Net Working Capital Prediction with Holt's Linear Method: Evidence from Turkey

Tolga Tuzcuoğlu[1]

Research Article

Abstract

This research paper introduces a predictive methodology for forecasting net working capital to allow companies to proactively monitor their optimal net working capital levels from a future-oriented perspective. Additionally, it aims to assist organizations in identifying their ideal net working capital that aligns with their operational goals. The analysis of the net working capital data for the BIST-30 corporations in Turkey from the second quarter of 2016 to 2023 revealed that Turkey's 24 largest publicly traded companies had diverse net working capital values, encompassing both negative and positive figures. The projected future trends suggested that net working capital values will persist and undergo modifications during the following four quarters within the expected timeframe.

Keywords

Corporate Finance, Net Working Capital Management, Financial Forecasting, Time Series Analysis, Holt's Linear Model

Article Info

Received
26.09.2023

Accepted
12.10.2023

Holt'un Doğrusal Yöntemi ile Net İşletme Sermayesi Tahminlemesi: Türkiye'den Kanıtlar

Öz

Bu araştırma makalesi, işletmelerin optimal net işletme sermayesi seviyelerini geleceğe yönelik bir perspektiften proaktif olarak izlemelerine olanak sağlamak amacıyla tahmine dayalı bir metodoloji sunmaktadır. Buna ek olarak çalışma, firmaların operasyonel hedeflerine uygun ideal net işletme sermayelerini belirlemelerine destek olmayı amaçlamaktadır. Çalışma kapsamında Türkiye'deki BIST-30 şirketlerinin 2016 ikinci çeyreğinden 2023 ikinci çeyreğine kadar net işletme sermayesi verileri analiz edilmiştir. Çalışma, Türkiye'nin halka açık en büyük 24 şirketinin hem negatif hem de pozitif değerleri kapsayan çok çeşitli net işletme sermayesi değerlerine sahip olduğunu ortaya çıkarmıştır. Gelecek için öngörülen trend, net işletme sermayesi değerlerinin önümüzdeki dört çeyrekte hem benzer eğilimde devam edeceğini hem de değişikliklere uğrayacağını göstermektedir.

Anahtar Kelimeler

İşletme Finansı, Net İşletme Sermayesi Yönetimi, Finansal Tahminleme, Zaman Serisi Analizi, Holt'un Doğrusal Modeli

Makale Hakkında

Gönderim Tarihi
26.09.2023

Kabul Tarihi
12.10.2023

[1] Dr., tolga.tuzcuoglu@tau.edu.tr, 0000-0002-5269-9701.

Introduction

Companies have grown interest in net working capital (NWC) as a key financial performance indicator, along with sales, profitability, and cash flow metrics. NWC refers to the difference between the current assets and short-term liabilities, precisely the sum of trade receivables and inventories deducted by trade payables. Major corporations increasingly focus on working capital to generate substantial cash flow streams, highlighting its potential as a competitive advantage (Boisjoly et al.: 2020). In addition, it is consistently prioritized as one of the critical factors in assessing liquidity (Apak et al.: 2016) since it enables firms to free up cash and improve solvency (Dhole et al.: 2019).

Working capital management (WCM) pertains to the immediate financial resources needed to support day-to-day business operations. Enhanced WCM is associated with improved performance, particularly in more giant corporations, resulting in subsequent enhancements in the overall value of these organizations (Barros et al.: 2022). Moreover, effective WCM is crucial for businesses' long-term performance and sustainability. It is pivotal in facilitating seamless operations, capitalizing on growth prospects, maintaining enough liquidity, mitigating risks, and bolstering resilience against economic downturns (Tarkom and Ujah: 2023). Managing working capital involves determining the optimal investment amount and effectively managing the duration required to transform working capital into liquid cash. Choosing the appropriate level of investment in working capital is a crucial decision since an excessive allocation in this area can lead to idle investment, diminishing overall value (Dhole et al.: 2019). The effectiveness of WCM arises from the simultaneous management of inventory, receivables, and payables (Banerjee and Deb: 2023). In other words, effective working capital administration involves optimizing financial resources allocated to stocks, trade receivables, and payables, which impacts an organization's valuation and performance. Maintaining an inventory balance serves as a means of safeguarding against price volatility, reducing supply costs, and ultimately fostering customer pleasure. In a similar vein, trade credit serves to augment both sales and earnings (Dhole et al.: 2019). Implementing effective WCM is a strategic approach that can significantly improve a firm's performance and overall value. This is especially true for financially challenged organizations, as generating internal funds helps alleviate financial limitations (Afrifa et al.: 2022). Inadequate WCM can result in heightened reliance on external finance, constraining potential investment prospects and elevating credit risk (Banerjee and Deb: 2023). WCM is closely related to a corporation's cash conversion cycle (CCC). CCC is a metric used to assess the effectiveness of WCM, whereby a shorter CCC is associated with enhanced sustainability and profitability. Successful WCM is of utmost importance for organizations' operational activities, encompassing several aspects such as procurement, revenue creation, receivable collection, and payment administration. Managers strive to reduce CCC to enhance financial performance (Sawarni et al.: 2023). In addition to minimizing the duration of the CCC, strategies such as expediting inventory turnover, deferring payments to creditors, and promptly collecting receivables can be considered other strategies to manage WCM efficiently (Hassan et al.: 2023).

