Transactions and Human Resource Management before and after restrictions of Sunday trading in Poland

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Abstract

Aim. In March 2018, the Solidarity trade union forced new Polish law banning nearly all commercial transactions on Sundays, including supermarkets and majority of other retailers. However, there were exceptions, such as petrol stations and e-commerce online shops that were permitted to continue their operations. Therefore, a number of additional transactions in e-commerce and stationary hot spots in petrol stations on Sundays increased significantly. In our research, the quantitative relationship between these restrictions and a demand expressed by a number of transactions hourly and daily has been considered according to real data sets and observations collected from e-commerce transactions and a local petrol station in Głogów (Poland) that belong to the British Petroleum network.

Methods. The Detrended Fluctuations Analysis (DFA) has been applied to detect new clients on Sundays and to exploit and track their behaviour and customs from time series on other trading days in petrol stations.

Results. According to our results, free market as an equilibrium theory works well because significant groups of additional customers on Sundays were detected. Moreover, these new customers may continue purchasing on other trading days, which depends on human resources of the petrol stations. This result is consistent with other effects, such as e-commerce development in Poland after 2018.

Conclusion. The success of involving new customers is determined by the quality of human resources development at local petrol stations. On the other hand, e-commerce development may constitute an alternative solution.

Keywords: detrended fluctuation analysis, free market, time series analysis, commodity markets, human resources

Introduction

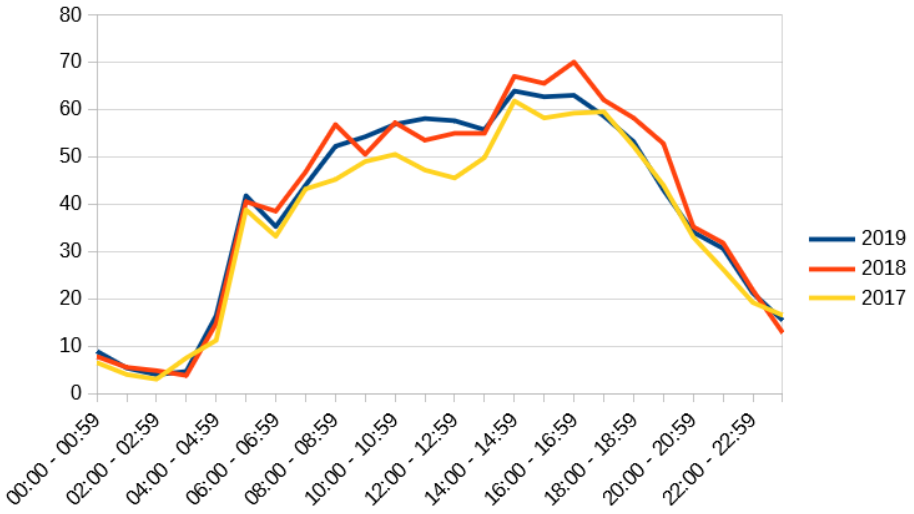
On 11 March 2018, new Polish regulations launched by the Solidarity trade union were approved, banning almost all commercial trading on Sundays, including big stationary markets and the majority of other retailers. There were, however, certain exceptions, such as e-commerce (that was at first intended to be banned as well) and petrol stations, permitted to continue their trading on Sundays (*Ustawa z dnia 10 stycznia 2018 r. o ograniczeniu handlu w niedziele i święta oraz w niektóre inne dni*, 2018). Hence, in 2019 and 2020, this regulation was a challenge both for entrepreneurs operating petrol stations alone and for the stations that were a part of the networks operated by oil companies.

In our research, observations and data sets (exploited from time series of transactions from the local BP petrol station in Głogów, Poland) are analysed from the quantitative point of view. All the data were collected from daily and hourly transactions in three consecutive years: 2017, 2018 and 2019 to detect the impact of Sunday trade restrictions. These transactions were possible because petrol stations in Poland offer a wide array of goods to their customers, rather than just petrol, gas, oil, etc..

