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Is the Performance of Shares in the Stock Market Affected by Monetary Policy Change and the Transmission Channel of Exchange Rate? The Case of Turkey

Summary: In this study, in case that the objectives are price and financial stability, it is investigated whether the transmission channel based on exchange rate due to changes in monetary policy affects the performance of shares due to external debt stock. Borsa Istanbul is chosen as the stock market and the performance of nine sectors is examined during the high and low foreign exchange rate periods due to monetary policy change. The performance of the sectors is defined by portfolio performance measurement methods, and the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) analysis based on entropy is used for multi-criteria decision making. It is concluded that the monetary policy change affects the performance of the sectors, which constitutes a substantial proportion of external debt stock.

Keywords: Stock market, Performance analysis, TOPSIS, Monetary policy, Exchange rate.

JEL: C02, E44, E50, F31, G11.

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As it is known, the ultimate economic objectives, such as sustainable growth, full employment, price stability and a healthy balance of payments, are provided by monetary transmission channels. Frederic S. Mishkin (1995) stated that these channels may be defined as interest rate, credit, exchange rate and other asset price channels. For instance, monetary policy influences money supply, thereby having a substantial impact on corporate lending and corporate investment (Linh My Tran et al. 2019). In addition, changing interest rates and monetary policy may affect capital inflow and outflow between countries and allows to determine the value of foreign exchange rates. The study on the impact of monetary policy on capital inflows by Ebele S. Nwokoye and Jonathan O. Oniore (2017) implied that exchange rate and interest rate were both the short-run and long-run determinants of foreign capital inflows. Guillermo A. Calvo, Leonardo Leiderman, and Carmen M. Reinhart (1993) stated that it was argued that the capital inflows to Latin America were the result of lower interest rates outside Latin America. As a result of the increase in foreign capital inflows, supply exceeds demand and foreign exchange rates start to decrease. Besides, exchange rate is one of the channels of monetary policy transmission as well. In this intermediate goal, financial stability might be the ultimate economic objective, as in the case of Turkey after the 2008-2009 global financial crisis. However, the changes in the exchange rates may trigger the changes in the relative prices of goods and services, and affect firms whose net worth significantly depends on foreign currencies.

In this study, in case that the objectives are price and financial stability, it is investigated whether the transmission channel based on exchange rate due to changes in monetary policy affects the performance of shares.

1. Transmission Channel of Exchange Rate and Stock Returns

As expressed by James Obben, Andrew Pech, and Shamim Shakur (2006), net exporter and importer firms are sensitive to exchange rates and in the literature, this is related to goods market theory, which implies that increases or decreases in exchange rates affect the competitiveness and profitability of firms. On the other hand, as mentioned by Huan Li et al. (2021), due to strictly controlled exchange rates, the role of transmission channel of exchange rates could be unimportant as in the case of China. The study results showed that the credit channel, the interest rate channel, the asset price channel and the exchange rate channel respectively explained 42%, 31%, 20% and 7% of the effects of the monetary policy shock in China. Likewise, Pragyan Deb et al. (2023) stated that monetary policy could be more effective in countries with a flexible exchange rate regime. Olli-Matti Laine (2023) analyzed the monetary policy impact on risk premia, using vector autoregressive (VAR) models. Willem Thorbecke (2023) studied the exposure of 53 assets to monetary policy surprises, concluding that monetary policy changes could increase the stock market volatility. Similarly, the research by Jonathan Benchimol, Yossi Saadon, and Nimrod Segev (2023) suggested that the stock market reaction to monetary policy surprises under uncertainty was asymmetric. Examining 41 developed and developing economies through GMM-Panel VAR model, Sakshi Saini and Sanjay Sehgal (2023) verified monetary policy and stock market interaction for the periods before and after the crisis of 2008. Ramin Cooper Maysami, Lee Chuin Howe, and Mohamad Atkin Hamzah (2004) stated in their study that Singapore's stock market and the property index had cointegrating relationship with interest rates, industrial production, price levels, exchange rate and money supply. So it is possible to state that there is a chain of impact which starts from monetary policy and ends with investment decision.

Regarding a stock market, one of the investment decisions is to decide which sector to invest in. The reason for that is that the dynamics of sectors may change according to economic conditions in the country in question. Mehtap Kesriyeli, Erdal Özmen, and Serkan Yiğit (2005), stated that real exchange rate depreciations had the impact of contractionary investment and profit on the sectors with higher liability dollarization. A sector which has considerable net debt in terms of foreign exchange rates may considerably underperform, while foreign exchange rates increase due to its increasing debt in terms of local currency. Especially, the sectors which are net importers may face this kind of risk. Timothy K. Chue and David Cook (2008), in their study on emerging market exchange rate exposure, found that a firm's foreign currency debt outstanding was a significant determinant of this kind of exposure, and the stock return reacted negatively. In another study by Chue and Cook (2008), they concluded that depreciations had a negative impact on emerging market stock returns for the sub-period of 1999-2002. This is valid for vice versa as well. The sectors which are net exporters may perform a high performance due to increasing revenues in terms of local currency. As explained by Maysami, Howe, and Hamzah (2004), a depreciation of the local currency would result in an increase in demand for the subject country's exports and increase cash flows to the country in question, assuming that the demand for export was sufficiently elastic. José Miguel Benavente, Christian A. Johnson, and Felipe G. Morande (2003), expressed that larger firms had the high portion of dollar debt in Chile, and that firm size and export orientation were the variables in explaining the amount of losses due to exchange rate fluctuations for manufacturing companies.

2. Turkish Economy and Empirical Literature

Testing the performance of shares in case that the objectives are price and financial stability can be achieved by investigating Turkish economy before and after 2008-2009 financial crisis. The Central Bank of the Republic of Turkey has started to implement a new policy composition after the 2008-2009 global financial crisis. According to this, financial stability has been adopted while maintaining price stability: Reserve requirements, interest rate corridor, foreign currency liquidity policies and Reserve Option Mechanism (ROM) have been used as monetary policies (Havva Arabacı 2016). This can be summarized as stated below:

Table 1 Monetary Policies

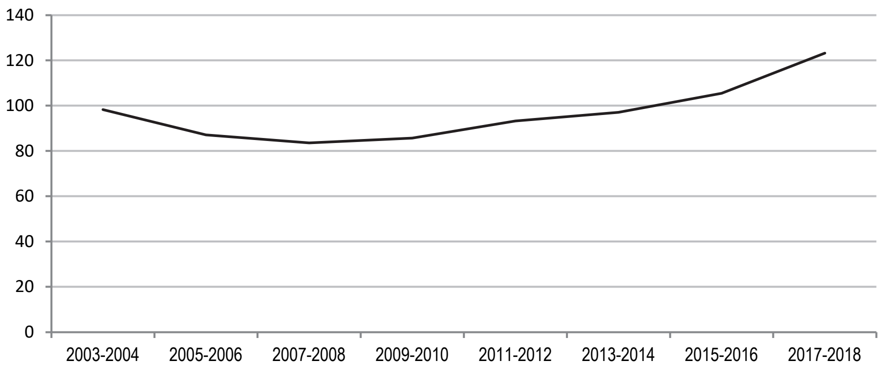
	Instruments	Objectives
Old framework	Policy interest One-week repo rate	Price Stability
New framework	Interest rate corridor One-week repo rate Liquidity management Reserve requirements	Price stability Financial stability

Source: Mehmet Kara and Mehmet Behzat Ekinci (2018).

