euclidean distance as a measure of dissimilarity. K-Means is a partitioning algorithm that uses the distance between cases to find the best grouping combination.

Internal cluster validation was perform using the Silhouette coefficient (a measure of intra-group similarity and inter-group dissimilarity) (Torgo, 2016) (Appendix O.3). This coefficient ranges from -1 and 1, the closer to 1 the better. The global Silhouette coefficient for the K-Means algorithm was 0,4 (a low to moderate value). Iterations with different number of clusters were performed, but no relevant improvements were observed. Cluster #1 obtained a higher value (0,44) and cluster #2 a lower coefficient value (0,19). According to these values, cluster #2 doesn't appear to be very homogeneous, and no more regional patterns were visible with robust Silhouette coefficient values.

A hierarchical clustering algorithm was also used to compare the K-means findings, with the results obtained from a different technical approach. As can be verified in the dendrogram in Appendix O.4, the results are very similar, with five of the six regions in cluster #2 also clustered together in the dendrogram, and with the vast majority of the regions clustered together in a larger group.

Regions from cluster #2, had less NE and appear to have been more resilient, showing higher mean performance indicators (Table 7). With the exception of *Caldas da Rainha* region, all other cluster #2 regions namely *Seia*, *Elvas*, *Coruche*, *Ponte de Sôr*, and *Montemor-o-Novo*, were identified in the 2011 ERS report as having competition problems (with high CR_2's and HHI's concentration ratios) (Figure 11), with dominant positions from MFR providers in most of them. These aspects could have contributed to the higher resilience shown in these regions in 2020. Despite these results, we observed that the country is relatively homogeneous regarding the regional performance of its physiotherapy providers.

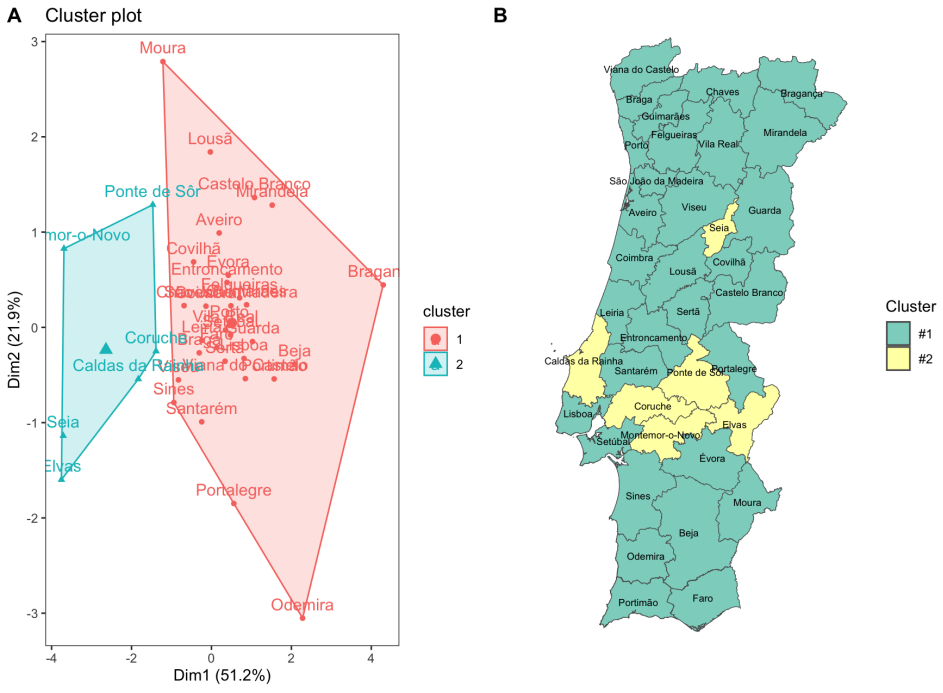


Figure 31. K-Means cluster plot with two clusters by RRAS region (partitioning clustering) (data from 2020).

Table 7. Clusters statistics (mean).

Cluster	NE	Δ% Sales	Δ% EBITDA	ROA (%)	ROE (%)
#1	2,3	-13,0	-47,8	-0,5	4,8
#2	1,8	-3,5	38,5	12,3	23,0

6. Discussion

6.1 Missing data and limitations

Economic and financial data for this study was obtained from the SABI Informa database from BvD. The main issue that we encountered with the data from SABI was the amount of missing information, a limitation we also found in the ORBIS Global BvD database. Bajgar (2020) in his study for OECD, found that ORBIS has better coverage in larger firms, in top performers and in manufacturing sectors. He added that despite its limitations, alternative databases would probably underperform ORBIS in most settings. These characteristics are probably also present in SABI, since they're both from the same provider and share the same data sources. Coverage in ORBIS (probably also in SABI) varies across sectors, types of firms, years, and some authors recommend to focus data analysis on the best covered years and in firms with more than 10 employees (Bajgar, 2020; Gal, 2013).

We focused our analysis on years with good coverage (2007-2021) but focusing on providers with more than 10 employees would completely lose representativeness, especially in a sector (physiotherapy) with 83% of its providers with less than 10 employees (Figure 18). Additionally, the sector's main focus is on services, making it particular sensitive to SABI/ORBIS limitations. Despite these limitations, we believe that the SABI database was the best option for this study (SABI data is less pre-processed than in ORBIS and has a historical record of 25 years vs a maximum of 10 in ORBIS). We acknowledge that economical and financial information from the Portuguese healthcare sector providers (especially in certain periods) suffer from a moderate lack of coverage in SABI, and we also recognize that SABI may not be particularly tailored for this economic sector. For reasons not attributable to BvD, information from providers with sole proprietorship is not available in the database. This limitation was also encountered at least in one other study (Hintermann, 2019), and limits the scope of the analysis, especially in the case of the Portuguese physiotherapy sector, with 1200 active units in this particular situation (Figure 12).

An additional limitation, was that our definition of boundaries for the physiotherapy sector and its units/providers had to deal with the fact that most of the physiotherapy providers also provide other healthcare services (as discussed before), like medical consultations, speech and occupational therapy, etc. Due to this fact, we analysed if a stricter selection process to the physiotherapy providers group, could have led to different

conclusions. Our findings reported in Appendix L, support the idea that this was not the case. Notwithstanding, some endogeneity issues could be present, since the performance of the physiotherapy providers had some other healthcare services embedded in it, apart from physiotherapy services *per se*. We believe that this fact does not diminishes our main conclusions, because this effect shortens the gap between the two sectors, it does not widen it. Differences would probably be more evident between sectors if the physiotherapy providers performance was purged from non-physiotherapy healthcare services.

In order to identify the Portuguese physiotherapy private providers, we used the records from the national health regulator (ERS) SRER database. Only units and providers with active status have publicly available information on the ERS website. Due to this fact, our list of physiotherapy providers included exclusively those that are currently listed with active status. This naturally led to a survivorship bias, since data from physiotherapy providers that died during the analysed time period was not included in our study. We believe that (in a similar way as with the endogeneity issues discusses before) this does not diminish our main conclusions, since the physiotherapy providers performance would probably be even lower if we took into consideration those providers that did not survive during the studied period. The survivors are certainly those with better economic and financial performance.

6.2 The 2012 and 2020 recessions and their main drivers

In recent years, Portugal suffered two major economic shocks, the 2008 global financial crisis with the subsequent national sovereign debt crisis with an international financial intervention in 2011-2014, and the Covid-19 pandemic in 2020/2021. These shocks dramatically impacted the Portuguese economy, leading to the two most severe GDP drops since 1975 (PORDATA, 2022d). Despite being major economic shocks, both with severe economic recessions, their root causes were substantially different.

In 2012, in the aftershock of the 2008 global crisis, the main recession cause was the austerity policies associated with the Troika financial intervention (with a 78 billion € loan). Several taxes were increased, holidays and Christmas benefits were suspended, the governmental budget was reduced in several areas, and usage fees in public services like in the physiotherapy NHS sector were increased (doubled in some cases), resulting in a -4,1% GDP growth rate and in higher unemployment rates. This depression followed the 2009

recession and impacted severely the local economy at least until 2014. This naturally affected the physiotherapy sector, especially restricting the demand-side for physical therapy services, due to reduced liquidity, high public and personal debt, and the crisis-related economic uncertainty.

In 2020, the recession followed the Covid-19 health crisis, with the lowest GDP growth rate in Portuguese documented history (-8,3%), and with a direct impact on the supply-side, especially on the service economy due to the associated pandemic lockdowns. The healthcare demand-side was also naturally affected due to the loss of income associated with unemployment and with layoffs, loss of scheduled surgical activity, reduction of trauma related injuries, and to generalized health concerns regarding the Covid-19 transmission, especially in the elderly population (a major user of physical therapy services).

Comparing both recovery periods, the GDP recovered at a faster pace in the Covid-19 shock, mainly because the government assistance was much more effective. The country in 2020 was in a very different economic condition than it was in 2011, with the first budget surplus in democratic history occurring right before, in 2019. Families had less debt, the rebound was much quicker, and no severe depression occurred (at least in the short-term).

6.3 Performance of the physiotherapy providers in times of Black Swan events

Despite the different characteristics of the two analysed economic shocks, the physiotherapy providers decreased their economic performance in both, underperforming the rest of the healthcare providers in most of the indicators in both recessions, but significant differences where mainly observed in the impact of the Covid-19 pandemic crisis.

In the first analysed shock (the financial external intervention in mid-2011, following the 2008 global financial crisis), with the exception of Sales, no statistical differences were encountered when comparing both sectors, despite the comparative negative impact on the physiotherapy sector in most indicators. The differences in the impact of this shock appeared to have been less dramatic, and several reasons could have contributed to that. The increased user fees in public services after 2012 could have shifted part of the demand to private providers, as could be seen in the hospital MFR activity (Figure 8). Additionally, the impacts of the 2008 crisis and of the 2011 financial intervention definitely overlapped, making trends and pre-crisis vs post-crisis effects harder to interpret. The "parallel trends" assumption, required to correctly validate the differences found in the DiD approach, was not observed

in three of the ten analysis performed regarding the 2012 shock (Table 4). This was probably the result of a post 2008 crisis period, where both sectors were reacting differently during the subsequent years. This limited the DiD approach in these three comparisons, because the performance from the physiotherapy and from the healthcare providers in the 2010-2011 period was not in a relatively stable state with "parallel trends" (before the 2012 recession). On the contrary, in the period before the 2020 shock, the "parallel trends" assumption was verified in all analysis (at α=0,05), due to the fact that the pre-crisis period was a stable one, with no relevant economic disturbances of any kind. The starting point of both economic shocks was clearly different, and probably contributed to the different observed statistical results.

Our results suggest that the physiotherapy sector is less resilient to economic shocks than the rest of the healthcare sector, especially its MFR providers. In our sample, more than 40% of MFR units and providers had service contracts with the NHS. Typically, a large part of their "clients" are NHS users. The MFR providers usually have more staff, higher fixed costs, and in their relationship with the NHS, they are price takers, since the state defines the fees for each treatment procedure, and the maximum number of procedures each patient is entitled per medical prescription (typically four procedures per session and 15 sessions per prescription – Max. 60 procedures per prescription). Usually, the provider charges the NHS for the better-paid treatment procedures (compatible with the patient needs), but in reality, the treatments frequently require (and are provided with) more than four procedures, and the additional procedures are simply not billed. These characteristics, associated with the fact that they compete in an open market for recruiting professionals, can limit their profitability compared to non-MFR providers, especially in periods of economic pressure. The providers that don't rely on the NHS users have more market power, and are fully reliant on VHI companies, health subsystems and full OOP clients, mostly "better" payers than the NHS (with higher payments per procedure) (Appendix P). Payments per procedure, should naturally be superior to their costs, providing incentives to deliver good quality services and good health outcomes. Currently, prices and payments from the NHS are not indexed at the value that is delivered, and the lower prices per procedure can inhibit better quality services, better health outcomes, and eventually lower payments for the complete treatment programs. Prices should cover the cost to deliver the service, but also provide incentives and assure that providers receive a fair profit. Our regression models suggest that for MFR providers, having a contract with the NHS is beneficial in periods not troubled by economic shocks, but

detrimental in recession years such as 2020. However, these findings should be carefully interpreted, because the 2020 recession had a very particular root cause. The NHS focused its resources on the pandemic, and other healthcare needs were regarded as secondary, which led to a reduction in the overall clinical activity, and consequentially less referrals to the physiotherapy MFR contracted providers.

Physician owned self-referring physiotherapy providers, have been shown to have higher profitability than providers not owned by referring physicians, possibly the result of higher referral rates, but also of higher operational efficiency, with physiotherapists spending less time with their patients in these providers (Mitchell & Scott, 1992). Some level of self-referral is probably present in all types of physiotherapy providers, but the only case in which the treatments are free for the end-user and with virtually no limit to the time of the treatment program, is in MFR units through the NHS, where patients can continue their treatments uninterrupted in some cases for several years. The primary care physician acts as a gatekeeper, but the MFR provider physiatrist in charge, can recommend to his peer to continue to prescribe treatments for a patient if he sees the need for it. If during upturn periods there is no pressure to contain NHS costs, during downturn periods this pressure is increased, as was the case in the external financial intervention period in the Portuguese NHS. This could partially explain the positive relationship of having a contract with the NHS with the profitability ratios found in the regression models for 2019, but the negative relationship found for 2020 (not due to financial NHS constraints in that particular year, but to the lower non-Covid-19 clinical activity and subsequent reduced referrals to physiotherapy providers). When there are no economic pressures, the NHS provides a steady flow of users for the MFR providers with contract with the NHS, but in economic downturns, in a pro-cyclical behaviour, the NHS could naturally diminish this flow of users for these providers. In 2020, the NHS focused its resources on the Covid-19 pandemic, dramatically reducing the supply of other services such as surgical activity and non-Covid-19 medical appointments, consequentially decreasing the referrals for physical rehabilitation services by the NHS.

The lack of flexibility in price setting, the lack of differentiated services (these are not specifically funded by the NHS), the higher structural costs related to have at least one extra employee (the physiatrist in the clinical direction, usually the highest paid employee), and possibly lower profit margins, can also help to explain the negative impact of the NHS contracts on the profitability of the MFR providers found in 2020. However, as mentioned before, 2020 was not only a recession year, but a year when the health system was focused

on battling the pandemic. The impact of the Covid-19 shock, was not exclusively due to the economic recession impact *per se*, but also due to the lockdowns, travel restrictions, reduced clinical activity in public and private hospitals, etc.

Unilateral administrative price setting by the state, usually below the equilibrium price for a physiotherapy service, can provoke several undesired consequences. On the demand side, the demand increases due to the free service for the user and the relative low price for the payer. On the supply side, the effects can lead to a lower quality of care from the MFR providers. MFR providers acting in their behalf can also procrastinate some patient discharges, and unnecessarily prolong treatment programs, eventually leading to longer waiting lists, possibly delaying treatment programs to more in-need patients. Obviously, clients with higher economic capacity will naturally opt for providers with contract with VHI schemes or pay the full-service fee by themselves via OOP for shorter waiting lists and higher quality of service. This behaviour can help to explain the observed higher resilience and profitability from non-MFR providers. Additionally, non-MFR providers offer first-line services, without the need to see a medical doctor (possibly a gatekeeper), contributing to a more dynamic business relation with their clients. Non-MFR providers (especially those that are physiotherapist-owned) typically have a different organizational culture than MFR providers, engaging in a more dynamic approach to their services, focusing their efforts on a patient-centric approach, better service quality, and on the clinical value that is provided to justify their higher prices. In the long run, investors and providers (but also clients) might find more attractive to stay away from NHS contracted providers, and naturally focus their efforts on users from different payers, a detrimental effect for the NHS quality of service provided to its citizens.

In the analysed period, physiotherapy providers suffered a higher negative impact in their mean Sales than the rest of the healthcare providers (statistically significant in both economic shocks). The mean Sales of the physiotherapy sector has been declining since 2010, but the total Sales of the sector has been increasing since 2011. An increase in the total Sales, concurring with a decrease in the mean Sales, is most likely a sign of an increase in the number of units/providers. MFR providers were less resilient in their Sales than their non-MFR counterparts during both analysed shocks, but no significant differences were found. During the 2013-2019 upturn period, the mean MFR Sales trend was clearly positive, a possible sign of a lower birth rate of new MFR units when compared to the non-MFR units (that followed the trend of the physiotherapy sector as whole and showed a decline in their

mean Sales since 2010). The impossibility of new contracts with the NHS, is a probable deterring factor when considering opening new MFR units and increases in demand for NHS MFR contracted services are probably being channelled to providers already in business.

The EBITDA growth rate has been frequently negative in the physiotherapy sector (at least in the analysed period), with a significant comparative negative impact of the Covid-19 economic shock in the physiotherapy sector as a whole and in its MFR providers. Unlike in the Sales performance, significant differences were found in the impact of this shock on the MFR providers EBITDA (the higher structural costs probably contributed to this lower resilience in this performance indicator). The mean EBITDA has been constantly decreasing in the last decade (in the physiotherapy sector, but also on the rest of the healthcare sector), but in spite of this, more than 80% of the physiotherapy providers had positive EBITDA in 2012, and more than 60% in 2020.

The only performance indicator where no significant differences were observed between sectors and type of physiotherapy providers during both economic shocks, was the ROA. The different impacts remained visible, but no significant differences were found between sectors or between types of physiotherapy providers. The ROA measures profitability independently from the financing structure of the assets, an advantage for economic inter-providers comparisons. Despite no significant DiD differences were found in the impact of the economic shocks on the ROA between types of providers, differences in the impact on the ROE were found on the Covid-19 shock (physiotherapy sector and MFR providers with worst comparative performance). Since the ROE is the result of the ROA multiplied by the FL (Financial Leverage, also known as Equity Multiplier), aspects of the financial structure of the physiotherapy sector providers probably contributed to these results, possibly their higher FL than in the rest of healthcare providers (Appendix M.2). A higher FL can usually contribute to higher ROE's, but also to more debt and higher risks. During the analysed period, the ROE of the physiotherapy sector was always above the ROA. This is a case of a continuous favourable financial leverage, and an indicator that the ROA was always superior to the interest rates (the FL was always above 1), and that the mean provider was never at risk of default (for those that were not equity-financed). But during the aftershocks of the economic crisis of 2020, this higher debt and assumed risk, may have contributed to a bigger impact on the sector, especially in its MFR providers. Despite their higher FL, the physiotherapy providers had throughout the analysed period, consistently ROA's and ROE's below the healthcare sector mean.

Despite the lower resilience from the physiotherapy providers in times of major economic downturns, a large part of the providers had positive EBITDA during the worst recession years, and with the exception of 2020, more than 70% of the providers had positive profitability during the analysed years (usually with ROA's above 4% and ROE's above 10%).

The physiotherapy sector and most notably its MFR providers, appear to have been less resilient and less profitable than the rest of the healthcare providers, but since the drivers of profitability in the physiotherapy providers remain unclear (to some extent), further studies would be useful for a better understanding of our findings.

In our regression models regarding the drivers of profitability of the private physiotherapy providers, most of the used explanatory variables weren't associated with the observed profitability. We hypothesized that determinants of the demand for physiotherapy services and several structural characteristics, could be associated with the observed profitability ratios, but our findings didn't support this hypothesis. The profitability of these providers doesn't appear to be related to those non-significant variables. A more comprehensive understanding of the drivers of profitability is necessary (and open to explore), in order to better comprehend the root causes of the main findings of our study, especially the lower resilience of the physiotherapy providers in times of economic downturns. The observed profitability could naturally be related to economic, social, demographic and organisational variables not included in our models. Other proxy measures of performance could also be analysed to eventually confirm or disprove our findings.

