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INVESTIGATING THE RELATIONSHIP BETWEEN MARKET VALUE-ADDED (MVA) AND ECONOMIC VALUE-ADDED MOMENTUM (EVAM): EMPIRICAL EVIDENCE FROM TURKIYE*

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ABSTRACT
Purpose- This study aims to investigate the possible relationship between market value added (MVA) and economic value-added momentum (EVAM). Besides, any possible linkage between leverage (in terms of the degree of combined leverage) and market value added is also tested.
Methodology- This study conducts a time series analysis to the quarterly data of manufacturing industry, comprising Borsa Istanbul (BIST) listed manufacturing firms for the period of 2001.q2-2022.q4 to test MVA-EVAM relationship. It employs autoregressive distributed lag (ARDL) bounds testing approach, developed firstly by Pesaran and Shin (1999) and further revised by Pesaran, Smith and Shin (2001). The stationarity of the series is tested by the Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) unit root tests.
Findings- Empirical findings from ARDL bounds testing approach refers the existence of long-run relationships between market value added and economic value added momentum; and market value added and degree of total leverage. The coefficients of the long-run form of ARDL model reveal that both economic value-added momentum and degree of combined leverage have statistically significant and negative effects on market value added. The estimated short-run coefficients indicate that economic value added momentum has significantly negative effect on market value added created as similar to the long-run finding. Another finding is that though leverage has significantly positive effect on market value added in the short-run, this positive effect turns out to be negative in lag one period.
Conclusion- This study contributes to the literature on MVA-EVA relationship by employing autoregressive ARDL bounds testing approach to manufacturing industry comprising Borsa Istanbul (BIST) listed manufacturing firms of Turkey as an emerging market. Besides, the research model includes EVAM -as an independent variable- that is so rarely considered in existing literature.

Keywords: Market value-added, economic value-added momentum, leverage, time series analysis, ARDL bounds testing approach.
JEL Codes: G32, C32, C58.

1. INTRODUCTION

The classical corporate finance theory states that the primary objective of financial management is to create maximum value and wealth for shareholders referred to as (shareholder) wealth-maximization paradigm. Focusing on this paradigm -in conjunction with three major functions of a finance manager as investment, financing and dividend decisions-, is a must for both financially stable businesses and overall economic stability (Kim, 2004). This focus requires contemporary, reliable and accurate performance evaluation measures. However, traditional measures such as return on assets (ROA), return on equity (ROE), return on (invested) capital (RO(I)C), net operating profit after taxes (NOPAT), return on sales (ROS), earnings per share (EPS), dividend per share (DPS), operating cash flow (OCF), and etc. have been strongly criticized due to their inability to consider the overall cost of capital (Rappaport, 1986; Stewart, 1991; Panigrahi et al., 2014); inconsistency problems that make them not much useful from the perspective of valuation and strategic value management guidance (Kim, 2004; Damodaran, 2005) and inaccuracies as performance measures leading to wealth-maximization (Johnson et al., 1985; Stewart, 1991). Consequently, especially since the early 80s, the need for connecting wealth-maximization paradigm with managerial decision processes has led to the emergence of new measures of performance, including economic value added (EVA), market

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value added (MVA), cash value added (CVA), discounted economic profit (DEP), shareholder value added (SVA), cash flow return on investment (CFROI), and etc.

EVA -as the most widely accepted measure among all- was firstly introduced in 1991 by a global consulting firm, Stern, Stewart & Co. It is a reconsidered version of shareholder wealth-maximization paradigm, that prioritizes shareholders as the primary stakeholders in hierarchical structure of any firm in evaluating economic and financial performance. However, the roots of EVA dates back to a well-known traditional accounting measure called residual income (or economic profit) as mentioned earlier by Marshall (1890), Scovell (1924) and Virtanen (1975). Residual income is, simply, calculated by subtracting capital charge from operating profit. EVA, as a variation of residual income with adjustments, differs from it by using net operating profit after taxes instead of operating profit in its calculation. The logic behind EVA is the calculation of value added created by any firm after deducting the overall cost of capital. This superiority of EVA to other measures has been supported by many researchers such as Lehn and Makhija (1996), Milunovich and Tsuei (1996), Bao and Bao (1998), Grant (2003), Worthington and West (2004) and, Lee and Kim (2009). Besides, within a short period, more than 300 worldwide companies including Coca-Cola & Co., Eli Lilly & Co., US Postal Service, Burton Group, SmithKline Beecham and Monsanto have adopted EVA to some degree and started disclosing their EVA information (Wallace, 1997; Ehrbar, 1998).

It can be concluded that existing literature on EVA mainly focuses on presenting, promoting and/or discussing EVA and its related concepts in relation to consulting firms and business consultants, mostly optimistically foregrounding advantages of these concepts. On the other hand, rejecting this optimism, some researchers have noted the existence of weak or no relationship between EVA and shareholder value or stock returns (see, for instance, Biddle et al., 1997; Chen and Dodd, 1997; Kramer and Pushner, 1997; Turvey et al., 2000; Ismail, 2006; Kyriazis and Anastassis, 2007, Kumar and Sharma, 2011).