In the new framework, the transmission channels between instruments and objectives are credit growth and exchange rate. The reason that the central bank has started using a new policy composition can be explained as follows: In the traditional monetary policy implementation (when price stability is the only objective and the short-term policy rate is the single tool) the central bank does not need to have a separate impact on credit and exchange rate channels and will raise the policy rate to lead to a fall in inflation. Yet, if the central bank has the objective of financial stability, increasing the policy rate may not be desirable since it would lead to exchange rate appreciation, which may conflict with the objective. Therefore, the use of credit and exchange rate channels separately may be required. Accordingly, the central bank may need to use other instruments along with the policy rate in order to affect both credit and exchange rate channels (A. Hakan Kara 2012).

Vittorio Grilli and Nouriel Roubini (1995) studied the impacts of monetary policy for all the G7 countries except the USA, stating that the effect of positive monetary shocks in the USA was the appreciation of the US Dollar, while in the other countries, the impact was opposite and resulted in the depreciation of currencies because of the fact that the monetary policy in these countries was decided according to that of the USA. The study by Yuriy Garbuza (2003), investigated the transmission mechanism (exchange rate channel) of monetary policies for central and eastern European countries via the case of Poland. The study implied that there could be a difference between developed countries and transition economies due to some features such as insufficient development of the banking sector and the low level of external economic integration which is present in transition economies. According to the results, it was stated that the weakness of the credit channel in transition economies was compensated by relative strength of interest rate and exchange rate channels, but due to the low level economic integration, the exchange rate channel did not dominate the interest rate one as it did in developed counties. It was also expressed in the study, that the shock transmitted through the exchange rate channel had an impact on external sector variables and affected nominal and real trade balances. This implication confirms the hypothesis that there is an impact starting from monetary policy and being able to affect investment decisions, considering the foreign exchange position of firms.

After the implementation of the new policy by the Central Bank of the Republic of Turkey, it is seen that foreign exchange rates in Turkey have started to increase as of 2010. This can be shown through Figure 1.

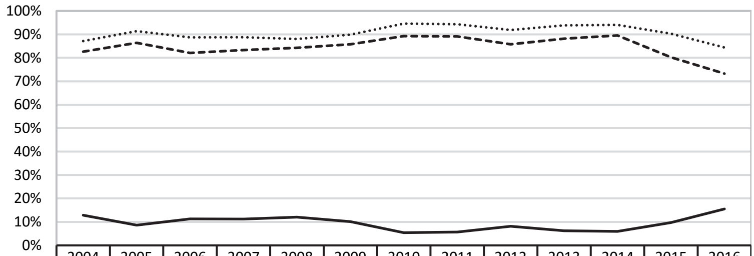


Source: The data are compiled from Central Bank of the Republic of Turkey (2018)[1].

Figure 1 Real Effective Foreign Exchange Rate Index

When the short term external debt stock of sectors is considered, it is seen that the financial sector has the highest debt stock, while non-financial sectors have the lowest. According to Central Bank of the Republic of Turkey, the ratio of sectors' short term external debt stock to total short term external debt stock is as follows:

[1] **Central Bank of the Republic of Turkey.** 2018. www.tcmb.gov.tr (accessed December 12, 2018).



	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Financial	87%	91%	89%	89%	88%	90%	95%	94%	92%	94%	94%	90%	84%
Banks	83%	86%	82%	83%	84%	86%	89%	89%	86%	88%	90%	80%	73%
Non-Financial	13%	9%	11%	11%	12%	10%	5%	6%	8%	6%	6%	10%	16%

Financial Banks Non-Financial

Source: The data are compiled from Central Bank of the Republic of Turkey (2018).

Figure 2 Sector Short Term External Debt Stock / Total Short Term External Debt Stock

In this frame, according to Figure 2, in case of any substantial increase in foreign exchange rates, investing in the financial sector and banks is more risky than the non-financial sectors. The figure also implies that financial sectors' and banks' performance should be better than that of other sectors before the new monetary policy was implemented. The root assumption here is based on: "...With less 'dollarization' of liabilities, the link between real exchange rate movements and financial fragility would be greatly weakened, as Ricardo Hausmann and Berry Eichengreen (1999) and a number of other analysts have observed" (Luis Felipe Cespedes, Roberto Chang, and Andrés Velasco 2000). This is in line with the study conducted by Giovanni Ugazio and Weining Xin (2024), in which they followed Chunya Bu, John Rogers, and Wenbin Wu (2021) and Gabriele Ciminelli, John Rogers, and Wenbin Wu's (2022) approaches and stated that the countries with lower foreign exchange reserves, higher external debt, weaker fiscal balances and higher public debt were exposed to larger growth declines due to contractionary monetary policy compared to the countries with stronger fundamentals.

In the literature, there are various studies on performance analysis. Robiyanto Robiyanto (2018) investigated the performance of 19 stock indices in the Indonesia Stock Exchange through daily data between January 3, 2011, and July 17, 2017, using the Sortino Ratio, the Sharpe Index, the Treynor Ratio, the Jensen Alpha, the Adjusted Sharpe Index and the Adjusted Jensen Alpha Index. The results of the research indicated that three stock price indices have better performance than risk-free and stock-market instruments. Zeijong Zhou and Benshan Shi (2004) analyzed the performance of 16 open-end funds in China for a period of one year (2003-2004) through weekly data, and stated that they had a positive market timing ability when calculated by using the Treynor Mazuy measure and that market timing and selectivity abilities had a negative correlation. In another study, Robiyanto (2017) analyzed nine stock indices in the Indonesia Stock Exchange by using only the Sharpe Index and the Treynor Ratio and indicated that SRI-KEHATI was the best performer with the highest risk aversion rate during the January 3, 2013 to April 11, 2016 period. In the study made by Marcin Flotynski (2015), 11 stock indices in Poland were studied during the period between 2008 and 2013 through the Sharpe Index, the Treynor Ratio and the Jensen Alpha. Md Ejaz Rana and Waheed Akhter (2015), investigated the performance of the Islamic and the Conventional stock indexes in Pakistan and, they used the Jensen's Alpha, the Sharpe Ratio, the Treynor Ratio and the MM Performance Measure. According to the results, the conventional index (KSE-100) has better performance than the Islamic index (KMI-30) in terms of the Jensen's Alpha, the Sharpe Ratio and the Treynor Ratio.

