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Key drivers of pharmaceutical sales in OECD countries

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Abstract

Background: The pharmaceutical industry is constantly evolving, and the increasing growth in pharmaceutical sales has multiple economic and sociological implications. Namely, it has been a long time since prescription drugs accounted for the majority of sales in the pharmaceutical industry, which makes this industry interesting from both investor and regulatory policy perspective.
Purpose: This paper aims to analyse the determinants of pharmaceutical sales at the county level in order to identify fertile markets. A deeper insight into the issue could help managers in this growing industry to discover fruitful markets and policy makers to adjust their policies and regulations for the (online) sale of pharmaceuticals.
Study design/methodology/approach: The empirical part of the paper is based on a panel data analysis conducted for 31 OECD countries in the period from 2010 to 2022. The data was extracted from the OECD Data Explorer database and processed with Stata 13.1. Furthermore, pooled ordinary least squares models, fixed effect model and random effect model were formed, with pharmaceutical sales per person as the dependent variable.
Findings/conclusions: The results show that GDP per capita, the proportion of the population aged 65 and over and the proportion of people who have purchased online in the last 12 months have a positive impact on pharmaceutical sales, while life expectancy and the proportion of people who perceived their health as good/very good do not appear to affect it. Only the results on the effect of employment level indicate a negative influence on pharmaceutical sales.
Limitations/future research: Future analyses should provide a more detailed insight into pharmaceutical sales by expanding the sample, including additional explanatory variables and analysing the determinants of the different categories; i.e. an analysis of pharmaceutical consumption by different disease classes influenced by economic, sociological and medical reasons would be a fruitful future scientific path.

Keywords
pharmaceutical sales, OECD countries, determinants, panel data, country-level

Introduction

The pharmaceutical industry is constantly evolving and pharmaceutical sales are a significant component of healthcare expenditure, both at the individual and country level. Global sales of pharmaceuticals reached USD 1,332 billion in 2023, an increase of 28.5% compared to 2020, with the United States accounting for 50%, while the share of emerging markets (22.4%) is higher than that of Europe (18.6%) (Statista, 2024). This growth in production and consumption is not surprising, as the population in developed countries is ageing, the number of people with various chronic diseases is increasing and consumer habits and attitudes are changing (GBD 2021 Risk Factors Collaborators, 2024). Namely, the pharmaceutical industry reshaped consumers' attitudes toward pharmaceutical consumption by introducing profitable medicines for a range of everyday activities (Fox & Ward, 2008). This pharmaceuticalisation of daily life and the increasing proportion of online purchases of medicines (Lobuteva et al., 2022) are significantly enhancing the demand for pharmaceutical products. In addition to the increasing consumption of pharmaceuticals in developed countries, the strength of the pharmaceutical industry is also growing in emerging markets. These so-called "phamerging" countries are becoming increasingly

important players in the industry as producers and fertile markets.

Given the complexity of the factors that drive the sales of pharmaceuticals, they can be categorised into groups that focus on consumer, producer, industry and country characteristics. In this sense, this paper focuses on the country-specific determinants (c.f. Figure 1), as this segment is under-analysed. More specifically, this paper analyses the influence of various economic and socio-demographic factors on pharmaceutical sales.