To take a glimpse on the performance of a few examples of specific physiotherapy providers, we briefly analysed the performance of five of the biggest Portuguese physiotherapy-related economic groups (Appendix Q). We could verify that different groups of providers, pursued growth using different strategies (organically vs mergers & acquisitions), and that each group reacted slightly differently to the economic shocks. Nonetheless, all of these larger physiotherapy-related economic groups, continued to grow despite the recession periods and the implicit economic pressures. The impossibility of new contracts with the NHS does not appear to be a limitation for investments in new non-MFR physiotherapy units (as in the case of providers with organic growth), but could affect the supply to citizens with limited financial capacity, especially in rural areas, were the supply of providers with contract with the NHS is limited.

Recent data from OdF shows that 76% of all physiotherapists work in private institutions, and that 10% are self-employed in their own units (OdF, 2023). The private

physiotherapy providers continue to be the main service providers of physical rehabilitation services, and with the exception of the lower resilience to economic shocks, appear to be good business investments, although not as profitable as the rest of the healthcare providers. New business models, based on telerehabilitation, home-care services, and blended treatment modalities, could improve the economic resilience during periods of economic downturns or in future lockdowns. In a very labour intense business sector, the adoption and integration of new technologies, could help mitigate the lower resilience and increase the efficiency and productivity in this sector, creating stronger and more versatile service providers. Differentiation and innovation growth strategies as can be seen in more recent non-MFR physiotherapist-owned service providers, could potentially be a viable way of increasing the resilience of these providers, in a more dynamic and flexible way.

6.4 Final considerations

Throughout this study, a frequently encountered constraint that we faced was the lack of previous research studies on the topic and the limited supporting evidence to ground our analysis and to improve the discussion of our results (while comparing them to previous findings from other authors). In science we frequently build our studies from previous evidence while pursuing our research path. Unfortunately, the economic literature regarding the physiotherapy sector is extremely limited, and no similar studies or robust supporting evidence were found. We searched for journal articles, books, etc. in several bibliographic databases such as Clarivate Web of Science™, Scopus®, b-on, EBSCOhost, JSTOR®, ScienceDirect®, PubMed®, PEDro (Physiotherapy Evidence Database) using as search strategy several combinations of the following terms: "physiotherapy", "physical therapy", "performance", "economic", "downturns", "recession", "business cycles", "profitability", etc., but with very limited results.

While acknowledging this "limitation", we chose to build our study largely from our data, from our empirical knowledge, and from the best available information and supporting evidence that we found. We believed that building our study from our data, and dealing with the difficulties that we encountered in the best way that we could, would, at least partially, provide a starting point to further similar studies, and some economic insights from a healthcare sector underrepresented in the current economic literature.

7. Conclusion

With this study we hoped to contribute to a better understanding of the Portuguese private physiotherapy providers performance and bring some light to a healthcare business sector that receives little attention in the current economic literature.

We took a deeper look at how this market is currently organized, and how its providers performed during different economic cycles.

With the focus on the Sales, EBITDA and on the ROA and ROE profitability ratios, we investigated if in periods of major economic shocks, these providers remained profitable and resilient to financial strains, and if differences in the type of physiotherapy setting (MFR vs non-MFR) led to differences in performance. We believed that physiotherapy providers could be economically less resilient to economic shocks than the rest of the healthcare sector, that differences in performance between type of provider (MFR vs non-MFR) would be found, and that these differences would vary depending on the cause of the economic downturn (financial crisis vs public health crisis).

We concluded that the physiotherapy sector and especially its MFR providers underperformed the rest of the healthcare sector and non-MFR providers, respectively, in times of major economic downturns (especially in the Covid-19 economic shock) and appear to be less resilient during severe economic recessions. Despite this lower resilience from the physiotherapy providers, a large part of the providers had positive EBITDA during the worst recession years, and with the exception of 2020, approximately 70% of the providers had positive ROA and ROE during the 15 analysed years.

These results and knowledge gathered, hopefully could lead future investors and decision makers to better informed decisions, to reduce their exposure to future economic shocks, and to better prepare for periods of economic uncertainty.

Appendices

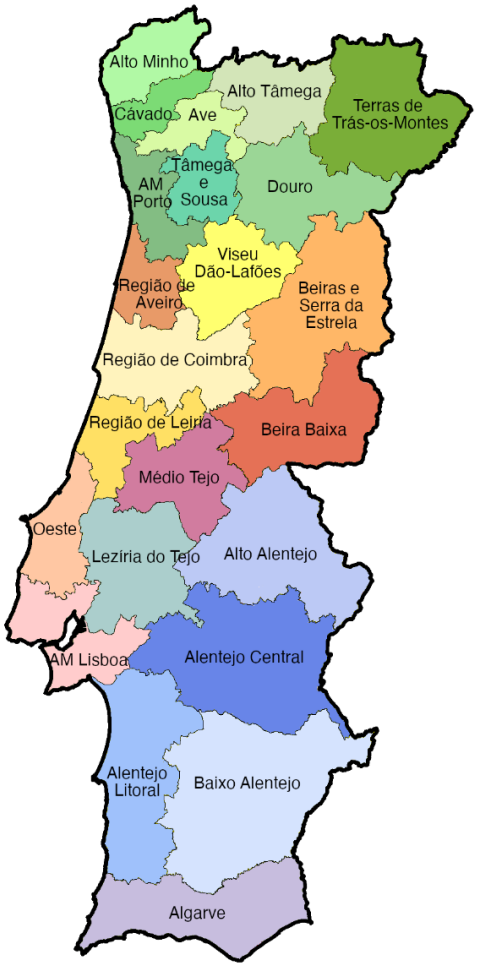
Appendix A – R script for data wrangling

```
# ERS DATA Scanner v 2.1

# install.packages("writexl")
# install.packages("XML")
# install.packages("stringr")

library(stringr)
library("writexl")
library("XML")
library(readr)
library("dplyr")


# Function to create web address with id

dados_entidade <- function(id) {

  link <- paste('https://www2.ers.pt/dmz/pesquisa/DetalheEstabelecimento.aspx?id=', id, sep="")

  dados_temp <- readLines(link)

  return(dados_temp)
}


# Create Data.Frame df

mat = matrix(ncol = 11, nrow = 5000)
df=data.frame(mat)

colnames(df) <- c('Entidade','NIPC','Estado','Estabelecimento','Estado', 'Void', 'CP', 'Localidade', 'Distrito',
'Fisioterapia', 'MFR')

a=1


# Import files with lists with web query ids results from www.ers.pt
#
# Files with lists with id's collected with Safari MacOSX Code Inspector
#
# https://www2.ers.pt -> dmz -> PesquisaPrestadores file (Files by Path)
#
# Content of the file was copied, and only the id's were kept. All additional info was removed.


Clean_Fisio <- read_csv("Clean_Fisio.txt", col_types = cols(id = col_number()))
Clean_Fisio <- Clean_Fisio %>% pull(id)

Clean_MFR <- read_csv("Clean_MFR.txt", col_types = cols(id = col_number()))
Clean_MFR <- Clean_MFR %>% pull(id)


# Remove duplicates

ERS = unique(c(Clean_Fisio, Clean_MFR))


# for cycle to scan all id's

for(ab in ERS){

print(paste("Processing >> id:", ab, "df:", a))

FISIO <- dados_entidade(ab)

if(length(grep("Fisioterapia",FISIO)) > 0 | length(grep("Reabilita&#231",FISIO)) >0 ){


# Providers name

  if (length(grep("DetalheEntidade", FISIO) >=1)) {

    df[a,1] <- str_sub(sub(".*id=", "",FISIO[grep("DetalheEntidade", FISIO)]),7,-5)
    #instrução extra para "limpar" os caracteres especiais no HTML
    df[a,1] = xmlValue(getNodeSet(htmlParse(df[a,1], asText = TRUE), "//p")[[1]])
    df[a,1] = sub(".*>", "", df[a,1])
  } else df[a,1] = xmlValue(getNodeSet(htmlParse(str_sub(FISIO[51],37,), asText = TRUE), "//p")[[1]])


# NIPC code

df[a,2] <-  str_sub(sub(".*value", "",FISIO[grep("NIPC", FISIO)+2]),3,-5)
```

```
# Providers status

df[a,3] <- str_sub(sub(".*value", "",FISIO[grep("Estado", FISIO)+2][1]),3,-5)
df[a,3] = xmlValue(getNodeSet(htmlParse(df[a,3], asText = TRUE), "//p")[[1]])


# Units name

df[a,4] <- str_sub(sub(".*value", "",FISIO[grep("Nome", FISIO)+2][2]),3,-5)
df[a,4] = xmlValue(getNodeSet(htmlParse(df[a,4], asText = TRUE), "//p")[[1]])


# Units status

df[a,5] <- str_sub(sub(".*value", "",FISIO[grep("Estado", FISIO)+2][2]),3,-5)
df[a,5] = xmlValue(getNodeSet(htmlParse(df[a,5], asText = TRUE), "//p")[[1]])


# Postal code

 if (length(grep("Morada", FISIO)) >=1)  df[a,7] <- sub("\\ .*", "", str_sub(sub(".*value",
"",FISIO[grep("Morada", FISIO)+4]),37,-8)) else df[a,7] = "NA"


# City

  if (length(grep("Morada", FISIO)) >=1){

    df[a,8] <- str_sub(sub(".*value", "",FISIO[grep("Morada", FISIO)+4]),51,-8)
    df[a,8] = xmlValue(getNodeSet(htmlParse(df[a,8], asText = TRUE), "//p")[[1]])

  } else df[a,8] = "NA"


# District

if (length(grep("Morada", FISIO)) >=1){

df[a,9] <- sub(".*, ", "",FISIO[grep("Morada", FISIO)+5])
if (str_length(df[a,9]) >=1) df[a,9] = xmlValue(getNodeSet(htmlParse(df[a,9], asText = TRUE), "//p")[[1]]) else
df[a,9] = "NA"

} else df[a,9] = "NA"


# Physiotherapy or MFR ?

if(length(grep("Fisioterapia",FISIO)) > 0) {  df[a,10] <- 1 } else df[a,10] <- 0

if (length(grep("Medicina F",FISIO)) > 0) { df[a,11] <- 1 } else df[a,11] <- 0

a=a+1

}

}


# Save data.frame on MS Excel file

write_xlsx(df, "./DR_ERS_Final.xlsx")
```

Appendix B – NUTS III vs RRAS regions

NUTS III 2013 (INE)*



RRAS 2008 (ERS)**

(Adapted from PORDATA, (2022a) and ERS, (2011))

* https://www.pordata.pt/Site_Static/PORDATA_NUTS2013_PT.pdf

** https://www.ers.pt/uploads/writer_file/document/143/Relatorio_Concorrencia_MFR.pdf

Appendix C – ERS registered physiotherapy units per RRAS region (11/2022)

RRAS	Population*	Registered Physiotherapists**	Registered Physiotherapists per 10.000 citizens	MFR Units	% C-NHS ***	Non-MFR Units	% C-NHS ***	Total Units
1 Aveiro	386.751	444	11	39	36%	132	1%	171
2 Beja	81.571	48	6	16	63%	8	0%	24
3 Braga	416.605	430	10	38	42%	136	0%	174
4 Bragança	54.400	47	9	5	40%	6	0%	11
5 Caldas da Rainha	363.511	273	8	28	46%	71	3%	99
6 Castelo Branco	68.680	89	13	8	50%	21	0%	29
7 Chaves	66.552	39	6	8	38%	5	0%	13
8 Coimbra	317.769	359	11	42	36%	98	0%	140
9 Coruche	72.806	32	4	4	75%	10	10%	14
10 Covilhã	88.126	81	9	7	43%	20	0%	27
11 Elvas	60.281	32	5	9	22%	7	0%	16
12 Entroncamento	204.131	135	7	20	40%	46	22%	66
13 Évora	80.799	56	7	10	40%	14	0%	24
14 Faro	244.686	201	8	20	65%	42	0%	62
15 Felgueiras	520.843	466	9	40	60%	109	0%	149
16 Guarda	93.059	78	8	5	40%	39	0%	44
17 Guimarães	502.744	481	10	44	50%	104	1%	148
18 Leiria	263.995	279	11	15	73%	98	0%	113
19 Lisboa	2.062.306	2.074	10	210	34%	426	3%	636
20 Lousã	119.978	96	8	16	75%	30	0%	46
21 Mirandela	76.146	51	7	6	50%	25	0%	31
22 Montemor-o-Novo	33.650	15	4	5	40%	7	0%	12
23 Moura	29.366	17	6	7	57%	4	0%	11
24 Odemira	34.377	12	3	3	33%	3	0%	6
25 Ponte de Sôr	32.716	15	5	9	89%	4	0%	13
26 Portalegre	43.435	45	10	11	82%	6	0%	17
27 Portimão	216.218	145	7	17	65%	53	0%	70
28 Porto	1.278.210	1.466	11	114	53%	365	0%	479
29 Santarém	167.190	89	5	12	42%	22	5%	34
30 São João da Madeira	267.407	210	8	24	46%	93	0%	117
31 Seia	38.380	40	10	2	50%	12	0%	14
32 Sertã	36.521	25	7	2	0%	9	11%	11
33 Setúbal	807.902	631	8	73	34%	126	6%	199
34 Sines	66.904	42	6	5	40%	15	0%	20
35 Viana do Castelo	231.266	202	9	46	24%	53	0%	99
36 Vila Real	173.851	154	9	26	23%	36	0%	62
37 Viseu	252.777	272	11	27	37%	75	1%	102
NA	-	-	-	32	0%	693	0%	725
TOTAL	9.855.909	9.171	9	1005	42%	3023	1%	4028

(NA= Not Assigned (home-based); C-NHS= Contract with NHS. Adapted from PORDATA, (2022c), OdF, (2022) and ARS, (2022))

* https://www.pordata.pt/municipios/populacao+residente+segundo+os+censos+total+e+por+grandes+grupos+etarios-22

** https://ordemdosfisioterapeutas.pt/dados-demograficos-dos-membros/

*** https://www.arsnorte.min-saude.pt/entidades-convencionadas/

https://www.arscentro.min-saude.pt/entidades-convencionadas/

https://www.arslvt.min-saude.pt/convencoes/pesquisa-de-prestadores-convencionados/

http://www.arsalentejo.min-saude.pt/utentes/cuidadossaude/AcordosConvencoes/Paginas/Acordos%20e%20Convenções.aspx

https://www.arsalgarve.min-saude.pt/acordos-e-protocolos/

Appendix D – ERS registered physiotherapy units (unlisted in SABI) per RRAS region

RRAS	Population*	Registered Physiotherapists**	Registered Physiotherapists per 10.000 citizens	MFR Units	% C-NHS ***	Non-MFR Units	% C-NHS ***	Total Units
1 Aveiro	386.751	444	11	1	100%	59	100%	60
2 Beja	81.571	48	6	0	0%	1	0%	1
3 Braga	416.605	430	10	4	75%	68	0%	72
4 Bragança	54.400	47	9	0	0%	4	0%	4
5 Caldas da Rainha	363.511	273	8	1	0%	29	7%	30
6 Castelo Branco	68.680	89	13	0	0%	9	0%	9
7 Chaves	66.552	39	6	0	0%	2	0%	2
8 Coimbra	317.769	359	11	5	40%	33	0%	38
9 Coruche	72.806	32	4	1	100%	4	25%	5
10 Covilhã	88.126	81	9	0	0%	1	0%	1
11 Elvas	60.281	32	5	5	20%	2	0%	7
12 Entroncamento	204.131	135	7	2	0%	23	43%	25
13 Évora	80.799	56	7	1	100%	4	0%	5
14 Faro	244.686	201	8	4	100%	12	0%	16
15 Felgueiras	520.843	466	9	4	75%	54	0%	58
16 Guarda	93.059	78	8	1	0%	19	0%	20
17 Guimarães	502.744	481	10	5	80%	37	0%	42
18 Leiria	263.995	279	11	4	75%	23	0%	27
19 Lisboa	2.062.306	2.074	10	21	29%	118	9%	139
20 Lousã	119.978	96	8	2	100%	14	0%	16
21 Mirandela	76.146	51	7	0	0%	10	0%	10
22 Montemor-o-Novo	33.650	15	4	1	100%	4	0%	5
23 Moura	29.366	17	6	0	0%	1	0%	1
24 Odemira	34.377	12	3	0	0%	3	0%	3
25 Ponte de Sôr	32.716	15	5	0	0%	0	0%	0
26 Portalegre	43.435	45	10	1	0%	2	0%	3
27 Portimão	216.218	145	7	5	60%	21	0%	26
28 Porto	1.278.210	1.466	11	9	33%	150	0%	159
29 Santarém	167.190	89	5	0	0%	8	13%	8
30 São João da Madeira	267.407	210	8	0	0%	43	0%	43
31 Seia	38.380	40	10	0	0%	3	0%	3
32 Sertã	36.521	25	7	0	0%	5	20%	5
33 Setúbal	807.902	631	8	4	25%	38	21%	42
34 Sines	66.904	42	6	0	0%	7	0%	7
35 Viana do Castelo	231.266	202	9	1	0%	20	0%	21
36 Vila Real	173.851	154	9	2	100%	9	0%	11
37 Viseu	252.777	272	11	3	100%	29	0%	32
NA	-	-	-	0	0%	541	0%	541
TOTAL	9.855.909	9.171	9	87	48%	1410	3%	1497

(NA= Not Assigned (home-based); C-NHS= Contract with NHS. Adapted from PORDATA, (2022c), OdF, (2022) and ARS, (2022))

* https://www.pordata.pt/municipios/populacao+residente+segundo+os+censos+total+e+por+grandes+grupos+etarios-22

** https://ordemdosfisioterapeutas.pt/dados-demograficos-dos-membros/

*** https://www.arsnorte.min-saude.pt/entidades-convencionadas/

https://www.arscentro.min-saude.pt/entidades-convencionadas/

https://www.arslvt.min-saude.pt/convencoes/pesquisa-de-prestadores-convencionados/

http://www.arsalentejo.min-saude.pt/utentes/cuidadossaude/AcordosConvencoes/Paginas/Acordos%20e%20Convenções.aspx

https://www.arsalgarve.min-saude.pt/acordos-e-protocolos/

Appendix E – ERS registered physiotherapy providers (included in the study) per RRAS region

RRAS	Population*	Registered Physiotherapists**	Registered Physiotherapists per 10.000 citizens	MFR Providers	Non-MFR Providers	Total Providers
1 Aveiro	386.751	444	11	18	49	67
2 Beja	81.571	48	6	4	4	8
3 Braga	416.605	430	10	19	46	65
4 Bragança	54.400	47	9	3	1	4
5 Caldas da Rainha	363.511	273	8	12	26	38
6 Castelo Branco	68.680	89	13	3	6	9
7 Chaves	66.552	39	6	4	3	7
8 Coimbra	317.769	359	11	13	37	50
9 Coruche	72.806	32	4	2	6	8
10 Covilhã	88.126	81	9	3	6	9
11 Elvas	60.281	32	5	2	3	5
12 Entroncamento	204.131	135	7	12	12	24
13 Évora	80.799	56	7	7	8	15
14 Faro	244.686	201	8	8	24	32
15 Felgueiras	520.843	466	9	19	32	51
16 Guarda	93.059	78	8	3	12	15
17 Guimarães	502.744	481	10	20	44	64
18 Leiria	263.995	279	11	2	42	44
19 Lisboa	2.062.306	2.074	10	125	212	337
20 Lousã	119.978	96	8	3	10	13
21 Mirandela	76.146	51	7	0	8	8
22 Montemor-o-Novo	33.650	15	4	3	1	4
23 Moura	29.366	17	6	1	3	4
24 Odemira	34.377	12	3	1	0	1
25 Ponte de Sôr	32.716	15	5	1	2	3
26 Portalegre	43.435	45	10	1	4	5
27 Portimão	216.218	145	7	6	15	21
28 Porto	1.278.210	1.466	11	56	130	186
29 Santarém	167.190	89	5	8	12	20
30 São João da Madeira	267.407	210	8	16	30	46
31 Seia	38.380	40	10	0	6	6
32 Sertã	36.521	25	7	2	3	5
33 Setúbal	807.902	631	8	48	55	103
34 Sines	66.904	42	6	3	8	11
35 Viana do Castelo	231.266	202	9	18	21	39
36 Vila Real	173.851	154	9	14	24	38
37 Viseu	252.777	272	11	11	27	38
TOTAL	9.855.909	9.171	9	471	932	1403