The optimization of NWC investment is a central concern in corporate finance, as evidenced by a growing body of research emphasizing the importance of maintaining an optimal level of NWC investment for efficient resource management (Ben-Nasr, 2016). Firm performance can be enhanced by reducing unnecessary working capital, which can be accomplished by reallocating underutilized resources to more valuable purposes. This reallocation process contributes to an overall improvement in performance (Aktas et al.: 2015). Positive and negative NWC levels and increasing and decreasing trends may have different implications for business enterprises. According to Jędrzejczak-Gas (2017), positive NWC denotes the practice of a corporation utilizing long-term capital to finance a portion of its current assets. This approach establishes an operational cushion that ensures a secure operating environment, effectively managing the balance between liabilities and receivables. A higher level of NWC contributes to enhanced financial stability. However, it also increases the weighted average cost of capital (WACC) due to elevated expenses associated with servicing. In contrast, a negative NWC situation arises when a firm utilizes short-term capital to finance its fixed assets. While cost-effective, this approach has a higher risk as the company may face operational challenges between its obligations and receivables due to insufficient buffer. Çelik et al. (2016) argued that a positive NWC signifies that a firm possesses adequate assets to sustain its operational activities and facilitate expansion, surpassing its outstanding debts. Conversely, a negative NWC suggests the company cannot fulfill its short-term obligations upon maturity. A negative trend indicates diminished

productivity, whereas elevated levels of negative NWC can precipitate a corporation's financial insolvency. A positive NWC enables the company to sustain its production activities by utilizing the residual current assets after settling its short-term liabilities. Baños-Caballero et al. (2019) related NWC increases to financial distress by reporting that an increase in NWC may result in higher financing requirements and opportunity costs for firms, which, in turn, leads to more financing charges and an elevated credit risk for the firms, ultimately increasing the likelihood of bankruptcy. Enterprises must maintain optimal working capital to ensure enough liquidity and promote operational efficiency (Hassan et al.: 2023). Investing in working capital can offer companies the advantage of maintaining liquidity, thereby safeguarding against the negative consequences of a cash deficit. Nevertheless, an excessive allocation of resources toward working capital may provide challenges for businesses concerning their profitability. This is because idle investments diminish returns and escalate financing costs. Hence, it is advantageous to make an optimal investment in working capital. Additionally, it is imperative for companies to effectively transform their working capital accounts into cash (Dhole et al.: 2019). On the other hand, calculating the ideal level of NWC requires a proactive and future-oriented strategy. Especially during periods of uncertainty, it becomes imperative to engage in proactive financial planning, as policy ambiguity has been correlated with a rise in the number of working capital days (Tarkom and Ujah: 2023). Hence, the proactive consideration of future NWC requirements is an integral component of an effective WCM approach.

In conclusion, NWC is a commonly employed metric in corporate settings, closely linked to maintaining day-to-day business activities, guaranteeing financial stability, and facilitating future expansion and profitability. Determining the appropriate level of NWC for companies is not universally agreed upon. This suggests that positive and negative NWC values can have beneficial and detrimental consequences. Consequently, it is crucial to maintain an ideal level of NWC that aligns with other indicators of corporate finance. Therefore, it is imperative for companies to consistently assess the requirements of their NWC in a forward-looking way. This study aims to provide a predictive methodology for companies operating in Turkey to manage their NWC. Given the present financial circumstances, challenges, and future priorities, using a predictive method might assist organizations in actively overseeing their ideal levels of NWC and furnish them with a forward-looking outlook, enabling them to utilize it as an early warning tool.

The study is structured as follows: Section 2 analyzes existing scholarly research on NWC, its relevance with key financial performance metrics in companies, and WCM. Section 3 provides an overview of the data utilized and the research technique implemented in the study. The empirical analysis is elucidated in Section 4 of the study. The final part concludes the study.