Methods and results

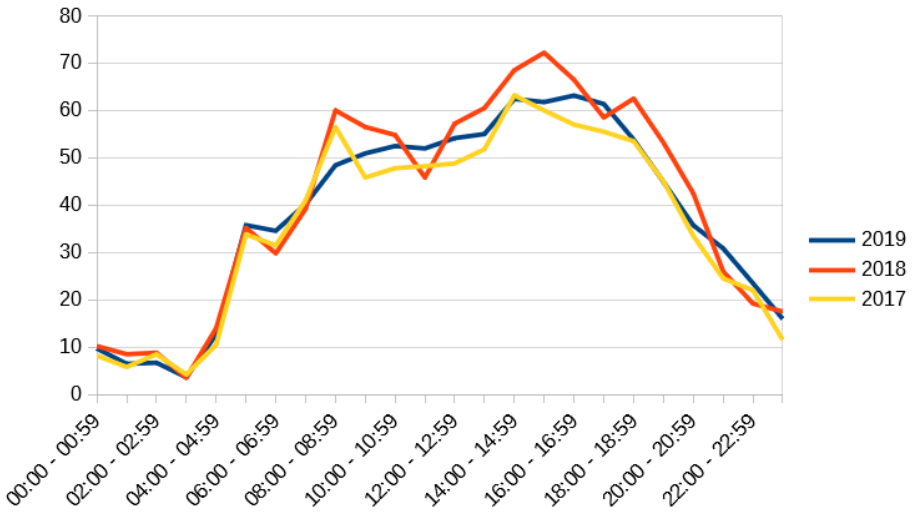
According to raw data (Figures 1–7), there were no big differences in the number of transactions performed in these three consecutive years that are considered.

Figure 1
The average number of transactions on Mondays in 2017, 2018 and 2019



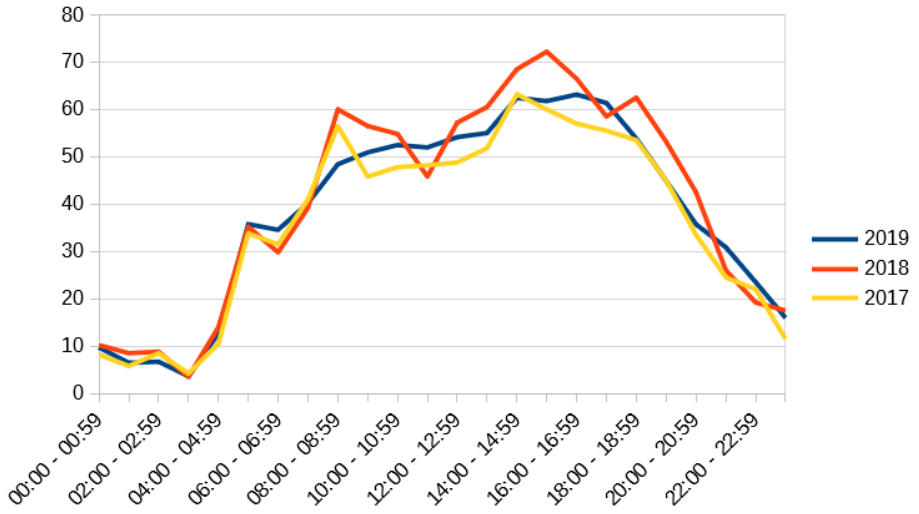
Source: own study.