In some research in the literature, while implementing the performance analysis methods, the monetary policy effect is left out of scope, while others that investigate the impact of monetary policy on performance and risk, use econometric models in which the performance is measured by return on assets (ROA) or return on equity (ROE) and the risk is defined as the standard deviation of ROA and ROE (Vijay Kumar, Sanjeev Acharya, and Ly T. H. Ho 2020; Xuan Vinh 2020; Xingjian Li et al. 2021; Huan Huu Nguyen, Thanh Phuc Nguyen, and Anh Nguyen Tram Tran 2022). Unlike the studies using ROA and ROE as performance indicators, within the scope of this study, the portfolio performance analysis methods along with the TOPSIS (Technique for Order Preference by Similarity to Ideal Solution) analysis based on entropy for multi-criteria decision making are used to see the impact of monetary policy changes on the sector performances in Turkey. The study also uses risk factors such as gold and the US dollar in performance evaluation, in addition to the Treynor ratio based on systematic risk (market risk) by Jack L. Treynor (1965) and allows to use of both the Treynor Mazuy's quadratic regression model by Treynor and Kay K. Mazuy (1966) and the other performance evaluation models such as the Jensen's alpha by Michael C. Jensen (1968), the Sharpe ratio by William F. Sharpe (1966) etc., which do not take the market timing issue into consideration, using the TOPSIS model based on entropy. In this regard, this study differs from many other studies, which investigate the effect of monetary policy on share prices or index returns as well as positive and/or negative shocks through regression analyses, in that, the main examination is for this study to run various performance evaluation methods together before and after the monetary policy change in question to see whether the transmission channel of exchange rate has a significant impact on the sector and share performance where the objectives are price and financial stability. The advantage of the employed method is that it combines techniques which consider both market timing and risk-based performance measures through the TOPSIS approach based on entropy, which enables to define objective weights peculiar to the data set. The study fills a gap in monetary policy literature by investigating the effect of transmission channel of exchange rate on sector/share performance via performance evaluation methods, taking the periods before and after the monetary policy change is implemented into account. In other words, many studies in the literature seem to investigate either the effectiveness of monetary policy or the stock portfolio performances individually, while this study examines both of them in order to get an idea how the portfolio/index performances change due to the monetary policy change.

3. Methodology

The performance analysis methods used in this study to see the effect of monetary policy change on the performance of sectors are the Sharpe ratio by Sharpe (1966), the Treynor ratio by Treynor (1965), performance measures based on different betas, the Jensen's Alpha by Jensen (1968), the modified Jensen measure by Keith V. Smith and Dennis A. Tito (1969) and the Treynor Mazuy measure based on quadratic regression model by Mazuy (1966) and the formulas thereof are stated below:

Table 2 Performance Analysis Methods

Sharpe ratio:

$$S_p = (r_{pt}\text{-}r_{ft})/б_p$$

Here,

r_{pt} = portfolio rate of return
r_{ft} = risk free rate of return
$б_p$ = standard deviation

Treynor ratio:

$$T_p = (r_{pt}\text{-}r_{ft})/b_p$$

Here,

r_{pt} = portfolio rate of return
r_{ft} = risk free rate of return
b_p = portfolio beta

Performance measures based on different betas:

$$T_p = (r_{pt}\text{-}r_{ft})/b_p$$

Here,

r_{pt} = portfolio rate of return
r_{ft} = risk free rate of return
b_p = portfolio beta (based on US dollar or gold)

Jensen (Alpha) measure:

$$r_p - r_f = a_p + b_p\,(r_m - r_f) + u$$

Here,

r_p = return on the portfolio
r_f = risk free rate of return
r_m = return of the market portfolio
a_p = Alpha
b_p = beta of portfolio

Modified Jensen's Alpha:

$$(MJA) = a_p / b_p$$

Here,

a_p = alpha
b_p = portfolio beta

Treynor Mazuy measure:

$$r_{pt} - r_f = a_p + b_p\,(r_{mt} - r_f) + c_p\,(r_{mt} - r_f)^2 + u_{pt}$$

Here,

r_p = portfolio rate of return
r_f = risk free rate of return
r_m = market rate of return
a_p = alpha, measure of selectivity skill
b_p = systematic risk measure of portfolio
c_p = measure of market-timing skill

In this study, the Treynor Mazuy measure is defined as follows (Yalçın Karatepe and Fazıl Gökgöz 2007):

$$TM = a_p + c_p\,б_m^2$$

Here,

TM = Treynor Mazuy performance measure
a_p = measure of selectivity skill
c_p = measure of market-timing skill
$б_m^2$ = variance of excess return

Source: Author's compilations.

As mentioned before, in this study, in order to decide on only one sector among the sectors, TOPSIS analysis based on entropy is used. TOPSIS analysis is one of the multi-criteria decision making methods. Just like the other multi-criteria decision making methods, when using TOPSIS, after alternatives, criteria and weights are decided, the analysis is performed. TOPSIS was developed by Ching-Lai Hwang and Kwang-sun Yoon (1981) and decision making is based on which alternative has the shortest distance from the positive ideal solution.

We can state the steps of TOPSIS as follows.

i) Forming Decision Matrix

As the first step, a decision matrix, where rows represent alternatives and coloumns represent criteria is formed. It can be shown as follows:

$$A_v = \begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ & & & \vdots \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

ii) Forming Standard Decision Matrix

In the second step, the data in the decision matrix are calculated as per the formula below and a standard decision matrix is obtained.