1. Literature Review

The existing literature on NWC has predominantly concentrated on two distinct strands. The initial body of literature mainly examined the relationship between working capital and various aspects of corporate performance, such as profitability and firm value. In this context, Deloof (2003) investigated the interaction between working capital and the operational performance of companies in Belgium. The findings of the study revealed a negative association between these two variables. In their research, Baños-Caballero et al. (2010) examined the link between NWC and company value in 30 countries. Their findings indicated that nations with robust investor protection mechanisms and higher financial and economic growth levels experienced increased shareholder value. The study conducted by Aktas et al. (2015) explored the relationship between excess NWC and stock performance. The study's findings disclosed that a lower level of NWC investment was associated with increased stock performance and vice versa. Tsuruta (2019) examined the relationships between working capital and firm performance in Japan throughout the global financial crisis. The study's findings revealed that the adverse relation between excessive working capital and firm performance showed heightened significance during the crisis. The study conducted by Chambers and Cifter (2022) examined the impact of working capital on firm performance within the hotel and tourism sector. The researchers discovered a curved link between working capital and firm performance, precisely an inverted U-shaped pattern. Hassan et al. (2023) investigated the relationship between WCM and business performance across Scandinavian markets. Their findings revealed a negative association between WCM and firm performance.

The subsequent body of literature has directed its attention toward managing working capital and developing techniques to sustain an optimal level of NWC. Jędrzejczak-Gas (2017) surveyed enterprises in the construction sector listed on the NewConnect market to identify the management strategies employed for NWC. The findings indicated that the prevailing strategies were moderate and aggressive, suggesting that these companies opted for a relatively higher proportion of short-term liabilities to obtain capital at a lower cost. In their study, Dhole et al. (2019) investigated the relationship between effective WCM and financial limitations within Australian enterprises. They proposed that implementing efficient WCM practices was linked to reduced financial constraints in firms over two to three years. Afrifa et al. (2022) employed stochastic frontier analysis to estimate the efficiency of WCM. The authors investigated the impact of many factors, including business size, firm age, cash holding, industry competition, export intensity, short-term bank credit, and sales growth, on WCM. The researchers concluded that working capital efficiency is associated with several characteristics: larger firm size, older firm age, cash reserves, and short-term bank credit. On the other hand, decreased working capital efficiency was observed concerning industry competition, export intensity, and sales growth. In a study by Tarkom (2022), the researcher investigated the effects of the COVID-19 pandemic on enterprises' WCM. The study's findings indicated that the pandemic had a noteworthy negative influence on WCM. However, the study also suggested that increased investment possibilities and government incentives may alleviate this impact. Researching US transportation and logistics companies, Banerjee and Deb (2023) discovered that managerial skills boosted WCM efficiency. In their study, Tarkom and Ujah (2023) investigated the impact of global economic policy uncertainty on the working capital decisions of enterprises. Additionally, they examined the potential moderating effect of national culture, focusing on uncertainty avoidance. The researchers concluded that policy uncertainty has a detrimental impact on enterprises' capacity to manage their working capital efficiently.

The current literature has not thoroughly addressed using predictive techniques in NWC management. In this work, our primary objective was to solve the gap by utilizing a time series model for predicting NWC.

2. Data and Method

The dataset used in this study was obtained from the Public Disclosure Platform in Turkey (Public Disclosure Platform, 2023). The Platform grants users access to the financial reports of companies registered on Borsa Istanbul (BIST), the stock exchange market in Turkey. The acquirement of the dataset started with the determination of the largest 30 publicly traded firms in Turkey, known as the BIST-30 index companies, according to the recent information provided in the Platform. Accordingly, the initial dataset encompassed the financial statements of the BIST-30 companies for the period spanning from the second quarter of 2016 through the second quarter of 2023, resulting in 29 data points. On the other hand, the analysis of the extracted financial statement files revealed that out of 30 companies, the reports of 5 companies were not available in the whole research period; hence, these companies were taken out of scope (ASTOR, GARAN, ISCTR, KRDMD, YKBNK). As for another refinement step, one further company (AKBNK) was omitted due to a lack of inventories, rendering the firm irrelevant for a comprehensive calculation of NWC. The final dataset consisted of 24 firms, encompassing 696 observations. The listed entities in the final dataset in alphabetical order were ALARK, ARCLK, ASELS, BIMAS, EKGYO, ENKAI, EREGL, FROTO, GUBRF, HEKTS, KCHOL, KOZAA, KOZAL, ODAS, PETKM, PGSUS, SAHOL, SASA, SISE, TAVHL, TCELL, THYAO, TOASO, and TUPRS, respectively.

The methodology employed in the study was fivefold. Initially, the descriptive statistics of 696 observations were presented. Following that, the NWC values for each company and period were computed in the following manner:

$$NWC = TR + Inv + TP \quad (1)$$

where TR stands for trade receivables, Inv represents inventories, and TP denotes trade payables derived from selected companies' balance sheets.