(Partially adapted from PORDATA, (2022c) and OdF, (2022))

* https://www.pordata.pt/municipios/populacao+residente+segundo+os+censos+total+e+por+grandes+grupos+etarios-22

** https://ordemdosfisioterapeutas.pt/dados-demograficos-dos-membros/

Appendix F – Consumer Price Index (CPI) for the healthcare sector

Reference period	Consumer Price Index (CPI, Base-year 2012) **Healthcare**		Rate of Growth (%)
	Portugal *	Continental Portugal *	Portugal **
2021	107,773	**107,910**	2,1
2020	105,534	105,633	1,1
2019	104,342	104,409	0,8
2018	103,490	103,556	1,1
2017	102,396	102,435	0,4
2016	101,945	101,990	-0,6
2015	102,569	102,652	0,4
2014	102,155	102,244	0,7
2013	101,490	101,521	1,5
2012	100	**100**	0,4
2011	99,646	99,575	4,5
2010	95,394	95,393	-1,3
2009	96,696	96,779	-1,4
2008	98,115	98,248	1,4
2007	96,797	**96,879**	7,4
2006	90,100	90,024	1,5
2005	88,753	88,675	0,9
2004	88,004	87,961	1,7
2003	86,525	86,617	2,4
2002	84,538	84,615	4,8
2001	80,658	80,747	3,7
2000	77,814	77,928	3,1

(Adapted from INE, (2022b) and PORDATA, (2022e))

*https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0003862&xlang=pt&contexto=bd&selTab=tab2

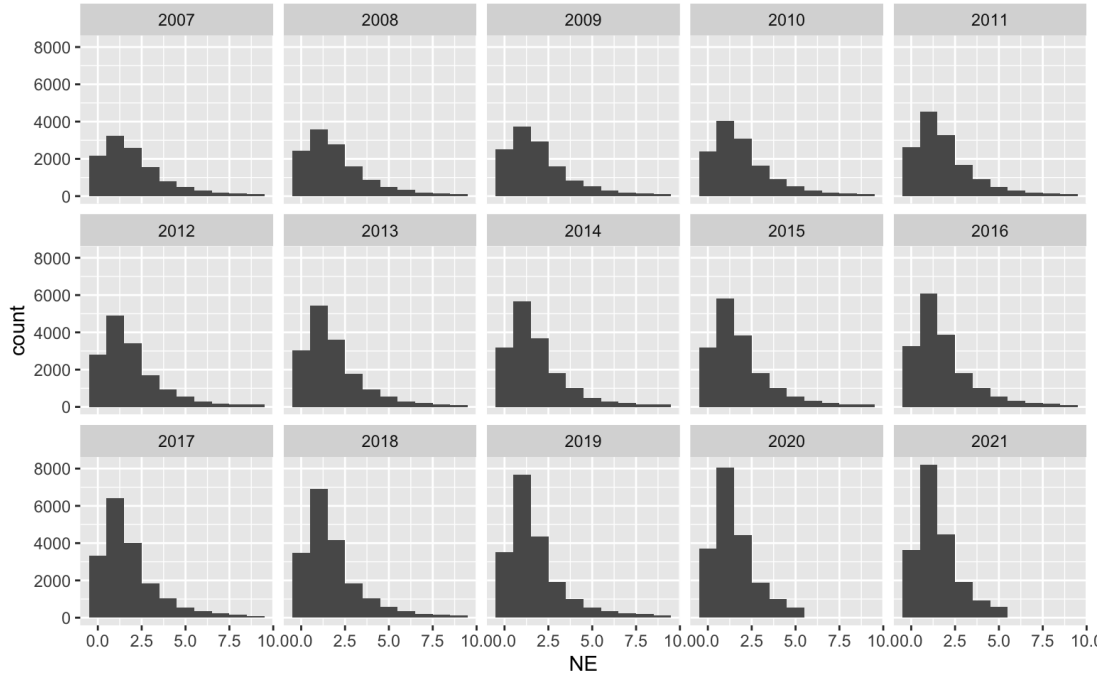
**https://www.pordata.pt/portugal/taxa+de+inflacao+(taxa+de+variacao+do+indice+de+precos+no+consumidor)+total+e+por+consumo+individual+por+objetivo-2315

Conversion example using the Continental Portugal Healthcare CPI (Base-year 2012):

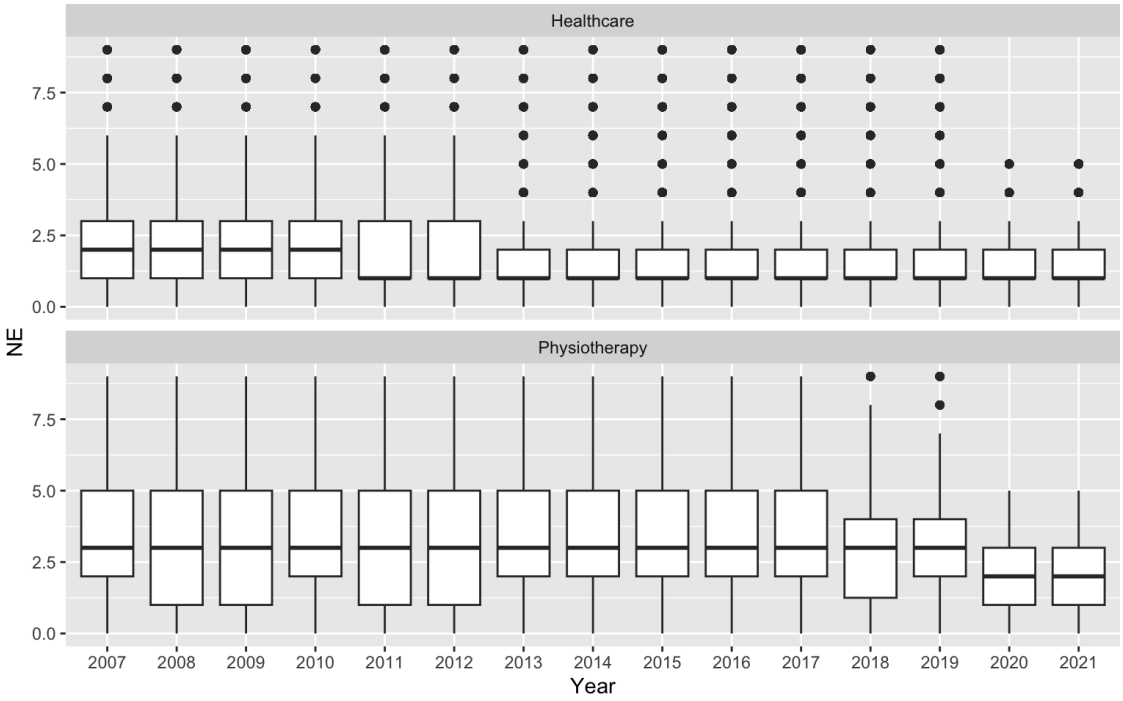
	2007	2012	2021
Current prices	€ 1000	€ 1250	€ 1500
Constant prices (Base-year 2012)	€ 1000 * 100/96,879 = € 1032	€ 1250 * 100/100 = € 1250	€ 1500 * 100/107,910 = € 1390
Constant prices (Converted to Base-year 2007)	€ 1000 * 96,879/96,879 = € 1000	€ 1250 * 96,879/100 = € 1210	€ 1500 * 96,879/107,910 = € 1346

Appendix G – Number of Employees (NE) statistical analysis

G.1 Histograms of NE by year



G.2 Boxplots of NE by year and sector



G.3 Descriptive statistics of NE by group

Sector: Healthcare Variable: NE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	11134	0	9	2	1.9	2	1.5	1.4	5
2008	12052	0	9	2	1.8	2	1.5	1.4	5
2009	12444	0	9	1.9	1.8	2	1.5	1.4	5.2
2010	12822	0	9	2	1.8	2	1.5	1.4	5.3
2011	13779	0	9	1.9	1.8	1	1.5	1.5	5.7
2012	14489	0	9	1.8	1.7	1	1.5	1.5	5.9
2013	15365	0	9	1.8	1.7	1	1.5	1.6	6.1
2014	15893	0	9	1.8	1.7	1	1.5	1.6	6.3
2015	16288	0	9	1.8	1.7	1	1.5	1.6	6.1
2016	16598	0	9	1.8	1.6	1	1.5	1.6	6.2
2017	17111	0	9	1.7	1.6	1	1.5	1.6	6.4
2018	17953	0	9	1.7	1.6	1	1.5	1.7	6.7
2019	18990	0	9	1.7	1.6	1	1.5	1.8	7
2020	18758	0	5	1.5	1.2	1	1.5	1	3.7
2021	18834	0	5	1.5	1.2	1	1.5	1	3.8

Sector: Physiotherapy Variable: NE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	458	0	9	3.5	2.5	3	3	0.6	2.3
2008	481	0	9	3.5	2.5	3	3	0.6	2.5
2009	504	0	9	3.5	2.5	3	3	0.6	2.4
2010	551	0	9	3.4	2.4	3	3	0.7	2.6
2011	571	0	9	3.4	2.4	3	3	0.7	2.7
2012	636	0	9	3.3	2.4	3	3	0.8	2.7
2013	675	0	9	3.4	2.4	3	3	0.8	2.7
2014	710	0	9	3.4	2.4	3	3	0.8	2.7
2015	749	0	9	3.4	2.4	3	3	0.8	2.7
2016	808	0	9	3.3	2.3	3	3	0.8	2.8
2017	861	0	9	3.3	2.3	3	3	0.8	2.7
2018	922	0	9	3.2	2.3	3	1.5	0.9	2.9
2019	975	0	9	3.2	2.3	3	1.5	0.9	3.1
2020	871	0	5	2.3	1.4	2	1.5	0.4	2.3
2021	889	0	5	2.4	1.3	2	1.5	0.4	2.4

Type: MFR Variable: NE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	263	0	9	4.3	2.6	4	3	0.2	2
2008	261	0	9	4.4	2.5	4	3	0.2	2.1
2009	264	0	9	4.4	2.6	4	3	0.2	1.9
2010	278	0	9	4.4	2.5	4	3	0.2	2
2011	274	0	9	4.5	2.5	4	3	0.2	2
2012	295	0	9	4.4	2.6	4	3	0.3	2
2013	303	0	9	4.5	2.5	4	3	0.2	2
2014	303	0	9	4.6	2.5	4	3	0.1	2
2015	307	0	9	4.6	2.6	4	3	0.1	2
2016	305	0	9	4.6	2.5	4	3	0.1	2
2017	293	0	9	4.6	2.4	4	3	0	1.9
2018	291	0	9	4.6	2.5	4	3	0.1	1.9
2019	278	0	9	4.6	2.4	4	3	0.2	2
2020	177	0	5	2.9	1.4	3	1.5	-0.1	2
2021	166	0	5	2.8	1.5	3	1.5	-0.2	2.1

Type: Non-MFR Variable: NE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	195	0	9	2.5	1.9	2	1.5	1.1	4
2008	220	0	9	2.4	1.9	2	1.5	1.2	4.3
2009	240	0	9	2.5	1.9	2	1.5	1.1	4.1
2010	273	0	9	2.5	1.8	2	1.5	1.1	4.3
2011	297	0	9	2.4	1.7	2	1.5	1.1	4.4
2012	341	0	9	2.3	1.8	2	1.5	1.2	4.6
2013	372	0	9	2.4	1.8	2	1.5	1.2	4.6
2014	407	0	9	2.5	1.7	2	1.5	1.2	4.5
2015	442	0	9	2.5	1.8	2	1.5	1.2	4.3
2016	503	0	9	2.6	1.8	2	1.5	1.3	4.6
2017	568	0	9	2.6	1.8	2	1.5	1.1	4.1
2018	631	0	9	2.6	1.8	2	1.5	1.2	4.2
2019	697	0	9	2.7	1.9	2	1.5	1.3	4.5
2020	694	0	5	2.2	1.3	2	1.5	0.5	2.5
2021	723	0	5	2.3	1.3	2	1.5	0.5	2.6

Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

G.4 NE DiD analysis

Healthcare vs Physiotherapy (2010+2011 vs 2012+2013)

```
Call:
lm(formula = NE ~ Physiotherapy * post.shock, data = sabi.test1)

Residuals:
    Min      1Q  Median      3Q     Max
-3.4144 -0.9262 -0.8137  1.0738  7.1863

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                  1.92617    0.01080 178.411  < 2e-16 ***
Physiotherapy                1.48827    0.05367  27.732  < 2e-16 ***
post.shock1                 -0.11251    0.01485  -7.578 3.56e-14 ***
Physiotherapy:post.shock1    0.04361    0.07314   0.596    0.551
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.761 on 58884 degrees of freedom
  (69952 observations deleted due to missingness)
Multiple R-squared:  0.02926,    Adjusted R-squared:  0.02921
F-statistic: 591.7 on 3 and 58884 DF,  p-value: < 2.2e-16
```

Healthcare vs Physiotherapy (2018+2019 vs 2020+2021)

```
Call:
lm(formula = NE ~ Physiotherapy * post.shock, data = sabi.test2)

Residuals:
    Min      1Q  Median      3Q     Max
-3.2056 -0.7132 -0.4549  0.5451  7.2868

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                 1.713153   0.007524  227.71  <2e-16 ***
Physiotherapy               1.492435   0.034043   43.84  <2e-16 ***
post.shock1                -0.258295   0.010594  -24.38  <2e-16 ***
Physiotherapy:post.shock1  -0.600702   0.049017  -12.26  <2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.446 on 78188 degrees of freedom
  (50648 observations deleted due to missingness)
Multiple R-squared:  0.04114,    Adjusted R-squared:  0.0411
F-statistic:  1118 on 3 and 78188 DF,  p-value: < 2.2e-16
```

MFR vs non-MFR (2010+2011 vs 2012+2013)

```
Call:
lm(formula = NE ~ MFR * post.shock, data = sabi.test3)

Residuals:
    Min      1Q  Median      3Q     Max
-4.4916 -1.4158 -0.4158  1.5543  6.6157

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       2.41579    0.09092  26.571  <2e-16 ***
MFR               2.02986    0.12962  15.660  <2e-16 ***
post.shock1      -0.03150    0.12196  -0.258   0.796
MFR:post.shock1   0.07748    0.17689   0.438   0.661
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 2.171 on 2429 degrees of freedom
  (3175 observations deleted due to missingness)
Multiple R-squared:  0.1853,    Adjusted R-squared:  0.1843
F-statistic: 184.1 on 3 and 2429 DF,  p-value: < 2.2e-16
```

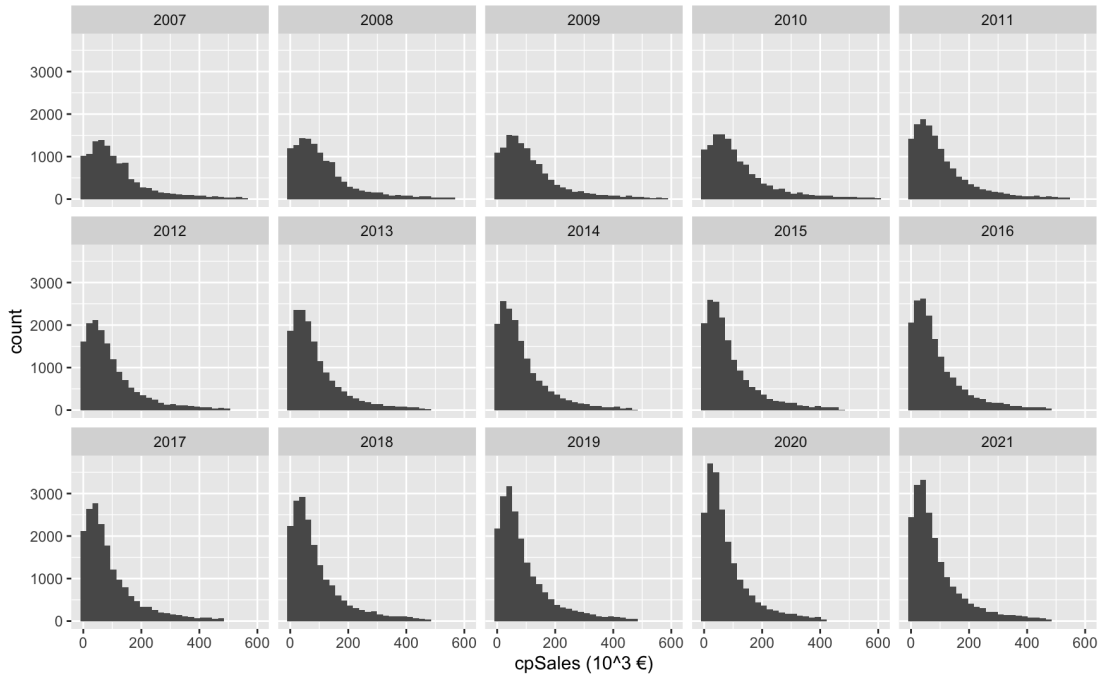
MFR vs non-MFR (2018+2019 vs 2020+2021)

```
Call:
lm(formula = NE ~ MFR * post.shock, data = sabi.test4)

Residuals:
    Min      1Q  Median      3Q     Max
-4.5905 -1.2131 -0.2131  0.7869  6.3878

Coefficients:
                 Estimate Std. Error t value Pr(>|t|)
(Intercept)       2.61220    0.04813  54.269  < 2e-16 ***
MFR               1.97831    0.08789  22.509  < 2e-16 ***
post.shock1      -0.39907    0.06700  - 5.957 2.82e-09 ***
MFR:post.shock1  -1.29348    0.13736  -9.417  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.754 on 3653 degrees of freedom
  (1951 observations deleted due to missingness)
Multiple R-squared:  0.1737,    Adjusted R-squared:  0.173
F-statistic: 255.9 on 3 and 3653 DF,  p-value: < 2.2e-16
```

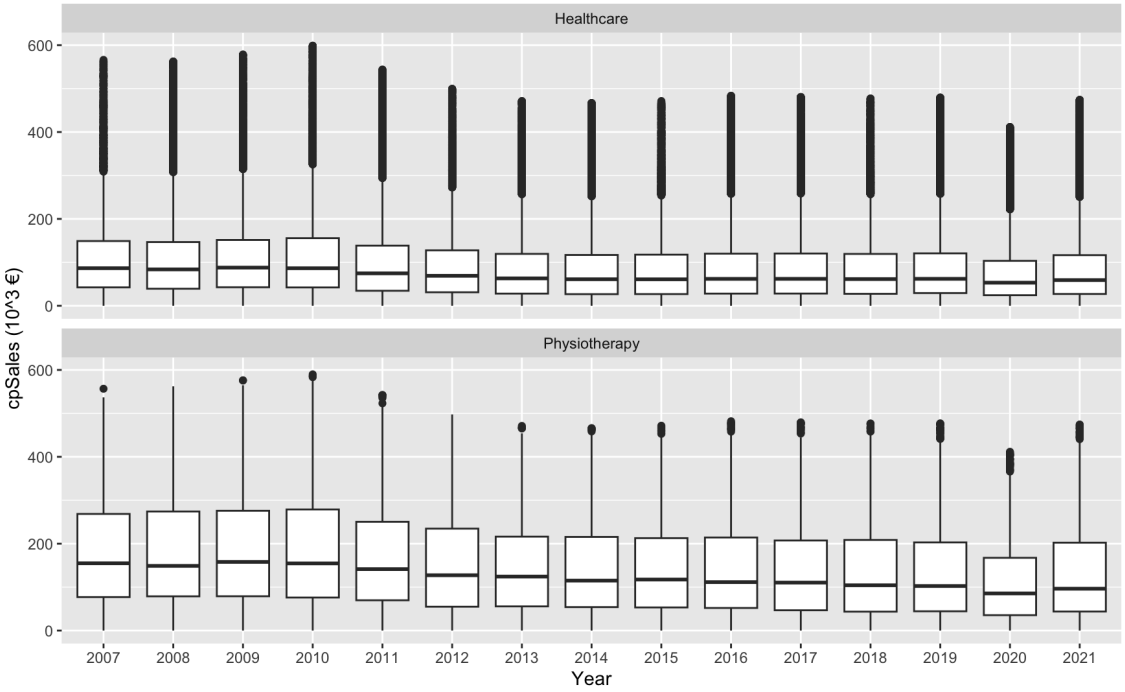
Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

Appendix H – Sales statistical analysis

H.1 Histogram of Sales by year.