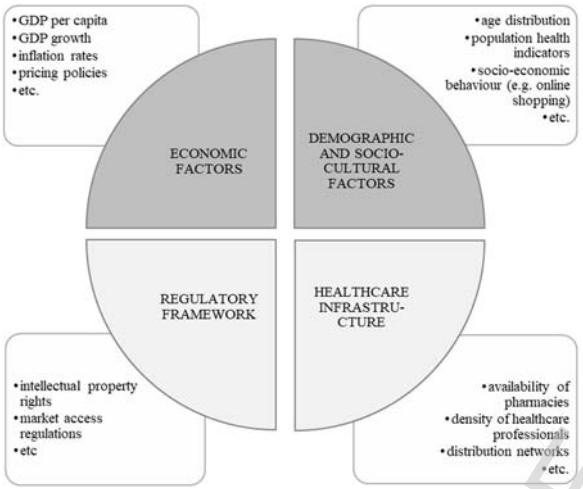

Figure 1 Determinants of country-level pharmaceutical sales
Source: the author

The aim of this paper is to identify and understand the key drivers of pharmaceutical sales at country level in order to provide pharmaceutical companies, policy makers and healthcare stakeholders with insights that could help them develop evidence-based strategies for the development of sustainable pharmaceutical markets and consequently improve public health outcomes. As already mentioned, the consumption of pharmaceuticals in general has increased, which makes this industry interesting in terms of profit. Furthermore, the development of highly expensive, innovative drugs for individualized treatments, alongside a marked increase in antidepressant consumption in Western societies (Di Valero et al., 2024), represents compelling new market niches. In this sense, it is beneficial for managers to detect fruitful markets.

However, this increasing consumption hides numerous issues that require policy measures that are not profit-orientated, but address issues such as the availability of necessary medicines, sustainability of public costs of pharmaceuticals (Odnoletkova et al., 2025), the reduction of unnecessary prescriptions, the health risks posed by the consumption of counterfeit and falsified medicines, etc. Hence, policy makers must balance the optimization of drug consumption, which reduces the revenues of pharmaceutical companies, with the fact that these companies are valuable market players whose activities have numerous positive effects on the country's economy. For example, in addition to the direct impact on employment, there are also indirect spillover effects through the increase in early-stage domestic innovation due to higher pharmaceutical spending (Kourouklis & Gandjour, 2022).

The empirical part of the paper therefore looks at the impact of different economic and socio-demographic variables on pharmaceutical sales in OECD countries using a panel data analysis. The above approach distinguishes this paper from similar studies as it uses a country-level analysis for a large group of countries. Namely, as described more extensively in Chapter 1.2., there are similar studies that analyse pharmaceutical sales or expenditures. Compared to this study, however, they either have a significantly smaller sample and use other explanatory variables (Leopold et al., 2014), focus on consumer-level data (Vogler et al., 2015), company-level data (Costinot et al., 2019) or use forecasting models (Bertolotti et al., 2024; Ghousi et al., 2012).

This paper is organised into five chapters. After the introduction, the literature review provides a contextual framework for the empirical analysis. The pharmaceutical industry has been studied for decades and this chapter briefly summarises the key aspects of this study. The data and methodology chapter then presents the variables analysed and formed panel models. A detailed presentation and discussion of the results obtained is provided in the fourth section. Finally, the paper ends with a conclusion that summarises the main findings from the previous sections, outlines their implications for the field and suggests directions for future research based on the shortcomings of this paper.

1. A brief literature overview

Various aspects of pharmaceutical sales are of importance to numerous stakeholders. As a result, numerous studies have explored this topic from a variety of perspectives, including those of consumers, companies, government, and the healthcare sector. Therefore, this chapter first looks at related topics that have a significant economic

impact, while the second section of the chapter provides an overview of studies that analyse aggregate levels of pharmaceutical sales or expenditure.

1.1. Selected economic aspects of the pharmaceutical industry

The pharmaceutical industry is highly capital-intensive industry, so it is not surprising that the high R&D costs and the need to increase efficiency during the drug development process have increased the influence of artificial intelligence in the pharmaceutical industry. In this sense, Kolluri et al. (2022), Lu et al. (2023), and Mak and Pichika (2019) critically evaluate the characteristics and use of artificial intelligence in the drug development process.

In addition, online drug trade has also been analysed for various reasons. On the one hand, it is seen as a threat to the pharmaceutical industry in terms of increased competition in the market. For example, Yang and He (2023) analyse the pharmaceutical e-commerce industry in terms of optimising the omni-channel sales strategy and their study provides interesting suggestions for managerial supply chain stakeholders. Lobuteva et al. (2022), Almohammed et al. (2023), Thaba et al. (2023) and Vera-Martinez (2023) analysed consumer attitudes towards online sales in this industry. At the same time, the increasing sale of counterfeit and falsified medicines online is a serious problem that requires stricter regulations as they can jeopardise consumer health (Mladinić et al., 2024; Sarkar, 2022; Limbu & Huhmann, 2023; Lee et al., 2017; Lavorgna, 2015; etc.).