This study aims to investigate the possible relationship between market value added (MVA) and economic value added momentum (EVAM). To the best of our knowledge, this is the first study that conducts a time series analysis to the quarterly data of manufacturing industry, comprising Borsa Istanbul (BIST) listed manufacturing firms for the period of 2001.q2-2022.q4, addressing MVA-EVAM relationship in Turkey. Besides, any possible linkage between MVA and leverage (in terms of the degree of combined leverage) is also tested. The empirical findings of the study are expected to fill the gap in existing literature and guide firm managers and investors to re-evaluate their asset allocations.

The remainder of the paper is as follows. In section two, a brief literature review is presented. Section three is about the sample, data, variables, the research model and empirical findings. Finally, section four summarizes the findings and concludes the discussion.

2. LITERATURE REVIEW

Though EVA has been subject of many studies due to its adaptability to integrated financial management systems (Stern et al., 1996); it is possible to mention that the majority of these studies has focused on analyzing EVA and its related concepts in relation to business world in a descriptive manner, paying no or a little attention on empirical findings [see, for instance, studies on EVA philosophy (Tully, 1993); implementation process of EVA (Ehrbar, 1998); EVA's role in CEO performance evaluation (Coles et al., 2001), optimal resource allocation (Zimmermann, 1997; Rompho, 2009) and formulation of organizations' strategic targets (Bahri et al., 2011)].

It is expected that the market value of a firm is the sum of invested capital (at the beginning) and discounted value of expected EVAs in the future. Therefore, integrating EVA into entire firm as a predictor of financial and business performance should provide significant benefits. From viewpoint of wealth-maximization paradigm, the general objective of EVA-related empirical studies is two-fold as: (*i*) to address whether EVA (and/or MVA) is superior to traditional accounting-based financial performance measures such as ROA, ROE, ROIC, ROS, EPS and DPS, etc. in explaining stock returns and market values; and (*ii*) to investigate the correlation between EVA and MVA.

Stewart (1991) and Stern et al. (1996) argue that accounting measures (and even cash flow) mostly lack of evaluating firm performance; and underline EVA's close linkage to firm's market value and its significant effect on MVA. Similarly, studies of Lehn and Makhija (1996) and Uyemura et al. (1996) using samples of 241 large US firms and 100 US banks, respectively, refer positive relationship among EVA, MVA and stock returns and EVA's slight advantage over accounting measures. This advantage is more perceivable for especially EVA-adopting firms that have better stock prices compared to those not using it [see, for instance, studies of Fernandez (2003) on 582 US firms; and Lee and Kim (2009) on the data set from Stern, Stewart & Co.]. Further support on EVA's superiority to accounting measures and positive correlation between EVA and MVA comes from Stern (1993), O'Byrne (1996), Biddle et al. (1997), Grant (1997), Hatfield (2002) and Irala (2005).

However, some researchers criticize the overrated predictive power of EVA relative to the accounting-based measures and its linkage to MVA. For example, De wet (2005) points the existence of relatively strong correlation between MVA and OCF, compared to very little correlation between MVA and EPS, and MVA and DPS. Biddle et al. (1998), Kramer and Peters (2001) and, Misra and Kanwall (2007) are among other researchers rejecting EVA's superiority compared to accounting measures such as ROC, OCF and EPS. Accordingly, Riahi-Belkaoui (1993), Kim (2006) and, Kumar and Sharma (2011) also provide evidence that measures such as NOPAT, EPS and OCF are relatively superior to EVA in explaining shareholder value and EVA has no significant effect on MVA. These opposite findings may be attributed to the extent of implementation period of EVA (Ehrbar, 1998); EVA's over-emphasis on (only financial) value creation (Zimmennan, 1997), inappropriateness of EVA to certain industries such as (bio)technology and high growth firms (Dierks and Patel, 1997) and failure of EVA in accounting for inflation (De Villiers and Auret, 1997).

3. METHODOLOGY

3.1. Sample and Data

This study conducts a time series analysis to the quarterly data of manufacturing industry, comprising Borsa Istanbul (BIST) listed manufacturing firms for the period of 2001.q2-2022.q4. The sample financial data is derived using *Financial Analysis* software developed by Finnet, a leading software company in Istanbul.

3.2. Variables

3.2.1. Independent Variable

The theoretical research model includes EVAM as the independent variable of interest. Though this model is so similar to that of O'Byrne (1996), Biddle et al. (1997), Grant (1997), Hatfield (2002), Zaima et al. (2005), De wet and Hall (2004) and, Aloy Niresh and Alfred (2014) that refers EVA variable as total amount of EVA created by the firm or EVA/Market Capitalization ratio, it differs greatly depending on how EVA is proxied. Along with Wirawann (2011), Nakhaei et al. (2012), Fayed and Dubey (2016) and Maeenuddina et al. (2020); this is one of the pioneering studies that proxies EVA by EVAM.