H.2 Boxplot of Sales by year and sector.



H.3 Descriptive statistics of Sales by group

Sector: Healthcare Variable: cpSales

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	11068	0	566.1	114.6	105.5	86.5	76	1.7	6.1
2008	11920	0	562.4	111.8	104.9	83.8	76.9	1.7	6.1
2009	12276	0	578.5	115.9	106.5	87.8	77.1	1.7	6.1
2010	12672	0	598.7	117.7	110.2	86.5	78.2	1.7	6.2
2011	13616	0	543.9	103.7	100.3	74.7	70.2	1.7	6.2
2012	14311	0	499.5	95.4	92.4	69	65.4	1.7	6.1
2013	15157	0	471.3	88.4	86.9	63.1	60.8	1.7	6.1
2014	15664	0	466.8	86.3	85.4	61.1	60.1	1.7	6.1
2015	16052	0	471.4	87.6	87.6	61	60.3	1.7	6.2
2016	16374	0	483.5	89.2	88.9	61.9	61	1.7	6.2
2017	16869	0	480.6	89.3	89.4	62	60.5	1.7	6.3
2018	17693	0	477.2	89.1	89.7	61.5	59.7	1.7	6.1
2019	18693	0	479.5	90.1	89.7	62	59	1.7	6.1
2020	19188	0	411.6	77.5	77.9	53.2	51.8	1.7	6.1
2021	19229	0	474.2	87.6	89.3	59.1	57.9	1.8	6.2

Sector: Physiotherapy Variable: cpSales

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	501	0	556.7	185.9	136.8	154.9	132.6	0.8	2.7
2008	526	0	562.3	187.1	139.3	148.9	135.8	0.8	2.7
2009	550	0	576.2	190.4	142.4	158	139.9	0.8	2.7
2010	585	0	589.8	190.6	144.9	154.6	139.6	0.8	2.8
2011	610	0	542.4	174.7	135.3	141.5	132.5	0.8	2.9
2012	664	0	497.6	156.6	124.3	127.4	123.7	0.8	2.9
2013	698	0	471.1	149.3	116.2	124.3	114.4	0.9	3
2014	732	0	465.9	147.4	116.8	115	110.5	0.9	3
2015	772	0	471.6	145.7	116.2	117.5	111.6	0.9	3
2016	842	0	481.9	145.6	119.9	111.5	109.2	0.9	3
2017	897	0	479.3	142.4	118.2	110.4	110.3	1	3.1
2018	959	0	476.7	139.4	119.7	104.3	105.2	1	3.1
2019	1010	0	476.8	139	119.4	102.5	103	1.1	3.3
2020	1097	0	411.6	115.6	100.9	85.5	87.7	1	3.3
2021	1103	0	474.2	135.1	117.8	96.4	98.4	1	3.2

Type: MFR Variable: cpSales

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	311	0	536.9	217.8	137.5	198	143	0.5	2.3
2008	311	0	562.3	227.7	141	197.6	149.2	0.5	2.2
2009	314	0	576.2	230.9	145.6	199	159	0.5	2.2
2010	316	0	589.8	235.4	149.5	203.5	166.1	0.5	2.3
2011	317	0	542.4	218.3	138.5	193.1	147.4	0.5	2.4
2012	329	0	497.6	200.5	126.7	175.8	127.5	0.5	2.4
2013	332	0	471.1	191.3	114.4	172.6	118.8	0.6	2.5
2014	333	0	465.9	195.5	116.1	178.2	118.4	0.6	2.5
2015	339	0	467	196.8	117.2	179.9	124	0.5	2.5
2016	347	0	481.9	204.2	123.6	187.3	133.9	0.4	2.3
2017	336	0	479.3	203.8	124.1	187.6	137.5	0.5	2.3
2018	337	3.3	476.7	205.6	127.4	182.8	140.1	0.4	2.1
2019	320	0	476.8	209.2	129.1	176	129	0.5	2.1
2020	355	0	411.6	172.8	111.2	149.9	122.4	0.5	2.1
2021	318	0	474.2	209.1	132.2	181	154.6	0.4	2

Type: Non-MFR Variable: cpSales

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	190	0	556.7	133.7	118.6	94.3	85.3	1.4	4.7
2008	215	0	561	128.3	113.5	101.7	90.7	1.4	5.1
2009	236	0	560.1	136.4	118.4	105.5	100.5	1.3	4.4
2010	269	0	586.5	138	119.8	108.1	101.5	1.3	4.7
2011	293	0	535.3	127.7	114.5	98.4	102.1	1.3	4.4
2012	335	0	493.8	113.5	105.7	78.7	81	1.3	4.3
2013	366	0	466.6	111.2	104.1	76.2	77.3	1.4	4.6
2014	399	0	465.7	107.3	101.4	74.9	75.3	1.4	4.4
2015	433	0	471.6	105.6	98.6	70.7	71.7	1.4	4.5
2016	495	0	478.4	104.6	98.4	69.1	69.8	1.4	4.7
2017	561	0	476.3	105.6	97.6	74.6	72.1	1.4	4.6
2018	622	0	466.3	103.5	98.1	73.8	73.8	1.4	4.6
2019	690	0	476.7	106.4	98.9	76.8	76.9	1.4	4.8
2020	742	0	408.3	88.3	82.7	60.6	62.9	1.3	4.5
2021	785	0	471.1	105.2	96.6	74.4	73.6	1.3	4.3

Sales in constant 2007 prices and in 10^3 €

Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

H.4 Sales DiD analysis

Healthcare vs Physiotherapy (2010+2011 vs 2012+2013)

```
Call:
lm(formula = cpSales ~ Physiotherapy * post.shock, data =
sabi.test1)

Residuals:
   Min     1Q Median     3Q    Max
-182.52 -67.57 -27.80  35.30 488.29

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                110.4173     0.6111 180.673  < 2e-16 ***
Physiotherapy               72.1077     2.9308  24.603  < 2e-16 ***
post.shock1                -18.6184     0.8406 -22.148  < 2e-16 ***
Physiotherapy:post.shock1  -11.0414     4.0165  -2.749  0.00598 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 99.09 on 58309 degrees of freedom
  (70527 observations deleted due to missingness)
Multiple R-squared:  0.02731,    Adjusted R-squared:  0.02726
F-statistic: 545.7 on 3 and 58309 DF,  p-value: < 2.2e-16
```

Healthcare vs Physiotherapy (2018+2019 vs 2020+2021)

```
Call:
lm(formula = cpSales ~ Physiotherapy * post.shock, data =
sabi.test2)

Residuals:
   Min     1Q Median     3Q    Max
-139.17 -59.88 -27.39  30.05 391.66

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                 89.6258     0.4637 193.271  <2e-16 ***
Physiotherapy               49.5407     2.0467  24.205  <2e-16 ***
post.shock1                 -7.0646     0.6471 -10.918  <2e-16 ***
Physiotherapy:post.shock1   -6.6754     2.8195  -2.368  0.0179 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 88.46 on 78968 degrees of freedom
  (49868 observations deleted due to missingness)
Multiple R-squared:  0.01507,    Adjusted R-squared:  0.01503
F-statistic: 402.8 on 3 and 78968 DF,  p-value: < 2.2e-16
```

MFR vs non-MFR (2010+2011 vs 2012+2013)

```
Call:
lm(formula = cpSales ~ MFR * post.shock, data = sabi.test3)

Residuals:
   Min     1Q Median     3Q    Max
-226.82 -90.22 -30.67  68.60 453.90

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      132.636      5.156  25.725  < 2e-16 ***
MFR               94.182      7.084  13.295  < 2e-16 ***
post.shock1      -20.304      6.921  -2.934  0.00338 **
MFR:post.shock1  -10.664      9.701  -1.099  0.27174
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 122.2 on 2553 degrees of freedom
  (3051 observations deleted due to missingness)
Multiple R-squared:  0.1275,    Adjusted R-squared:  0.1265
F-statistic: 124.4 on 3 and 2553 DF,  p-value: < 2.2e-16
```

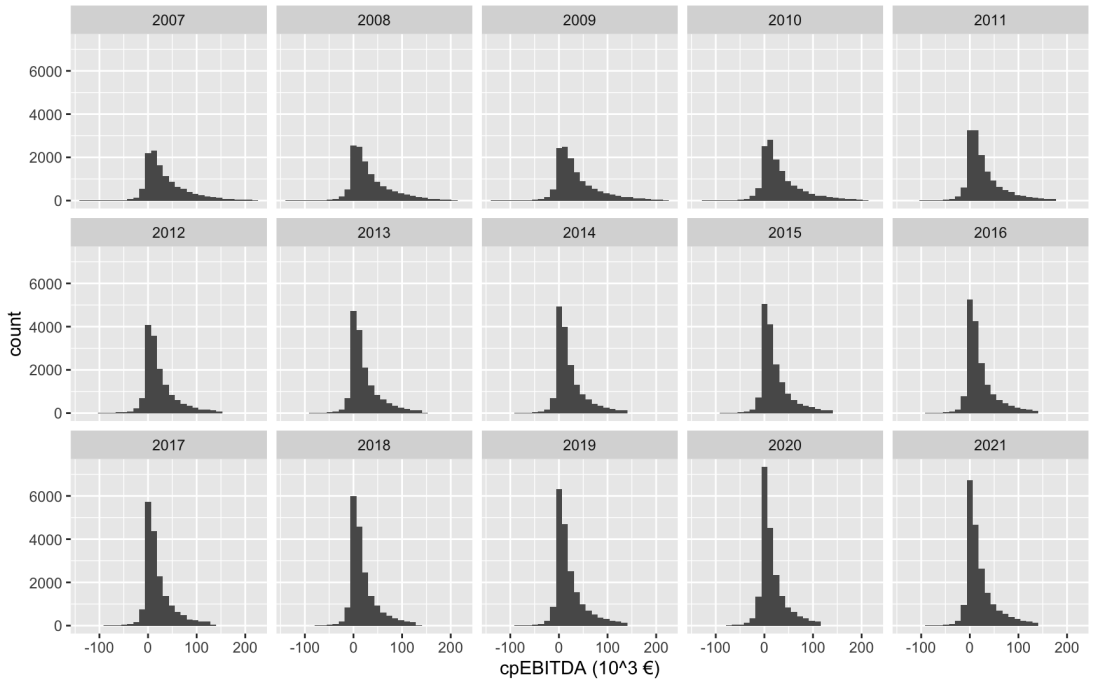
MFR vs non-MFR (2018+2019 vs 2020+2021)

```
Call:
lm(formula = cpSales ~ MFR * post.shock, data = sabi.test4)

Residuals:
   Min     1Q Median     3Q    Max
-207.34 -75.89 -29.19  58.55 374.06

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      105.026      2.906  36.141  <2e-16 ***
MFR              102.317      5.031  20.338  <2e-16 ***
post.shock1       -8.022      3.962  -2.024   0.043 *
MFR:post.shock1   -9.407      7.002  -1.343   0.179
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 105.3 on 4165 degrees of freedom
  (1439 observations deleted due to missingness)
Multiple R-squared:  0.1603,    Adjusted R-squared:  0.1597
F-statistic: 265.1 on 3 and 4165 DF,  p-value: < 2.2e-16
```

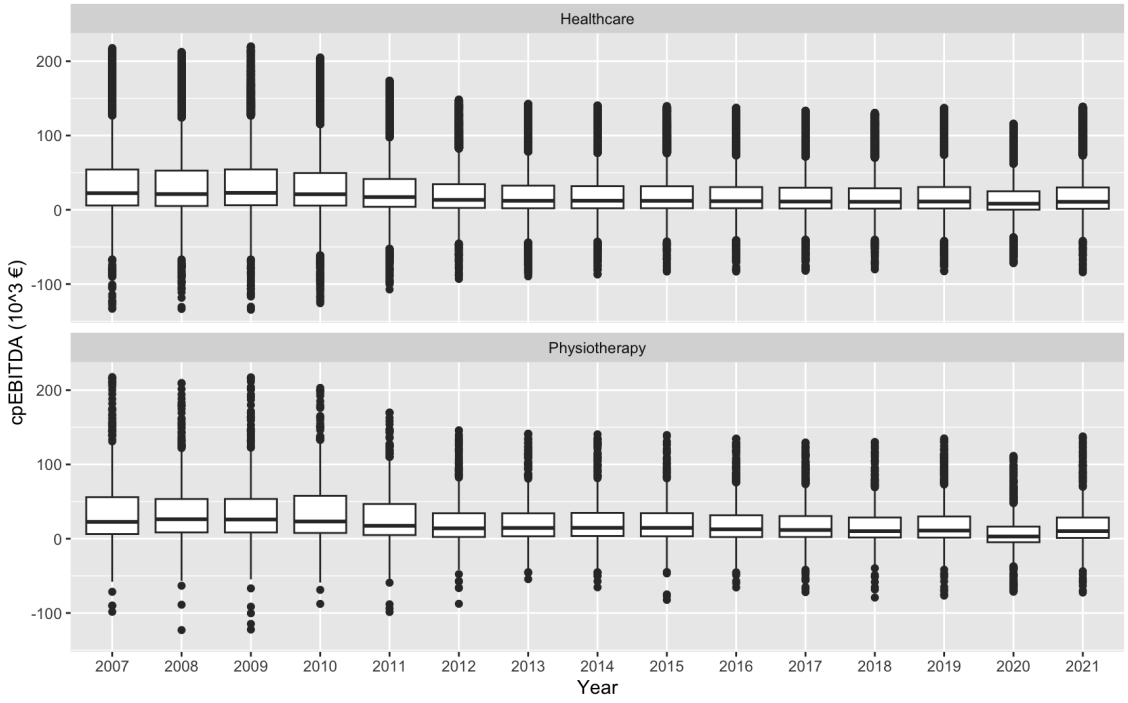
Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

Appendix I – EBITDA statistical analysis

I.1 Histogram of EBITDA by year.



I.2 Boxplot of EBITDA by year and sector.



I.3 Descriptive statistics of EBITDA by group

Sector: Healthcare Variable: cpEBITDA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	11382	-133.2	217.8	35.5	43.9	22.4	30.6	1.3	5
2008	12220	-133.5	212.4	34.3	43.3	21.2	29.3	1.3	5
2009	12577	-134.6	220	36.4	45.3	22.8	30.2	1.3	5.1
2010	12868	-125.7	205.1	33.4	42.6	20.9	28	1.3	5.3
2011	13748	-107.2	173.9	27.7	36.4	17.1	23.6	1.4	5.5
2012	14347	-93	148.4	22.9	32.1	13.4	19.8	1.3	5.4
2013	15167	-89.6	142.6	21.8	30.6	12.1	18	1.4	5.4
2014	15640	-87.1	140.5	21.4	29.9	12.2	18	1.4	5.5
2015	16035	-83.1	139.6	21.3	29.6	12.1	17.9	1.5	5.6
2016	16320	-83.1	137.4	20.9	29.4	11.6	17.2	1.5	5.6
2017	16833	-82.1	133.4	20.1	28.7	11.1	16.5	1.4	5.6
2018	17578	-80.2	130.6	19.6	28.1	10.8	16	1.5	5.5
2019	18657	-82.8	137.1	20.7	29.7	11.1	16.5	1.5	5.6
2020	19012	-71.9	115.9	16	25.7	8.2	14.1	1.3	5.3
2021	19139	-84.2	138.7	20.6	29.8	10.7	16	1.5	5.7

Sector: Physiotherapy Variable: cpEBITDA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	560	-98.4	217.7	37.7	50.4	22.7	31.2	1.3	5.1
2008	585	-123	209.7	37.4	45.4	26.2	30.8	1.1	4.8
2009	620	-122.3	217.3	38.7	49	25.9	32.1	1.2	5.3
2010	649	-87.7	203.1	37.1	44.7	23.2	28.9	1.3	4.6
2011	676	-98.6	169.9	29.3	40.2	17.4	24	1	4.4
2012	727	-87.6	146	23.2	33.6	14	20.7	1.1	4.8
2013	764	-54.4	141.5	23.4	31.6	14.5	20.2	1.4	5.1
2014	795	-65.4	140.6	23	31.4	14.7	19.7	1.2	5
2015	836	-82.3	139.7	22.4	30	14.6	20.1	1.2	5.2
2016	907	-65.6	134.6	21.6	31	12.7	18.3	1.4	5.2
2017	969	-71.9	129.4	19.9	29.4	11.8	17.2	1.2	5
2018	1029	-79.2	130.1	18.6	28.5	10.2	16.4	1.3	5.6
2019	1091	-76.6	135	19.5	30.5	11	16.6	1.3	5.4
2020	1160	-71.4	111.5	7.7	25.9	3	14.3	0.8	5.9
2021	1195	-72.5	137.8	19.2	31	10.3	17.3	1.4	5.7

Type: MFR Variable: cpEBITDA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	356	-90	217.7	41	50.1	27	33.7	1.2	4.9
2008	354	-123	209.7	42	48.6	28.5	33.1	0.9	4.5
2009	367	-122.3	217.3	44.2	52.1	29.8	33.9	1	4.7
2010	365	-87.7	203.1	43.3	48	30.1	34.4	1	4.1
2011	369	-93.8	169.5	33.9	43.4	21.2	29.3	0.8	3.6
2012	380	-87.6	146	27.2	37.9	18.7	26.4	0.7	3.8
2013	384	-54.4	141.5	28.4	34.9	19.7	25.3	1	3.9
2014	376	-65.4	140.6	28.6	33.9	20.2	22.9	1	4.5
2015	382	-44.8	139.7	29	31.7	21.3	24.2	1	4
2016	390	-65.6	134.6	29	35.2	20	24.5	1	3.9
2017	385	-71.9	129.4	28.2	34.5	18.5	25	0.7	3.6
2018	384	-79.2	130	27.3	32.6	20.5	24.8	0.7	3.9
2019	376	-74.9	135	31.1	37.9	19.4	25.6	0.7	3.3
2020	390	-70.6	111.1	8.3	31.6	4.2	21.1	0.6	4.3
2021	372	-70.5	136.8	28.7	38.8	19.3	25.4	0.8	3.5

Type: Non-MFR Variable: cpEBITDA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	204	-98.4	215.3	32.1	50.5	16.7	23.5	1.4	5.6
2008	231	-46.8	179	30.3	39	21.1	25.6	1.4	5.1
2009	253	-91.5	216.9	30.8	42.9	19	27.5	1.7	6.9
2010	284	-40.5	192.4	29.1	38.6	16.8	24.1	1.6	5.7
2011	307	-98.6	169.9	23.9	35.2	13.1	19	1.3	6
2012	347	-35.9	133.9	18.8	27.5	9.9	15.3	1.8	6.8
2013	380	-28.4	141.1	18.4	27.1	10.2	15.3	1.9	7.3
2014	419	-57.4	126.3	18	28.1	10.6	15.8	1.4	5.7
2015	454	-82.3	137.7	16.9	27.3	9.5	14.7	1.3	6.8
2016	517	-59.8	129.7	15.9	25.9	8.7	13.8	1.6	6.8
2017	584	-65	114.2	14.4	24	7.6	13.4	1.4	6.8
2018	645	-68.4	130.1	13.4	24.3	6.9	12.5	1.8	8.4
2019	715	-76.6	121.1	13.4	23.5	6.7	12.6	1.5	7.7
2020	770	-71.4	111.5	7.3	22.5	2.7	11.8	1	7.2
2021	823	-72.5	137.8	14.9	25.6	7.8	14.1	1.7	7.6

