Original Article

Econometric Profit Forecasts of a Company Selling Sports Equipment

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Abstract:

Sport infrastructure has been developing dynamically in Poland since the beginning of the 21st century. Sport fields/arenas, bicycle paths, swimming pools, recreation centers in parks and in housing estates are being built. This causes a great need for sporting equipment. The demand for sporting equipment is fostered by the sporting successes achieved by Poles in many disciplines. The level of household affluence has also been increasing, which is conducive to this type of spending. The subject of this study entails the profit of an enterprise selling sporting equipment via the Internet. Profit is an enterprise characteristic which does not belong to the categories analyzed using econometrics tools. As such, literature lacks publications on the subject of enterprise profit forecasting. Literature also lacks econometric models describing the mechanisms of profit variability. Only works addressing the issue of optimization models can be found, where profit functions as a goal.

The purpose of this work is to describe the mechanism of enterprise-profitability variability using a stochastic econometric model. The econometric model's equations include causal conditions, autoregression, a trend and seasonal fluctuations. The volatility mechanisms of three profit measures has been examined: the sales, the operating and the net profit. A recursive mechanism has been considered, examining the impact on profit of such factors as: the company's sales volume and the economic situation represented by the Warsaw Stock Exchange Index (WIG). Positive verification of the empirical model allowed construction of short-term profit forecasts for the enterprise. To estimate the profit forecasts, extrapolative forecasts of profit factors have been used, i.e. the sales revenues and the value of the WIG index. The quality of the profit forecasts, therefore, depend on the quality of the forecasts of these profit factors.

Key Words: econometric forecasts, profit analysis, trade in sports equipment.

Introduction

Sporting infrastructure has been developing dynamically in Poland since the beginning of the 21st century. Sport fields/arenas, bicycle paths, swimming pools, recreation centers in parks and in housing estates are being built. This causes a great need for sporting equipment. The demand for sporting equipment is fostered by sporting successes achieved by Poles in many disciplines. The level of household affluence is also increasing, which is conducive to this type of spending.

The subject of this study entails the profit of an enterprise selling sporting equipment via the Internet [Wingreen S.C. et al., Pursky O. et al (2014, 2019)]. Literature lacks econometric models describing the mechanisms of profit variability [Babenko V. et al. (2019), de Janvry A. (2016)]. Only works addressing the issue of optimization models can be found, where profit functions as a goal [G. Ch. (1989), Chen, J. T. (1980), Junankar, P. N. (1980), Pando, Valentín, Juan García-Laguna, and Luis A. San-José (2012)]. Stochastics in profit analysis has been recognized e.g. by Chaiho Kim (2007). Works addressing the profitability of business operations can also be found, e.g.: [Skvarciany, V., Simanavičiute, J. (2018), Tassis, C.D. (2013)].

The purpose of this work is to describe the mechanism of enterprise-profitability variability using a stochastic econometric model. A recursive mechanism will be considered, examining the impact of the size of the company's sales revenues and of the economic situation, represented by the Warsaw Stock Exchange Index (WIG), on its profit. Positive verification of the empirical model will allow construction of short-term profit forecasts. The importance of forecasts in company management has been recognized in the work of Dobrodolac T. (2011). Profit forecasts will enable the company manager to properly prepare for future events, both positive and negative ones.

Materials and methods

The subject of the study entails statistical information on the costs and revenues in an enterprise that sells sports equipment on the Internet. Statistical data comes from the website: <https://www.biznesradar.pl/raporty-finansowe-rachunek-zyskow-i-strat/INTERSPPL.Q>. In addition, information on the average enterprise-sector pay in the years 2006 - 2019 was used, found at: <https://wynagrodzenia.pl/gus/dane-kwartalne>. As such, 54 statistical

observations from the following quarters were used: from 2006.01 to 2019.02. The company sells online. As a result, the company's clients are located throughout Poland.

The econometric model's equations will include causal conditions, autoregression, a trend and seasonal fluctuations. The study will incorporate linear stochastic econometric equations, in the following form:

$$y_t = \sum_{j=0}^k \alpha_j x_{tj} + \sum_{i=1}^4 \beta_i y_{t-i} + \sum_{i=1}^4 \sum_{j=1}^k \lambda_{ij} x_{t-i,j} + \alpha_{k+1} t + \sum_{h=1}^3 \gamma_h dq_h + \eta_t, \quad (1)$$

where:

y_t – observations on the dependent variable ($t = 1, \dots, n$),

x_{tj} – observations on exogenous variables,

t – the time variable,

$dq1, dq2, dq3$ – the dummy variables, taking the value of 1 in the distinguished quarter and 0 in the remaining quarters,

η_t – the random component of the equation.