As a size-neutral measure, EVA's failure is that it is mostly reported in absolute monetary value, causing uncertainty for especially certain investors. This failure has motivated Stewart (2009) to improve a new measure over classical EVA. In this regard, EVAM, firstly introduced by Stern, Stewart & Co. in 2009, has come out as a new economic profit ratio that accounts for the change in economic profit over sales for the prior period. This recent EVA-based measure is thought to be the best single financial performance measure ever by Stewart (2009).

EVAM (*also called* EVA margin) is, simply, the same as the ratio of EVA to sales [for detailed calculation, see Stewart (2013: 123-129)]:

$$\mathrm{EVAM} = (\mathrm{EVA_t} - \mathrm{EVA_{t-1}}) \div \mathrm{Sales_{t-1}} \tag{1}$$

where $\mathrm{EVA_t}$ and $\mathrm{EVA_{t-1}}$ denote economic value added created by the firm in period t and t-1, respectively.

As EVA's primary goal is to calculate the real economic profit, focusing on the effects of managerial actions; the first step in EVA calculation deals with net operating profit after taxes (Beaver, 2001; Fernandez, 2005):

$$\mathrm{EVA} = \mathrm{NOPAT_t} - (\mathrm{IC_{t-1}} \times \mathrm{k_{WACC}}) \tag{2}$$

where $\mathrm{NOPAT_t}$, $\mathrm{IC_{t-1}}$ and $\mathrm{k_{WACC}}$ denote net operating profit after tax in period t; invested capital in period t-1 and weighted average cost of capital, respectively.

In his own words, Stewart (1991) defines NOPAT as "*the profit derived from company's operations after taxes, but before financing costs and non-cash bookkeeping entries*". NOPAT is, simply, after-tax profit of a firm under the assumption that the firm is debt-free and has no investment in non-operating assets such as underutilized cash, marketable securities, unutilized assets, loans receivable, etc. These assets are considered apart from firm's core operations and income generated from these assets contributes to the non-operating income of the firm. Therefore, compared to net income, NOPAT can be considered to be a better operating performance measure, as it excludes effects of financial decision; and is calculated as:

$$\mathrm{NOPAT_t} = \mathrm{NI_t} + \mathrm{i}(1 - \mathrm{tax\ rate}) \tag{3}$$

where $\mathrm{NI_t}$ and i denote net income in period t and interest expense, respectively.

Stewart (1991) ignores depreciation in NOPAT calculation, considering it as a "true economic expense" and adjusts NOPAT as an income available to shareholders plus after-tax interest expenses. This adjustment deviates NOPAT from classical definition of economic profit.

EVA calculation totally requires 164 adjustments and approximately 120 of these adjustments are about NOPAT. Typical adjustments required in EVA calculations can be classified into two major groups as (*i*) adjustments to net income -adding net capitalized intangibles, impairment and deferred income tax and goodwill written-off, and deducting depreciation)- and (*ii*) adjustments to invested capital -adding net book value of amortized intangible assets, accumulated provision for depreciation and goodwill amortization previously written off, provisions related to bad debts and deferred income tax- (Cheng, 2011). Stewart (1991) claims that these adjustments would minimize potential accounting-based distortions due to the inherent nature of different Generally Accepted Accounting Principles (GAAP) in different countries. Considering the complexity of these adjustments, he suggests that only four common adjustments would be sufficient to truly convert accounting net income to economic income, NOPAT, as a promising financial performance measure for investors. These common adjustments are (*i*) deferred tax reserve, (*ii*) Last-in-First-out (LIFO) reserve, (*iii*) goodwill amortization and (*iv*) research and development costs amortization (Banerjee, 2000).

Invested capital refers to the sum of all of firm's financing net of short-term non-interest-bearing liabilities (NIBL) (or operating liabilities) such as accounts payable, deferred revenues, and accrued liabilities. NIBL do not require any interest payment and are ignored in net debt calculation. Hence, IC is the sum of shareholders' equity plus all interest bearing both short-term and long-term debt (Young, 1998). EVA considers long-term non-interest-bearing liabilities as an equity equivalent item and includes in shareholders' equity, and refers invested capital as total (net) assets net of short-term NIBL:

$$\mathrm{IC}_{t-1} = \text{Total Assets}_{t-1} - \mathrm{NIBL}_{t-1} \tag{4}$$

The underlying logic of weighted average cost of capital (k_{WACC}) as a discount rate is that the value of a firm is a function of (*i*) the after-tax cost of debt, (*ii*) the cost of equity, (*iii*) the systematic risk of debt and equity and (*iv*) the capital structure of the firm. Thus, k_{WACC} can be formulated by considering exclusively two important sources of finance, debt and equity mechanisms (Villarreal and Cordoba, 2010):

$$k_{WACC} = [k_E \times (E \div IC)] + [k_D(D \div IC)(1 - T)] \tag{5}$$

where k_E, E, k_D, D and T denote cost of equity, shareholders' equity, cost of debt, debt and tax rate, respectively. Here, cost of equity is calculated by Capital Asset Pricing Model (CAPM) introduced by Sharpe (1964) and Lintner (1965):

$$k_E = r_f + \beta(r_M - r_f) \tag{6}$$

where r_f, r_M, β and $(r_M - r_f)$ denote risk-free rate of return, average rate of return on the market, market risk (measured by beta coefficient) and risk premium.