EBITDA in constant 2007 prices and in 10^3 €

Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

I.4 EBITDA DiD analysis

Healthcare vs Physiotherapy (2010+2011 vs 2012+2013)

```
Call:
lm(formula = cpEBITDA ~ Physiotherapy * post.shock, data =
sabi.test1)

Residuals:
   Min     1Q Median     3Q    Max
-156.19 -22.20 -10.40  12.81 174.68

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                  30.4596     0.2183 139.503  < 2e-16 ***
Physiotherapy                 2.6787     1.0027   2.672  0.00755 **
post.shock1                  -8.1592     0.3011 -27.097  < 2e-16 ***
Physiotherapy:post.shock1    -1.6637     1.3782  -1.207  0.22738
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 35.62 on 58942 degrees of freedom
  (69894 observations deleted due to missingness)
Multiple R-squared:  0.0133,    Adjusted R-squared:  0.01325
F-statistic: 264.7 on 3 and 58942 DF,  p-value: < 2.2e-16
```

Healthcare vs Physiotherapy (2018+2019 vs 2020+2021)

```
Call:
lm(formula = cpEBITDA ~ Physiotherapy * post.shock, data =
sabi.test2)

Residuals:
    Min      1Q  Median      3Q     Max
-102.942  -17.916   -8.966    9.415  124.258

Coefficients:
                            Estimate Std. Error t value Pr(>|t|)
(Intercept)                  20.1787     0.1496 134.911  < 2e-16 ***
Physiotherapy                -1.1166     0.6362  -1.755   0.0792 .
post.shock1                  -1.8773     0.2089  -8.988  < 2e-16 ***
Physiotherapy:post.shock1    -3.6650     0.8776  -4.176  2.97e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 28.47 on 78857 degrees of freedom
  (49979 observations deleted due to missingness)
Multiple R-squared:  0.002178,    Adjusted R-squared:  0.00214
F-statistic: 57.39 on 3 and 78857 DF,  p-value: < 2.2e-16
```

MFR vs non-MFR (2010+2011 vs 2012+2013)

```
Call:
lm(formula = cpEBITDA ~ MFR * post.shock, data = sabi.test3)

Residuals:
    Min      1Q  Median      3Q     Max
-132.402  -22.541   -9.926   13.776  166.037

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)       26.398      1.533  17.222  < 2e-16 ***
MFR               12.167      2.059   5.908.  3.88e-09 ***
post.shock1       -7.808      2.064  -3.783.  0.000158 ***
MFR:post.shock1   -2.946      2.823  - 1.044    0.296741
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 37.26 on 2812 degrees of freedom
  (2792 observations deleted due to missingness)
Multiple R-squared:  0.03648,    Adjusted R-squared:  0.03545
F-statistic: 35.49 on 3 and 2812 DF,  p-value: < 2.2e-16
```

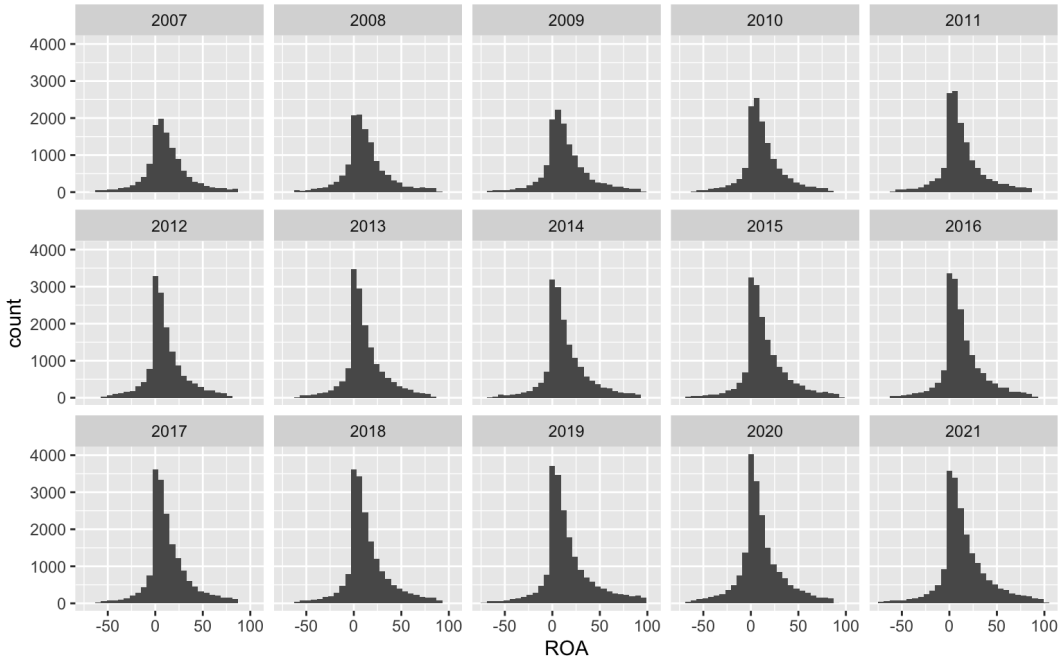
MFR vs non-MFR (2018+2019 vs 2020+2021)

```
Call:
lm(formula = cpEBITDA ~ MFR * post.shock, data = sabi.test4)

Residuals:
    Min      1Q  Median      3Q     Max
-108.427  -14.975   -6.583    9.283  126.540

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)      13.3949     0.7803  17.167  < 2e-16 ***
MFR              15.8086     1.3032  12.131  < 2e-16 ***
post.shock1      -2.1568     1.0623  -2.030    0.0424 *
MFR:post.shock1  -8.7566     1.8179  -4.817  1.51e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 28.77 on 4471 degrees of freedom
  (1133 observations deleted due to missingness)
Multiple R-squared:  0.0468,    Adjusted R-squared:  0.04616
F-statistic: 73.17 on 3 and 4471 DF,  p-value: < 2.2e-16
```

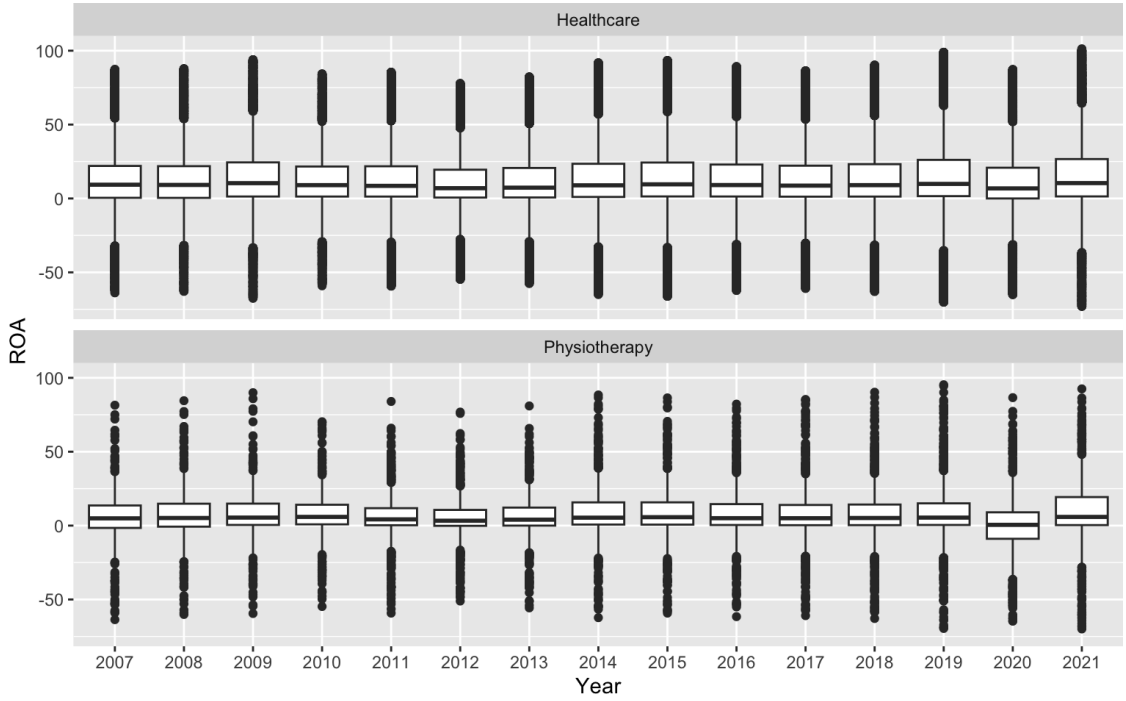
Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

Appendix J – ROA statistical analysis

J.1 Histogram of ROA by year.



J.2 Boxplot of ROA by year and sector.



J.3 Descriptive statistics of ROA by group

Sector: Healthcare Variable: ROA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	11227	-63.8	87.4	11.9	22.6	9.3	15	0.4	4.6
2008	11987	-62.9	87.8	12.2	22.9	9.2	14.7	0.5	4.6
2009	12569	-67.5	93.9	13.9	24.2	10.3	15.4	0.4	4.6
2010	12705	-59.1	84.3	12.3	21.4	9	13.4	0.4	4.6
2011	13540	-59.3	85.4	12.9	22.6	8.5	12.6	0.6	4.5
2012	14024	-54.7	77.8	10.8	20.2	6.9	11.4	0.5	4.5
2013	14928	-57.5	82.2	11.6	21.1	7.3	11.7	0.5	4.5
2014	15526	-64.9	91.8	13.5	23.1	8.9	13.2	0.6	4.7
2015	15987	-66.1	93.4	14.3	23.3	9.6	14.2	0.6	4.8
2016	16278	-62.2	89.2	13.4	22.1	9.1	13.5	0.6	4.7
2017	16762	-60.9	86.4	13	21.6	8.7	12.9	0.6	4.8
2018	17442	-63	90.3	13.8	22.9	9	13.4	0.7	4.7
2019	18713	-70.2	98.9	15.8	25.9	9.9	14.6	0.7	4.5
2020	18756	-65.1	87.3	10.7	23.6	6.8	14	0.4	4.4
2021	19219	-72.9	101.3	15.5	25.8	10.4	15.4	0.6	4.6

Sector: Physiotherapy Variable: ROA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	564	-63.6	81.5	5.1	18	4.9	11.7	-0.2	6.3
2008	600	-60.1	84.5	6.6	17.7	5.1	10.9	0.3	6.3
2009	630	-59.5	90	6.8	17.2	5.4	10.1	0.3	6.6
2010	665	-54.7	70.3	7.6	16.6	5.9	8.7	0.3	5.7
2011	692	-59.2	84	5.5	17.1	4.2	8.4	0.1	5.7
2012	738	-51	76.8	4.4	16.3	3.3	8.5	0.2	5.8
2013	791	-55.7	81	5.2	16.2	4	9.4	0.1	5.6
2014	825	-62.3	88.4	8.4	18.8	5.4	9.4	0.4	6.2
2015	872	-59.2	86.4	8	18.1	5.7	9.6	0.4	6.4
2016	923	-61.6	82.2	7.6	18.1	5	9.6	0.4	5.7
2017	997	-60.9	85.3	7	19.5	5	10	0.5	6.2
2018	1057	-62.9	90.2	6.7	19.5	5.1	10.4	0.1	5.9
2019	1137	-69.6	95.3	7.7	21.4	5.4	10.7	0.3	5.8
2020	1151	-64.6	86.6	-0.1	20.2	0.5	13.2	0	4.9
2021	1225	-69.9	92.5	8.8	22	5.9	13.7	0	4.9

Type: MFR Variable: ROA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	363	-59	75	4.4	15.5	4.3	10	-0.3	7
2008	368	-60.1	84.5	6.5	15.8	4.7	9.2	0.1	7.2
2009	378	-54.5	90	7.1	14.8	5.4	8.5	0.4	7.8
2010	385	-49.7	70.3	8.4	14.6	6.3	8.5	0.5	6.1
2011	389	-53.1	65.9	4.5	14.9	3.7	7.1	-0.1	6.8
2012	395	-45.1	58.1	3.1	13.6	2.8	7.1	0	6
2013	412	-53.9	56.2	4.6	13.8	3.3	7.7	0	6.3
2014	416	-54.8	88.4	6.8	15	4.7	7	0.6	8.8
2015	418	-53.2	62.1	6.6	13.1	5.1	6.8	0	7.7
2016	425	-55	82.2	6.3	15.5	4.4	7.6	0.4	6.9
2017	427	-44.9	85.3	6.8	14.5	5.4	7.9	0.7	8.1
2018	435	-57.3	71.5	6.8	14.9	5.3	8.1	-0.2	7.1
2019	430	-69.6	76.1	7.3	17.4	6	8.8	-0.2	6.7
2020	422	-60.3	61.6	-2	16.4	-0.8	10	-0.2	5.8
2021	417	-60.3	83.7	7.9	17.6	4.9	10.4	0.4	6

Type: Non-MFR Variable: ROA

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	201	-63.6	81.5	6.3	21.7	6.9	12.4	-0.2	5.1
2008	232	-59	77.2	6.7	20.4	5.3	14.4	0.3	5.1
2009	252	-59.5	85.9	6.4	20.4	5.4	14.5	0.3	5.3
2010	280	-54.7	69.9	6.6	19	5.1	10.7	0.2	5.1
2011	303	-59.2	84	6.7	19.6	4.9	10.7	0.1	4.6
2012	343	-51	76.8	5.8	18.9	3.9	10.9	0.1	5
2013	379	-55.7	81	5.8	18.6	5	11.3	0.1	4.8
2014	409	-62.3	86.6	9.9	22	6.2	14	0.2	4.8
2015	454	-59.2	86.4	9.3	21.6	6.7	13.4	0.3	5
2016	498	-61.6	79.5	8.7	20	5.7	11.4	0.3	5
2017	570	-60.9	85.2	7.2	22.5	4.6	13.3	0.4	5
2018	622	-62.9	90.2	6.7	22.2	5.1	12	0.2	5
2019	707	-68.9	95.3	7.9	23.5	5	12.5	0.4	5.2
2020	729	-64.6	86.6	0.9	22.1	1.6	14.8	0	4.4
2021	808	-69.9	92.5	9.3	23.9	6.7	15.5	-0.1	4.5

ROA in %

Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

J.4 ROA DiD analysis

Healthcare vs Physiotherapy (2010+2011 vs 2012+2013)

```
Call:
lm(formula = ROA ~ Physiotherapy * post.shock, data = sabi.test1)

Residuals:
   Min     1Q Median     3Q    Max
-71.886 -10.761  -3.728   8.819  77.487

Coefficients:
                              Estimate  Std. Error  t valu  Pr(>|t|)
(Intercept)                    12.5954      0.1304  96.602  < 2e-16 ***
Physiotherapy                  -6.0797      0.5880 -10.339  < 2e-16 ***
post.shock1                    -1.3751      0.1800  -7.638  2.24e-14 ***
Physiotherapy:post.shock1      -0.3389      0.8081  -0.419     0.675
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 21.12 on 58079 degrees of freedom
  (70757 observations deleted due to missingness)
Multiple R-squared:  0.005215,        Adjusted R-squared:  0.005164
F-statistic: 101.5 on 3 and 58079 DF,  p-value: < 2.2e-16
```

Healthcare vs Physiotherapy (2018+2019 vs 2020+2021)

```
Call:
lm(formula = ROA ~ Physiotherapy * post.shock, data = sabi.test2)

Residuals:
   Min     1Q Median     3Q    Max
-86.084 -12.970  -4.653  10.117  88.157

Coefficients:
                              Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)                    14.8736      0.1288  115.496  <2e-16 ***
Physiotherapy                  -7.6614      0.5384  -14.230  <2e-16 ***
post.shock1                    -1.7388      0.1799   -9.664  <2e-16 ***
Physiotherapy:post.shock1      -0.9950      0.7470   -1.332   0.183
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 24.49 on 78696 degrees of freedom
  (50140 observations deleted due to missingness)
Multiple R-squared:  0.007434,        Adjusted R-squared:  0.007396
F-statistic: 196.5 on 3 and 78696 DF,  p-value: < 2.2e-16
```

MFR vs non-MFR (2010+2011 vs 2012+2013)

```
Call:
lm(formula = ROA ~ MFR * post.shock, data = sabi.test3)

Residuals:
   Min     1Q Median     3Q    Max
-65.880  -5.789  -1.341   6.848  77.351

Coefficients:
                 Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)        6.6516      0.6860    9.696  <2e-16 ***
MFR               -0.2382      0.9083.  -0.262     0.793
post.shock1       -0.8229      0.9222.  -0.892     0.372
MFR:post.shock1   -1.7075      1.2430   -1.374     0.170
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 16.56 on 2882 degrees of freedom
  (2722 observations deleted due to missingness)
Multiple R-squared:  0.004499,        Adjusted R-squared:  0.003463
F-statistic: 4.342 on 3 and 2882 DF,  p-value: 0.004639
```

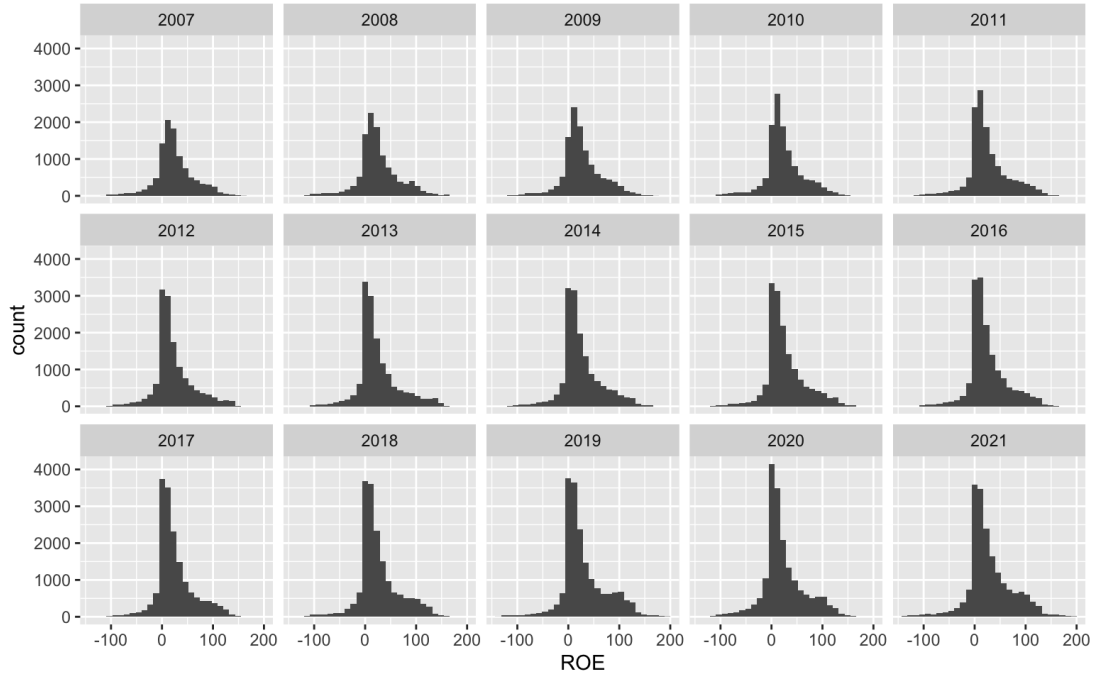
MFR vs non-MFR (2018+2019 vs 2020+2021)

```
Call:
lm(formula = ROA ~ MFR * post.shock, data = sabi.test4)

Residuals:
   Min     1Q Median     3Q    Max
-76.616  -7.615  -1.477   8.304  87.984

Coefficients:
                 Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)        7.3344      0.5786   12.675  <2e-16 ***
MFR               -0.3099      0.9215   -0.336  0.7367
post.shock1       -2.0080      0.7901.  -2.541  0.0111 *
MFR:post.shock1   -2.0917      1.2919   -1.619  0.1055
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 21.09 on 4566 degrees of freedom
  (1038 observations deleted due to missingness)
Multiple R-squared:  0.005728,        Adjusted R-squared:  0.005075
F-statistic: 8.769 on 3 and 4566 DF,  p-value: 8.519e-06
```

