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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Does financial innovation improve performance: Case study of Turkey

Tarana Azimova[1]*

Abstract: The mutual funds' performance over time can be driven by a number of dynamic determinants including financial innovation. In fact, financial innovation can be considered as a key factor for improving the performance and increasing the profitability of mutual funds. The purpose of this study is to examine the process of financial innovation in Turkey and its role in accelerating the development and improvement of the performance of the mutual funds industry. This study provides a framework to analyze and evaluate the developments in financial practices over the eight-year period from 2011 to 2018. The process of financial innovation is defined as new financial products and services. Based on panel analysis it is observed that the activity of mutual funds responded to a great extent to innovative market forces.

Subjects: Economics; Finance; Business, Management and Accounting

Keywords: Mutual funds' performance; financial innovation; panel analysis

1. Introduction

Investors are increasingly concerned about mutual fund performance and use this information for fund selection. A number of studies attempted to explain the performance of mutual funds using various parameters (Asad & Siddiqui, 2019; Barber et al., 2016; Ferreira et al., 2013; Ferreira & Miguel, 2013; Zhang & Tjong, 2012). However, this study is unique in that it considers financial innovation as a key determinant in improving the funds' activity. Mutual funds currently operate in a financial industry characterized by innovative investment products and services. The mutual funds industry has moved from offering single investment opportunity to offering broad investment schemes (Ercolani et al., 2018; Otero & Reboredo, 2018). The industry is responding very rapidly to development of the financial market infrastructure worldwide (Beck et al., 2012; Cooper & Gregory-Allen, 2017). The

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PUBLIC INTEREST STATEMENT

Interest in mutual funds has a long history; at the present time mutual funds are primary tools for investors through which they can invest their funds in various securities of their choice such as bond, equity, natural resources (gold) or real estate, etc. Investors are naturally interested on major factors influencing the mutual fund's performance over time. In this study, we develop a new model that hypothesizes the relationship between financial innovation and fund performance. Statistical experiments are designed to prove that trends in financial services such as internet banking, mobile banking, future contracts, bank branches and research and developments in financial sector in Turkey in fact improves performance of the funds.

total amount of financial securities owned by the global mutual fund industry increased from 14 USD trillion in 2013 to nearly 30 USD trillion in early 2018 (Champagne et al., 2018). Turkish mutual funds also experienced phenomenal expansion in terms of types, total portfolio value and numbers, with acceptance of The Corporate and Income Tax Law that aimed to provide a tax advantage to the funds ("GelirVergisi Kanunu," 1960). As of the beginning of 2018, the number of mutual funds reached 433 with a total portfolio value of 14 USD billion (Turkish Yatırım, 2019).

Financial innovations such as market structures and institutional organizations aimed to protect investors' interest made it possible for mutual fund managers to rely more on capital markets and therefore increase and diversify their investments. For example, the first cash collective structure still active in the markets is the T. Iş Bank, B-type liquid mutual fund. The liquid mutual fund began its operations in 1987 by investing in only liquid securities with a residual maturity of up to 90 days. Asset allocation of the mutual funds in balancing their investment priorities saw major changes since then. Table 1 summarizes this situation and shows that among the investment priorities of Turkish mutual funds are various types of financial instruments.

In the study, we venture to show that the development of new liquidity and risk management instruments and practices loosened funding constraints and improved market liquidity conditions. On the other hand, automated approaches introduced by new technology and data mining increased efficiency of markets, institutional organizations and the investment structures operating in it. This change lead to the creation of the innovative liquidity tools and new types of investment vehicles. The mutual funds market in Turkey started with the introduction of liquid mutual fund and grew into a market that includes almost all types of fund categories. Table 2 classifies the mutual funds operating in Turkey and their investment objectives.