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}}$$

$$R_v = \begin{bmatrix} r_{11} & r_{12} & \dots & r_{1n} \\ r_{21} & r_{22} & \dots & r_{2n} \\ & & & \vdots \\ r_{m1} & r_{m2} & \dots & r_{mn} \end{bmatrix}$$

iii) Forming Weighted Standard Decision Matrix

In the third step, all the data in each coloumn of the standard decision matrix is multiplied by the weight attributed to the subject criteria/coloumn (the total of the weights are equal to 1) and the weighted standard decision matrix is obtained.

$$\sum_{i=1}^{n} w_i = 1$$

$$V_v = \begin{bmatrix} w_1 r_{11} & w_2 r_{12} & \dots & w_n r_{1n} \\ w_1 r_{21} & w_2 r_{22} & \dots & w_n r_{2n} \\ & & & \vdots \\ w_1 r_{m1} & w_2 r_{m2} & \dots & w_n r_{mn} \end{bmatrix}$$

Although various methods can be used to obtain the weights, in order to be objective and be able to define the weights peculiar to the data set, using the entropy method will be convenient. In this regard, the weights will be defined as follows (Yetkin Çınar 2004):

- Firstly, the distances of alternatives to the ideal solution are calculated.

Let x_j^* be the maximum,

for benefit attributes;

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^* - x_j^{min}}$$

for cost attributes;

$$r_{ij} = \frac{x_j^* - x_{ij}}{x_j^* - x_j^{min}}$$

are used. The outputs are between [0,1] and hence normalized.

- Later, the outputs are used as inputs for the following formula and the data of P_{ij} is obtained:

$$p_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \ ; \ \forall i \ ; \ j$$

- Using the P_{ij} matrix for each column, the information of the decision is obtained. The formula for that is as follows:

$$k = 1 / \ln m,$$

$$E_j = -k \sum_{i=1}^{m} p_{ij} \, . \, lnp_{ij} \ , \forall j \ (0 \leq E_j \leq 1)$$

- The weight calculation is made by using the E_j data in the formulas below:

$$d_j = 1 - E_j, \forall j$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \ , \forall j$$

iv) Defining Positive and Negative Ideal Solutions

In the weighted standard decision matrix, a positive ideal solution is the data set which consists of maximum data in the columns (for cost attributes, the minimum ones), while a negative ideal solution, is the data set which consists of minimum data in the columns (for cost attributes, the maximum ones):

$$A^* = \left\{ (\max_i v_v \ \middle| j \epsilon J), (\min_i v_v \ \middle| j \epsilon J') \right\}$$

$$A^- = \left\{ (\min_i v_v \ \middle| j \epsilon J), (\max_i v_v \ \middle| j \epsilon J') \right\}$$

v) Defining Positive and Negative Ideal Separation Measure

For a positive ideal separation measure, the deviation of each alternative from the ideal solution data is calculated. In order to do so, the sum of the squares of deviations is obtained, and the square root thereof is found. The amount to be obtained is the ideal separation measure:

$$S_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2}$$

For a negative ideal separation measure, the deviation of each alternative from the negative ideal solution data is calculated. In order to do so, the sum of the squares of deviations is obtained and the square root thereof is found. The amount to be obtained is the negative ideal separation measure:

$$S_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2}$$

vi) Calculating Relative Closeness to Ideal Solution

In the sixth step, for each alternative, the negative ideal separation measure is divided by the sum of the positive and negative ideal separation measures. The values obtained are classified, and the highest value is chosen as the best option. In other words, the subject value (to be between 0 and 1) reflects how high the ratio of distance from undesired data to the sum of distances of desired and undesired data is:

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \qquad 0 \leq C_i^* \leq 1$$

4. Empirical Study

In this study, the weekly data of periods that reflect the decrease and increase trends of real effective foreign exchange rates before and after the new monetary policy implemented (in order to eliminate the effects of the coup in Turkey dated July 15, 2016, the period between 2016 July - 2016 December is not included in the analysis) is used. Since the performance analysis methods may indicate different sectors to invest in, TOPSIS analysis based on entropy is also used for multi-criteria decision making.

The performance criteria obtained are stated below using the data of pre-policy implementation needed for performance evaluation in the Appendix (Table A1).

Table 3 Performance Measures (Pre-Policy Implementation)

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on market risk)	Treynor measure (based on USD risk)	Jensen (alpha) measure	alpha / beta (market)	Treynor Mazuy measure	Average / standard deviation
Chemistry	0,0537	0,0697	0,0028	-0,0020	0,0006	0,0008	-0,0003	0,1656
Financials	-0,0140	0,0785	0,0025	-0,0021	0,0007	0,0006	0,0002	0,1594
Technology	-0,0103	0,0227	0,0011	-0,0006	-0,0007	-0,0009	0,0007	0,1005
Bank	-0,0169	0,0996	0,0033	-0,0029	0,0015	0,0014	0,0003	0,1780
Real est. inv. trust	-0,0016	0,0074	0,0003	-0,0002	-0,0016	-0,0016	0,0013	0,0842
Food beverage	0,0113	0,0363	0,0017	-0,0012	-0,0002	-0,0003	0,0006	0,1198
Holding and inv.	-0,0048	0,0237	0,0008	-0,0006	-0,0012	-0,0011	-0,0003	0,1025
Services	-0,0217	0,0734	0,0029	-0,0024	0,0006	0,0009	0,0014	0,1854
Industry	-0,0690	0,0457	0,0016	-0,0012	-0,0003	-0,0004	0,0011	0,1499

Source: Author's calculations.

A correlation analysis among the performance criteria in question is performed and the criteria which have a high correlation with each other are removed from the analysis process. The correlation matrix is shown in the Appendix (Table A2) and the criteria to be included in the TOPSIS analysis are stated below:

Table 4 Performance Criteria to Be Involved in TOPSIS Analysis (Pre-Policy Implementation)

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on USD risk)	Treynor Mazuy measure
Chemistry	0,05370	0,06965	-0,00203	-0,00034
Financials	-0,01397	0,07852	-0,00211	0,00023
Technology	-0,01027	0,02269	-0,00060	0,00074
Bank	-0,01686	0,09965	-0,00292	0,00030
Real est. inv. trust	-0,00161	0,00736	-0,00021	0,00126
Food beverage	0,01134	0,03627	-0,00118	0,00061
Holding and inv.	-0,00478	0,02367	-0,00059	-0,00031
Services	-0,02169	0,07342	-0,00243	0,00144
Industry	-0,06901	0,04574	-0,00116	0,00114

Source: Author's calculations.

Table 4 above represents a decision matrix, showing alternatives and criteria. After that, the steps stated in the Appendix are followed, and then the positive and negative ideal separation measures and closeness to the ideal solution are reached:

As per Table 5, the chemistry index is chosen as the index which has the best performance compared to other indexes.