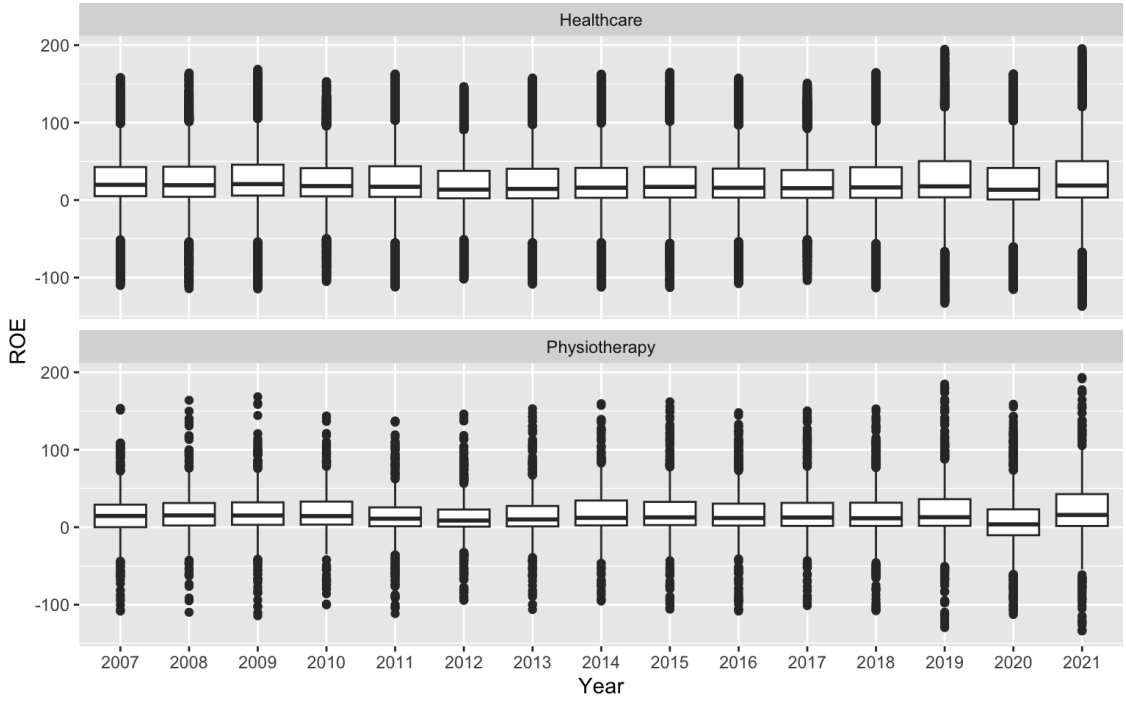
Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

Appendix K – ROE statistical analysis

K.1 Histogram of ROE by year.



K.2 Boxplot of ROE by year and sector.



K.3 Descriptive statistics of ROE by group

Sector: Healthcare Variable: ROE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	10016	-110.2	158.1	24.8	37.2	19.7	25.7	0.2	4.4
2008	10817	-114.3	164	25.1	39.1	19.2	26.4	0.2	4.5
2009	11311	-114.7	168.8	27.2	38.3	20.6	26.8	0.3	4.3
2010	11691	-104.9	152.9	24.7	36.8	18.1	23.9	0.3	4.4
2011	12565	-112.1	162.6	26.3	39.4	17.2	23.9	0.5	4.2
2012	13014	-101.8	146.4	22.9	37	13.5	20.1	0.8	4.5
2013	13888	-108.5	157.6	24.9	40.2	14.4	21.3	0.8	4.4
2014	14400	-112.4	162.4	25.2	38.3	16	23.7	0.6	4.4
2015	14843	-112.7	164.9	26.1	37.7	17	24.2	0.6	4.4
2016	15284	-107.8	157.4	25	36.7	15.9	22.9	0.7	4.4
2017	15699	-103.9	150.9	24.6	36.2	15.3	22.2	0.8	4.3
2018	16434	-113.2	164.5	26.2	39.5	16.3	23.8	0.6	4.2
2019	17524	-133.2	194.7	29.6	43.5	17.7	25.9	0.5	4.2
2020	17352	-115.2	162.7	23.2	40.5	13.3	22.8	0.5	4
2021	17828	-137	195.3	28.9	43.1	18.7	27.8	0.4	4.4

Sector: Physiotherapy Variable: ROE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	484	-108.3	153.5	15.7	36.3	14.5	21.5	0.2	5.1
2008	507	-109.8	163.8	19.5	34.1	15.2	21.3	0.6	5.7
2009	549	-114.2	168.4	18.7	35	15.1	20.2	0.2	6.1
2010	594	-100.2	143.7	18	33.3	14.3	19.1	0.1	5.3
2011	620	-111.4	137	12.7	34.5	11	15.9	0	5.4
2012	649	-94.3	146.1	12	33.4	8.6	15.8	0.3	5.4
2013	683	-106.2	152.9	15.4	34.1	10	17	0.6	5.8
2014	729	-95.3	159.4	18.7	34.5	12.1	18.8	0.6	5.2
2015	769	-105.7	161.9	19.1	36.1	12.7	18.7	0.5	5.8
2016	809	-108.3	147.8	17.9	36	11.9	18	0.2	5.3
2017	876	-101.2	150.1	19.1	34.9	12.5	18.6	0.7	5.4
2018	920	-107.7	152.8	17.3	36.3	11.5	20	0.3	5
2019	999	-129.5	184.7	21.3	42.1	12.9	22.6	0.6	5.5
2020	957	-112.7	158.7	7.1	41.1	3.7	24.8	0.3	4.5
2021	1058	-133.7	193.3	21.9	44.2	15.8	26.8	0.2	4.9

Type: MFR Variable: ROE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	323	-108.3	151.1	12.7	31.3	11.6	19.1	0.1	6
2008	327	-76.4	163.8	16.3	31.4	12	17.9	0.8	6.4
2009	348	-114.2	168.4	17.8	34.1	14.2	19	0.4	7.6
2010	363	-100.2	143.7	17	31.6	14.1	18	0.1	5.7
2011	361	-111.4	108.3	9.5	30.7	9.2	14.4	-0.4	5.9
2012	359	-94.3	95.6	7.6	28.1	7.4	11.5	-0.3	5.5
2013	373	-106.2	152.9	12.4	31.3	8	13.3	0.6	7.2
2014	381	-92.6	139.3	15.8	27.5	10.2	14.2	0.7	6.6
2015	390	-94.4	155.7	16.7	30.8	10.7	14.3	1.1	8.5
2016	396	-108.3	144.3	14.5	32.5	9.8	14.7	0.3	6.3
2017	400	-88.6	127.2	15.2	27.2	10.7	14.9	0.7	5.9
2018	408	-106.9	149.4	15.9	29	11.1	15	0.5	6.9
2019	397	-113.1	174.7	18.1	34.8	11.7	16.8	1	7.4
2020	372	-105.9	155.3	-1.9	33.1	0.3	19	0.1	6
2021	378	-123.4	193.3	16.5	37.5	10.8	19.8	0.5	6.6

Type: Non-MFR Variable: ROE

Year	n	Min	Max	Mean	SD	Median	MAD	Skewness	Kurtosis
2007	161	-106.7	153.5	21.6	44.2	19	29.3	0.1	3.8
2008	180	-109.8	149.8	25.4	37.8	19.6	27.2	0.3	5.1
2009	201	-110.2	114.4	20.2	36.4	17.4	23.3	-0.2	4.2
2010	231	-99.8	141.3	19.5	35.7	15.4	24.1	0	4.7
2011	259	-100	137	17.3	38.8	13.7	22.3	0.2	4.5
2012	290	-94.1	146.1	17.3	38.5	11	20	0.4	4.6
2013	310	-99.8	142.8	19.2	37	12.9	21.4	0.6	4.6
2014	348	-95.3	159.4	21.8	40.6	15.3	29.3	0.3	4.1
2015	379	-105.7	161.9	21.6	40.7	16.4	25.3	0.1	4.5
2016	413	-105.5	147.8	21.1	38.9	17.1	22.7	0.1	4.7
2017	476	-101.2	150.1	22.3	40	15.5	23.8	0.6	4.5
2018	512	-107.7	152.8	18.5	41.2	12.8	25.2	0.2	4.1
2019	602	-129.5	184.7	23.3	46.2	15.1	26.4	0.4	4.8
2020	585	-112.7	158.7	12.8	44.5	8.1	27.2	0.2	3.9
2021	680	-133.7	191.5	24.9	47.2	20.6	32	0	4.4

ROE in %

Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

K.4 ROE DiD analysis

Healthcare vs Physiotherapy (2010+2011 vs 2012+2013)

```
Call:
lm(formula = ROE ~ Physiotherapy * post.shock, data = sabi.test1)

Residuals:
    Min      1Q  Median      3Q     Max
-137.670  -21.259   -8.634   15.730  139.178

Coefficients:
                              Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)                   25.54569   0.24555  104.033  < 2e-16 ***
Physiotherapy                -10.23266   1.12474   -9.098  < 2e-16 ***
post.shock1                   -1.62418   0.33862   -4.796.  1.62e-06 ***
Physiotherapy:post.shock1      0.05936   1.55481    0.038      0.97
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 38.24 on 53700 degrees of freedom
  (75136 observations deleted due to missingness)
Multiple R-squared:  0.003646,        Adjusted R-squared:  0.00359
F-statistic:  65.5 on 3 and 53700 DF,  p-value: < 2.2e-16
```

Healthcare vs Physiotherapy (2018+2019 vs 2020+2021)

```
Call:
lm(formula = ROE ~ Physiotherapy * post.shock, data = sabi.test2)

Residuals:
    Min      1Q  Median      3Q     Max
-163.08  -24.20  -10.26   19.05  178.40

Coefficients:
                              Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)                   27.9732    0.2268   123.346  < 2e-16 ***
Physiotherapy                 -8.6079    0.9806    -8.778  < 2e-16 ***
post.shock1                   -1.9173    0.3179    -6.031  1.64e-09 ***
Physiotherapy:post.shock1     -2.5984    1.3704    -1.896     0.0579 .
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 41.79 on 73068 degrees of freedom
  (55768 observations deleted due to missingness)
Multiple R-squared:  0.003527,        Adjusted R-squared:  0.003486
F-statistic: 86.21 on 3 and 73068 DF,  p-value: < 2.2e-16
```

MFR vs non-MFR (2010+2011 vs 2012+2013)

```
Call:
lm(formula = ROE ~ MFR * post.shock, data = sabi.test3)

Residuals:
    Min      1Q  Median      3Q     Max
-124.696  -12.811   -2.891   12.871  142.874

Coefficients:
                 Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)      18.35342    1.52409   12.042  < 2e-16 ***
MFR              -5.09811    1.97356   -2.583   0.00984 **
post.shock1      -0.09561    2.05423   -0.047.  0.96288
MFR:post.shock1  -3.10786    2.71051   -1.147.  0.25166
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 33.74 on 2542 degrees of freedom
  (3062 observations deleted due to missingness)
Multiple R-squared:  0.01072,        Adjusted R-squared:  0.009553
F-statistic: 9.182 on 3 and 2542 DF,  p-value: 4.844e-06
```

MFR vs non-MFR (2018+2019 vs 2020+2021)

```
Call:
lm(formula = ROE ~ MFR * post.shock, data = sabi.test4)

Residuals:
    Min      1Q  Median      3Q     Max
-153.016  -18.153   -4.907   16.703  185.866

Coefficients:
                 Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)      21.090     1.237      17.051   < 2e-16 ***
MFR              -4.111     1.910      -2.153   0.03140 *
post.shock1      -1.815     1.696      -1.070   0.28472
MFR:post.shock1  -7.779     2.696      -2.886   0.00393 **
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 41.28 on 3930 degrees of freedom
  (1674 observations deleted due to missingness)
Multiple R-squared:  0.01391,        Adjusted R-squared:  0.01316
F-statistic: 18.48 on 3 and 3930 DF,  p-value: 6.621e-12
```

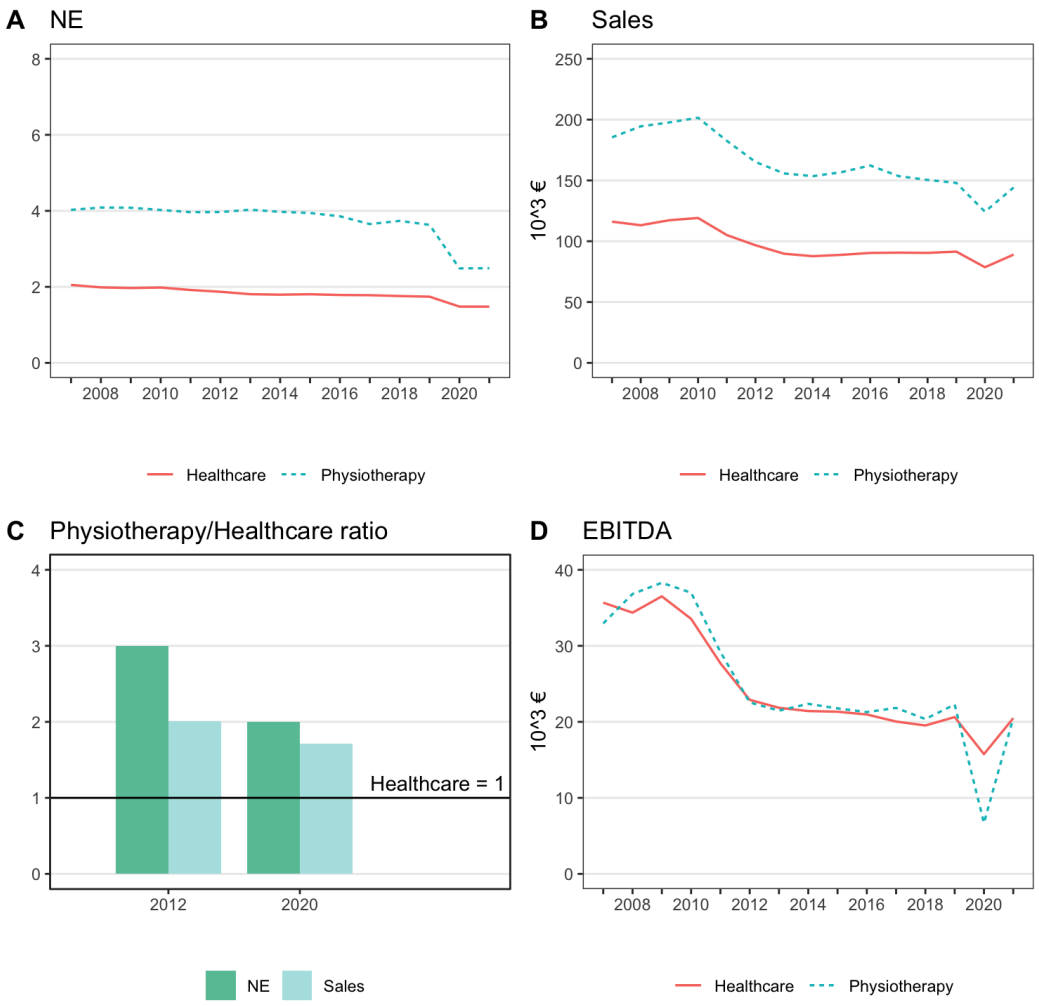
Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

Appendix L – Physiotherapy restricted subgroup analysis

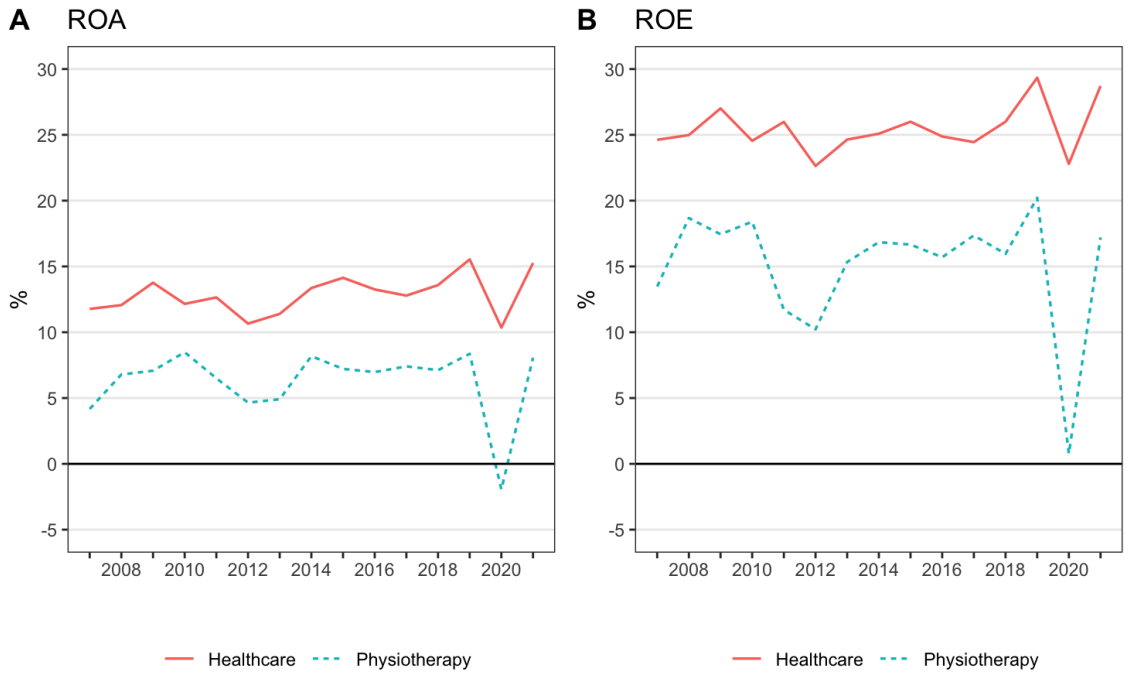
To assess if a stricter selection process (regarding the physiotherapy providers) could have led to different results, we've decided to study a subgroup of our set of physiotherapy providers, with a stricter inclusion criterion. The providers in this subgroup, utilizing physiotherapy related terms in their company's name, are eventually more focused on physiotherapy services *per se* than those who don't share this characteristic.

In Figure L.1 and L.2 we can verify that the patterns observed in the main analysis of the study, regarding the comparative behaviour of the physiotherapy and the healthcare sectors during the recession periods, remain visible and aligned with our previous findings.

L.1 Physiotherapy vs healthcare sector mean NE (A), Sales (B), NE and Sales ratios (C) and EBITDA (D).



L.2 Mean ROA (A) and ROE (B) of the healthcare sector vs the physiotherapy sector.



Apart from the NE behaviour in the first recession (without any visible impact in both sectors), in all other indicators and analysis, the physiotherapy sector suffered a higher impact from both recessions, and a clearly more pronounced impact in the 2020 Covid-19 shock. These results suggest that even if we had chosen a stricter entry criteria for the physiotherapy providers main group analysis, the results would still point to a lower resilience of this sector, especially in the 2020 recession.