Figure 2
The average number of transactions on Tuesdays in 2017, 2018 and 2019



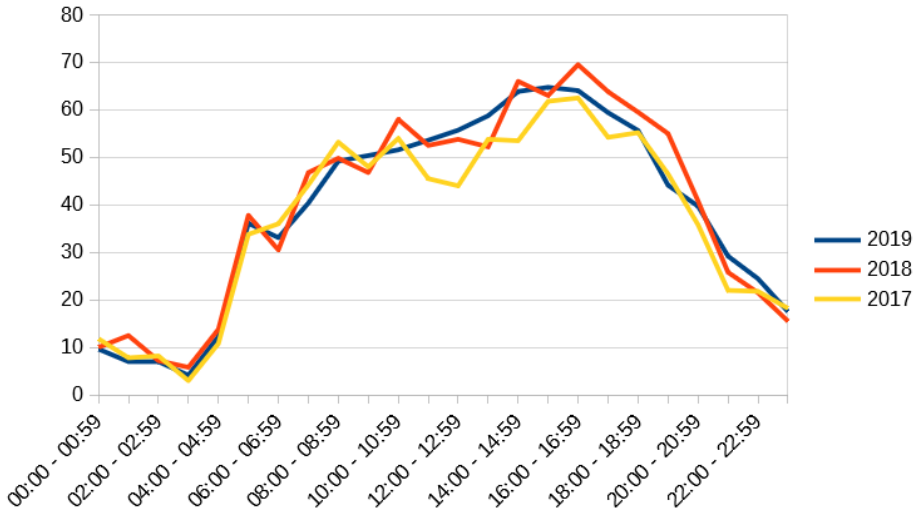
Source: own study.

Figure 3
The average number of transactions on Wednesdays in 2017, 2018 and 2019



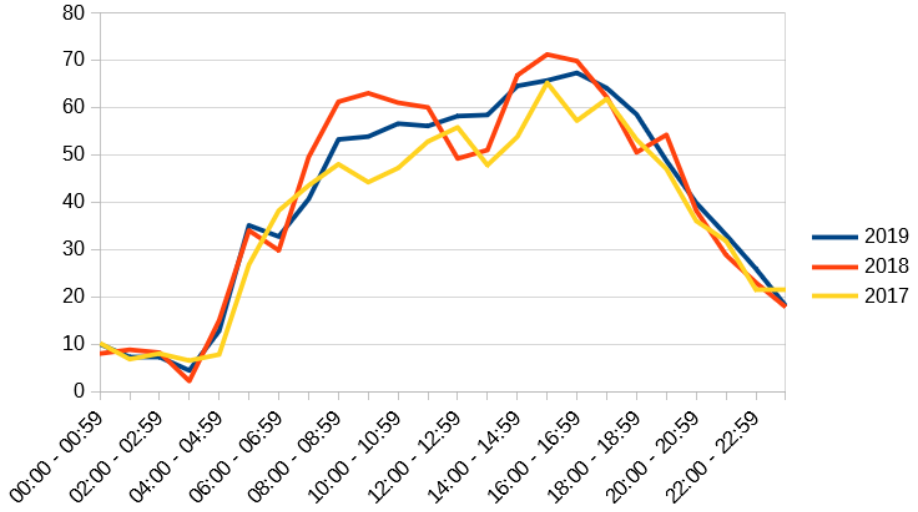
Source: own study.

Figure 4
The average number of transactions on Thursdays in 2017, 2018 and 2019



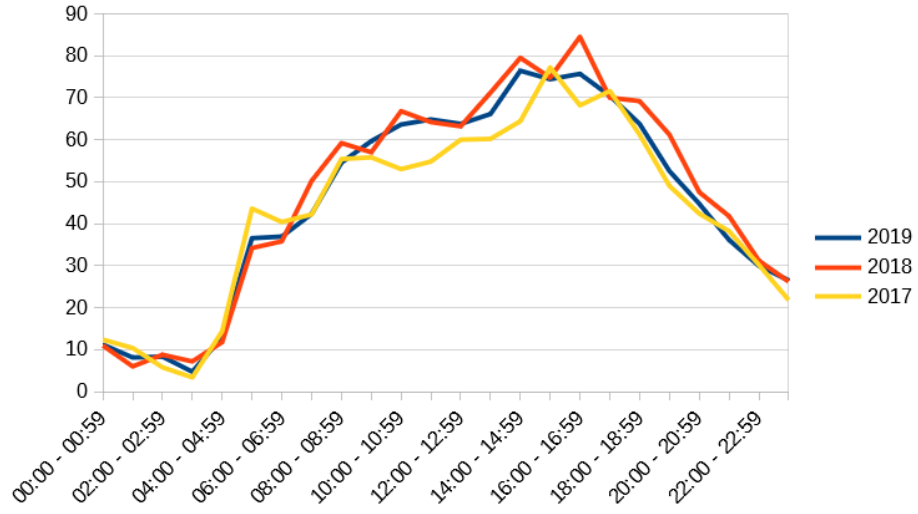
Source: own study.