There endogenous variables will occur in the model, representing the company's profit, expressed in millions PLN:

PROFSAL – the sales profit,

EBIT – the operating profit,

NETPROFIT – the net profit.

The next two endogenous variables will represent the causal determinants of profit:

SALES – the sales revenue,

WIG – value of the Warsaw Stock Exchange Index at the end of the quarter (in points).

Correspondingly high sales revenues allows exceedance of the enterprise's profitability threshold, from which the profit arises. WIG is a measure of the economic situation. It can be assumed that the better the economic situation, the better the financial result the company achieves. Profit is thus conditioned by the value of the WIG index. The general scheme of the recursive relationships in the system describing profit mechanisms is as follows:

$$\longrightarrow \text{WIG} \longleftarrow \text{PROFIT} \quad \text{SALES} \quad (2)$$

The empirical equations describing the variables SALES and WIG will be used to estimate the extrapolative forecasts SALES_{Tp} and WIG_{Tp} , which will be used to build profit forecasts: PROFSAL_{Tp} , EBIT_{Tp} or NETPROFIT_{Tp} . Forecasts will be equipped with average prediction errors (V_T) and relative prediction errors (V_T^*). The relative boundary error of prediction will be set at $V_T^* = 10\%$.

Results

The empirical equations describing the variables SALES and WIG are presented in tables 1, 3. Tables 2 and 4 as well as figures 1 and 2 contain extrapolative forecasts of the sales revenues (SALES_{Tp}) and the main stock-exchange index (WIG_{Tp}) for subsequent 6 quarters.

The empirical equation describing the variable SALES is causal in nature, with autoregression, a trend and seasonal fluctuations in the second and the third quarters. The equation describing the variability of WIG only contains first- and second-order autoregressions and a linear trend.

Table 1 Dependent variable (Y): SALES, observations used 2007:1-2019:2 (N = 50)

Variable	Coefficient	Std. Error	t-Statistic	Prob. p	Significance
const	-45614.6	25931.3	-1.7591	0.0857	*
APAY_2	29.4293	9.942	2.9601	0.0050	***
EFFECT	52675	6382.34	8.2532	<0.0001	***
time	-1173.48	370.129	-3.1705	0.0028	***
dq2	-7038.51	2657.98	-2.6481	0.0113	**
dq3	-8525.5	2628.13	-3.2439	0.0023	***
SALES_4	0.570512	0.0922924	6.1816	<0.0001	***
Mean dependent var.		52053.16	S.D. dependent var.		12160.37
Sum squared resid.		1.50e+09	S.E. of regression		5897.647
R-squared		0.793587	Adjusted R-squared		0.764786
F(6, 43)		27.55342	Prob(F-statistic)		3.15e-13
Log likelihood		-501.2918	Akaike info criterion		1016.584
Schwarz criterion		1029.968	Hannan-Quinn criterion		1021.680
Autocorrel. coeff. (rho1)		0.060576	Durbin-Watson Stat.		1.821773

Source: Own calculations using the GRETl package

Table 2 Forecasts of sales revenues, quarterly for the period between 2019:3 - 2020:4

Forecasted period (T)	SALES _{Tp}	Average prediction error (V_T)	Relative prediction error (V_T^*) (%%)	Forecast range at a confidence level of 95%
2019:3	52378.5	5897.65	11.3	(40484.8; 64272.2)
2019:4	154388	5897.65	3.8	(142494; 166282)
2020:1	69165.5	5897.65	8.5	(57271.7; 81059.2)
2020:2	71571.8	5897.65	8.2	(59678.1; 83465.6)
2020:3	69162.9	6789.94	9.8	(55469.7; 82856.2)
2020:4	186240	6789.94	3.6	(172547; 199933)

Source: Own calculations using the GRETl package

Fig. 1 Forecasts of sales revenues, quarterly for the period between 2019:3 - 2020:4

Table 3 Dependent variable: WIG observations used 2006:3-2019:2 (N = 52)