3.2.2. Control Variable

Leverage is included as a control variable in the research model in the context of degrees of operational, financial and combined leverage. As known, change in operating profit (or loss) may sometimes be more sensible and vulnerable to change in the sales volume. The degree of operating leverage (DOL) is a quantitative measure of this sensitivity. The degree of operating leverage of a firm at a particular level of sales is, simply, calculated as the percentage change in operating profit (or earnings before interest and taxes-EBIT) over the percentage change in sales that causes the change in profits:

$$\mathrm{DOL}_{\text{at q units}} = \text{Percentage Change in EBIT} \div \text{Percentage Change in Sales} \tag{7}$$

DOL, as only one determinant of the overall business risk of the firm, overemphasizes the uncertainty of sales and production costs on the variability of operating profits. However, under the assumption that firm's sales and cost structure are constant, high DOL will be meaningless. Therefore, DOL should be considered as a measure of potential risk that activates only in the presence of sales and production cost variability (Van Horne and Wachowizc, Jr. 2008: 424).

Operating leverage is mostly related to physical requirements of the firm's operations. It is a must, rather than a choice for firms especially operating in heavy industries such as construction, mining, shipbuilding, and etc. that face with large fixed operating costs consisting of depreciation. On the other hand, financial leverage is always optional. Compared to debt-financing, firms may have options to finance their operations and investments with retained earnings and/or external equity financing. The favorability of financial leverage depends on the effect of debt-financing on earnings per share (EPS) to common shareholders. This effect is sensible to the relationship between EPS and EBIT under various financing alternatives and the indifference points between these alternatives. The degree of financial leverage (DOF) is a quantitative measure of this sensitivity and is calculated as the percentage change in EPS over the percentage change in EBIT that causes the change in EPS (Van Horne and Wachowizc, Jr. 2008: 432):

$$\mathrm{DFL}_{\text{EBIT of X dollars}} = \text{Percantage Change in EPS} \div \text{Percentage Change in EBIT} \tag{8}$$

The combination of operating leverage and financial leverage is referred to as combined (or total) leverage. The degree of combined leverage (DCL) is calculated as the percentage change in EPS over the percentage change in sales that causes the change in EPS:

$$\mathrm{DCL}_{\text{at q units of sales}} = \text{Percantage Change in EPS} \div \text{Percentage Change in Sales} \tag{9}$$

3.2.3. Dependent Variable

The dependent variable of the research model is MVA as a proxy for market valuation. MVA is so similar to market-to-book value ratio with a little difference that it is absolute measure of value while market-to-book value ratio is a relative measure. Theoretically, the cost of capital approach values the market value of entire firm by discounting the cumulated (expected) free cash flows to all claim holders in the firm by the weighted average cost of capital. The linkage between MVA and EVA involves exactly the same logic that MVA equals to the present value of all expected EVAs:

$$\mathrm{MVA} = \sum_{t=1}^{\infty} \frac{\mathrm{EVA_t}}{(1+\mathrm{k_{WACC}})^t} \qquad (10)$$

Besides, MVA can also be calculated by deducting invested capital (total assets net of short-term non-interest-bearing liabilities) from the total market value of the firm:

$$\mathrm{MVA} = \text{Total Market Value of the Firm} - \text{Invested Capital} \qquad (11)$$

Derivation of Equation 11 is linked to alternative valuation approaches used to incorporate the effect of leverage (debt) in equity valuation of a firm. These methods as discussed by Fernandez (2004) depends on the same idea that the value of a levered firm equals the sum of the value of unlevered firm and the present value of the tax shields arising from debt financing:

$$\mathrm{MV_E} + \mathrm{MV_D} = \mathrm{V_L} = \mathrm{V_U} + \mathrm{PV_{TS}} \qquad (12)$$

where $\mathrm{MV_E}$, $\mathrm{MV_D}$, $\mathrm{V_L}$, $\mathrm{V_U}$ and $\mathrm{PV_{TS}}$ denote market value of equity of a levered firm, market value of debt of a levered firm, the value of a levered firm, the value of unlevered firm and the present value of tax shields arising from debt financing.

Table 1 summarizes definitions and descriptions of the variables in the research model.