Appendix M – DuPont analysis

M.1 DuPont analysis for the ROA of the physiotherapy sector as one

	ROA	PM	AT	Margin (PM) effect[1]	Rotation (AT) effect[2]	Interaction effect[3]
2007	4,53%	4,77%	0,95			
2008	6,01%	6,33%	0,95	0,01484	-0,00005	-0,00002
2009	6,23%	6,54%	0,95	0,00199	0,00017	0,00001
2010	6,54%	6,77%	0,97	0,00211	0,00094	0,00003
2011	4,75%	4,98%	0,95	-0,01729	-0,00083	0,00022
2012	3,54%	3,71%	0,95	-0,01204	-0,00003	0,00001
2013	4,00%	4,29%	0,93	0,00550	-0,00079	-0,00012
2014	5,40%	5,66%	0,95	0,01278	0,00092	0,00029
2015	6,26%	6,24%	1,00	0,00554	0,00278	0,00029
2016	5,76%	5,75%	1,00	-0,00497	-0,00003	0,00000
2017	6,02%	5,88%	1,02	0,00134	0,00123	0,00003
2018	5,95%	5,66%	1,05	-0,00223	0,00154	-0,00006
2019	6,17%	5,63%	1,10	-0,00033	0,00258	-0,00001
2020	0,15%	0,16%	0,93	-0,05988	-0,00936	0,00909
2021	6,53%	6,12%	1,07	-0,05533	0,00023	0,00824

1. Margin effect $_t = (PM_t - PM_{t-1}) * AT_{t-1}$
2. Rotation effect $_t = (AT_t - AT_{t-1}) * PM_{t-1}$
3. Interaction effect $_t = (PM_t - PM_{t-1}) * (AT_t - AT_{t-1})$

$(ROA_t - ROA_{t-1}) = 1 + 2 + 3$

M.2 DuPont analysis for the ROE of the physiotherapy sector as one

	ROE	ROA	FL	ROA effect[1]	Leverage (FL) effect[2]	Interaction effect[3]
2007	11,26%	4,53%	2,48			
2008	14,98%	6,01%	2,49	0,03669	0,00038	0,00012
2009	15,59%	6,23%	2,50	0,00540	0,00069	0,00002
2010	16,74%	6,54%	2,56	0,00772	0,00361	0,00018
2011	11,75%	4,75%	2,47	-0,04585	-0,00568	0,00156
2012	8,59%	3,54%	2,43	-0,02985	-0,00235	0,00060
2013	9,90%	4,00%	2,48	0,01113	0,00183	0,00024
2014	12,43%	5,40%	2,30	0,03466	-0,00694	-0,00243
2015	14,18%	6,26%	2,27	0,01982	-0,00206	-0,00033
2016	12,83%	5,76%	2,23	-0,01131	-0,00238	0,00019
2017	13,78%	6,02%	2,29	0,00579	0,00359	0,00016
2018	13,48%	5,95%	2,27	-0,00172	-0,00133	0,00002
2019	13,89%	6,17%	2,25	0,00505	-0,00095	-0,00004
2020	0,36%	0,15%	2,38	-0,13542	0,00784	-0,00765
2021	16,45%	6,53%	2,52	0,15172	0,00021	0,00897

1. ROA effect $_t = (ROA_t - ROA_{t-1}) * FL_{t-1}$
2. Leverage effect $_t = (FL_t - FL_{t-1}) * ROA_{t-1}$
3. Interaction effect $_t = (ROA_t - ROA_{t-1}) * (FL_t - FL_{t-1})$

$(ROE_t - ROE_{t-1}) = 1 + 2 + 3$

M.3 DuPont analysis for the ROA of the healthcare sector as one

	ROA	PM	AT	Margin (PM) effect[1]	Rotation (AT) effect[2]	Interaction effect[3]
2007	11,95%	15,77%	0,76			
2008	11,73%	15,64%	0,75	-0,00091	-0,00124	0,00001
2009	12,75%	17,39%	0,73	0,01312	-0,00263	-0,00029
2010	10,84%	14,85%	0,73	-0,01862	-0,00067	0,00010
2011	10,41%	14,39%	0,72	-0,00337	-0,00086	0,00003
2012	8,71%	12,36%	0,70	-0,01469	-0,00277	0,00039
2013	9,34%	13,49%	0,69	0,00769	-0,00149	-0,00014
2014	10,39%	15,09%	0,69	0,01107	-0,00054	-0,00006
2015	10,76%	15,35%	0,70	0,00177	0,00187	0,00003
2016	10,32%	14,86%	0,69	-0,00344	-0,00095	0,00003
2017	9,90%	14,18%	0,70	-0,00468	0,00046	-0,00002
2018	10,26%	14,11%	0,73	-0,00049	0,00418	-0,00002
2019	11,35%	14,93%	0,76	0,00594	0,00467	0,00027
2020	8,08%	12,13%	0,67	-0,02129	-0,01410	0,00264
2021	11,23%	15,19%	0,74	0,02036	0,00891	0,00225

1. Margin effect $_t = (PM_t - PM_{t-1}) * AT_{t-1}$
2. Rotation effect $_t = (AT_t - AT_{t-1}) * PM_{t-1}$
3. Interaction effect $_t = (PM_t - PM_{t-1}) * (AT_t - AT_{t-1})$

$(ROA_t - ROA_{t-1}) = 1 + 2 + 3$

M.4 DuPont analysis for the ROE of the healthcare sector as one

	ROE	ROA	FL	ROA effect[1]	Leverage (FL) effect[2]	Interaction effect[3]
2007	21,76%	11,95%	1,82			
2008	21,16%	11,73%	1,80	-0,00390	-0,00221	0,00004
2009	22,18%	12,75%	1,74	0,01839	-0,00748	-0,00065
2010	19,02%	10,84%	1,76	-0,03338	0,00209	-0,00031
2011	17,93%	10,41%	1,72	-0,00739	-0,00364	0,00014
2012	14,76%	8,71%	1,70	-0,02940	-0,00274	0,00045
2013	15,47%	9,34%	1,66	0,01075	-0,00341	-0,00025
2014	16,45%	10,39%	1,58	0,01734	-0,00680	-0,00076
2015	16,83%	10,76%	1,57	0,00583	-0,00194	-0,00007
2016	15,94%	10,32%	1,54	-0,00683	-0,00220	0,00009
2017	15,10%	9,90%	1,53	-0,00655	-0,00192	0,00008
2018	15,89%	10,26%	1,55	0,00560	0,00221	0,00008
2019	17,65%	11,35%	1,56	0,01684	0,00074	0,00008
2020	12,83%	8,08%	1,59	-0,05093	0,00381	-0,00110
2021	17,99%	11,23%	1,60	0,05008	0,00106	0,00042

1. ROA effect $_t = (ROA_t - ROA_{t-1}) * FL_{t-1}$
2. Leverage effect $_t = (FL_t - FL_{t-1}) * ROA_{t-1}$
3. Interaction effect $_t = (ROA_t - ROA_{t-1}) * (FL_t - FL_{t-1})$

$(ROE_t - ROE_{t-1}) = 1 + 2 + 3$

Appendix N – Profitability regression models - List of variables and auxiliary plots

N.1 List of variables

Variable	Description	Level	Source
ROA	Net Income / Total Assets	Firm	SABI BvD
ROE	Net Income / Equity	Firm	SABI BvD
MFR	(1 = MFR provider, 0 = non-MFR provider)	Firm	ERS [1]
NE	Number of Employees	Firm	SABI BvD
Sales	Sales in thousands €	Firm	SABI BvD
Self_Employed	% of payments to staff dedicated to self-employed workers [2]	Firm	SABI BvD
Labour_Int	% of total costs dedicated to payments to staff (contracted and self-employed workers) [3]	Firm	SABI BvD
Owned_Premises	(1 = With owned premises, 0 = Without owned premises) [4]	Firm	SABI BvD
Rural	(1 = Rural location, 0 = Urban location)	Civil Parish	INE [5]
RatioTertiarySector	(Primary and secondary sector workers) / (Tertiary sector workers)	Municipality	PORDATA [6]
Aging	Number of elders (>65 years) per 100 youngsters (<15 years)	Municipality	PORDATA [7]
Income	Average monthly income	Municipality	INE [8]
Accidents	Yearly number of road accidents with injuries	Municipality	INE [9]
NHS_Contract	(1 = With contract with the NHS, 0 = No contract with the NHS)	Firm	SPMS [10]
ADSE_Provider	(1 = ADSE provider, 0 = non-ADSE provider)	Firm	ADSE [11]
Public_MFR_Hospital	(1 = With public MFR hospital in the region, 0 = Without public MFR hospital in the region)	Municipality	SPMS [12]

[1] https://www.ers.pt/pt/prestadores/servicos/pesquisa-de-prestadores/

[2] (SNC account 6224 / (SNC account 6224 + SNC account 632)) * 100

[3] ((SNC account 6224 + SNC account 632) / Total costs) * 100

[4] (SNC account 432 > 0 €) = 1 ; (SNC account 432 = 0 €) = 0

[5] https://www.ine.pt/ngt_server/attachfileu.jsp?look_parentBoui=233291154&att_display=n&att_download=y

[6] https://www.pordata.pt/municipios/populacao+residente+segundo+os+censos+total+e+por+grandes+grupos+etarios-22

[7] https://www.pordata.pt/municipios/indice+de+envelhecimento-458

[8] https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0006914&xlang=pt&contexto=bd&selTab=tab2

[9] https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&indOcorrCod=0008639&contexto=bd&selTab=tab2

[10] https://transparencia.sns.gov.pt/explore/dataset/exames-convencionados-e-area-mcdt/

[11] https://www.adse.pt/pesqmed/

[12] http://tempos.min-saude.pt/#/instituicoes-especialidade-cth

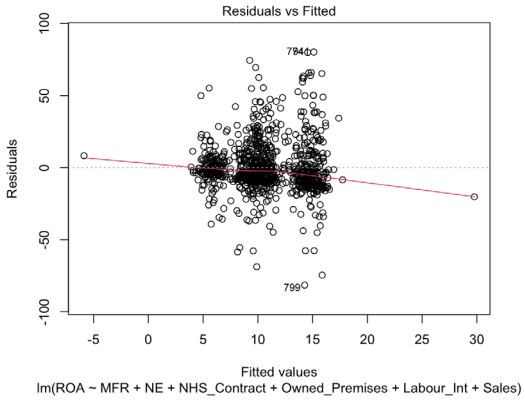
SNC account 432: 4/Investments. 43/Tangible non-current assets. 432/Properties and other buildings.

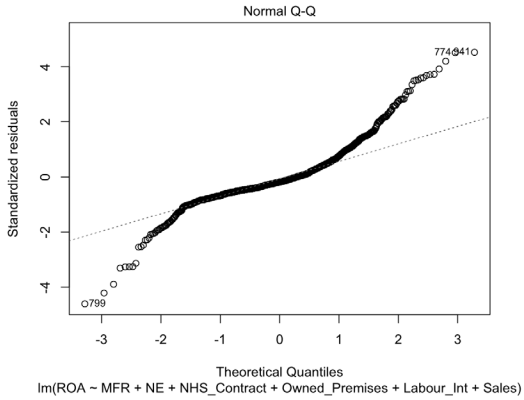
SNC account 632: 6/Costs. 63/Costs with staff. 632/Staff fees (*Remunerações*).

SNC account 6224: 6/Costs. 62/Supplies and external services. 622/Specialized services. 6224/Fees (*Honorários*).

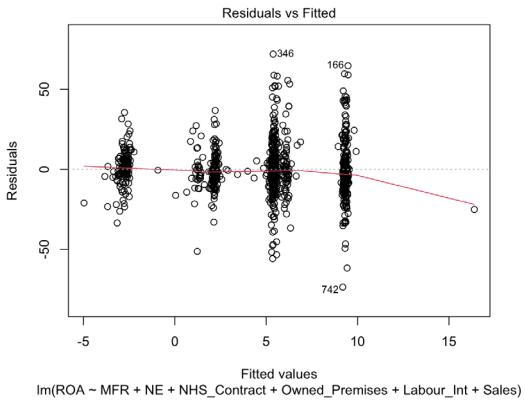
N.2 ROA linear regression models residuals plots

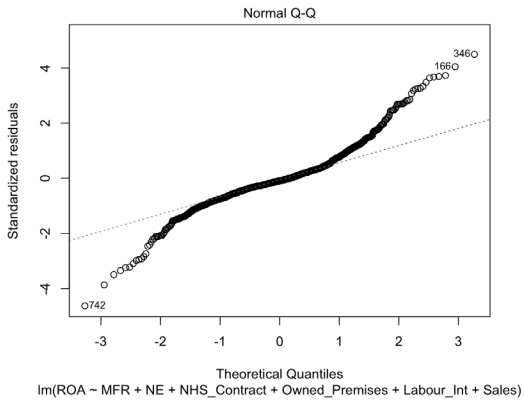
2019





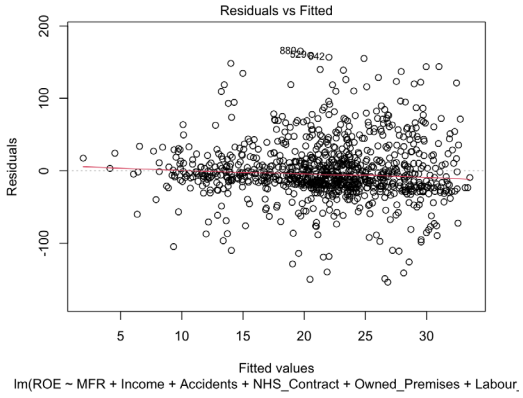
2020

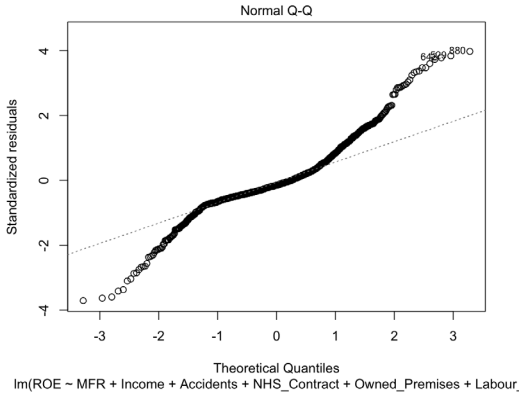




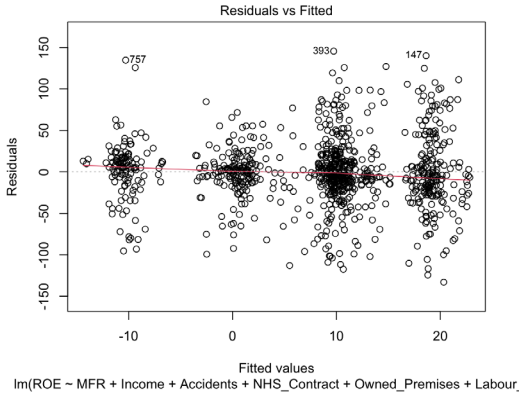
N.3 ROE linear regression models residuals plots

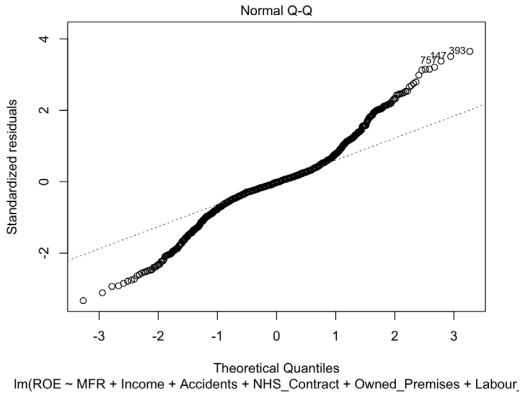
2019





2020





N.4 OLS regression models without stepwise selection of variables

ROA 2019

```
lm(formula = ROA ~ MFR + NE + Rural + RatioTerciarySector +
Aging + Income + Accidents + NHS_Contract + ADSE_Provider
+ Public_MFR_Hospital + Owned_Premises + Self_Employed +
Labour_Int + Sales, data = sabi.lm.19)

Residuals:
   Min     1Q  Median     3Q    Max
-81.981  -8.679  -3.113   5.932  79.939

Coefficients:
                    Estimate    Std. Error   t value  Pr(>|t|)
(Intercept)       14.1480355  5.8786686   2.407   0.016287 *
MFR               -3.2470942  1.5237714  -2.131   0.033346 *
NE                -0.1243750  0.0696450  -1.786   0.074441 .
Rural             -0.4704550  2.0298022  -0.232   0.816763
RatioTerciarySector  0.0160371  0.0251520   0.638   0.523881
Aging              0.0080936  0.0100984   0.801   0.423054
Income            -0.0034688  0.0041699  -0.832   0.405692
Accidents          0.0008786  0.0012494   0.703   0.482074
NHS_Contract       4.9588357  1.9098387   2.596   0.009563 **
ADSE_Provider     -1.7126955  1.7233744  -0.994   0.320569
Public_MFR_Hospital  0.1850168  1.2921277   0.143   0.886172
Owned_Premises    -4.8199750  1.2350274  -3.903   0.000102 ***
Self_Employed     -0.0269097  0.0224405  -1.199   0.230762
Labour_Int         0.0656267  0.0387677   1.693   0.090815 .
Sales              0.0016138  0.0008046   2.006   0.045165 *
---
Signif. codes:  '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Residual standard error: 17.78 on 959 degrees of freedom
  (21 observations deleted due to missingness)
Multiple R-squared:  0.03781,        Adjusted R-squared:  0.02376
F-statistic: 2.692 on 14 and 959 DF,  p-value: 0.0006902
```

ROA 2020

```
lm(formula = ROA ~ MFR + NE + Rural + RatioTerciarySector +
Aging + Income + Accidents + NHS_Contract + ADSE_Provider
+ Public_MFR_Hospital + Owned_Premises + Self_Employed +
Labour_Int + Sales, data = sabi.lm.20)

Residuals:
   Min     1Q  Median     3Q    Max
-74.731  -7.829  -1.419   6.354  71.642

Coefficients:
                    Estimate    Std. Error   t value  Pr(>|t|)
(Intercept)       15.0660958  5.2520923   2.869  0.004218 **
MFR               -1.9193062  1.4213151  -1.350  0.177230
NE                -0.0312482  0.0621520  -0.503  0.615247
Rural             -0.2964249  1.8155445  -0.163  0.870341
RatioTerciarySector -0.0146612  0.0230455  -0.636  0.524815
Aging             -0.0025752  0.0092128  -0.280   0.779909
Income            -0.0043699  0.0036924  -1.183  0.236926
Accidents         -0.0005761  0.0019504  -0.295  0.767759
NHS_Contract      -3.9598020  1.7804102  -2.224  0.026385 *
ADSE_Provider     -4.1408575  1.6129146  -2.567  0.010407 *
Public_MFR_Hospital  1.2525672  1.1878959   1.054  0.291959
Owned_Premises    -3.8165787  1.1382369  -3.353  0.000832 ***
Self_Employed     -0.0015631  0.0211751  -0.074  0.941172
Labour_Int         0.0077928  0.0347799   0.224  0.822761
Sales              0.0006389  0.0008013   0.797  0.425512
---
Signif. codes:  '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' '

Residual standard error: 16 on 915 degrees of freedom
Multiple R-squared:  0.0649,        Adjusted R-squared:  0.05059
F-statistic: 4.536 on 14 and 915 DF,  p-value: 5.671e-08
```