Another important economic aspect of the pharmaceutical industry is the sales strategies employed. Namely, pharmaceutical companies spend a large part of their revenues on marketing and advertising aimed at healthcare professionals (Ali et al., 2022). It is therefore essential to examine the behaviour of sales representatives and healthcare professionals to determine whether it is ethical, as profit-oriented prescribing, when influenced by sales strategies, may result in unnecessary and/or expensive medicines being prescribed to patients, which may negatively impact their health and well-being (Khan et al., 2024; Noor et al., 2023; Pokorny et al., 2023; Barbaroux et al., 2022; Sawad & Andrews, 2022; etc.)

Besides the strong pharmaceutical industry in developed countries, the pharmaceutical market in emerging markets is also growing rapidly for several reasons: 1) there is a shift towards the use of generic drugs in developed and developing countries, 2) lifestyle changes in emerging markets are leading to changing disease patterns in these countries, and 3) the patent cliff is impacting leading branded drugs (Tannoury & Attieh, 2017). Emerging pharmaceutical countries are new players in the industry and incumbents should expect increased competition from phamerging countries such as Brazil, China, India and Russia. At the same time, these countries are a source of additional demand for pharmaceutical products. With this in mind, the pharmaceutical industry in these phamerging countries has been analysed from many angles. For example, some studies focus on their characteristics, i.e. their performance (e.g. Li et al., 2024; Luo et al., 2024; Nandy, 2022). Others look at the differences between Europe, the US and emerging pharmaceutical markets (Akkari et al., 2016), specific sales strategies (Civaner, 2012), etc.

As mentioned above, the consumption of pharmaceuticals is increasing due to the ageing of the population, the increase in chronic diseases and the habit of consumers to solve their health problems quickly through the use of medicines instead of gradually improving their lifestyle habits (Sinclair et al., 2024; Kip & Parr-Brownlie, 2023; etc.). Therefore, there is more and more pharmaceutical waste to take care of (Luo & Wan, 2024). As a result, many studies address various related issues, such as: a) the need to educate consumers on judicious consumption and appropriate disposal of unused/expired pharmaceuticals (Rogowska et al., 2019), b) the release of pharmaceuticals and their metabolites into the environment, including water, which is recognised as an environmental problem and a risk to human health (Al Smadi et al., 2023; Janik-Karpinska et al., 2023; Wilkinson et al., 2022; Gonzales Pena et al., 2021), c) the concept of anti-consumption in the context of sustainable consumption of pharmaceuticals (Kaladharan et al., 2024), d) sustainable pharmaceutical waste management (Kumar et al., 2025; Agarwal et al., 2024; Kusturica et al., 2022; Okeke et al., 2022, etc.).

Another important aspect of the pharmaceutical industry, considered from the perspective of individual countries, is the issue of access to medicines and the selection of the list of essential medicines. Pharmaceutical products have a significant impact on healthcare expenditure, which must be rationalised without jeopardising

people's health. Therefore, pricing policies and production quality control should safeguard medicine users while not unduly affecting returns in this highly capital-intensive yet lucrative industry. In other words, it is essential that policies related to the pharmaceutical sector are balanced to encourage investment, given the industry's numerous positive spillover effects, without compromising the well-being of the country's citizens. In this sense, there are studies that focus on public pharmaceutical expenditure and pricing policies (Joosse et al., 2023; Li, 2023; Zhou et al., 2023; Main et al., 2022; Rodwin, 2022; Papanicolas et al., 2018; etc.), or on access to medicines (Barber et al., 2024; Koduah, 2023; Mirza et al., 2023; Bjerke, 2022; Blankart & Felder, 2022; Sarkisova et al., 2022; etc.) and lists of essential medicines (Li et al., 2024; Slamang et al., 2024; Isaranuwatchai et al., 2022; Luz et al., 2022; etc.).