Adam Smith in fact initiated the idea of financial innovation two centuries ago in his book " An Inquiry into the Nature and Causes of the Wealth of Nations". According to Adam Smith (1975) "The obligation of building party walls, in order to prevent the communication of fire, is the violation of natural liberty exactly of the same kind with the regulations of banking trade which are here proposed" (p. 324). In his work, he brings new lights to the significance and necessity of the State to follow prudent banking practice such as having close regulations on financial markets (banks) in order to prevent a market failure. In the academic literature, financial innovation is often considered as outcome of government regulations on the capital markets (Frame & White, 2004; Hawawini, 2014; Kane, 1977; Miller, 1986; Silber, 1983). State regulations simultaneously define the new opportunities and constraints levied on companies and organizations. The process of financial innovation in Turkey began in 1981 with institutional changes, such as the enactment of the Capital Market Board and introducing the necessary framework of regulations such as the Capital Markets Law, which later gave rise to the establishment of the Istanbul Stock Exchange in 1985. The Law of Liberalization of financial markets has given rise to primary and secondary market structures (Akcaoglu, 1996). With enacting interbank money market regulations in 1987 the Central Bank intervened in the money markets for the first time aimed at stabilizing the liquidity levels (The Banks Association of Turkey, 2005). Started from 1994, the government regulations demanded that all stock transactions started to be conducted by the means of electronic devices and computers (Aldis, 2011). The Banking Regulation and Supervision Agency (BRSA) was established to ensure stability in financial markets and coordinate the operation of financial institutions (The Banks Association of Turkey, 2005).

The infrastructure of the marketplace defines the demand for new financial products and practices, which began to emerge with the state regulations directed toward promoting fairness and transparency in the financial markets, fostering the development of markets, and protecting the rights of investors. Innovative financial products in Turkey can be observed under broad categories such as liquidity management products, investment contracts, market structures, institutional organizations, and new products associated with technological advancement.

- Liquidity management instruments are the first broad category of financial innovation that emerged between 1970 and 1990 periods. (Silber, 1983.) Among the liquidity management

Table 1. Total portfolio distribution of investment funds (%) and total portfolio value

Years	Public Debt Instruments	Foreign Securities	Reverse Repo	Private Sector Debt Instruments	Share	Exchange Money Market	Other	Total Portfolio Value (Million TL)
2016	13.31	4.97	15.92	47.45	4.92	5.22	8.21	39.128
2017	10.51	7.39	4.30	50.13	5.71	14.33	7.63	43.755
2018	5.93	12.02	2.92	43.49	8.31	17.23	10.1	54.208

Source: Turkish Yatırım (2019) Yatırım Fonları Bülteni, Central Bank of Turkey Report.

Table 2. Types of mutual funds and their investment objectives	
Funds Type	**Investment Information**
Fixed-income fund	At least 51 percent of the total assets invested in public or private note and bonds
Equity funds	At least 51 percent of the total assets invested into securities issued by local companies
Sector funds	At least 51 percent of the total assets invested into securities issued by Turkish companies
Subsidiary funds	At least 51 percent of the total assets invested into securities issued by subsidiaries of the founder
Group funds	At least 51 percent of the total assets invested into securities issued by a certain group
Composite Funds	Follow mixed investment strategy.

Source: Capital Markets Board of Turkey, 2019 <https://spk.gov.tr/>

products are money market certificates, debit cards, Automated Teller Machines, repos, and Eurobonds. These products were developed to loosen financing restrictions and increase liquidity in the markets.

- The Turkish Derivatives Exchange (TURKDEX) formed the legal grounds for the establishment of investment markets and investment derivatives in Turkey (Ersoy, 2001). Investment markets in Turkey such as FX Derivatives, Index Derivatives, Equity Derivatives, Foreign Indices Derivatives, and Interest Rate Derivatives are created with respect to investment contracts. At present, a wide range of financial assets and commodities such as single stocks, equity indexes, foreign currency, precious metals, commodities, energy, foreign indexes, and overnight repo rate are traded on Istanbul Derivative Market (VIOP) based on futures investment contracts. Option contracts on the other hand are based mostly on a single stock equity index and foreign currencies (Oktayer, 2007, 2011).