Table 1: Variables

Dependent variable	*Symbol*	*Definition*
Market Value Added	*MVA*	Total Market Value of the Firm – Invested Capital
Independent variables		
Economic Value-Added Momentum	*EVAM*	Net Operating Profit After Tax – [Capital Employed × Weighted Average Cost of Capital]
Degree of Combined Leverage	*DCL*	Percentage Change in Earnings per Share ÷ Percentage Change in Sales

3.3. The Research Model

The research model tests the relationship between MVA and EVAM by the regression equation as given below:

$$MVA_t = \alpha_0 + \beta_1 EVAM_t + \beta_2 DCL_t + \beta_t \qquad (13)$$

3.4. Empirical Findings

Time series analysis is a specific method to identify and forecast trends in repeated sampling of the same data over time. However, before proceeding any type of time series analysis, stationarity of data should be ensured (Granger and Newbold, 1974; Gujarati, 2006). If the mean, variance and autocorrelation structure of a time series do not change over time, it said to be stationary. Stationarity, as the key idea in time series, indeed emphasizes that behavior of a time series does not alter over time. This means that the values always vary around the same level and their variability is steady over time (Charlton and Caimo, 2012).

This study refers autoregressive distributed lag (ARDL) bounds testing approach, developed firstly by Pesaran and Shin (1999) and further revised by Pesaran et al. (2001) to test MVA-EVAM relationship. ARDL bounds testing approach differs from classical cointegration approaches of Granger (1981), Engle and Granger (1987) and Johansen (1988, 1991) that it can be applied though variables in the data set are a combination of stationary *I*(0), non-stationary *I*(1), or each of them in a different order of cointegration. Despite this superiority of ARDL approach, possible presence of an integrated stochastic trend of *I*(2) necessitates to use various unit root tests to check the number of unit roots in the series for increasing reliability of the empirical findings.

3.4.1. Unit Root Tests

This study tests the stationarity of the series of MVA, EVAM and DCL by employing the Augmented Dickey-Fuller (ADF) and Phillips and Perron (PP) unit root tests.

Dickey and Fuller (1981) derive ADF test considering a higher order autoregressive process formulated as:

$$Y_t = \emptyset_1 Y_{t-1} + \cdots + \emptyset_p Y_{t-p} + e_t \qquad (14)$$

In this process, the current value of time series is a linear combination of previous values of the time series and a white noise term, e_t. Here, the white noise refers to a random shock is what is not explained by the past values of time series (Cryer and Chan, 2008) and has a zero mean and variance σ_e^2 whereas $\emptyset_i$ are fixed coefficients. The process in Equation 14 can also be formulated by using the lag operator as:

$$\emptyset(L)Y_t = e_t \quad (15)$$

where

$$\emptyset(L) = 1 - \emptyset_1(L) - \cdots - \emptyset_P L^P \quad (16)$$

The process has a unit root under the condition that the polynomial $\emptyset(1) = 1 - \emptyset_1 - \cdots - \emptyset_P$ equals zero. Hence, the hypothesis that should be considered is if $\emptyset(1) = 0$. This hypothesis can be tested by Equation 17 and estimated by Ordinary Least Squares (OLS) as:

$$\Delta Y_t = aY_{t-1} + \sum_{i=1}^{p-1} \emptyset_i \Delta Y_{t-1} + e_t \quad (17)$$

According to Dickey and Fuller (1981), a linear trend can be included into Equation 17 as:

$$\Delta Y_t = \delta + aY_{t-1} + \sum_{i=1}^{p-1} \emptyset_i \Delta Y_{t-1} + e_t \quad (18)$$

where $\sum_{i=1}^{p-1} \emptyset_i \Delta Y_{t-1} + e_t$ is a stationary process and e_t are normally and independently distributed $(0, \sigma^2)$. Further, $a = -\emptyset(1)$ and $\emptyset_i = -(\emptyset_{i+1} + \cdots + \emptyset_n)$. ADF test has the hypothesis $H_0: a = 0$ and $H_1: a < 0$ meaning that time series contains and does not contain a unit root, respectively. The calculated t-value is compared to the simulated critical values provided by Fuller (1976) and the null hypothesis is rejected for small values.

The unit root test statistics (Z statistics) developed by Phillips and Perron (1988) have gained popularity in especially financial time series analysis. They have differentiated their test by considering the limiting distributions of the usual ADF tests. While the autoregressive moving average (ARMA) structure of the errors in the test regression is approximated by a parametric autoregression in ADF tests, Phillips Perron test ignores any serial correlation in the test regression. PP test solves the problem of serial correlation in the errors by a correction factor. Despite its serious size distortion problems due to the presence of negative autocorrelations, PP test also allows for dependence among disturbances of either AR or MA form. Besides, PP tests are robust to general forms of heteroskedasticity in the error term, u_t and does not require the specification of a lag length for the test regression. These properties of PP test enable it to be more powerful than ADF tests.