Similarly, for the period after the policy implementation, a performance analysis is performed. The needed data to do so are specified in the Appendix (Table A8). The results of the performance analysis are shown in Table 6.

Table 5 Positive and Negative Ideal Separation Measures and Closeness to Ideal Solution (Pre-Policy Implementation)

	S_i^*	S_i^-	C_i^*
Chemistry	0,1940	0,4521	0,6998
Financials	0,1950	0,3146	0,6173
Technology	0,2317	0,3083	0,5709
Bank	0,2605	0,2544	0,4940
Real est. inv. trust	0,2870	0,2609	0,4761
Food beverage	0,2908	0,2489	0,4612
Holding and inv.	0,2835	0,2273	0,4450
Services	0,2973	0,2301	0,4363
Industry	0,4516	0,1680	0,2711

Source: Author's calculations.

Table 6 Performance Measures (Post-Policy Implementation)

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on market risk)	Treynor measure (based on USD risk)	Jensen (alpha) measure	alpha / beta (market)	Treynor Mazuy measure	Average / standard deviation
Chemistry	-0,000249	0,016551	0,000137	-0,000219	0,000556	0,000753	0,000490	0,077772
Financials	0,001172	-0,088755	-0,000552	0,000638	0,000066	0,000060	0,000261	-0,033411
Technology	-0,001493	0,115767	0,001153	-0,001529	0,001210	0,001768	0,001168	0,170748
Bank	0,001302	-0,096087	-0,000617	0,000715	-0,000006	-0,000005	0,000240	-0,048734
Real est. inv. trust	-0,000068	0,004277	0,000034	-0,000033	0,000504	0,000648	0,000761	0,065008
Food beverage	0,002605	-0,093004	-0,000721	0,001022	-0,000102	-0,000105	-0,000142	-0,043145
Holding and inv.	0,001016	-0,073485	-0,000470	0,000566	0,000137	0,000144	0,000098	-0,011787
Services	0,001644	-0,136500	-0,000898	0,001023	-0,000234	-0,000283	-0,000428	-0,067793
Industry	0,001190	-0,072778	-0,000476	0,000625	0,000115	0,000139	-0,000043	-0,003726

Source: Author's calculations.

When the Appendix (Table A8) is evaluated, it seems that the adjusted R-squared of both USD and gold is weak. In addition, the beta coefficient of gold is not statistically significant at a 10% level. For this reason, the Treynor methods based on USD and gold in Table 6 are left out of evaluation. As for the remaining methods, in terms of all the remaining methods, the technology index has the best performance. Similarly, the chemistry index is in the second place, having high performance. To see the classification of other sectors, TOPSIS analysis is used once more. After the steps stated in the Appendix are followed, the positive and negative ideal separation measures and closeness to the ideal solution are reached:

Table 7 Positive and Negative Ideal Separation Measures and Closeness to Ideal Solution (Post-Policy Implementation)

	S_i^*	S_i^-	C_i^*
Chemistry	0,1888	0,2344	0,5539
Financials	0,3425	0,0857	0,2001
Technology	0,0000	0,4214	1,0000
Bank	0,3599	0,0719	0,1665
Real est. Inv. trust	0,2042	0,2223	0,5212
Food beverage	0,3759	0,0480	0,1132
Holding and inv.	0,3222	0,1005	0,2377
Services	0,4214	0,0000	0,0000
Industry	0,3227	0,0996	0,2358

Source: Author's calculations.

In order to see the effect of the new monetary policy implementation on sector performances in Turkey, the following Table 8 is formed:

Table 8 Performance Classification before and after the Monetary Policy

# Ranking	Before the monetary policy change	After the monetary policy change
1	Chemistry	Technology
2	Financials	Chemistry
3	Technology	Real est. inv. trust
4	Bank	Holding and inv.
5	Real est. inv. trust	Industry
6	Food beverage	Financials
7	Holding and inv.	Bank
8	Services	Food beverage
9	Industry	Services

Source: Author's calculations.

According to Table 8, it is seen that, after the new monetary policy, the performance of financial and banking sectors having higher portion of foreign currency debt has declined, reflecting the expected movement as per the increasing real effective exchange rates.

5. Conclusion

In this study examining the indices of chemistry, financials, technology, bank, real estate investment trusts, food and beverage, holding and investment, services and industry in Borsa Istanbul, it is evaluated whether the performance of sectors has been affected by the transmission channel of exchange rate and monetary policy change in Turkey after the 2008-2009 global financial crisis. With the monetary policy change, the ultimate economic objective in Turkey has been both price stability and financial stability, whereas it was previously only the price stability. To ensure this, the transmission channel of exchange rate has been started to be used as well. After this, it is seen that the real effective foreign exchange rate index in Turkey has started to increase, meaning that it risks the performance of sectors having the big portion of foreign exchange debt. The results of the study using the performance evaluation methods and TOPSIS analysis based on entropy to determine which sector has high performance, shows that the performance of financial and banking sectors, which have an 80% or higher portion of the short term external foreign exchange debt and had high performance before the monetary policy change, has fallen with the increase in the real effective foreign exchange rate index. Therefore, it can be said that the results of this study based on the example of Turkey, are consistent with the literature. However, the scope of the study might be expanded to see whether different policy compositions along with the transmission channel of exchange rate have the same effect on the performance of sectors in different countries.

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Appendix

Table A1 The Data Needed for Performance Evaluation (Pre-Policy Implementation)

	Average	Standard deviation	Sensitivity to market (beta)	Sensitivity to market p-value	Sensitivity to market adjusted R-squared
Chemistry	0,0051	0,0306	0,7712	1,10E-24	0,6453
Financials	0,0058	0,0363	1,1201	1,64E-79	0,9708
Technology	0,0038	0,0377	0,8027	3,01E-15	0,4564
Bank	0,0067	0,0374	1,1260	7,10E-58	0,9216
Real est. inv. trust	0,0032	0,0382	0,9589	2,29E-24	0,6401
Food Beverage	0,0042	0,0351	0,7653	3,34E-16	0,4793
Holding and inv.	0,0038	0,0372	1,0843	1,29E-45	0,8630
Services	0,0049	0,0262	0,6722	4,32E-26	0,6672
Industry	0,0042	0,0282	0,8140	1,44E-43	0,8497