Following the calculation of the NWC metric, the average values of all four indicators were examined at the company level. Thirdly, 24 time series were constructed for each company covering

the research period between the second quarters of 2016 and 2023. Accordingly, each series covered 29 observations. The series were afterward graphed to assess the presence of trend and seasonality visually. In this context, the data series of companies were partitioned into two distinct sub-datasets. These sub-datasets were utilized to train and test the time series model. The training sub-dataset consisted of the initial 25 periods, while the testing sub-dataset comprised the latter four. In the fourth stage, the validity of the time series model was examined by comparing the calculated root mean square error (RMSE) value of the naïve forecast. The fifth and last step entailed estimating the NWC for each series in a prediction horizon of four upcoming quarters.

3. Empirical Analysis

The empirical analysis started with obtaining a basic understanding of the dataset under consideration. In this sense, a high-level descriptive analysis was conducted to examine trade receivables, inventories, trade payables, and NWC values of the companies in scope. The summary statistics of the dataset are presented in Figure 1, in which the trade receivables, inventories, trade payables, and NWC values are expressed in units of million Turkish Lira (M TRY).

Table 1: Descriptive Statistics of NWC Components in M TRY, 2016-2023

Metric	Count	Mean	Std. Dev.	Min	Median	Max
Trade Rec.	696	4,919.66	9,556.19	0.10	2,041.96	106,948.00
Inventories	696	5,518.97	10,731.77	12.67	1,600.43	95,396.00
Trade Pay.	696	6,158.59	13,557.84	5.63	2,232.02	130,563.00
NWC	696	4,280.04	8,991.74	-9,569.93	954.22	71,781.00

According to Figure 1, the NWC values ranged from - 9,569.93 to 71,781.00 M TRY. The mean and median values for NWC were calculated as 4,280.04 and 954.22 M TRY, respectively. Negative values within the range can be attributed to firms' operational size and diverse strategies for managing NWC, specifically concerning their decision-making regarding the optimal level of NWC. Following this, the examination was further advanced by directing attention towards the indicators at the company level. The mean values of four metrics at the firm level are depicted in Table 2.

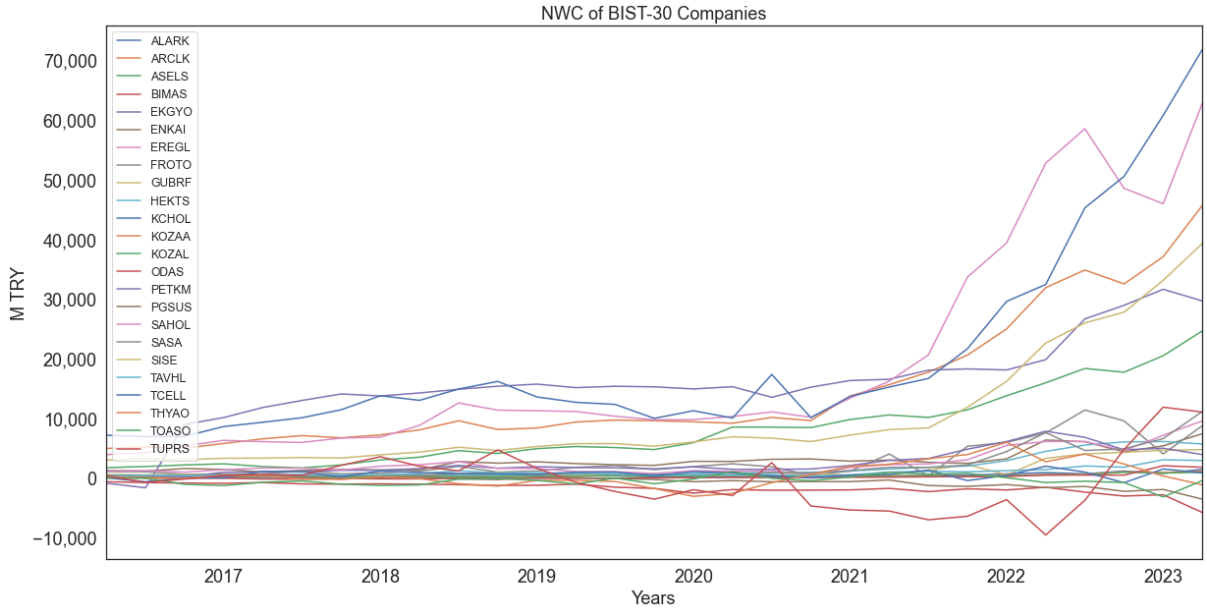
Table 2: Average Values of NWC Components in M TRY, 2016-2023