ROE 2019

```
lm(formula = ROE ~ MFR + NE + Rural + RatioTerciarySector +
Aging + Income + Accidents + NHS_Contract + ADSE_Provider
+ Public_MFR_Hospital + Owned_Premises + Self_Employed +
Labour_Int + Sales, data = sabi.lm.19)

Residuals:
    Min      1Q  Median      3Q     Max
-150.270  -19.689   -6.287   14.878  163.898

Coefficients:
                    Estimate.   Std. Error   t value  Pr(>|t|)
(Intercept)       30.487459  13.767369   2.214   0.0270 *
MFR               -7.795902   3.568550  -2.185   0.0292 *
NE                -0.238985   0.163103  -1.465   0.1432
Rural              1.183580   4.753634   0.249   0.8034
RatioTerciarySector  0.010420   0.058904   0.177   0.8596
Aging              0.017958   0.023650   0.759   0.4478
Income            -0.013177   0.009766  -1.349   0.1776
Accidents          0.004640   0.002926   1.586   0.1131
NHS_Contract      10.490546   4.472689   2.345   0.0192 *
ADSE_Provider     -2.126060   4.036004  -0.527   0.5985
Public_MFR_Hospital  0.443336   3.026059   0.147   0.8836
Owned_Premises    -6.325484   2.892335  -2.187   0.0290 *
Self_Employed     -0.065686   0.052554  -1.250   0.2116
Labour_Int         0.180565   0.090791   1.989   0.0470 *
Sales              0.003717   0.001884   1.973   0.0488 *
---
Signif. codes:  '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Residual standard error: 41.64 on 959 degrees of freedom
  (21 observations deleted due to missingness)
Multiple R-squared:  0.02502,        Adjusted R-squared:  0.01079
F-statistic: 1.758 on 14 and 959 DF,  p-value: 0.0404
```

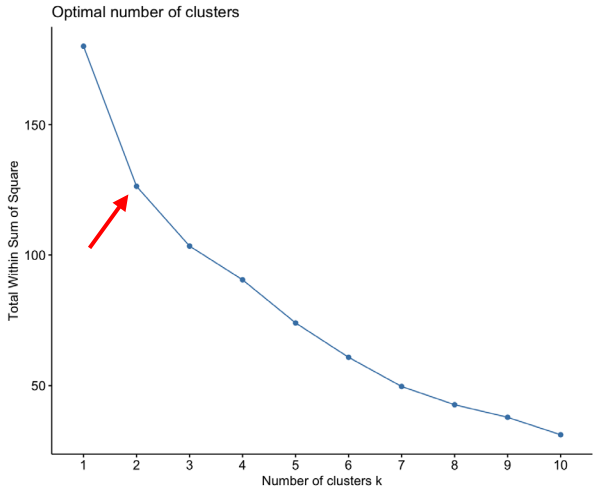
ROE 2020

```
lm(formula = ROE ~ MFR + NE + Rural + RatioTerciarySector +
Aging + Income + Accidents + NHS_Contract + ADSE_Provider
+ Public_MFR_Hospital + Owned_Premises + Self_Employed +
Labour_Int + Sales, data = sabi.lm.20)

Residuals:
    Min      1Q  Median      3Q     Max
-131.205  -17.287   -1.255   16.692  140.447

Coefficients:
                    Estimate    Std. Error  t value  Pr(>|t|)
(Intercept)       43.014467  13.100251   3.283  0.00106 **
MFR               -7.128361   3.545175  -2.011   0.04465 *
NE                -0.158126   0.155025  -1.020   0.30800
Rural              0.413142   4.528498   0.091   0.92733
RatioTerciarySector -0.110325   0.057482  -1.919   0.05526 .
Aging             -0.023733   0.022979  -1.033   0.30198
Income            -0.014058   0.009210  -1.526   0.12725
Accidents          0.001736   0.004865   0.357   0.72127
NHS_Contract      -9.445459   4.440863  -2.127   0.03369 *
ADSE_Provider     -5.463774   4.023080  -1.358   0.17476
Public_MFR_Hospital  4.860149   2.962959   1.640   0.10129
Owned_Premises    -7.993393   2.839095  -2.815   0.00498 **
Self_Employed     -0.102715   0.052817  -1.945   0.05211 .
Labour_Int         0.023689   0.086751   0.273   0.78487
Sales              0.001930   0.001999   0.966   0.33454
---
Signif. codes:  '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1

Residual standard error: 39.91 on 915 degrees of freedom
Multiple R-squared:  0.06862,        Adjusted R-squared:  0.05437
F-statistic: 4.815 on 14 and 915 DF,  p-value: 1.261e-08
```

Note: R outputs with decimal point (instead of the decimal comma used in the rest of the text).

Appendix O – Cluster analysis

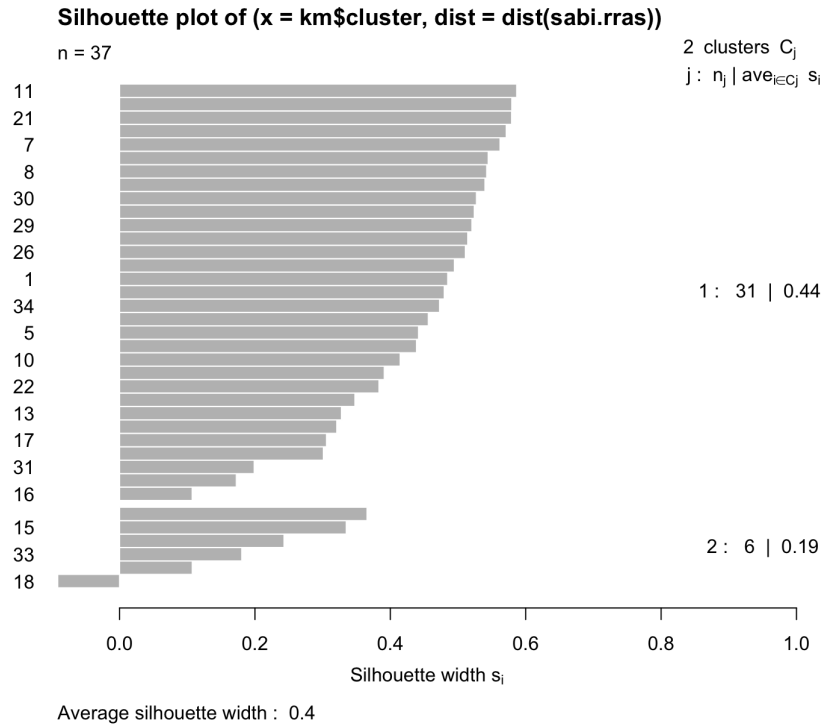
O.1 Optimal number of clusters analysis using the Euclidean Distance and the Total Within Sum of Squares (WSS)



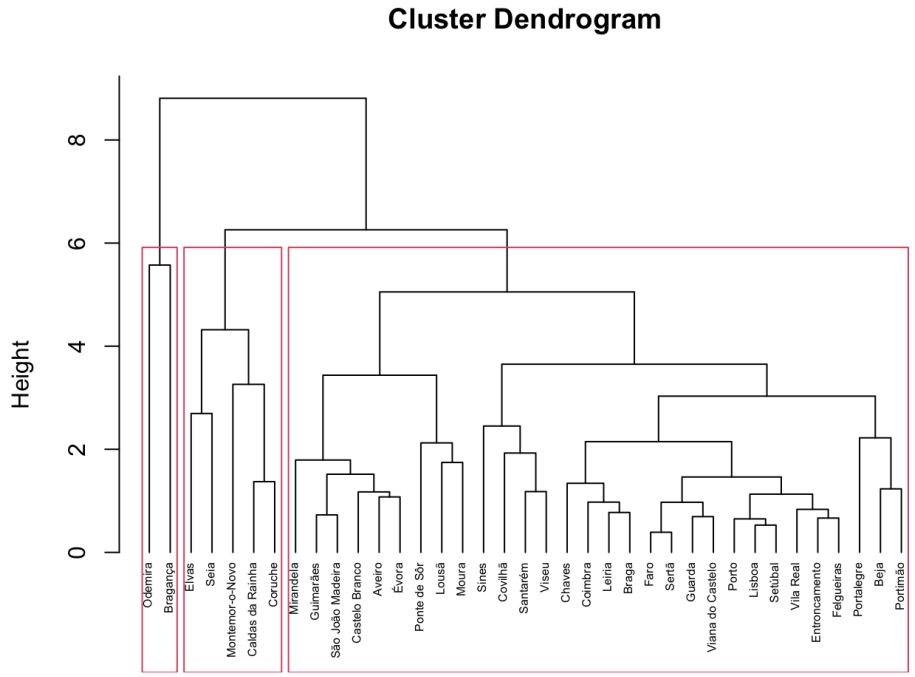
O.2 K-Means clustering results

```
K-means clustering with 2 clusters of sizes 31, 6

Cluster means:
          NE      Sales     EBITDA       ROA        ROE
1  0.1038989 -0.1850693 -0.2971206 -0.339469 -0.1790619
2 -0.5368112  0.9561914  1.5351229  1.753923  0.9251529

Clustering vector:
          Aveiro          Covilhã            Elvas    Entroncamento            Évora
               1                1                2                1                1
            Faro       Felgueiras           Guarda        Guimarães           Leiria
               1                1                1                1                1
          Lisboa            Beja           Lousã        Mirandela  Montemor-o-Novo
               1                1                1                1                2
           Moura          Odemira     Ponte de Sôr       Portalegre         Portimão
               1                1                2                1                1
           Porto         Santarém           Braga São João Madeira             Seia
               1                1                1                1                2
           Sertã          Setúbal           Sines Viana do Castelo       Vila Real
               1                1                1                1                1
           Viseu        Bragança Caldas da Rainha   Castelo Branco           Chaves
               1                1                2                1                1
        Coimbra          Coruche
               1                2

Within cluster sum of squares by cluster:
[1] 99.50050 26.85266
 (between_SS / total_SS =  29.8 %)

Available components:

[1] "cluster"      "centers"      "totss"        "withinss"     "tot.withinss"
[6] "betweenss"    "size"         "iter"         "ifault"
```

O.3 Silhouette plot with Silhouette coefficient



O.4 Hierarchical clustering with dendrogram



Appendix P – Physiotherapy treatment profiles and income by client/payer

P.1 Common physiotherapy treatment profiles

Treatment profile	Treatment procedures codes			
#1 Orthopaedic patient (TKA)	60377	60233	61102	60404
#2 Neurologic patient (Stroke)	60377	61087	61102	60404
#3 Paediatric patient (Cerebral palsy)	60377	61087	61102	60404
#4 Pulmonary patient (COPD)	60437	60430	61102	60435
#5 Oncologic patient (Mastectomy)	60825	60377	61102	60435

TKA – Total Knee Arthroplasty
COPD – Chronic Obstructive Pulmonary Disease

60377 – Special techniques of kinesiotherapy
60233 – Manual massage in more than one region
61102 – Manual muscular strengthening
60404 – Balance and gait training
61087 – Activities of daily living training
60437 – Aerosol therapy
60430 – Respiratory kinesiotherapy
60435 – Postural drainage
60825 – Intermittent pneumatic compression

P.2 Income by treatment profile (by therapy session) and by client/payer

Payer	Treatment profiles				
	#1	#2	#3	#4	#5
NHS contract*	7,91€	10,11€	10,11€	8,67€	10,05€
ADSE subsystem**	8,93€	9,88€	9,88€	7,82€	9,35€
Advancecare VHI***	12,05€	12,05€	12,05€	12,62€	12,05€
OOP estimate****	35,00€	35,00€	45,00€	35,00€	35,00€

* https://www.acss.min-saude.pt/2016/10/03/tabelas-meios-complementares-de-diagnostico-e-terapeutica/ (07/2022)

** https://www2.adse.pt/rede-adse/tabela-de-precos-e-regras/ (03/2023)

*** https://areareservada.unaseguros.pt/US/PDF/pdi433.pdf (04/2023)

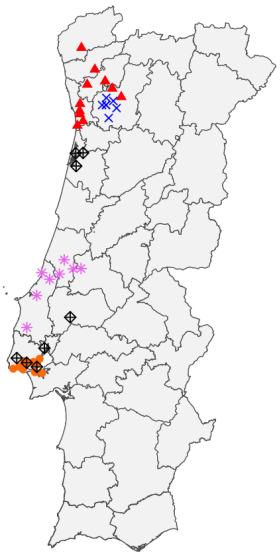
**** https://www.clinicamedicadoporto.pt/tabela-preco-consultas/ (04/2023)

Appendix Q – Physiotherapy larger economic groups comparative performance

The following economic groups (Q.1) were identified as being composed by several physiotherapy units/providers (MFR and non-MFR). In most of these cases they have several NIPC's within the same umbrella brand belonging to the same owners. A brief comparative performance analysis was performed. This analysis doesn't represent an analysis on the performance of the umbrella brands/economic groups, since some of their units and providers had different ownership earlier in their economic life, but on the global performance of the group of providers currently controlled by these umbrella brands.

Q.1 Top 5 economic groups by number of physiotherapy units and their geolocation

Economic group	**Number of units**
Esferasaúde – Unidades Médicas Especializadas	**11** ▲
One Clinics – Clínicas de Medicina Física e Reabilitação	**10** ●
CMM – Centros Médicos e Reabilitação	**8** ⌖
Physioclem – Fisioterapia e Bem-estar	**8** ✳
Arrifana de Sousa – Clínica Médica	**7** ×



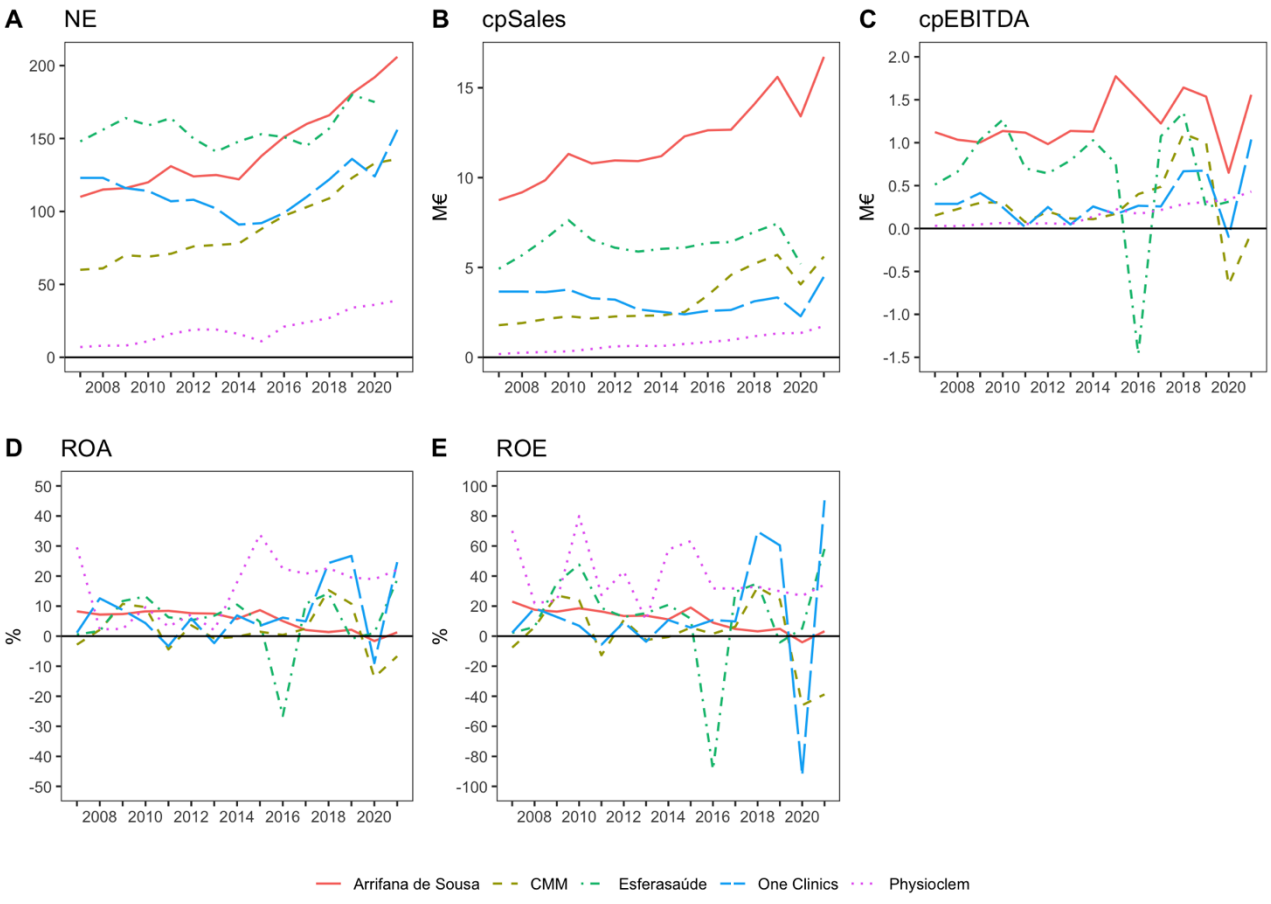
Two of these five economic groups grew organically during the analysed period (Arrifana de Sousa and Physioclem), while the others grew essentially through mergers and acquisitions. Interestingly, each approach could have had a different impact in their performance and in their exposure to the economic downturn periods.

As we can verify in Q.2, the providers from Physioclem, the group with the lowest number of units and Sales (in constant 2007 prices (cpSales)), grew their NE, Sales and EBITDA progressively, and practically didn't feel the impact of the economic downturns. Their ROE and ROA were unstable during the 2007-2012 period, but afterwards they stabilize it and remained at a comparative higher level than most of the other groups. The

2020 Covid-19 recession practically didn't impact their profitability, and neither their EBITDA growth. Remarkably, they had the second highest EBITDA in 2020, despite being the group with the lowest Sales volume.

Arrifana de Sousa, a more diversified healthcare economic group, and the one with the highest Sales and EBITDA throughout most of the whole period, grew their network of units completely organically and remained more stable than the remaining economic groups (except Physioclem). They suffered a hard decline on their EBITDA in 2020 but came back to their previous level right back in 2021. Their profitability ratios (ROA and ROE) have been slowly declining throughout the years, reaching negative profitability in 2020. Despite their current lower profitability, we need to consider their bigger economic scale in terms of Sales and Net Income. The 2012 recession appears to have had just a minor impact on their overall performance.

Q.2 Comparative performance plots



On the other hand, One Clinics, CMM and Esferasaúde are typical examples of economic groups that pursue growth by acquiring physiotherapy providers already in business. One Clinics started their group in 2011 acquiring three providers and expanded their operations after 2016, mainly with one acquisition a year (currently they have 10 units/providers). The providers now under the One Clinics umbrella, haven't increased their Sales dramatically over the years as can be verified in Q.2-B, but after 2016, the year of the group's expansion, the total EBITDA and profitability ratios increased dramatically, possible due to synergies and positive effects from the larger regional scale that they acquired. These providers felt the effects of both economic downturns but reacted much more effectively after the Covid-19 recession. Despite the larger decline in 2020 in most performance indicators, in the majority of these, they recovered with excess in the following year.

CMM started to operate in 2008 and expanded their operations by acquiring already running providers in 2012, 2017, 2019, 2020 and 2021. They currently own eight physiotherapy units, and control two additional units from the social sector. They increased their profitability after their expansion in 2017, but their performance through the analysed period was very volatile. Their EBITDA in 2020 was -635.000€ and they didn't recover from the 2020 shock to positive grounds in 2021. They were the only economic group from this analysis with negative EBITDA and negative profitability ratios in 2021.

Esferasaúde is one of the largest groups of physiotherapy providers in the country. It started to operate in 2008, and progressively grew its number of units through several acquisitions mainly in 2016 and 2020. Their performance reached a local negative maximum in 2012 (in almost all variables), only surpassed in 2016 (a year with a lot of investments in acquisitions), and in the Covid-19 2020 recession. They had a record negative EBITDA of almost -1,5 million € in 2016, and a negative ROE of -80%. These results from 2016 are probably related to the corporate growth strategy, and not so much to after-shocks of the 2012 recession since they occurred in an upturn period. Despite the lower performance related to the economic downturns of 2012 and 2020, this group of providers appeared to recover relatively rapidly from these shocks (although slower from the 2012 shock). Data for 2021 is incomplete, and the missing data is probably related to a merger of two providers within the umbrella group.

Despite the differences in the overall performance behaviour from these groups of physiotherapy providers, they appeared to be relatively dynamic and resilient to the economic downturns, continuing to grow in line with their strategy, despite the economic shocks.

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