	Sensitivity to USD (beta)	Sensitivity to USD p-value	Sensitivity to USD adjusted R-squared	Sensitivity to gold (beta)	Sensitivity to gold p-value
Chemistry	-1,0482	1,716E-08	0,2639	0,0396	0,0327
Financials	-1,3525	4,683E-10	0,3135	-0,2039	0,0369
Technology	-1,4192	2,925E-10	0,3198	-0,0833	0,0605
Bank	-1,2787	1,996E-08	0,2618	-0,2212	0,0174
Real est. inv. trust	-1,3607	3,511E-09	0,2862	-0,1738	0,0287
Food beverage	-1,0775	7,018E-07	0,2094	0,1122	0,0990
Holding and inv.	-1,4839	1,285E-11	0,3599	-0,1842	0,0909
Services	-0,7920	1,089E-06	0,2027	-0,0887	0,0718
Industry	-1,1081	2,743E-11	0,3504	-0,0187	0,0615

	Sensitivity to gold adjusted R-squared	Jensen alpha value	Jensen alpha p-value	Jensen alpha adjusted R-squared	Treynor Mazuy a value
Chemistry	0,2873	0,0006	1,22E-24	0,6446	-0,0008
Financials	0,2121	0,0007	2,18E-79	0,9706	0,0002
Technology	0,2650	-0,0007	3,74E-15	0,4541	0,0040
Bank	0,2443	0,0015	8,16E-58	0,9214	0,0002
Real est. inv. trust	0,2456	-0,0016	2,62E-24	0,6392	0,0036
Food beverage	0,2779	-0,0002	3,04E-16	0,4803	0,0018
Holding and inv.	0,2715	-0,0012	1,49E-45	0,8627	-0,0001
Services	0,1919	0,0006	4,62E-26	0,6668	0,0017
Industry	0,2960	-0,0003	1,58E-43	0,8494	0,0013

	Treynor Mazuy b value	Treynor Mazuy c value	Variance of errors	Treynor Mazuy p-value	Treynor Mazuy adjusted R-squared
Chemistry	0,7963	1,3518	0,0003	1,23E-23	0,6448
Financials	1,1284	0,4501	0,0000	9,63E-78	0,9706
Technology	0,7118	-4,4470	0,0007	3,59E-15	0,4756
Bank	1,1516	1,3252	0,0001	7,55E-57	0,9231
Real est. inv. trust	0,8615	-4,9091	0,0005	4,51E-25	0,6676
Food beverage	0,7300	-1,9522	0,0006	2,13E-15	0,4810
Holding and inv.	1,0632	-1,0471	0,0002	2,74E-44	0,8628
Services	0,6545	-1,0008	0,0002	5,5E-25	0,6663
Industry	0,7846	-1,5226	0,0001	7,23E-43	0,8535

Source: Author's calculations.

Table A2 The Correlation Matrix of Performance Criteria

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on market risk)	Treynor measure (based on USD risk)	Jensen (alpha) measure	Alpha / beta (market)	Treynor Mazuy measure	Average / standard deviation
Treynor measure (based on gold risk)	1							
Sharpe measure	-0,00229	1						
Treynor measure (based on market risk)	0,098721	0,978473	1					
Treynor measure (based on USD risk)	-0,03777	-0,9879	-0,98945	1				
Jensen (alpha) measure	0,054196	0,981154	0,987506	-0,97948	1			
Alpha / beta (market)	0,099541	0,978651	0,99999	-0,98929	0,987733	1		
Treynor Mazuy measure	-0,57679	-0,21292	-0,18906	0,146125	-0,189	-0,1905	1	
Average / standard deviation	-0,09135	0,9427	0,955139	-0,95125	0,921814	0,954729	-0,04102	1

Source: Author's calculations.

TOPSIS Analysis Steps for Pre-Policy Implementation

Using the matrix of performance criterias to be involved in TOPSIS analysis (Pre-policy implementation) and the formula below, the standard decision matrix is formed:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}}$$

Table A3 Standard Decision Matrix (Pre-Policy Implementation)

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on USD risk)	Treynor Mazuy measure
Chemistry	0,57060	0,39640	-0,39466	-0,13729
Financials	-0,14850	0,44687	-0,40937	0,09052
Technology	-0,10915	0,12915	-0,11718	0,29822
Bank	-0,17915	0,56710	-0,56684	0,11982
Real est. inv. trust	-0,01716	0,04187	-0,04009	0,50329
Food beverage	0,12054	0,20643	-0,22965	0,24257
Holding and inv.	-0,05085	0,13472	-0,11542	-0,12551
Services	-0,23047	0,41786	-0,47211	0,57841
Industry	-0,73337	0,26033	-0,22597	0,45520

Source: Author's calculations.

To move to next step, the weights are defined and weighted standard decision matrix is formed. To define weights and be objective, the entropy method is used. The values are normalized as per the formula below:

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{*} - x_j^{min}}$$

Table A4 The Matrix Normalized (Pre-Policy Implementation)

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on USD risk)	Treynor Mazuy measure
Chemistry	1	0,67500	0,32686	0
Financials	0,44852	0,77109	0,29893	0,31830
Technology	0,47870	0,16617	0,85363	0,60849
Bank	0,42502	1	0	0,35924
Real est. inv. trust	0,54925	0	1	0,89504
Food beverage	0,65485	0,31331	0,64012	0,53075
Holding and inv.	0,52341	0,17678	0,85698	0,01645
Services	0,38566	0,71586	0,17982	1
Industry	0	0,41594	0,64712	0,82783

Source: Author's calculations.

After that, *pij* data are obtained through the formula below and the following matrix is formed.

$$p_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \; ; \forall \mathrm{i} \; ; \mathrm{j}$$

Table A5 Pij Matrix (Pre-Policy Implementation)

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on USD risk)	Treynor Mazuy measure
Chemistry	0,22394	0,15942	0,06805	0,00000
Financials	0,10044	0,18211	0,06223	0,06986
Technology	0,10720	0,03925	0,17771	0,13356
Bank	0,09518	0,23617	0,00000	0,07885
Real est. inv. trust	0,00000	0,00000	0,20818	0,19645
Food beverage	0,14665	0,07400	0,13326	0,11649
Holding and inv.	0,11722	0,04175	0,17841	0,00361
Services	0,08637	0,16907	0,03744	0,21948
Industry	0,00000	0,09824	0,13472	0,18170

Source: Author's calculations.