Company	Trade Receivables	Inventories	Trade Payables	NWC
ALARK	392.06	262.58	357.45	297.19
ARCLK	15,481.42	11,279.17	12,141.40	14,619.20
ASELS	5,768.55	5,659.97	3,389.17	8,039.35
BIMAS	2,754.03	5,304.06	9,789.36	-1,731.27
EKGYO	2,255.81	15,847.85	2,318.83	15,784.83
ENKAI	2,762.90	2,584.84	2,528.52	2,819.23
EREGL	6,069.12	17,299.75	4,286.06	19,082.81
FROTO	7,494.31	4,859.65	9,538.92	2,815.04
GUBRF	1,042.55	2,100.63	1,927.46	1,215.71
HEKTS	1,179.48	709.07	306.26	1,582.30
KCHOL	32,063.48	30,160.00	42,465.26	19,758.22
KOZAA	27.37	451.73	96.58	382.52
KOZAL	2.44	423.36	83.82	341.97
ODAS	301.79	203.98	330.56	175.21

PETKM	2,336.25	1,855.52	1,712.53	2,479.24
PGSUS	618.72	149.82	1,380.39	-611.84
SAHOL	2,973.98	5,446.50	5,844.93	2,575.55
SASA	1,389.80	2,367.38	1,798.36	1,958.82
SISE	6,843.59	6,438.78	3,333.36	9,949.01
TAVHL	1,274.34	241.17	583.29	932.21
TCELL	4,183.02	243.69	3,836.92	589.79
THYAO	6,879.10	2,458.07	8,834.10	503.07
TOASO	4,742.52	1,894.51	7,079.68	-442.65
TUPRS	9,235.21	14,213.17	23,842.86	-394.49

The comparison of the BIST-30 companies in scope between the second quarters of 2016 and 2023 revealed that, on average, KCHOL maintained the highest positive NWC value with 19,758.22 M TRY. In contrast, ODAS had the lowest positive with 175.21 M TRY. In addition, BIMAS, PGSUS, TOASO, and TUPRS continued their operation with negative NWC on average. The plot in Figure 1 illustrates the progress of the NWC for the companies included in the BIST-30 index throughout the research period.

Figure 1: NWC Plot of BIST-30 Companies, 2016-2023



Based on the visual analysis of Figure 1, it can be inferred that a discernible trend was observed in most of the data series. In contrast, seasonality was hardly observed within the specified research timeframe. The time series model selection for NWC forecasting followed the visual analysis. The predictive model employed in the study was Holt's Linear Model, which is also known as double exponential smoothing. Holt's model was selected because the exponential smoothing approach is widely utilized in various domains, including commercial operations and environmental research, owing to its notable advantages in simplicity and effectiveness. The model's effectiveness can be attributed to its localized nature, which enables automatic parameter adaptation based on the available data, effectively compensating for structural changes (Maia and De Carvalho: 2011). The approach involves preprocessing raw data to mitigate the influence of random variations and enhance the significance of more recent data in the prediction process. The data that undergo processing is referred

to as smoothing values. These values create the forecasting model and ultimately predict the target values (Jiang et al.: 2020).

The model is represented as follows (Holt, 2004; Hyndman and Athanasopoulos, 2018)

$$\ell_t = \alpha y_t + (1-\alpha)(\ell_{t-1}+b_{t-1}) \quad (2)$$

$$b_t = \beta^*(\ell_t-\ell_{t-1}) + (1-\beta^*)b_{t-1} \quad (3)$$

$$y_{t+h|t} = \ell_t + h_{bt} \quad (4)$$

where:

ℓ_t: estimate of the level of the series at time t

b_t: estimate of the trend (slope) of the series at time t

α: level smoothing factor, $0 \leq \alpha \leq 1$

β^*: trend smoothing factor, $0 \leq \beta^* \leq 1$

In Holt's model, updating two components, the level (Eq. 2) and the trend (Eq. 3), is necessary. After each period, the level represents a smoothed estimation of the data's value. In contrast, the trend represents a smoothed estimation of the average growth at the end of each period (Maia and De Carvalho: 2011).

During the prediction phase, the series was partitioned into two sub-series: the train sub-series, consisting of the first 25 data points, and the test sub-series, consisting of the remaining four observations. Holt's model was implemented on the train sub-series, and subsequently, the implemented model was utilized to forecast the test data points. Afterward, a comparison was made between the predicted and actual values to calculate the RMSE for the test series. The RMSE value obtained from the derived approach was subsequently compared to the RMSE of the naïve method, which served as the baseline. The baseline RMSE value computation used the same final data point value in the train sub-series over the test period horizon. The RMSE values of the naïve forecast and Holt's technique for 24 series are presented in Table 3.

