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ORIGINAL PAPER

IMPACT OF THE COVID-19 PANDEMIC ON THE PHARMACY MARKET IN POLAND

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K e y w o r d s: COVID-19, drug sales, pharmacies, market shock.

A b s t r a c t

The outbreak of the COVID-19 pandemic has increased demand for medicines and hygienic personal care products. The increase in demand for medicinal products should increase the turnover of pharmacies. It was therefore hypothesised that the outbreak of the COVID-19 pandemic caused shocks to the pharmacy market in Poland. The aim was to identify and determine the nature of the shocks to the pharmacy market in Poland and compare them to the period before the pandemic. The subject of the study was the value of sales in open pharmacies in Poland in the years 2010–2021. To identify shocks and verify the hypothesis, an automatic TRAMO-SEATS procedure was used. The results obtained unequivocally confirmed the hypothesis, with the changes being more visible when analysing the value of total sales in open pharmacies expressed in current prices rather than in constant prices. The shocks were the result of increased demand for medicines and hygienic personal care products resulting from panic in the face of an unprecedented threat such as SARS-CoV-2.

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WPŁYW PANDEMII COVID-19 NA RYNEK APTECZNY W POLSCE

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Kody JEL: A10, C5, E30, I15.

Słowa kluczowe: COVID-19, sprzedaż leków, apteki, szok rynkowy.

Abstrakt

Wybuch pandemii wywołanej przez wirusa SARS-CoV-2 spowodował zwiększenie zapotrzebowania na leki oraz higieniczne środki ochrony osobistej. Wzrost zapotrzebowania na produkty lecznicze powinien wpłynąć na zwiększenie obrotów aptek. Postawiono więc hipotezę, że wystąpienie pandemii COVID-19 wywołało szoki na rynku aptecznym w Polsce. Za cel przyjęto zidentyfikowanie oraz określenie charakteru szoków na rynku aptecznym w Polsce oraz porównanie ich z okresem przed pandemią. Przedmiotem badania była wartość sprzedaży w aptekach otwartych w Polsce w latach 2010–2021. Do identyfikacji szoków i weryfikacji postawionej hipotezy wykorzystano automatyczną procedurę TRAMO-SEATS. Otrzymane wyniki pozwoliły na jednoznaczne potwierdzenie postawionej hipotezy, przy czym zmiany były lepiej widoczne w przypadku analizowania wartości sprzedaży całkowitej w aptekach otwartych wyrażonej w cenach bieżących niż w cenach stałych. Szoki były efektem zwiększonego popytu na leki oraz higieniczne środki ochrony osobistej, wynikającego z paniki w obliczu niespotykanego dotąd zagrożenia, jakim jest SARS-CoV-2.

Introduction

The outbreak of the SARS-CoV-2 coronavirus in early 2020 prompted a number of countermeasures to limit the spread of the virus. In almost all countries, restrictions on catering, hotel, and retail activities were introduced first by closing these establishments completely or partially. The in-person activity of universities, schools and kindergartens was limited, and remote education via Internet educational platforms was introduced. Cinemas, theatres, and other cultural institutions were closed. Restrictions were introduced on movement, and passenger limits in public and private transport. This caused employees to have problems with getting to their workplaces and manufacturing companies to have problems with labour shortages. As evidenced by a study by Coibion, Gorodnichenko and Weber (Coibion *et al*., 2020, p. 1-50), due to the restrictions of the COVID-19 pandemic, there has been a reduction in employment, a decrease in consumer spending, and an increase in the poverty rate of the population, among other things. Many companies have reduced employment, and production. Remote working was introduced to reduce the spread of the virus and to limit the number of cases (Shibayama *et al*., 2021, p. 70-93).

Business models in almost every industry changed, most notably: customer structure, distribution channels, customer relationships, revenue structure,

key resources, areas of operation, partners, and cost structure (Szarucki *et al.*, 2021, p. 95-114). The change in the operating model also concerned the key (due to the provision of medicines and hygiene products used to protect against viral infection) retail outlets for that period, i.e. pharmacies. Many countries noted the need for pharmacies to adapt to the new operating conditions. As noted by Liu, Luo, Tang, Hu, Polidoro, Sun and Gong (Liu *et al.*, 2020, p. 299-304), due to the coronavirus pandemic, countries should establish new and strengthen current pharmacy services. In particular, pharmacists should be able to identify and meet the unique needs of pharmacy services that arise during a pandemic. A national emergency drug formulary should be created and pharmacists should monitor and address potential drug shortages associated with a pandemic. Targeting remote pharmacy activities to prevent the transmission of the coronavirus was also noted. Hussain, Dawoud and Babar also highlighted the implementation of drive-thru or online pharmacy services and their role in improving public health during a crisis (Hussain *et al.*, 2021, p. 1920-1924).