After *Pij* matrix, first of all, for each coloumn, information of decision is reached as stated below and then the related weights are calculated:

$$\mathrm{k} = 1 / \ln \mathrm{m},$$

$$E_j = -\mathrm{k} \sum_{i=1}^{m} p_{ij} . lnp_{ij} \; , \forall j \; (0 \leq E_j \leq 1)$$

$$d_j = 1 - E_j, \forall \mathrm{j}$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \; , \forall j$$

Table A6 Calculations (Pre-Policy Implementation)

Ej	E1	E2	E3	E4
	0,80716	0,87589	0,89138	0,85938
dj	d1	d2	d3	d4
	0,19284	0,12411	0,10862	0,14062
wj	w1	w2	w3	w4
	0,34059	0,21920	0,19185	0,24836

Source: Author's calculations.

As per the weights calculated, weighted standard decision matrix is specified below:

Table A7 Weighted Standard Decision Matrix (Pre-Policy Implementation)

	Treynor measure (based on gold risk)	Sharpe measure	Treynor measure (based on USD risk)	Treynor Mazuy measure
Chemistry	0,19434	0,086890081	-0,07572	-0,0341
Financials	-0,05058	0,097953163	-0,07854	0,022482
Technology	-0,03718	0,02830857	-0,02248	0,074064
Bank	-0,06102	0,12430726	-0,10875	0,029759
Real est. inv. trust	-0,00584	0,009177412	-0,00769	0,124997
Food beverage	0,041055	0,045249603	-0,04406	0,060245
Holding and inv.	-0,01732	0,0295305	-0,02214	-0,03117
Services	-0,0785	0,091594797	-0,09058	0,143654
Industry	-0,24978	0,057065077	-0,04335	0,113052

Source: Author's calculations.

Through weighted standard decision matrix, the positive and negative ideal solutions are defined below:

$$A^* = \{0{,}1943;\ 0{,}1243;\ -0{,}0077;\ 0{,}1437\}$$

$$A^- = \{-0{,}2498;\ 0{,}0092;\ -0{,}1087;\ -0{,}0341\}$$

The positive and negative ideal separation measures and closeness to ideal solution are calculated as per the formulas below and the related values is stated below:

$$S_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2} \qquad S_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2}$$

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \qquad 0 \leq C_i^* \leq 1$$

Table A8 The Data Needed for Performance Evaluation (Post-Policy Implementation)

	Average	Standard deviation	Sensitivity to market (beta)	Sensitivity to market p-value	Sensitivity to market adjusted R-squared
Chemistry	0,00047612	0,00608266	0,737955015	2,33E-14	0,531339589
Financials	-0,0002263	0,00672851	1,08795656	8,52E-53	0,954023838
Technology	0,00116396	0,00677298	0,684504217	2,90E-09	0,364688431
Bank	-0,0003857	0,0078642	1,233233452	2,12E-39	0,896555501
Real est. inv. trust	0,00040119	0,00613176	0,776714258	3,34E-16	0,580416368
Food beverage	-0,0003243	0,00746878	0,970252965	1,81E-17	0,611143342
Holding and inv.	-7,16E-05	0,00603565	0,94945442	2,44E-40	0,902267505
Services	-0,0003698	0,00541992	0,829571769	1,20E-33	0,853495525
Industry	-2,023E-05	0,00539289	0,830619919	6,29E-35	0,864417893

	Sensitivity to USD (beta)	Sensitivity to USD p-value	Sensitivity to USD adjusted R-squared	Sensitivity to gold (beta)	Sensitivity to gold p-value
Chemistry	-0,4620066	0,01505119	0,063126619	-0,406603615	0,005013583
Financials	-0,9417946	2,3324E-06	0,245902708	-0,512827648	0,001255522
Technology	-0,5159658	0,01474236	0,063579794	-0,528548744	0,000936925
Bank	-1,0637517	5,6487E-06	0,228776999	-0,584006961	0,00170423
Real Est. Inv. Trust	-0,8021431	1,2491E-05	0,2131294	-0,389552661	0,007813645
Food Beverage	-0,6843082	0,00307606	0,097844339	-0,268419403	0,138646472
Holding and Inv.	-0,7890889	1,2665E-05	0,212853633	-0,439301316	0,002133921
Services	-0,7275211	6,8177E-06	0,22509198	-0,452842037	0,000367215
Industry	-0,6317738	0,00011315	0,168313087	-0,332007212	0,01005612

	Sensitivity to gold adjusted R-squared	Jensen alpha value	Jensen alpha p-value	Jensen alpha adjusted R-squared	Treynor Mazuy a value
Chemistry	0,08718137	0,00055592	3,32064E-14	0,526991593	0,000426029
Financials	0,11728493	6,5641E-05	1,71856E-52	0,953167543	0,000272998
Technology	0,1235915	0,00121036	3,88294E-09	0,359918649	0,000974841
Bank	0,11067682	-5,582E-06	4,3847E-39	0,894559089	0,000292305
Real Est. Inv. Trust	0,0774732	0,00050356	5,1386E-16	0,575674826	0,000957368
Food Beverage	0,0158452	-0,0001022	2,33598E-17	0,608554944	-0,000204941
Holding and Inv.	0,10579968	0,00013653	4,17484E-40	0,900877707	9,40484E-05
Services	0,14359781	-0,0002345	2,24474E-33	0,851070912	-0,000454341
Industry	0,07194951	0,00011549	1,18415E-34	0,862144248	-6,23437E-05

	Treynor Mazuy b value	Treynor Mazuy c value	Variance of errors	Treynor Mazuy p-value	Treynor Mazuy adjusted R-squared
Chemistry	0,74319578	3,65991074	1,73461E-05	3,65641E-13	0,521614956
Financials	1,07955274	-5,8424818	2,00199E-06	1,77029E-51	0,95449659
Technology	0,69226148	6,63603602	2,9053E-05	2,87667E-08	0,353850216
Bank	1,22143857	-8,3932934	6,25443E-06	4,94885E-38	0,896099831
Real Est. Inv. Trust	0,75779476	-12,786421	1,53673E-05	2,48479E-15	0,581234847
Food Beverage	0,97657131	2,89425418	2,16721E-05	3,13632E-16	0,603721337
Holding and Inv.	0,95122231	1,1969682	3,558E-06	1,33977E-38	0,899657812
Services	0,83817853	6,19531663	4,22392E-06	2,54346E-32	0,852460785
Industry	0,83716201	5,01068681	3,89131E-06	1,79099E-33	0,862539274

Source: Author's calculations.