Table 3: RMSE Values of Trained Exponential Smoothing Models versus Naïve Forecasts

Series (Company)	Naïve Method	Holt's Linear Method
ALARK	327	334
ARCLK	7,510	9,089
ASELS	5,119	2,323
BIMAS	2,357	2,187
EKGYO	9,559	8,139
ENKAI	1,230	1,816
EREGL	7,033	29,189
FROTO	2,858	4,473
GUBRF	1,174	1,271
HEKTS	1,400	3,039
KCHOL	26,673	11,965
KOZAA	416	350
KOZAL	350	298
ODAS	1,022	910
PETKM	2,915	7,188

PGSUS	1,024	816
SAHOL	1,959	2,677
SASA	2,734	8,882
SISE	10,333	7,262
TAVHL	1,172	990
TCELL	1,589	1,694
THYAO	2,368	2,261
TOASO	1,220	1,330
TUPRS	16,755	16,935

According to the findings presented in Table 3, it can be observed that Holt's model demonstrated superior performance compared to the naïve method in about 50% of the series. This was evident from the reduced RMSE values reported by Holt's model compared to the baseline approach. In the concluding stage, Holt's model was retrained using the entire dataset to predict the forthcoming four quarters commencing from September 2023. The subsequent figure, Figure 2, represents an extended version of the preceding Figure 1. Figure 2 includes the predictions for the following four time periods as extra data points.

Figure 2: NWC Forecast Plot of BIST-30 Companies, 2016-2024

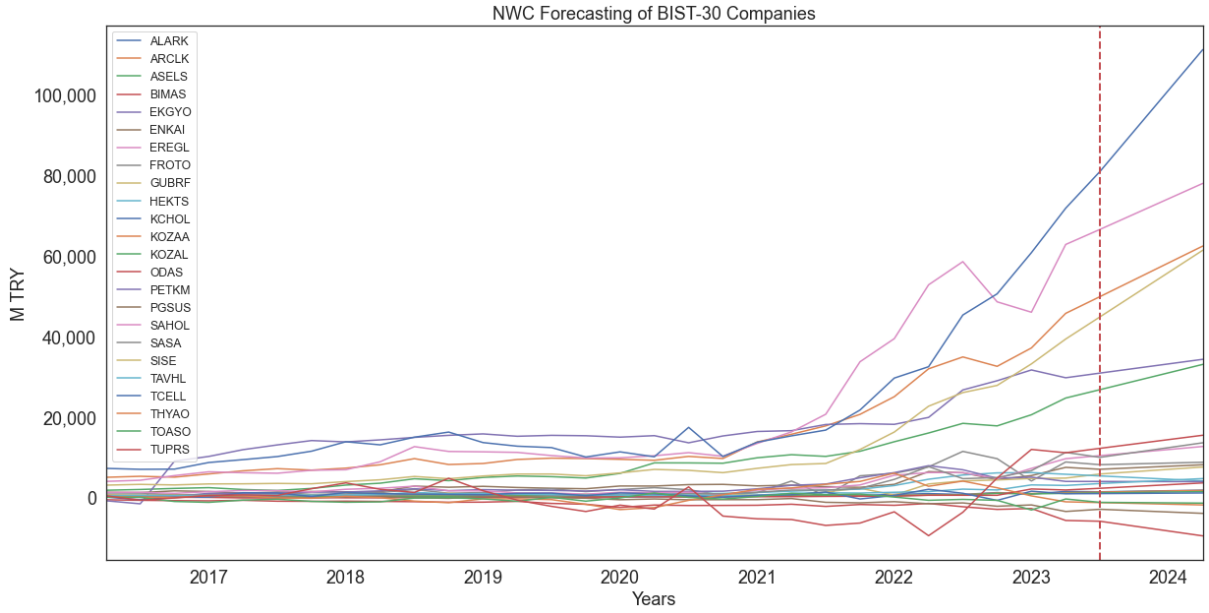


Table 4 presents the NWC figures for the BIST-30 enterprises during the two most recent quarters and the point estimates for the subsequent four periods, denominated in M TRY. Accordingly, the given information revealed that among the 24 companies under consideration, it was forecasted that 14 of them would experience a positive trend in their NWC during the upcoming year. In contrast, it was stated that five companies would experience a decline in their NWC values within the projected time frame. Four firms were projected to have a declining tendency followed by a subsequent period of consistent NWC growth. One company was reported to increase and then decrease the NWC stock in the following one-year period.

Table 4: Actual and Forecast NWC Values for Selected Companies in Scope (M TRY)