Figure 5
The average number of transactions on Fridays in 2017, 2018 and 2019



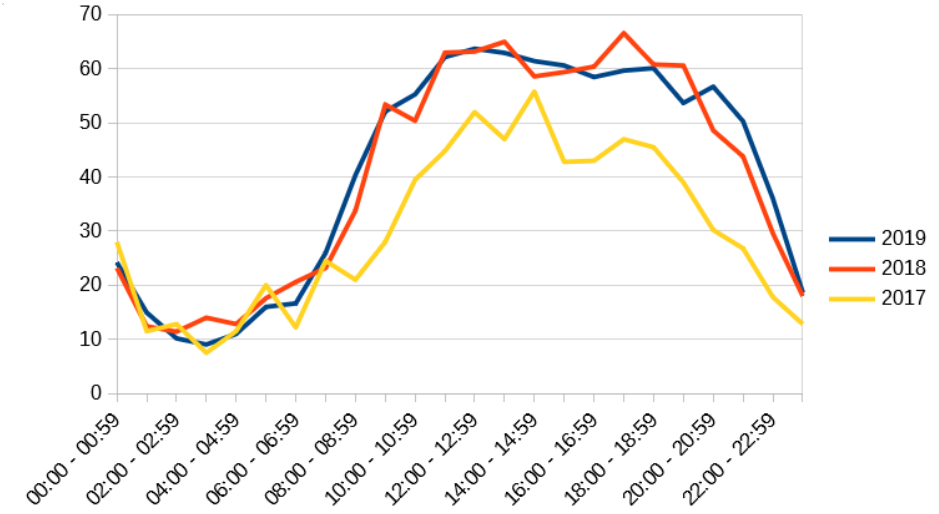
Source: own study.

Figure 6
The average number of transactions on Saturdays in 2017, 2018 and 2019



Source: own study.

Figure 7
The average number of transactions on Sundays in 2017, 2018 and 2019



Source: *own study.*

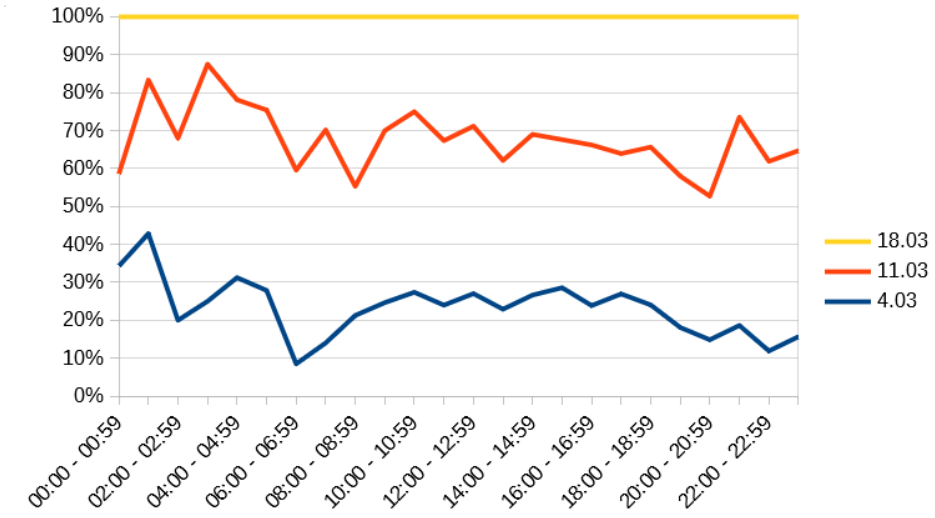
It is clearly visible that it is hard to detect significant changes in customers behaviour. Moreover, the correlation matrix between these sales trends (2017–2019) has almost the same constant coefficients near unity (Table 1). However, the only significant impact may be detected on Sundays (Figure 7), where number of transactions performed in 2018 and 2019 is significantly higher (+15%) than in 2017. Gradual differences may be clearly visible after considering the cumulative number of transactions on Sundays in 2019 as 100% (Figure 8). This phenomenon had an effect on human resource development in the investigated petrol station because the staff numbers were expanded immediately after 11 March 2018 and the optimalisation of delivery was introduced (Figure 9). This trend might be visible when a comparison is made to other week days.