- The market structures and institutional organizations are the third group of innovations that continue to rise in Turkey. Among these institutions are the Electronic Fund Trading Platform, MerkeziKayıt Istanbul, Investor Compensation Center, Association of Financial Institutions, Participation Banks Association of Turkey and so on. For example, Merkezi Kayıt Istanbul is the central depository for all dematerialized capital market instruments. The institution finished the dematerialization process of real estate certificates and electronic warehouse receipts in 2017.

- Internet banking and mobile banking are among the new services and products associated with technological advancement. These involve artificial intelligence, which helps users obtain instantaneous access to funds at any time and fulfill transactions at a low cost. Internet and mobile banking provide a wide range of services and are considered a good alternative to traditional banking. In Turkey, mobile banking was introduced in 2011 with the introduction and wide use of the smart phones. According to the statistics from the Banks Association of Turkey, the number of active mobile banking users in Turkey reached 2.2 million in 2011 and rapidly increased to 39 million in 2018. On the other hand, the number of active internet banking customers grew from 968 thousand in 2011 to 125 million in 2018. This indicates that the introduction of mobile banking had a greater impact and more positive response from the population compared to internet banking.

This study shows that the mutual funds' performance over time can be driven by a range of new dynamic factors such as financial innovation. In fact, financial innovation may well be an important parameter for augmenting the performance and profitability of all market segments. In fact, the mutual funds industry in Turkey experienced considerable growth in the number, and types of the funds and portfolio diversification opportunities. This unprecedented growth prompted researchers to investigate the dynamic parameters affecting the mutual funds industry. The academic literature provides broad research on the impact of financial innovation on different industries including, but not limited to, banks, companies, and investment organizations. However, there is limited research on

Table 3. Variables and abbreviations	
Fund performance	**Information Ratio**
Research and developments in financial sector	FRD
Automated teller machines per 100,000 adults	ATM
Commercial bank branches per 100,000 adults	CBB
Internet banking/change in volume of financial transactions	IB
Mobile banking	MB
Futures contracts traded values and options contracts premium values	FCOC
Fund's characteristics such as total portfolio value of mutual funds	FPV

the role of financial innovation in profitability of mutual funds. Moreover, despite the growing interest of academicians in this industry, little or no attention has been given to Turkey. This study thus explores whether new financial services and products can enhance activity and broaden the investing opportunities of mutual funds. In this study, we venture to quantify the impact of innovative financial methods and practices on the risk and return profiles of mutual funds.

The relatively sparse research on financial innovation and its impact on mutual fund performance have left room for further research. Much of the existing research focused on either financial innovation or mutual fund performance. Beck et al. (2012), Ferreira and Miguel (2013), ValverdeCarbó et al. (2011), Barber et al. (2016), Mollaahmetoğlu and Azimova (2017), Cooper and Gregory-Allen (2017), and Asad and Siddiqui (2019) found correlations between financial innovation and different macro and micro parameters such as the size of the investment banks, bank profitability, investments and savings. On the other hand, Alonso-Martínez et al. (2019) found a correlation between financial performance and innovation. Cai et al. (1997) analyzed the performance of Japanese mutual funds using Jensen's alpha for 1981 to 1992 finding significant and considerably low underperformance ranging from −6% to −11% per annum. Ferson and Schadt (1996) addressed the accuracy problem of measuring the performance of managed portfolios. Using monthly data for 67 mutual funds over the 1968–1990 period for the United States, their study shows that the conventional measures of average fund performance such as Jensen's alpha are negative more often than positive, which has been interpreted as subordinate fund performance (Ferson & Schadt, 1996). Kahn and Rudd (1995) reported similar results using information ratios and looking at 300 equity mutual funds from 1983 to 1993.