Company	Actual NWC		*Forecast NWC*			
	2023 Q1	**2023 Q2**	***2023 Q3***	***2023 Q4***	***2024 Q1***	***2024 Q2***
ALARK	762.18	1,435.17	*1,335.33*	*1,469.11*	*1,602.89*	*1,736.67*
ARCLK	37,061.96	45,659.36	*49,818.08*	*54,006.65*	*58,195.22*	*62,383.79*
ASELS	20,469.84	24,624.11	*26,703.63*	*28,796.69*	*30,889.75*	*32,982.81*
BIMAS	-2,819.69	-5,788.71	*-5,980.32*	*-7,193.75*	*-8,407.19*	*-9,620.62*
EKGYO	31,599.08	29,660.95	*30,820.20*	*31,962.03*	*33,103.86*	*34,245.69*
ENKAI	5,366.78	7,400.85	*6,923.61*	*7,298.09*	*7,672.58*	*8,047.06*
EREGL	45,939.44	62,773.06	*66,511.30*	*70,323.19*	*74,135.08*	*77,946.97*
FROTO	4,017.16	8,738.28	*8,064.32*	*8,266.70*	*8,469.07*	*8,671.45*
GUBRF	4,642.35	4,735.39	*5,750.13*	*6,330.02*	*6,909.90*	*7,489.79*
HEKTS	6,100.74	5,687.64	*5,279.54*	*4,869.00*	*4,458.46*	*4,047.92*
KCHOL	60,742.00	71,781.00	*80,905.58*	*90,997.98*	*101,090.38*	*111,182.79*
KOZAA	919.66	1,111.09	*1,266.41*	*1,405.85*	*1,545.29*	*1,684.74*
KOZAL	808.23	940.24	*1,064.55*	*1,169.97*	*1,275.38*	*1,380.80*
ODAS	2,038.00	1,787.39	*2,205.44*	*2,649.17*	*3,092.89*	*3,536.62*
PETKM	4,970.54	3,912.52	*3,900.74*	*3,883.77*	*3,866.80*	*3,849.82*
PGSUS	-1,930.71	-3,555.41	*-3,009.08*	*-3,347.01*	*-3,684.94*	*-4,022.87*
SAHOL	7,139.20	9,557.47	*10,309.58*	*11,070.82*	*11,832.05*	*12,593.28*
SASA	6,585.35	11,123.65	*9,892.15*	*11,097.09*	*12,302.02*	*13,506.95*
SISE	33,105.26	39,277.82	*44,787.17*	*50,305.71*	*55,824.24*	*61,342.78*
TAVHL	3,044.83	2,910.31	*3,386.26*	*3,795.91*	*4,205.56*	*4,615.21*
TCELL	1,486.05	849.04	*882.79*	*936.90*	*991.00*	*1,045.10*
THYAO	319.00	-1,157.00	*-1,346.12*	*-1,541.69*	*-1,737.25*	*-1,932.82*
TOASO	-3,184.77	-450.35	*-1,288.88*	*-1,352.24*	*-1,415.59*	*-1,478.95*
TUPRS	11,855.56	11,033.93	*12,128.91*	*13,213.55*	*14,298.19*	*15,382.83*

Conclusion

Based on their quarterly financial statements, this study explored the NWC development of Turkey's 24 largest publicly listed firms from June 30, 2016, to June 30, 2023. The descriptive analysis revealed that the companies under consideration exhibited negative and positive values for NWC. Following the descriptive analysis, the data series related to firms was divided into two sub-datasets. These sub-datasets were used to train and evaluate the selected Holt's Linear model compared to the naïve forecast. The findings indicated that the model had superior performance compared to the baseline forecast in about 50% of the series. Holt's technique was utilized to forecast the NWC of each organization for the subsequent four quarters in the concluding part. It can be highlighted that there is no definitive answer to the question of what level of NWC a company ought to have. This suggests that positive and negative NWC values may have beneficial and detrimental impacts. Because of this, it is essential to keep a level of NWC that is both ideal and complementary to the other corporate finance indicators. The empirical results substantiated that Turkey's largest 24 publicly traded firms showed diverse NWC levels, spanned negative and positive values. The anticipated future trends indicated that the values of NWC were expected to persist and undergo changes during the next four

quarters. The practical consequences of this study for enterprises lie in recognizing the importance of predictive methodologies in managing working capital, specifically in determining an ideal NWC that aligns with operational objectives.

Regarding the study's limitations, it should be noted that the analyzed firm data encompassed a limited number of sectors even though these companies constituted the largest group of listed companies in Turkey. Furthermore, the time series prediction methodology only incorporated Holt's linear technique. These constraints simultaneously provide opportunities for future study, which could involve increasing the sample size to include a more comprehensive array of sectors and doing a sector-specific analysis. Furthermore, it is possible to employ additional prediction models and evaluate their efficacy through a comparative methodology to offer the best possible predictive model for sector-specific future insights.

References

Afrifa, G. A., Tingbani, I., and Adesina, O. O. (2022). Stochastic frontier modelling of working capital efficiency across Europe. Technological Forecasting and Social Change, 184, 122012. https://doi.org/10.1016/j.techfore.2022.122012

Aktas, N., Croci, E., and Petmezas, D. (2015). Is working capital management value-enhancing? Evidence from firm performance and investments. Journal of Corporate Finance.