1.2. Pharmaceutical industry - a country-level analysis

The country-specific determinants of pharmaceutical sales are insufficiently analysed, especially when various economic and socio-demographic variables are taken into account. However, there are studies that deal with some factors that affect pharmaceutical sales or expenditure. In other words, there are studies that follow a more or less similar logic to the one presented in this study. In this sense, Leopold et al. (2014) carried out a descriptive analysis of the impact of policies on pharmaceutical sales in eight European countries observed in the period 2008-2011. In turn, Ying et al. (2022) analysed the relationship between economic growth and health status using multiple panel regression models with these two variables as dependent variables using data for 29 selected OECD countries over the period 2000-2019. Akca et al. (2017) used the decision-three method on data from the 35 OECD countries from 2014 and analysed the determinants of health expenditure as a share of GDP, with pharmaceutical sales as one of the independent variables. Similar to the previous study, Kadkhodamanesh et al. (2021) analysed the determinants of the GDP share of pharmaceuticals for selected OECD countries using a panel data analysis for the period 2008-2017, and for Iran using a time series regression for the period 1998-2017. Further, Elek et al. (2017) used aggregated data from 21 European countries between 2000 and 2012 to examine per capita pharmaceutical expenditure using hierarchical linear models, and identified differences between higher and lower income countries.

Bertolotti et al. (2024) used a different approach. They developed a forecasting model which they tested in multiple Italian regions to simulate the future consumption of active pharmaceutical ingredients, integrating consumption data, demographic statistics and information on the prevalence of diseases. Similarly, Ghousi et al. (2012) analysed the use of different data mining techniques as forecasting methods. Using data on different product types with data on demographic specifications of the consumption area from the drug distribution centre in Tehran, they provided a critical overview of the forecasting methods used to predict pharmaceutical consumption. Furthermore, Vogler et al. (2015) used consumer-level data from the European Health Interview Survey (2007-2009) to analyse differences in pharmaceutical consumption in eight countries in Central Eastern Europe based on socioeconomic factors. Costinot et al. (2019) analysed the pharmaceutical sales of 2,650 companies in 56 target countries using data from 2012, but their aim was to test the home market effect, i.e. whether there is a correlation between domestic demand and sales abroad.

2. Data and methodology

2.1. Data and descriptive statistics

The empirical part of the study focuses on the following 31 OECD countries: Australia, Austria, Belgium, Canada, Chile, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, the Netherlands, New Zealand, Norway, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom. These countries are monitored from 2010 to 2022 and the list of variables analysed is shown in Table 1.

Table 1 Description of variables

Variable (code)	Definition
PSales	Pharmaceutical sales; US dollars per person, PPP converted
GDPpc	Gross domestic product per capita; US dollars per person, PPP converted, Current prices
Population65	Population 65 years or over; percentage of population

Employment	Labour force participation rate (labour force divided by the total working-age population); percentage
LifeE	Life expectancy at birth; in years
Health	Perceived health status: Good/very good health; individuals 15 years old or over; percentage of the population in the same age
OnlineP	Individuals who have purchased online in the last 12 months, from 16 to 74 years; percentage of the population

Source: the author

The aim of the study is to analyse the determinants of pharmaceutical sales in a heterogeneous group of OECD countries (see Table 2 for descriptive statistics). Therefore, this value is analysed on a per capita level. Pharmaceutical products, especially prescription drugs, are used when needed and therefore belong to necessary goods (Lubiani et al., 2018), which means that their consumption does not (significantly) increase with an increase in income. However, the sale of pharmaceuticals also includes non-prescription medicines and various products that are not necessary but are intended to benefit consumers' health, and their consumption is expected to increase with income. Therefore, GDP per capita is expected to have a positive impact on pharmaceutical sales. In other words, richer countries are expected to have higher pharmaceutical sales, as residents there can afford to buy various non-essential pharmaceutical products.

The percentage of the population aged 65 and older is expected to increase pharmaceutical sales, as health deteriorates with age, increasing the need for various pharmaceutical products. A similar logic applies to the variable reflecting longevity, i.e. countries with higher life expectancy are expected to have higher pharmaceutical sales. On the other hand, perceived health status is likely to have a negative impact, i.e. the more people rate their health status as good or very good, the lower the sales of pharmaceuticals are likely to be.