As highlighted above, the problem of monitoring shortages of medicines was particularly highlighted for pharmacies. This suggests that there was an increased demand for medicines and hygienic personal care products that could not be met. The increased demand caused by the panic, manifested as the hoarding of medicines and food (Gardocka-Jałowiec *et al.*, 2020, p. 176), should therefore translate into increased sales in pharmacies, including the occurrence of market shocks. It can therefore be hypothesized that "the occurrence of the COVID-19 pandemic caused shocks to the pharmacy market in Poland". Pharmaceutical market shocks, manifested by sudden increases or decreases in sales resulting in short-term or permanent changes in the level of sales, have occurred in the retail pharmaceutical market in Poland before. The factors influencing these shocks were changes in legislation and the occurrence of influenza epidemics (Olejarz-Wahba & Rutkowska-Ziarko, 2015, p. 471-479). Therefore, the aim of this study is to identify and determine the nature of shocks in the pharmacy market in Poland during the COVID-19 pandemic and to compare them to shocks occurring before the pandemic.

Research methodology and data

A market shock, understood as an outlier, is an observation that deviates so much from the other observations in the sample that it raises suspicion that this observation was generated by a different mechanism than the rest of the sample (Hawkins, 1980, p. 1-12). Market shocks can be positive, negative, one-time, temporary, or permanent, and can affect the price, level of supply, or level of demand (Blinder & Rudd, 2013, p. 1-81). The identification of these anomalies, which are sudden changes in the phenomenon under study of a dynamic nature

(Balke, 1993, p. 81-92). poses many problems in the modelling process (Chang *et al.*, 1988, p. 193-204) and often depends on the data quality.

Methods for identifying outlier observations are diverse and come from different departments of statistical research methodology: discriminant methods, taxonomic methods, density function estimation, and data visualisation and signal processing (Trzęsiok, 2016, p. 95-105). In the case of time series, the most commonly used methods to identify outliers are: the method of Chen and Liu, dedicated to ARIMA models; a method using the distance criterion based on Mahalanobis distances (Healy, 1068, p. 157-161), and methods based on the generation of statistical automatic learning methods such as SVMs (Support Vector Machines).

This paper hypothesizes that the COVID-19 pandemic caused shocks in the pharmaceutical retail market in Poland. In order to verify the hypothesis, it was decided to use an automatic method based on ARIMA models which can identify outliers (shocks) and determine their nature – the TRAMO-SEATS procedure. The Demetra+ software was used for the calculations. The TRAMO-SEATS procedure and software are recommended by Eurostat for time series analysis within the ESS (European Statistical System) in order to improve the overall quality of European statistics and ensure comparability of national data. The TRAMO-SEATS procedure was developed by A. Maravell and V. Gomez in 1996 and can identify four types of non-normal observations in time series (Muirhead, 1986, p. 39-47; Fox, 1972, p. 350-363; Chen & Liu, 1993, p. 284-297; *Handbook on Seasonal Adjustment*, 2018):

– AO – additive outliers – a one-time, significant deviation from the expected value of the studied phenomenon, which does not affect the values in subsequent periods;

– LS – level shift – a permanent change in the level of a variable;

– TC – temporary change in the level of a variable and return to the initial level, usually according to the exponential or linear function;

– IO – innovation outliers – innovative impulses caused, for example, by the application of a new production technology, causing a change in the whole data generating process, including a change in the form of the trend.

The hypothesis was verified on the basis of data obtained from monthly reports of the PEX PharmaSequence company (formerly PharmaExpert). The data covered the value of total sales in open pharmacies in Poland, and was analysed as the value of sales in current prices and in constant prices. The use of fixed prices in the analysis is aimed at ensuring the comparability of physical changes in different periods and determining the size of changes in terms of value. The monthly data came from 2010–2021 and covered the time before the COVID-19 pandemic, the beginning of the pandemic and the occurrence of the first, second and third waves of coronavirus infections in Poland.

In accordance with the current law, the term pharmacy (otherwise known as open pharmacy) is considered any pharmacy open to the public or a pharmacy

point. A pharmacy open to the public and a pharmacy point are public health care facilities in which pharmaceutical services are provided, consisting of (Baka, 2011, p. 4-10) dispensing medicinal products and medical devices, preparing prescription and pharmacy drugs, and providing information about medicinal products and medical devices.

The value of total sales in open pharmacies in Poland is the sales value of the range of products available in general pharmacies and pharmacy points in Poland, which is strictly defined by pharmaceutical law and includes medicinal products prescribed by doctors and manual selling.