Academic investigations on whether new financial services and products can enhance mutual funds' activities are rare. Hawawini (2014), Frame and White (2004), Miller (1986), Silber (1983), and Kane (1977) refered to financial innovation as a by-product of state regulations on financial markets. Lynch Koski and Pontiff (2002) examined investment managers' use of derivatives by crosschecking the return allocations for equity mutual funds that use and do not use derivatives. Their results demonstrate that risk variations are essentially less intense for funds using derivatives, consistent with the characterization that managers use derivatives to diminish the effect of performance on risk. Walia and Kiran (2009), examined investors' perceptions of the risk-return tradeoff for mutual fund services. The cases disclosed in this study emphasize the choices of various investors who wish to invest in mutual funds but also call for innovations and added quality dimensions in existing services. The scarcity of previous academic research make it imperative to study mutual funds from a different angle, and to uncover new parameters that account for investors' expectations and their satisfaction with the mutual funds' industry.

2. Methodology and data

2.1. Data

The data used in this study come from Data stream, including monthly returns on mutual funds operating actively in Turkey. All junk equity mutual funds and poorly operating funds were excluded from the analysis. Moreover, due to data limitations in overall 64 equity funds have been included in the analysis with the research period from 2011 to 2018.

2.2. Methodology

2.2.1. Panel data analysis

This study uses panel data analysis, which allows the intercepts for each cross-sectional element to spur from a common α intercept. The use of panel technique provides the benefit of raising the sample size while obtaining a cross-fund perspective. This condition can be formulated as follows:

$$U_{it} = \alpha + \beta V_{it} + c G_{it} + \gamma P_{it} + \rho S_{it} + w_{it}, \quad w_{it} = \epsilon_i + u_{it}$$

ϵ_i is a zero mean random variable that is constant over time but varies cross-sectionally. The i designates the cross-section magnitude and t designates the time-series magnitude with variant periodicity. Panel data implicate several different linear models; the analysis find random model to be appropriate. Random model is found to be heteroskedastic, autocorrelated, and correlated between the groups. The panel data analysis is found to be an appropriate for this research, due to the fact that it analyzes cross-sectional and longitudinal data.

2.2.2. Information ratios

The information ratio is widely considered as a sound measure for calculating the performance of the mutual funds. Grinold and Kahn (2000) first quantifies information ratios and considers it as an alternative approach for measuring active portfolio performance. The information ratio depends on the residual return and residual risk of an investment. Indeed, behind the concept of information ratio lays the idea of scaling the return while accepting reasonable amount of the risk. An information ratio can be measured by dividing the residual return of the fund by its tracking error:

$$IR = \frac{\alpha_p}{\beta_p}$$

where α_p the alpha or residual is return and β_p is the residual risk of an investment.

3. Analysis and results

The analysis and result section is subdivided into two broad sections. The first section provides calculations on performances of mutual funds. The second section tests the role of innovative financial products in mutual funds industry.

3.1. Measuring fund performance

We aim to test the relevance of using the information ratios to measure the fund performance (Table 3). This is in fact a focal point of the study, because if information ratios are not suitable for the particular funds industry then we cannot rely on the estimation results. We therefore concentrate first on alpha forecasts. As alpha is the forecast of the residual returns, we aim to obtain good and positive estimations of the residual return of individual funds. Because alpha has the portfolio characteristics, we carry out our estimations using a monthly return on portfolios of individual funds. The residual return is estimated by obtaining alpha coefficient in the regression analysis $r_P(t) = \alpha_p + \beta_p r_b(t) + \varepsilon_p(t)$ between two important parameters of a fund portfolio such as the excess return to the fund $r_P(t)$ and excess return to

the benchmark$r_b(t)$. Table 4 summarizes the estimations of the expected residual return on the selected portfolios

The probability values of the models show that for most of the funds residual returns are statistically significant. T-statistics in performance regressions are positive and are within acceptable range. The coefficients are statistically significant and positive for all funds. Moreover, the high R-squared values indicate on the appropriateness information ratios to measure mutual funds industry performance in Turkey. In this study, we therefore use the yearly information ratios as an indicator of the mutual fund performance. We estimate the yearly information ratios using the yearly alpha and the yearly standard deviation of residual errors $\varepsilon_p(t)$ of each fund for the period between 2007 and 2018. Table 5 provides information on forecasted values of residual returns and information ratios on selected mutual funds.