With regard to the level of employment, it can be assumed that a high labour force participation rate increases the value of pharmaceutical sales. In countries with a higher level of employment, more consumers are able to afford more pharmaceutical products, especially those that are not essential, i.e. those that do not require a prescription. The percentage of the population shopping online is also included in the analysis, as the number of online purchases is increasing across all product groups (Statista, 2025b) and pharmaceutical products are no exception (e.g. revenue in the online pharmacy market are expected to reach USD 97.18 billion in 2025; Statista, 2025a). This variable is therefore expected to have a positive impact.

The unbalanced panel data were taken from the OECD Data Explorer database and processed with Stata 13.1.

Table 2 Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
PSales	361	479.8942	156.1875	115	1085.9
GDPpc	390	47023.19	19864.44	17343.72	145971
Population65	390	17.49599	3.733426	7.117069	29.00114
Employment	390	61.67233	6.158142	48.14219	81.92857
LifeE	379	80.84222	2.388367	73.1	84.6
Health	342	68.69591	11.41002	30	91.4
OnlineP	338	57.30334	19.89083	5.2335	91.9695

Source: the author

2.2. Methodology

The static panel data analysis is performed using the following Pooled Ordinary Least Squares (POLS) model:

$$y_{it} = \beta_0 + \beta_1 x_{it1} + \beta_2 x_{it2} + \cdots + \beta_K x_{itK} + u_{it} \quad (1)$$

where $i = 1,\ldots n$, $t = 1,\ldots T$, y_{it} is the pharmaceutical sales for the observed country i in year t, and n is the total number of observation units (countries). The parameter β_0 is a constant term, other β are parameters related to six selected explanatory variables, and u_{it} is the error term, which is assumed to be independent and identically distributed by unit of observation and time. Based on the characteristics of its parameter estimates, both the fixed effect (FE) and random effect (RE) models were formed in addition to the POLS model. In order to select the most appropriate model from these three, the following tests were carried out: the overall F-test (POLS-FE), the

Breusch-Pagan test (POLS-RE) and the Hausman test (FE-RE).

3. Results and discussion

As already mentioned, three tests were carried out to select the most suitable model. According to the results presented in Table 3, the RE model is the most appropriate. In this sense, the results presented in Table 3 show that, as expected, sales of pharmaceutical products are higher in countries with a higher GDP per capita. These results suggest that, from a microeconomic perspective, pharmaceutical products are normal goods that are purchased more as wealth increases, which is approximated by GDP per capita at the country level. The results presented here are consistent with the findings of similar studies showing that higher income consumers are more likely to use medicines (Vogler et al., 2015), i.e. that pharmaceutical expenditures are higher in countries with higher GDP per capita (Kadkhodamanesh et al., 2021; Elek et al., 2017).

Table 3 POLS, FE, and RE estimates

Dependent variable: PSales	Model POLS	Model FE	Model RE
GDPpc	-0.00002 (0.00053)	0.0023*** (0.00066)	0.0021*** (0.00061)
Population65	8.1099*** (2.77836)	14.8652** (5.99539)	12.4488*** (4.45495)
Employment	-5.1124*** (1.55269)	-5.9304*** (2.27490)	-5.3659*** (2.01545)
LifeE	9.6657** (3.79828)	-1.3941 (6.55028)	1.4416 (5.57002)
Health	0.1541 (0.92263)	-1.6320 (1.76637)	-1.2654 (1.31656)
OnlineP	3.0267*** (0.63887)	3.0669*** (0.64544)	3.2129*** (0.58620)
Constant	-302.892 (266.4319)	529.8635 (547.6752)	287.7555 (454.7651)
Observations	287	287	287
R-squared	0.2992	0.2467	0.263
POLS vs FE (F-test and Prob > F)		35.94 (0.000)	
POLS vs RE (chibar2 and Prob > chibar2 – BP test)			729.1 (0.000)
Hausman test (chibar2 and Prob > chibar2)		0.95 (0.9662)	