Apak, S., Açıkgöz, A. F., Erbay, E. R. and Tuncer, G. (2016). Cash vs. Net Working Capital as Strategic Tools for the Long-term Relation between Bank Credits and Liquidity: Inequalities in Turkey. Procedia-Social and Behavioral Sciences, 235, 648–655. https://doi.org/10.1016/j.sbspro.2016.11.046

Banerjee, P., and Deb, S. G. (2023). Capital investment, working capital management, and firm performance: Role of managerial ability in US logistics industry. Transportation Research Part E: Logistics and Transportation Review, 176, 103224. https://doi.org/10.1016/j.tre.2023.103224

Baños-Caballero, S., García-Teruel, P. J., and Martínez-Solano, P. (2019). Net operating working capital and firm value: A cross-country analysis. BRQ Business Research Quarterly, S2340943618300963. https://doi.org/10.1016/j.brq.2019.03.003

Baños-Caballero, Sonia and García-Teruel, Pedro and Solano, Pedro. (2010). Working capital management in SMEs. Accounting and Finance. 50. 511-527. 10.1111/j.1467-629X.2009.00331.x.

Barros, V., Falcão, P. F. and Sarmento, J. M. (2022). Are more sustainable firms able to operate with lower working capital requirements? Finance Research Letters, 46, 102407. https://doi.org/10.1016/j.frl.2021.102407

Ben-Nasr, H. (2016). State and foreign ownership and the value of working capital management. Journal of Corporate Finance, 41, 217–240. https://doi.org/10.1016/j.jcorpfin.2016.09.002

Boisjoly, R. P., Conine, T. E. and McDonald, M. B. (2020). Working capital management: Financial and valuation impacts. Journal of Business Research, 108, 1–8. https://doi.org/10.1016/j.jbusres.2019.09.025

Çelik, R., Bilen, B. and Bilen, Ö. (2016). The Impacts of Changes in Macro-Economic Data on Net Working Capital: The Case of Turkey's Industrial Sector. Procedia Economics and Finance, 38, 122–134. https://doi.org/10.1016/S2212-5671(16)30184-8

Chambers, N. and Cifter, A. (2022). Working capital management and firm performance in the hospitality and tourism industry. International Journal of Hospitality Management, 102, 103144. https://doi.org/10.1016/j.ijhm.2022.103144

Deloof, M. (2003), Does Working Capital Management Affect Profitability of Belgian Firms?. Journal of Business Finance Accounting, 30: 573-588. https://doi.org/10.1111/1468-5957.00008

Dhole, S., Mishra, S. and Pal, A. M. (2019). Efficient working capital management, financial constraints and firm value: A text-based analysis. Pacific-Basin Finance Journal, 58, 101212. https://doi.org/10.1016/j.pacfin.2019.101212

Holt, C. C. (2004). Forecasting seasonals and trends by exponentially weighted moving averages. International Journal of Forecasting, 20, 5–13.

Hyndman, R.J. and Athanasopoulos, G. (2018) Forecasting: principles and practice, 2nd edition, OTexts: Melbourne, Australia.

Hassan, M. K., Aysan, A. F., Kayani, U. N. and Choudhury, T. (2023). Working capital as a firm performance savior? Evidence from Scandinavian countries. Research in International Business and Finance, 65, 101959. https://doi.org/10.1016/j.ribaf.2023.101959

Jędrzejczak-Gas, J. (2017). Net Working Capital Management Strategies in the Construction Enterprises Listed on the New Connect Market. Procedia Engineering, 182, 306–313. https://doi.org/10.1016/j.proeng.2017.03.098

Jiang, W., Wu, X., Gong, Y., Yu, W. and Zhong, X. (2020). Holt–Winters smoothing enhanced by fruit fly optimization algorithm to forecast monthly electricity consumption. Energy, 193, 116779. https://doi.org/10.1016/j.energy.2019.116779

Maia, A. L. S. and De Carvalho, F. D. A. T. (2011). Holt's exponential smoothing and neural network models for forecasting interval-valued time series. International Journal of Forecasting, 27(3), 740–759. https://doi.org/10.1016/j.ijforecast.2010.02.012

Public Disclosure Platform (2023). Financial Statements [database]. https://www.kap.org.tr/

Sawarni, K. S., Narayanasamy, S. and Padhan, P. C. (2023). Impact of earnings management on working capital management efficiency. Finance Research Letters, 54, 103778. https://doi.org/10.1016/j.frl.2023.103778

Tarkom, A. (2022). Impact of COVID-19 exposure on working capital management: The moderating effect of investment opportunities and government incentives. Finance Research Letters, 47, 102666. https://doi.org/10.1016/j.frl.2021.102666

Tarkom, A. and Ujah, N. U. (2023). Global policy uncertainty and working capital management: Does national culture matter? Technological Forecasting and Social Change, 196, 122869. https://doi.org/10.1016/j.techfore.2023.122869

Tsuruta, D. (2019). Working capital management during the global financial crisis: Evidence from Japan. Japan and the World Economy, 49, 206–219. https://doi.org/10.1016/j.japwor.2019.01.002