The information ratios might be a good indicator on how much of an expected residual return a manager of a particular fund can get given a particular level of residual risk. In other words, the managerial expectations on returns will increase with the higher levels on the residual risk. The estimations in the Table show that these results are consistent for most of the mutual funds.

According to Kahn (2000), information ratios are independent of the manager's level of aggressiveness. It is assumed that the manager's level of positive residual return does not depend on his ability to tolerate risk. This conclusion is still disputable due to constraints of real trading such as short selling. Even though the performance measures do not depend on the level of aggressiveness, they do depend on the time factor. In fact, the time is an important parameter that affects the asset allocation within portfolios. Development of new financial products as the time goes by changes the investments' residual risk and return profiles of the mutual funds. Figure 1 summarizes this situation:

Because the information ratios depend on the property of portfolios, it can change significantly through the time horizon, as the properties of a portfolio change. Therefore, it is very hard to forecast the future performance of mutual funds based on historical returns. The academic studies (Berk & Green, 2004; Kahn & Rudd, 1995) on the persistence of mutual funds indicate that investors in fact need more information than just past performance numbers to select future winner fund. Figure 2 is a graphical representation of how information ratios can change with time.

The trend of information ratios of a set of equity funds over the last 7 years indicates on the pattern of co-movements of residual returns. We can observe from the graphical representation that the degree to which performance indicators for different funds move together has increased over time. For example, in 2013 all of the performance indicators declined in unison. The lesson is that although performance indicators can differ substantially among the funds in normal periods, they can become highly correlated during time of severe market turmoil. This can be explained by the fact that the performance indicators are affected by the same systematic risks.

We also report that information ratios are mostly positive for 2008–2018 for most mutual funds (Figure 3). This result is very important and shows the evidence of overperformance of mutual fund industry. Overall, the equity mutual funds of Turkey have the ability to tenure even with the market. This result is rather inconsistent with other studies performed for US funds. Chen et al. (2004) discover that US funds report an average alpha of −0.30% per quarter, thus underperforming market overall.

3.2. Financial innovation as determinants of fund performance
In this section, we venture to investigate whether different dimensions of financial innovation imply improved managerial ability of the mutual funds. We perform the estimations using an extensive list of financial innovation characteristics including liquidity management products, investment contracts, market structures, institutional organizations and new products associated with technological advancement. Following the large majority of the mutual fund literature, we

Table 4. Statistical results on residual returns of selected equity funds, 2018

MutualFunds	Coef. And P>|t|	t-statistics	R-squared	Prob> F
Ata Portföyİki. His. Sen. Fonu (HSYF)	49.52631 (0.026)	2.67	0.4423	0.0256
AvivaSAEm. ve Hay. His. Sen. EYF	45.18711 (0.024)	2.72	0.4517	0.0235
Anadolu Hayat Em. His. Sen. Gr. EYF	46.07929 (0.013)	3.08	0.5136	0.0131
Anadolu Hayat Em. His. Sen. EYF	49.47499 (0.009)	3.33	0.5526	0.0087
Anadolu Hayat Em. İki. His. Sen. EYF	47.67951 (0.010)	3.28	0.5445	0.0095
Atlas PortföyBir. His. Sen. Fonu (HSYF)	49.95498 (0.029)	2.59	0.4272	0.0292
AkPortföy His. Sen. Fonu (HSYF)	55.78363 (0.004)	3.86	0.6233	0.0039
AllianzYaşamveEm. His. Sen. EYF	45.73583 (0.014)	3.04	0.5074	
0.0139				
AegonEmeklilikveHay. His. Sen. EYF	48.66691 (0.012)	3.13	0.5210	
0.0121				
İstanbul Port. İki. His. Sen. Fonu (HSYF)	57.09355 (0.008)	3.37	0.5575	0.0083
FokusPortföy His. Sen. Fonu (HSYF)	50.95758 (0.013)	3.11	0.5176	0.0126