Source: the author

Notes: Symbols ***, **, * denote significance at the 1%, 5%, and 10% significance levels. Robust standard errors are in parenthesis. POLS vs FE - The overall F-test for 29 individual differences (F-test that all α_i=0) shows that there are significant differences between individuals and that the FE model is more appropriate (F test that all u_i=0: F(29, 251) = 35.94). The Breusch-Pagan test (BP) has been used to test for the presence of random effects, i.e., to choose between the POLS and RE model; since there are random effects, RE is preferred over POLS. The Hausman test fails to reject the null hypothesis that the coefficients for the years are jointly equal to zero (Prob > F is 0.9662), which confirms that the RE model should be used instead of the FE model.

The percentage of the population aged 65 and over has a strong, significant positive influence on the dependent variable in the countries analysed. In other words, as expected due to the deterioration in health status with increasing age, the value of pharmaceutical sales is higher in countries with a higher percentage of the population aged 65 and over. Vogler et al. (2015) also confirmed that advanced age is relevant for prescribed pharmaceutical consumption, while Elek et al. (2017) found a weak positive correlation between pharmaceutical expenditure and the proportion of the population aged 65 and over.

The percentage of the population that has bought something online is another variable that is expected to have a positive impact on physical sales. To the best of the author's knowledge, there is no similar study on the pharmaceutical market to compare the obtained here with the respective explanatory variable. However, Duch-Brown et al. (2017) confirmed that online sales generally have a positive effect on market expansion. In other words, an increased share of online sales in a

country's sales is a positive sign for an expected market expansion for all types of products, which then also applies to the pharmaceutical market.

On the other hand, life expectancy and self-perceived health status do not appear to have any influence on pharmaceutical sales. These results may seem unexpected at first, as countries with a higher life expectancy at birth would be expected to have higher pharmaceutical sales due to age-related deterioration in health. However, the results of a study on the determinants of pharmaceutical expenditure by Elek et al. (2017) also confirmed a statistically insignificant impact of life expectancy. On the other hand, Akca et al. (2017) found that life expectancy and perceived health are important while using the three-decision method to analyse the determinants of healthcare expenditure. The study by Kreouzi et al. (2024) on Blue Zones, i.e. zones where people live longer than the expected average, could provide an answer to this question. Indeed, they note that polypharmacy can be harmful for older patients, which means that there could be areas in countries with patients who consume fewer medicines compared to other areas, making it difficult to draw solid conclusions about the impact of these explanatory variables on pharmaceutical consumption at country level. In addition, total pharmaceutical sales are used as a dependent variable in this analysis, and it is possible that the effects of these two variables would be different if prescription drug sales had been separated from over-the-counter drug sales. Also, differentiating the results depending on life expectancy at different ages (at birth, middle age and advanced age as in Magazzino et al., 2024) could be beneficial for explaining the effects of these two variables.

Looking at the influence of these variables on the sale of pharmaceuticals, it seems that the time when pharmaceutical products are only sold when a person has a medical condition that requires their use is over. The results suggest that the value of pharmaceutical sales is likely to be higher in more affluent countries with more customers buying online and with a higher proportion of older people. This is interesting from a management perspective, as the results suggest that the sale of pharmaceutical products seem to follow the pattern of any other commodity when deciding where to direct marketing efforts. That is, companies should promote and sell these products in countries where people can afford them, who are more accustomed to buying online, and where the demand for pharmaceutical products is greater, especially among older consumers.

However, the results relating to the level of employment show that this market has its own peculiarities. The impact of employment levels on pharmaceutical sales is negative, which means that sales are likely to be higher in countries with higher unemployment. At first glance, these results may seem contradictory, but considering that unemployment is positively correlated with depression, leading to higher consumption of antidepressants (Lopez-Vila et al., 2025; Pisarska et al., 2024; Dackehag et al., 2023), future analysis of the structure of pharmaceutical sales could provide more precise information about its determinants. This is particularly interesting considering that pharmaceutical consumption of antidepressants has increased on average by 62% in the observed OECD countries, with significant differences between countries, e.g. observed consumption in Luxembourg in 2022 is only 5.9% higher than in 2010, while values for Estonia are almost 180% higher than in 2010 (OECD, 2024).