The pharmacies' primary product line is prescription drugs, called Rx drugs, Rp drugs, or ethical drugs. The terms prescription drugs, Rx drugs, Rp drugs, and ethical drugs are used interchangeably. Ethical drugs are sold for 100 percent (full payment) or partial payment. In the case of partial payment, we are referring to reimbursement sales (Fig. 1).

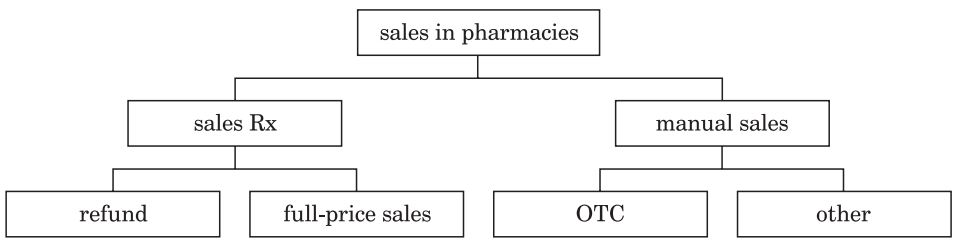

Fig. 1. Type structure of sales in pharmacies in Poland
Source: own study.

Manual selling is the sale of OTC (over the counter) medicines sold without a prescription (Odlanicka-Poczobutt, 2012, p. 249) for 100% of the price, as well as the sale of medical devices, medicinal products intended only for export, foodstuffs for special nutritional purposes, dietary supplements, cosmetics excluding cosmetics intended for perfume or beauty, hygiene products, items for the care of infants and the sick, foodstuffs containing in their composition pharmacopoeial natural ingredients of plant origin, and disinfectants used in medicine. These articles may be sold in pharmacies, provided that their storage and sale will not interfere with the primary activity of the pharmacies (Slawatyniec, 2013, p. 150, 151).

Results

The value of total sales in open pharmacies in Poland fluctuated between 2010 and 2021 (Fig. 2). Analysing the value of sales in current prices, one can see a steady increase in these sales with clear fluctuations suggesting the occurrence

of seasonality and market shocks. The values of total sales expressed in constant prices, recalculated to prices from the beginning of the analysed period (January 2010) are characterised by a constant downward trend with equally visible fluctuations suggesting the occurrence of seasonality and shocks. Market shocks observed in both cases are particularly visible at the turn of 2012, the beginning of 2020 and the turn of 2021.

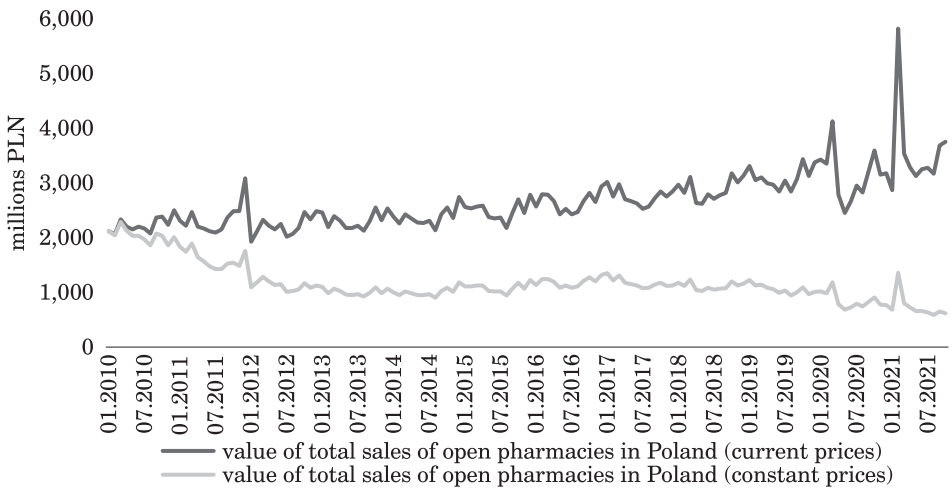

Fig. 2. Value of monthly total sales in open pharmacies in Poland in 2010–2021 in constant and current prices

Source: own study based on PEX PharmaSequence data.

Using the TRAMO-SEATS procedure, 12 outlier observations of the value of total sales in current prices and 3 outlier observations of the value of analysed sales expressed in constant prices were identified (Tab. 1). Among these observations, 5 (for sales expressed in current prices) cover the period of the COVID-19 pandemic.