The test regression in PP tests is as:

$$\Delta Y_t = \emptyset Y_{t-1} + \alpha + \beta t + u_t \quad (19)$$

where u_t is a stationary process (which also may be heteroscedastic). As stated before, any problem related to serial correlation and heteroscedasticity in the errors u_t of the test regression in Equation 19 can be corrected by directly modifying the test statistics. These modified statistics, Z_t and $Z_\emptyset$ are as:

$$Z_t = \left(\frac{\hat{\sigma}^2}{\hat{\lambda}^2}\right)^{\frac{1}{2}} t_{\phi=0} - \frac{1}{2}\left(\frac{\hat{\lambda}^2 - \hat{\sigma}^2}{\hat{\lambda}^2}\right)\left(\frac{Ts.e(\hat{\rho})}{\hat{\sigma}^2}\right) \quad (20)$$

$$Z_\emptyset = T\phi - \frac{1}{2}\left(\frac{Ts.e(\hat{\rho})}{\hat{\sigma}^2}\right)\left(\hat{\lambda}^2 - \hat{\sigma}^2\right) \quad (21)$$

$\hat{\sigma}^2$ and $\hat{\lambda}^2$ are consistent estimates of the variance parameters as:

$$\hat{\sigma}^2 = \lim_{T\to\infty} T^{-1} \sum_{t=1}^{T} E[u_t^2] \quad (22)$$

$$\hat{\lambda}^2 = \lim_{T\to\infty} \sum_{t=1}^{T} E[T^{-1} S_T^2] \quad (23)$$

where $S_T = \sum_{t=1}^{T} u_t$ (24)

The null hypothesis of the PP test is that there is a unit root, with the alternative hypothesis that there is no unit root. If the calculated t-value is above the simulated critical value, then the null hypothesis cannot be rejected. Results of ADF and PP unit root tests are given in Table 2. The results show that while a few variables are stationarity at level [*I*(0)] (according to only PP test results); all variables are stationarity at first differences [*I*(1)]. These results lead the research to autoregressive distributed lag (ARDL) cointegration analysis and bounds testing approach. Results of ADF and PP unit root tests are given in Table 2.

Table 2: Results of ADF and PP Unit Root Tests

Variable	ADF				PP			
	Level		1st Difference		Level		1st Difference	
	intercept	*intercept with trend*	*intercept*	*Intercept with trend*	*intercept*	*intercept with trend*	*intercept*	*intercept with trend*
MVA	-1.774 (0.398)	-2.141 (0.227)	-9.012* (0.000)	-9.121* (0,000)	-1,714 (0.424)	-2.178 (0.218)	-10.947* (0.000)	-11.241* (0.000)
EVAM	-1.191 (0.557)	-2.147 (0.601)	-6.111* (0.000)	-5.999* (0.000)	-5.425* (0.000)	-7.899* (0.000)	-19.114* (0.000)	-19.784* (0.000)
DCL	-1.726 (0.411)	-1.501 (0.743)	-8.999* (0.000)	-9.011* (0.000)	-1.698 (0.477)	-1.488 (0.847)	-10.024* (0.000)	-10.427* (0.000)
Level of significance	*Critical values***							
1%	-3.508	-4.068	-3.508	-4.068	-3.508	-4.068	-3.508	-4.068
5%	-2.895	-3.462	-2.895	-3.462	-2.895	-3.462	-2.895	-3.462
10%	-2.584	-3.157	-2.584	-3.157	-2.584	-3.157	-2.584	-3.157

Note: * indicates level of significance at level 1%. **The simulated critical values are provided by Fuller (1976).

3.4.2. ARDL Cointegration Analysis and Bounds Testing Approach

Its applicability though variables in the data set whether they are a combination of stationary *I*(0), non-stationary *I*(1), or each of them is in a different order of cointegration is not the only superiority of ARDL bounds testing approach over the residual based approach of Granger (1981), and Engle and Granger (1987) and the maximum-likelihood based approach of Johansen (1988, 1991), and Johansen and Juselius (1990). It also enables a simultaneous estimation of both short-run and long-run relationships among variables and effectively overcomes the endogeneity problem by adding lags of both dependent and independent variables in the model. Besides, ARDL bound testing approach enables to derive a dynamic error correction model through a simple linear transformation that allows for inferences of long-run estimates (Banerjee et al., 1993). Another advantage of the approach is that it is also efficient even the sample size is small (Al-Assaf and Al-Abdulrazag, 2015).

ARDL approach is indeed a two-stage test. While the existence of long-run relationships among all the variables are examined is the first stage, the second stage is about the estimation of both the long-run and the short-run coefficients under the same equation. The second stage depends on the existence of a long-run relationship in the first stage.

The relationships among MVA, EVAM and DCL can be modelled as a conditional ARDL model as:

$$\Delta MVA_t = c_0 + c_1 trend + \alpha_1 MVA_{t-1} + \alpha_2 EVAM_{t-1} + \alpha_3 DCL_{t-1} + \sum_{i=1}^{p} \delta_i \,\Delta MVA_{t-i} + \sum_{i=0}^{q} \beta_i \,\Delta EVAM_{t-i} + \sum_{i=0}^{s} \theta_i \,\Delta DCL_{t-i} + e_t \quad (25)$$

where Δ, c_0 and α_{1-3} are the first difference operator, the constant term and long-run coefficients of the variables, respectively.

Before proceeding to test the conditional ARDL model in Equation 25, the optimal lag length for each variable should be selected. ARDL approach makes this selection by estimating $(p+1)k$ number of regressions, where p and k the maximum number of lags used and the number of variables. The best fitting model in this study is selected by using the Akaike information criterion (AIC) and of Schwarz information criterion (SIC) developed by Akaike (1974) and Schwarz (1978), respectively.