Variable	Coefficient	Std. Error	t-Statistic	Prob. p	Significance
const	7699.89	2338.66	3.2924	0.0019	***
time	62.8329	31.8959	1.9699	0.0546	*
WIG_1	1.43398	0.111789	12.8276	<0.0001	***
WIG_2	-0.629077	0.111918	-5.6209	<0.0001	***
Mean dependent var.	48493.80	S.D. dependent var.	9070.356		
Sum squared resid.	4.21e+08	S.E. of regression	2960.138		
R-squared	0.899759	Adjusted R-squared	0.893494		
F(3, 48)	143.6150	Prob(F-statistic)	5.65e-24		
Log likelihood	-487.3392	Akaike info criterion	982.6785		
Schwarz criterion	990.4834	Hannan-Quinn criterion	985.6707		
Autocorrel. coeff. (rho1)	-0.140724	Durbin h-statistic	-1.714879		

Source: Own calculations using the GRETl package

Table 4 Quarterly forecasts of the WIG index, for the period between 2019:3 - 2020:4

Forecasted period (T)	WIG _{Tp}	Average prediction error (V_T)	Relative prediction error (V_T^*) (%%)	Forecast range at a confidence level of 95%
2019:3	58497.3	2960.14	5.1	(52545.6; 64449.1)
2019:4	57984.2	5175.00	8.9	(47579.1; 68389.2)
2020:1	57630.4	6680.55	11.6	(44198.3; 71062.6)
2020:2	57508.8	7490.55	13.0	(42448.1; 72569.6)
2020:3	57619.8	7807.12	13.5	(41922.6; 73317.1)
2020:4	57918.3	7874.03	13.6	(42086.5; 73750.1)

Source: Own calculations using the GRETl package

Fig. 2 Forecasts of (WIG_{Tp}) for subsequent quarters in the period between 2019:3 - 2020:4

Source: Own calculations using the GRETl package

Tables 5, 6 and 8 present empirical equations of the profit expressed via the variables PROFSAL, EBIT and NETPROFIT. The low description quality of the variable PROFSAL ($R^2=0.367$) caused abandonment of the $PROFSAL_{Tp}$ forecasts for the next quarters of 2019, 2020. $EBIT_{Tp}$ and $NETPROFIT_{Tp}$, however, were estimated, as shown in tables 7 and in figures 3 and 4.

Table 5 Dependent variable: PROFSAL, observations used 2006:3-2019:2 (N = 52)

Variable	Coefficient	Std. Error	t-Statistic	Prob. p	Significance
const	1411.35	576.431	2.4484	0.0181	**
time	-50.9186	16.7239	-3.0447	0.0038	***
dq1	1124.79	615.56	1.8273	0.0739	*
PROFSAL_2	-0.420172	0.127321	-3.3001	0.0018	***
Mean dependent var.	144.2115		S.D. dependent var.		2149.410
Sum squared resid.	1.49e+08		S.E. of regression		1762.006
R-squared	0.367519		Adjusted R-squared		0.327989
F(3, 48)	9.297212		Prob(F-statistic)		0.000059
Log likelihood	-460.3625		Akaike info criterion		928.7250
Schwarz criterion	936.5300		Hannan-Quinn criterion		931.7173
Autocorrel. coeff. (rho1)	0,015101		Durbin-Watson Stat.		1,961090

Source: Own calculations using the GRETl package

Table 6 Dependent variable: EBIT, observations used 2007:1-2019:2 (N = 50)

Variable	Coefficient	Std. Error	t-Statistic	Prob. p	Significance
const	-443.653	1423.99	-0.3116	0.7568	
SALES	0.0837217	0.0271261	3.0864	0.0035	***
SALES_4	-0.0661719	0.0342363	-1.9328	0.0597	*
time	-52.2025	24.5923	-2.1227	0.0394	**
dq1	2034.09	726.17	2.8011	0.0075	***
EBID_4	0.246684	0.143911	1.7141	0.0935	*
Mean dependent var.	-379.0400		S.D. dependent var.		2609.938
Sum squared resid.	1.66e+08		S.E. of regression		1939.432
R-squared	0.504156		Adjusted R-squared		0.447810
F(5, 44)	8.947510		Prob(F-statistic)		6.38e-06
Log likelihood	-446.2586		Akaike info criterion		904.5172
Schwarz criterion	915.9894		Hannan-Quinn criterion		908.8859
Autocorrel. coeff. (rho1)	-0.044659		Durbin-Watson Stat.		2.072886