The outlier observations identified for the period before the coronavirus pandemic were:

– an increase in the trend level in December 2011 as a result of a significant increase in sales of reimbursed drugs due to the implementation of new pharmaceutical law on January 1, 2012, which imposed penalties on doctors for issuing prescriptions with errors, including granting reimbursement discounts to ineligible individuals, i.e. those without health insurance. This resulted in increased purchases of medicines for stock;

– a decline in the level of the trend in January 2012 (for current prices), which was also an effect of new laws coming into force and doctors protesting about these changes. Doctors were afraid of high penalties for issuing incorrect prescriptions or prescriptions deemed unjustified and did not sign agreements

with the National Health Fund to issue prescriptions for reimbursed drugs on a mass scale;

– the decrease in the level of the trend in July 2012 (for constant prices) is a result of the announcement on 28 June 2012 of a new set of reimbursed drugs along with official prices and margins;

– the sudden, one-off increase in February 2016 (for current prices) was not accompanied by changes in legislation. However, this was a period of increased flu and cold cases;

– the sudden, one-time increase in January 2017 (for current prices) may also have been due to a period of increased flu and cold illnesses;

– the temporary decrease in sales in April 2018 and March 2019 (for current prices) were not accompanied by significant regulatory changes.

Table 1

Outliers of total sales in open pharmacies in Poland identified by the Tramo-SEATS procedure

Total sales in current prices		Total sales in constant prices	
Outlier	parameter (*p*-value)	outlier	parameter (*p*-value)
TC (12.2011)	0.1534 (<0.000)	LS (01.2012)	-0.4067 (<0.000)
TC (01.2012)	-0.3662 (<0.000)	LS (04.2020)	-0.3334 (<0.000)
LS (07.2012)	-0.0905 (<0.000)	AO (02.2021)	0.6665 (<0.000)
AO (02.2016)	0.0731 (<0.000)	–	–
AO (01.2017)	0.0836 (<0.000)	–	–
TC (04.2018)	-0.1034 (<0.000)	–	–
TC (03.2019)	-0.0647 (<0.000)	–	–
LS (03.2020)	0.1509 (<0.000)	–	–
LS (04.2020)	-0.3826 (<0.000)	–	–
LS (07.2020)	0.1342 (<0.000)	–	–
TC (12.2020)	-0.1685 (<0.000)	–	–
AO (02.2021)	0.6311 (<0.000)	–	–

Source: own study based on PEX PharmaSequence data using Demetra+.

The first case of coronavirus infection in Poland was confirmed on 4 March 2020. Two weeks later, the first restrictions were introduced, including the suspension of in-person classes in schools and the introduction of remote education and restrictions on movement. Fear of the virus led to increased interest in medicines and personal protective equipment (masks), which translated into an increase in total sales in open pharmacies in Poland (at current prices) identified as a change in the trend level (growth). This increase amounted to approx. 23.26% in comparison with the previous month, shaping the sales of pharmaceutical products and open pharmacies in Poland at the level of PLN 4,127 billion. Strong interest in products from the pharmacy offer, with

simultaneous shortages of supply and introduced restrictions on movement resulted in a decline in total sales in April 2020 in current prices (down by approx. 32.52%) and in constant prices (down by approx. 33.64%), identified as a decrease in the trend level. In contrast, in July 2020 there was an increase in total sales (by approximately 11%) in open pharmacies identified as a change in trend level (increase) most likely triggered by increased purchases of pharmacy cosmetics during the summer. At the end of 2020, a reduction in the level of total sales (trend) (at constant and current prices) was identified, triggered by the occurrence of large drug shortages in pharmacies and a reduction in movement during the holiday period. Sales in December 2020 were approx. 6.84% lower than in December 2019 and amounted to 3,178 billion. In contrast, the sudden increase in sales in February 2021 was the result of increased sales of medicines due to the occurrence of the next wave of the COVID-19 pandemic. This was the largest increase recorded in the entire period under review and was 102.99% for current prices and about 99.41% for fixed prices. The value of sales of all pharmaceutical products in February 2021 amounted to PLN 5,820 billion.

Conclusion

Changes in legislation and the increased number of cases of influenza and the common cold caused shocks in the pharmacy market in Poland prior to the COVID-19 pandemic. During the COVID-19 pandemic, shocks in the value of total sales of pharmaceutical products in general pharmacies in Poland concerned only situations related to the pandemic itself. There were no shocks related to changes in legislation. These sudden changes were more pronounced for total sales expressed in current prices than in constant prices. Shocks were also much greater in the pandemic period than in the pre-pandemic COVID-19 period, and reached up to 100% (increase on the previous month) showing how the public panicked at the emergence of an unprecedented threat, i.e. the SARS-CoV-2 coronavirus. The panic was reflected in greater purchases of medicines and the accumulation of medicines in households. These shocks would probably have been much greater had it not been for the supply constraints associated with the lack of supply of medicines and hygienic personal care products from China and other countries.

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