Table 3: The Models Selected by AIC and SIC

Lag length suggested by AIC and SIC	*intercept*				*intercept with trend*			
	AIC	SIC	$\chi^2(1)$	$\chi^2(4)$	AIC	SIC	$\chi^2(1)$	$\chi^2(4)$
1	-1.0822	-1.1007**	0.0015 (0.912)	8.1781 (0.084)	-1.0251	-0.9124	0.0796 (0.668)	9.0879 (0.087)
2	-1.1024	-1.0956	6.1214 (0.007)	11.1572 (0.009)	-1.1041	-1.0111	8.4498 (0.087)	16.1569 (0.049)
3	-1.2281**	-0.9812	0.4802 (0.547)	6.1289 (0.118)	-1.4265**	-1.0245**	2.2358 (0.388)	9.5789 (0.134)
4	-1.2047	-0.8714	0.0128 (0.642)	4.1289 (0.514)	-1.4017	-0.9345	0.0078 (0.897)	4.6428 (0.428)

Note: ** are the smallest AIC and SIC values referring optimal lag lengths. $\chi^2(1)$ and $\chi^2(4)$ are LM test statistics. *p*-values of χ^2 statistics are given in parenthesis.

Both information criterions are estimators of prediction errors and measures of the goodness of fit of a statistical model. They are referred to compare regression models and the smaller the AIC or SIC values are, the better the time series model is. The existence of autocorrelation of the residuals is tested by Lagrange Multiplier (LM) test of Breusch and Pagan (1979). The models selected by AIC and SIC are given in Table 3.

After selecting the lag lengths, the results of ARDL bounds test indicating the existence of long-run relationships among the series are given in Table 4. The value of *F*-statistics in Table 4 is compared to the lower and upper bound critical values by Pesaran et al. (2001). The null hypothesis (H_0: $\alpha_1 = \alpha_2 = \alpha_3 = 0$) ignoring whether the series are *I*(0) or *I*(1) is rejected in case of that the *F*-statistics calculated is greater than the upper bound critical value, concluding the existence of long-run relationships among the series. The empirical results show that at significance level of 5% only *F-v* statistics is over the upper bound critical values (ARDL Model 3.0.1.).

Table 4: Results of ARDL Bounds Test

intercept			intercept with trend			
Lag length suggested by AIC and SIC	*F-iii*	*t-iii*	Lag length suggested by AIC and SIC	*F-iv*	*F-v*	*t-iv*
3 (AIC)	4.458 (0.003)	-3.191 (0.001)	*3 (AIC)*	5.213 (0.003)	6.004* (0.001)	-3.811 (0.002)
1 (SIC)	3.812 (0.019)	-3.109 (0.002)	*3 (SIC)*	5.871 (0.002)	5.428 (0.003)	-3.717 (0.001)

Note: Lower and upper bound critical values for *k*=2 at significance level of 5% are *F-iii* = [3.79-4.85], *F-iv* = [5.17-6.15], *F-v* = [4.87-5.85], *t-iii* = [(-2.57)-(-3.21)], *t-iv* = [(-3.13)-(-4.34)]. *F-iv* is the *F*-statistics testing $\alpha_1 = \alpha_2 = \alpha_3 = 0$ and $c_1 = 0$ and *F-v* is the *F*-statistics only testing $\alpha_1 = \alpha_2 = \alpha_3 = 0$ as given in Equation 25.

The long-run coefficients estimated by ARDL Model 3.0.1. based on AIC are given in Table 5. EVAM and DCL have both statistically significant and negative effects on MVA for the intercept model. Similar empirical findings are also valid for the intercept with trend model. However, these findings are not statistically significant.

Tablo 5: Long-Run Coefficients (ARDL Model 3.0.1.)

intercept (ARDL Model 3.0.1.)			Intercept with trend (ARDL Model 3.0.1.)		
Variable	Coefficient	*t*-statistics	Variable	Coefficient	*t*-statistics
EVAM	-7.212	-1,428 (0,047)**	*EVAM*	-5.759	-1,117 (0,245)
DCL	-0.742	-3,128 (0,000)*	*DCL*	-0.351	-1,751 (0,129)
c	2.012	5,359 (0,000)	*c*	1.786	4.286 (0,000)

Note: * and ** indicate level of significance at level 1% and 5%. *p*-values are given in parenthesis.

The second stage in ARDL bounds testing approach is about the estimation of both the long-run and the short-run coefficients under the same equation. After confirming the long-run relationship, short-run dynamics can be captured by converting the conditional ARDL model into an error correction model (ECM). ECM firstly introduced by Davidson et al. (1978), then developed by Engle and Granger (1987) is proper to use when a priori theory dictates that the dependent variable exhibits short-run changes in response to changes in the independent variable as well as long-run levels consistent with those of the independent variable(s) (Durr, 1992). These changes in the dependent variable regarding to independent variable(s) can be expressed by an error correction term (ECT) and this term refers the direction and the speed of adjustment in the model depending on any short-run disequilibrium.