Source: Own calculations using the GRETl package

Table 7 Quarterly operating-profit values, in the period between 2019:03 - 2020:04

Forecasted period (T)	EBIT _{Tp}	Average prediction error (V _T)	Relative prediction error (V _T [*]) (%%)	Forecast range at a confidence level of 95%
2019:3	-2101.97	1939.43	92.3	(-6010.64; 1806.70)
2019:4	1961.70	1939.43	98.9	(-1946.97; 5870.36)
2020:1	783.454	1939.43	247.5	(-3125.21; 4692.12)
2020:2	-1862.98	1939.43	104.1	(-5771.65; 2045.68)
2020:3	-1717.67	1997.57	116.3	(-5743.51; 2308.17)
2020:4	2284.30	1997.57	87.4	(-1741.54; 6310.14)

Source: Own calculations using the GRETl package

Fig. 3 Quarterly operating-profit values, in the period between 2019:03 - 2020:04

Source: Own calculations using the GRETl package

Table 8 Dependent variable (Y): NETPROFIT, observations used 2007:1-2019:2 (N = 50)

Variable	Coefficient	Std. Error	t-Statistic	Prob. p	Significance
const	-13511.7	3900.8	-3.4638	0.0013	***
SALES	0.0756882	0.0244254	3.0988	0.0035	***
SALES_3	0.063652	0.0332911	1.9120	0.0629	*
WIG	0.10304	0.0375236	2.7460	0.0089	***
WIG_4	0.0560224	0.0329262	1.7015	0.0964	*
time	-139.037	28.5118	-4.8765	<0.0001	***
dq1	3901.87	751.507	5.1921	<0.0001	***
dq2	2539.69	808.574	3.1409	0.0031	***
dq3	1718.06	747.875	2.2973	0.0268	**
Mean dependent var.		-794.7000	S.D. dependent var.		2234.427
Sum squared resid.		1.05e+08	S.E. of regression		1600.495
R-squared		0.570697	Adjusted R-squared		0.486930
F(8, 41)		6.812949	Prob(F-statistic)		0.000012
Log likelihood		-434.8891	Akaike info criterion		887.7781
Schwarz criterion		904.9863	Hannan-Quinn criterion		894.3311
Autocorrel. coeff. (rho1)		-0.039019	Durbin-Watson Stat.		2.076384

Source: Own calculations using the GRETl package

Table 9 Quarterly forecasts of net profit in the period between 2019:03 - 2020:04

Forecasted period (T)	NETPROFIT _{Tp}	Average prediction error (V_T)	Relative prediction error (V_T^*) (%)	Forecast range at a confidence level of 95%
2019:3	712.265	2431.72	341.4	(-4198.69; 5623.22)
2019:4	2683.94	2835.98	105.7	(-3043.44; 8411.32)
2020:1	535.880	1753.09	327.1	(-3004.55; 4076.31)
2020:2	-1053.72	1782.57	169.2	(-4653.69; 2546.25)
2020:3	4279.40	3623.44	84.7	(-3038.29; 11597.1)
2020:4	5861.09	3423.95	58.4	(-1053.72; 12775.9)

Source: Own calculations using the GRETl package

Fig. 4 Quarterly forecasts of net profit in the period between 2019:03 - 2020:04

Source: Own calculations using the GRETl package

Discussion

Empirical equations describing the two main profit factors (SALES, WIG) have different structures. The sales revenues are described causally, since the explanatory variables contain the pay in the enterprise sector (delayed by 3 quarters) and the dummy variable (EFFECT), which distinguishes the period of a particular increase in the company's revenues. In addition, a negative linear trend and negative seasonal fluctuations occur in the second and the third quarters. The variable WIG is at most described by a positive trend as well as a positive first-order autoregression and a negative second-order autoregression. Both equations allowed estimation of moderately precise forecasts of $SALES_{Tp}$ and WIG_{Tp} . A continuation of the increase in the sales revenues can be expected, whereas in the fourth quarters of 2019 and 2020, these increases will be rapid, analogous to the results in the fourth quarter of 2018. Forecasts of the WIG stock-exchange index indicate that, in the next six quarters, its value will fluctuate around 58 thousand points.