TOPSIS Analysis Steps for Post-Policy Implementation

Using the matrix of performance criterias to be involved in TOPSIS analysis (post-policy implementation) and the formula below, the standard decision matrix is formed:

$$r_{ij} = \frac{a_{ij}}{\sqrt{\sum_{k=1}^{m} a_{kj}^2}}$$

Table A9 Standard Decision Matrix (Post-Policy Implementation)

	Sharpe measure	Treynor measure (based on market risk)	Jensen (alpha) measure	alpha / beta (market)	Treynor Mazuy measure	Average / standard deviation
Chemistry	0,06311	0,07037	0,38097	0,36546	0,30819	0,34945
Financials	-0,33842	-0,28316	0,04498	0,02927	0,16451	-0,15012
Technology	0,44141	0,59089	0,82945	0,85781	0,73514	0,76722
Bank	-0,36637	-0,31608	-0,00383	-0,00220	0,15098	-0,21898
Real est. inv. trust	0,01631	0,01742	0,34509	0,31452	0,47904	0,29210
Food beverage	-0,35462	-0,36931	-0,07005	-0,05111	-0,08954	-0,19386
Holding and inv.	-0,28019	-0,24097	0,09356	0,06976	0,06189	-0,05296
Services	-0,52047	-0,46004	-0,16068	-0,13711	-0,26958	-0,30461
Industry	-0,27750	-0,24375	0,07915	0,06745	-0,02698	-0,01674

Source: Author's calculations.

To move to next step, the weights are defined and weighted standard decision matrix is formed. To define weights and be objective, the entropy method is used. The values are normalized as per the formula below:

$$r_{ij} = \frac{x_{ij} - x_j^{min}}{x_j^{*} - x_j^{min}}$$

Table A10 The Matrix Normalized (Post-Policy Implementation)

	Sharpe measure	Treynor measure (based on market risk)	Jensen (alpha) measure	alpha / beta (market)	Treynor Mazuy measure	Average / standard deviation
Chemistry	0,60670	0,50470	0,54705	0,50513	0,57506	0,61023
Financials	0,18926	0,16831	0,20771	0,16723	0,43205	0,14413
Technology	1	1	1	1	1	1
Bank	0,16020	0,13698	0,15841	0,13560	0,41859	0,07990
Real est. inv. trust	0,55805	0,45432	0,51081	0,45393	0,74511	0,55672
Food beverage	0,17242	0,08633	0,09153	0,08644	0,17919	0,10333
Holding and inv.	0,24979	0,20845	0,25677	0,20793	0,32991	0,23478
Services	0	0	0	0	0	0
Industry	0,25260	0,20581	0,24221	0,20561	0,24146	0,26858

Source: Author's calculations.

After that, *pij* data are obtained through the formula below and the following matrix is formed.

$$p_{ij} = \frac{r_{ij}}{\sum_{i=1}^{m} r_{ij}} \; ; \; \forall i \; ; \; j$$

Table A11 *Pij* Matrix (Post-Policy Implementation)

	Sharpe measure	Treynor measure (based on market risk)	Jensen (alpha) measure	alpha / beta (market)	Treynor Mazuy measure	Average / standard deviation
Chemistry	0,19025	0,18254	0,18147	0,18290	0,14665	0,20357
Financials	0,05935	0,06087	0,06890	0,06055	0,11018	0,04808
Technology	0,31358	0,36168	0,33173	0,36207	0,25501	0,33359
Bank	0,05023	0,04954	0,05255	0,04910	0,10674	0,02665
Real est. inv. trust	0,17499	0,16432	0,16945	0,16436	0,19001	0,18572
Food beverage	0,05407	0,03122	0,03036	0,03130	0,04570	0,03447
Holding and inv.	0,07833	0,07539	0,08518	0,07528	0,08413	0,07832
Services	0,00000	0,00000	0,00000	0,00000	0,00000	0,00000
Industry	0,07921	0,07444	0,08035	0,07444	0,06158	0,08960

Source: Author's calculations.

After *Pij* matrix, first of all, for each coloumn, information of decision is reached as stated below and then the related weights are calculated:

$$k = 1 / \ln m,$$

$$E_j = -k \sum_{i=1}^{m} p_{ij} . lnp_{ij} \ , \forall j \ (0 \leq E_j \leq 1)$$

$$d_j = 1 - E_j, \forall j$$

$$w_j = \frac{d_j}{\sum_{j=1}^{n} d_j} \ , \forall j$$

Table A12 Calculations (Post-Policy Implementation)

Ej	E1	E2	E3	E4	E5	E6
	0,84667	0,81503	0,83477	0,81450	0,88670	0,80882
dj	d1	d2	d3	d4	d5	d6
	0,15333	0,18497	0,16523	0,18550	0,11330	0,19118
wj	w1	w2	w3	w4	w5	w6
	0,15433	0,18618	0,16630	0,18671	0,11404	0,19243

Source: Author's calculations.

As per the weights calculated, weighted standard decision matrix is specified below:

Table A13 Weighted Standard Decision Matrix (Post-Policy Implementation)

	Sharpe measure	Treynor measure (based on market risk)	Jensen (alpha) measure	alpha / beta (market)	Treynor Mazuy measure	Average / standard deviation
Chemistry	0,0097392	0,013102031	0,0633573	0,0682358	0,0351472	0,0672435
Financials	-0,052228	-0,05271836	0,007481	0,0054651	0,0187615	-0,028888
Technology	0,068123	0,110013903	0,1379422	0,1601647	0,0838366	0,147633
Bank	-0,056542	-0,05884807	-0,000636	-0,00041	0,0172184	-0,042137
Real est. inv. trust	0,0025169	0,003242918	0,0573901	0,0587247	0,054631	0,0562076
Food beverage	-0,054728	-0,06875869	-0,01165	-0,009543	-0,010211	-0,037304
Holding and inv.	-0,043242	-0,04486509	0,01556	0,0130251	0,0070585	-0,010191
Services	-0,080323	-0,08565071	-0,026721	-0,0256	-0,030743	-0,058615
Industry	-0,042826	-0,04538141	0,0131623	0,0125943	-0,003076	-0,003222

Source: Author's calculations.

Through weighted standard decision matrix, the positive and negative ideal solutions are defined below:

$$A^* = \{0{,}0681;\ 0{,}1100;\ 0{,}1379;\ 0{,}1602; 0{,}0838; 0{,}1476\}$$
$$A^- = \{-0{,}0803;\ -0{,}0857;\ -0{,}0267;\ -0{,}0256;\ -0{,}0307;\ -0{,}0586\}$$

The positive and negative ideal separation measures and closeness to ideal solution are calculated as per the formulas below and the related values is stated below:

$$S_i^* = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^*)^2} \qquad S_i^- = \sqrt{\sum_{j=1}^{n}(v_{ij} - v_j^-)^2}$$
$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \qquad 0 \leq C_i^* \leq 1$$

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