The results obtained are also interesting from the point of view of policy decision-makers. In countries with a higher GDP per capita, vibrant pharmaceutical markets with consumers accustomed to buying online and a larger proportion of older people, the policies relating to pharmaceutical markets should be strongly developed. In other words, pharmaceutical companies and online shops that are only after profit will target these markets. Therefore, consumers should be protected by limiting the sales strategies of pharmaceutical companies to avoid over-prescriptions, for instance. At the same time, the online sale of pharmaceuticals in these countries should be strictly monitored to prevent the sale of counterfeit and falsified medicines. In addition, special attention should be paid to the sale and consumption of medicines in countries with high unemployment. Combined with the results of studies examining antidepressant consumption, the results obtained here indicate that consumers are increasingly taking various medications to cope with the negative consequences of unemployment and improve their mental health.

Conclusion

The main purpose of this study was to analyse the factors affecting the sales of pharmaceuticals at country level, as this aspect of the pharmaceutical industry has not yet been sufficiently investigated. The country perspective is interesting from both

the investors' and the policy makers' point of view. This is because the pharmaceutical industry, like any other industry, is profit-driven and seeks to find fertile markets so that it can optimise its returns by maximising profits and minimising costs. In this sense, stakeholders in the pharmaceutical industry should take into account the differences between countries when planning strategies to increase their pharmaceutical sales. However, due to the nature of its products, this industry is often highly regulated, which is why new distribution strategies and channels for pharmaceuticals have been developed for years in order to increase sales. Against this background, policy makers should constantly monitor changes in this market so that they can adapt their policies to protect consumers' health, especially in the case of online sales, without overburdening this highly developed industry with its numerous positive spillover effects in domestic countries. In other words, special care should be taken to ensure that both the healthcare professionals who prescribe medicines and the users of various pharmaceutical products are advised on the latest scientific knowledge on how to optimise the use of medicines. In this way, only the necessary medicines are used and the resulting waste is disposed of properly.

The strength of this study is that it broadens the field by analysing the impact of various economic and socio-demographic factors on pharmaceutical sales in 31 OECD countries. There are studies on pharmaceutical expenditure, pharmaceutical consumption from the consumer's perspective, etc., but to the best of the author's knowledge, this research takes a unique standpoint that provides useful insights into the subject. Indeed, the results obtained show that the pharmaceutical market, while following the expected pattern in certain aspects, also has its peculiarities. Countries with higher purchasing power in terms of GDP per capita, a higher proportion of the population aged 65 and over, and more consumers used to buying online are expected to have higher pharmaceutical sales. On the other hand, life expectancy and self-perceived health status do not appear to have any influence on this. As for the impact of employment levels, one should be cautious in drawing conclusions, as the results of the panel data analysis show that countries with higher employment levels will have lower pharmaceutical sales. Therefore, both investors and policy makers should be aware of the complex relationship and causalities between employment and consumers' physical and mental health that affect pharmaceutical consumption when developing strategic plans to expand the target market or when designing policies that address the pharmaceutical industry. In other words, the findings presented here show that dealing with the pharmaceutical industry requires constant fine-tuning of related sales tactics and regulatory measures.

Several shortcomings of this paper serve as a starting point for future studies in this area. First, the sample is limited to OECD countries as a heterogeneous group of countries, and an extension of the sample could provide additional insights into relevant factors influencing pharmaceutical sales. Furthermore, it could be beneficial to analyse countries separately according to their income level or healthcare system. Furthermore, additional economic and demographic variables at country level could help to better identify differences between pharmaceutical markets. The inclusion of alternative health indicators such as lifestyle measures, which provide additional information, e.g., on the extent of alcohol consumption and smoking, could also add to the field. Finally, analysing the determinants of sales of different groups of pharmaceutical products as opposed to total sales could be a fruitful scientific avenue, especially when it comes to products dealing with mental health issues.

Declarations

Availability of data and materials

The data sets used and analysed in this study are available on reasonable request from the corresponding author.

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