The empirical equation describing the profit-on-sales mechanism (PROFSAL) is characterized by low accuracy in explaining volatility, since $R^2 = 0.368$. None of the factors (SALES, WIG) turned out to be statistically significant, neither simultaneously nor with delay. Only a negative linear trend, a negative second-order autoregression and a positive seasonal deviation in the first quarter appear in the equation. This weakness results in a resignation from forecasting this variable, because the risk of low-precision forecasts is very high.

Positive impact of the simultaneous variable SALES and negative impact of the sales revenues delayed by 4 quarters occur in the equation describing the operating profit (EBIT). An important profit factor turned out to be statistically significant. There is no impact of the economic-situation measure (EWIG) on the operating profit. A negative linear trend, negative autoregression of the fourth order and a positive seasonal deviation in the first quarter can be noticed again with regard to the variable EBIT. The value of $R^2 = 0.504$ does not bode well for the precision of $EBIT_{Tp}$ forecasts. Nevertheless, the $EBIT_{Tp}$ forecasts were estimated (table 7). They are characterized by large errors - from a formal perspective, they are unacceptable. The specificity of the variable forecasted, however, results in naturally large ex ante errors, because the forecasted variable oscillates around zero. These forecasts, however, can be of indication for decision making. They roughly show the direction of the operating result (profit, loss). Operating profit can be expected in the fourth quarters of 2019 and 2020 and in the first quarter of 2020. In the remaining quarters (2019:3, 2020:2, 2020:3), operating loss should be expected. Net profit (NETPROFIT) is explained, in the empirical equation, with the highest accuracy, since $R^2 = 0.571$. This

mainly results from the significant impact of the causal variables (SALES, WIG) on the operating profit. Both of these variables turned out to be positive factors of net profit. The variable SALES, both the simultaneous and the delayed by three quarters, stimulates the amount of profit. An increase in the size of the variable WIG also increases the value of the net profit; both the simultaneous and the delayed by four quarters values favor the amount of net profit. Unfortunately, the variable NETPROFIT has a negative linear trend. Its seasonal fluctuations, in all quarters, are also significant. These seasonal fluctuations amount to:

in the first quarter: 1861.97 thousand PLN,
in the second quarter: 499.79 thousand PLN,
in the third quarter: -321.84 thousand PLN,
in the fourth quarter: -2039.92 thousand PLN.

The results of the econometric modeling indicate that net profit mainly occurs in the first two quarters of the course, while net loss occurs in the third and the fourth quarters.

Net-profit forecasts have been estimated. They are not very precise; from a formal perspective, they should be considered inadmissible. Despite this disadvantage, the net forecasts available can be used in company management as directional information. They indicate the periods in which net profits can be expected and the quarters with expected net losses. Having such knowledge facilitates management's preparation for the challenges arising under the circumstances of profit generation, but also when anticipating a negative financial result, i.e. loss. In this sense, the forecast is of a warning character, which allows avoidance of negative phenomena or reduces their negative consequences.

Conclusions

Profit is a characteristic of an enterprise that does not fall within the area of the economic categories analyzed using econometrics tools. As such, literature lacks works on econometric modeling and forecasting of a company's profit [Juszczyk et al 2019, Malakhov, S (2016.), Martínez-López F.J (2016), Rheude J (2019), Tassis, C.D (2013), Trenz M (2015)]. The attempt to describe the mechanisms of enterprise profitability, undertaken in this paper, proved to be partially effective. The multitude of objective and subjective factors affecting the size of profit constricts construction of an econometric model that would be effective in forecasting. An external observer is able to include important objective factors as well as autoregression, a trend and periodic fluctuations, in an econometric model of profit. Achievement of a description accuracy at an R^2 level of around 0.5, under such circumstances, can be considered a moderate success.

Two of the profit measures analyzed (EBIT, NETPROFIT) proved to be dependent on important factors (SALES, WIG). The moderately-good empirical equations describing the variables EBIT and NETPROFIT allowed estimation of their short-term forecasts. Forecasts of $EBIT_{Tp}$, $NETPROFIT_{Tp}$ proved unacceptable, from a formal perspective. This, however, does not mean their uselessness. They can be used as directional results, allowing the company's management to prepare for future events. Negative forecasts will have a warning character, while positive ones - will allow preparation for rational consumption of the results.

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