Table 1
Correlation matrix between sales trends 2017-2019

Year	2019	2018	2017
2019	1	0.98	0.96
2018	0.98	1	0.95
2017	0.95	0.96	1

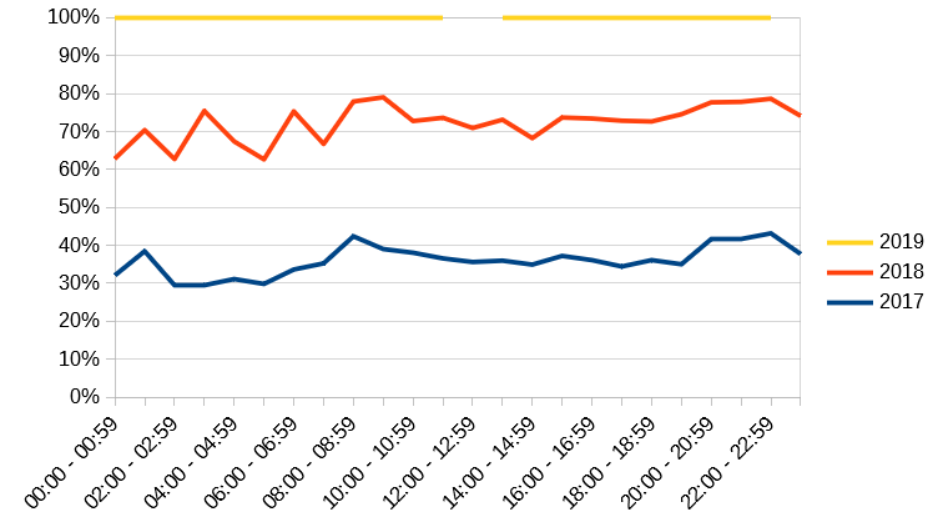
Source: own study.

Figure 8
The number of transactions per hour on Sundays 4.03, 11.03 and 18.03



Source: own study

Figure 9
The cumulated number of transactions per hour on Sundays in 2017, 2018 and 2019



Source: own study.

Special methods, such as detrended fluctuation analysis (DFA), can be used for determining the statistical self-affinity of a signal by isolating trends (1). It is useful for analysing time series that appear to be long-memory processes (Buda & Jarynowski, 2010; Kwapień & Dróżdż, 2012; Lloyd, 2001; Schmitt, Schertzer, & Lovejoy, 1999).

$$X_t = \sum_{i=1}^{t} (x_i - \langle x \rangle) \tag{1}$$

where *Xt* is a new signal created from time series xi by eliminating the average trend < x >.

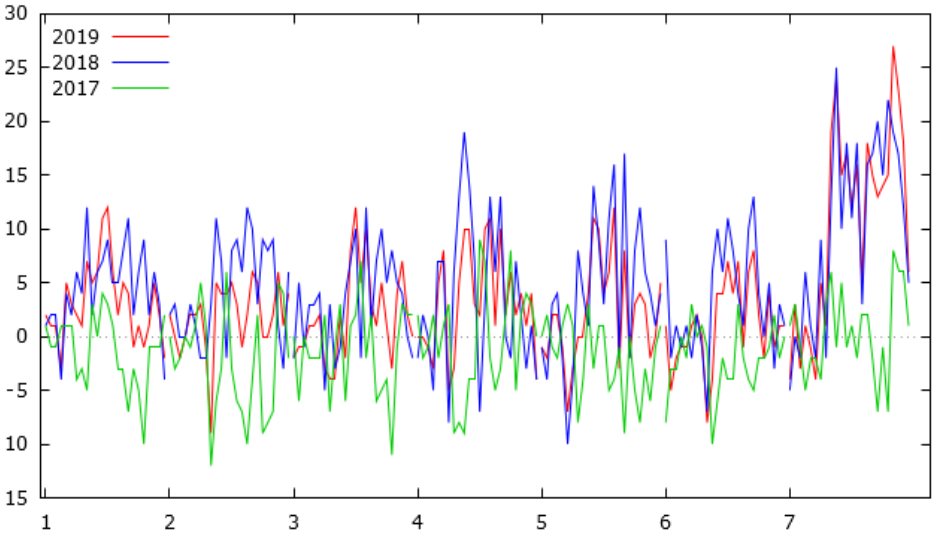
After applying DFA method, the detrended signal might reveal new properties after computing Harold Edwin Hurst exponents *H* (Hurst, 1951) as a function of the time span of a time series:

$$\mathrm{E}[\frac{R(n)}{S(n)}] \sim n^H \tag{2}$$

where E is an expected value, *R(n)* is the range of the first *n* cumulative deviations from the mean and *S (n)* is the series of the first *n* standard deviations.

For standard Brownian motion, the value of *H* equals 0.5 (Annis & Lloyd, 1976). For the investigated time series from 2017, *H* = 0.47. For signals given in 2018 and 2019, the Hurst exponent equals 0.60 and 0.71. According to these results, fluctuations in the number of transactions are not random anymore. However, the length of annual time series is too short to compute Hurst exponents that should be considered in log scales for long memory processes. Therefore the detrended signal for weekdays may be satisfactory to detect the additional group of customers on Sundays (Figure 10) that would later come again on Thursdays or Fridays.

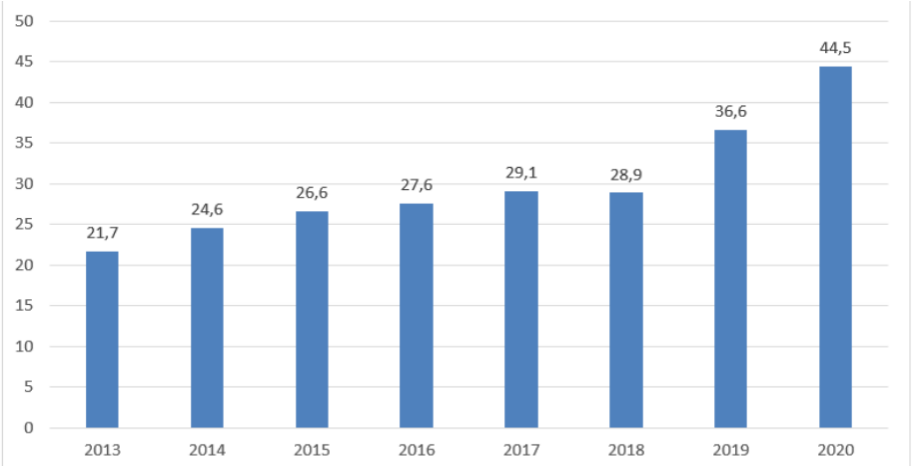
Figure 10
The detrended signal in weekdays used in the DFA method



Source: own study.

Moreover, other petrol stations from the BP network that did not react immediately to customers' needs still saw more transactions on Sundays, yet in the midweek transactions did not change at all. This phenomenon may be an example of the importance of proper human resources development (Brewster 2007, Pólkowski & Nycz 2017).

Figure 11
The number of Internet shops (in thousands) that sell goods online in Poland



Source: Dun & Bradstreet A Dun & Bradstreet Company.

Figure 12
In 2020 e-commerce was the safest business because of COVID-19

Source: own picture.

Restrictions in Sunday trading also influenced e-commerce in Poland as the number of Internet shops in Poland was almost constant (28 000) before 2018 and increased rapidly after 2018 (Figure 11). This process was determined by free market laws. However, we did not consider the further development of e-commerce in Poland and data from the twenties that might be affected by pandemic restrictions and war in Ukraine.

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