Error correction model can be formulated by replacing the lagged variables in the conditional ARDL model in Equation 25 with ECT_{t-1} and estimating the model after imposing the same optimal lags as:

$$\Delta MVA_t = c_0 + \sum_{i=1}^{p} \delta_i \, \Delta MVA_{t-i} + \sum_{i=0}^{q} \beta_i \, \Delta EVAM_{t-i} + \sum_{i=0}^{s} \theta_i \, \Delta DCL_{t-i} + \vartheta ECT_{t-1} + e_t \quad (26)$$

The coefficient of error correction implies the speed of re-adjustment to the long-run equilibrium after short-run shocks lead to disequilibrium. Here, the coefficient of ECT_{t-1}, i.e., ϑ, captures the speed of adjustment and ECT_{t-1} with a statistically significant and negative sign portrays causality in this process (Shabbaz et al., 2011). The error correction estimates and short-run dynamics are given in Table 6.

Table 6: Error Correction Estimates and Short-Run Dynamics

intercept (ARDL Model 3.0.1.)			Intercept with trend (ARDL Model 3.0.1.)		
Variable	Coefficient	*t*-statistics	Variable	Coefficient	*t*-statistics
ΔMVA(-1)	0.642	6.898 (0,000)*	*ΔMVA(-1)*	0.812	5,426 (0.000)*
ΔMVA(-2)	0.249	2.237 (0.017)**	*ΔMVA(-2)*	0.324	2,444 (0.024)**
ΔMVA(-3)	-0.278	-2.208 (0.018)**	*ΔMVA(-3)*	-0.215	-2.438 (0.006)*
ΔEVAM	-9.278	-1.824 (0.049)**	*ΔEVAM*	-7.936	-1.429 (0.192)
ΔDCL	0.071	1.859 (0.078)***	*ΔDCL*	0.061	1.790 (0.071)***
ΔDCL(-1)	-0.068	-2.567 (0.017)**	*ΔDCL(-1)*	-0.014	-2.512 (0.000)*
Constant	0.447	4.192 (0.000)*	*Constant*	0.491	3.771 (0.000)*
ECM(-1)	-0.169	-4.512 (0.000)*	*ECM(-1)*	-0.279	-4.612 (0.000)*
F-statistics	169.235 (0.000)		*F-statistics*	124.428 (0.000)	

Note: R^2 values are 0.821 and 0.834 for the intercept model and intercept with trend model, respectively. *, ** and *** indicate level of significance at level 1%, 5% and 10%. *p*-values are given in parenthesis.

An ARDL model also requires model diagnostic checking to ensure whether its fundamental assumptions such as that errors are serially independent and normally distributed. This study refers to Breusch-Godfrey LM test developed by Breusch (1978) and Godfrey (1978a, 1978b) to detect autocorrelation; White variance test proposed by White (1980) for checking heteroskedasticity and Jarque-Bera test introduced by Jarque and Bera (1980) for checking normality. ARDL Model (3.0.1) diagnostics given in Table 7 indicate that fundamental assumptions are met.

Table 7: Model Diagnostics

intercept (ARDL Model 3.0.1.)		Intercept with trend (ARDL Model 3.0.1.)	
Breusch-Godfrey LM Test	0.017 (0.932)	Breusch-Godfrey LM Test	0.041 (0.953)
White Test	0.524 (0.726)	White Test	0.642 (0.691)
Jarque-Bera Test	0.481 (0.782)	Jarque-Bera Test	2.245 (0.324)

The estimated short-run coefficients indicate that EVAM has statistically significant and negative effect on MVA, while DCL has statistically significant and positive effect on MVA. However, it is also observed that in lag one period, the positive effect of DCL on MVA turns out to be negative.

4. CONCLUSION

This study investigates the relationship between market value added and economic value-added momentum. To the best of our knowledge, this is the first study that conducts a time series analysis to the quarterly data of manufacturing industry, comprising Borsa Istanbul (BIST) listed manufacturing firms for the period of 2001.q2-2022.q4, addressing this relationship in Turkey. Besides, the effect of leverage on market value added is also tested. The empirical findings are expected to fill the gap in existing literature and guide firm managers and investors to re-evaluate their asset allocations.

Empirical findings from ARDL bounds testing approach indicates that -in the long-run- there exists a significantly negative relationship between market value added and economic value-added momentum. This finding is contrary to both the argument of Stewart (1991) and Stern et al. (1996) that there is closed and positive linkage between EVA and MVA; and the empirical findings of Lehn and Makhija (1996), and Uyemura et al. (1996) defending EVA's advantage over accounting measures. The relationship between market value added and leverage is also the same that leverage negatively affects market value added created in the long-run.

The estimated short-run coefficients indicate that economic value added momentum has significantly negative effect on market value added created as similar to the long-run finding. Another finding is that though leverage has significantly positive effect on market value added in the short-run, this positive effect turns out to be negative in lag one period.

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