(Continued)

Table 4. (Continued)

MutualFunds	Coef. And P>|t|	t-statistics	R-squared	Prob> F
AvivaSAEm. ve Hay. Tem. ÖdeyenŞir. His. Sen. EYF	36.79103 (0.030)	2.58	0.4249	0.0298
Ata PortföyBir. His. Sen. Fonu (HSYF)	50.51945 (0.025)	2.68	0.4435	0.0253
Allianz Hayat Em. His. Sen. EYF	47.56095 (0.010)	3.28	0.5441	0.0096
FibaEm. ve Hay. His. Sen. Gr. EYF	44.17155 (0.017)	2.93	0.4874	0.0169
Deniz Port. His. Sen. Fonu (HSYF)	52.96536 (0.003)	3.99	0.6389	0.0032
Global MdPortföyBir. His. Sen. Fonu (H.S.Y.F)	49.53353 (0.018)	2.89	0.4820	0.0178
FinansPortföyBir. His. Sen. Fonu (HSYF)	50.74157 (0.021)	2.79	0.4646	0.0209
GedikPortföyBir. His. Sen. Fonu (HSYF)	48.21008 (0.029)	2.60	0.4285	0.0288
GarantiEm. Hay. His. Sen. Gr. EYF	43.99574 (0.034)	2.50	0.4107	0.0336
HalkPortföy His. Sen. Fonu (HSYF)	49.13412 (0.040)	2.40	0.3895	0.0401

This table reports panel regressions of the performance of actively managed equity funds in 2018.The dependent variable is the excess to the fund and explanatory variable is the excess to the benchmark. The variables are estimated using monthly fund returns and monthly T-bill returns in Turkish liras.

Table 5. Performance indicators of selected portfolios, 2018		
Mutual Funds	**Residual returns**	**Information ratios**
Ata Portföyİki. His. Sen. Fonu (HSYF)	10.04885	2,01962223
AvivaSAEm. ve Hay. His. Sen. EYF	8,316,677	1,851,703,516
Anadolu Hayat Em. His. Sen. Gr. EYF	9,345,265	2,175,595,357
Anadolu Hayat Em. His. Sen. EYF	9,394,157	2,113,043,381
Anadolu Hayat Em. İki. His. Sen. EYF	9,705,495	2,248,549,813
Atlas PortföyBir. His. Sen. Fonu (HSYF)	9,668,483	1,894,319,993
AkPortföy His. Sen. Fonu (HSYF)	11,05974	2,343,174,639
AllianzYaşamveEm. His. Sen. EYF	9,170,356	2,138,037,995
AegonEmeklilikve Hay. His. Sen. EYF	9,279,144	2,060660142
İstanbul Port. İki. His. Sen. Fonu (HSYF)	10,40,834	2,037696925
FokusPortföy His. Sen. Fonu (HSYF)	9,304,496	1,966,597,953
AvivaSAEm. ve Hay. Tem. ÖdeyenŞir. His. Sen. EYF	6,824,068	1,809,875,009
Ata PortföyBir. His. Sen. Fonu (HSYF)	10,1401	2,000190348
Allianz Hayat Em. His. Sen. EYF	9,696,314	2,251,802,911
FibaEm. ve Hay. His. Sen. Gr. EYF	8,380,597	1,983,546,573
Deniz Port. His. Sen. Fonu (HSYF)	9,672,536	2,18,626,142
Global MdPortföyBir. His. Sen. Fonu (H.S.Y.F)	9,581,315	2,010171242
FinansPortföyBir. His. Sen. Fonu (HSYF)	10,00796	2,012855241
GedikPortföyBir. His. Sen. Fonu (HSYF)	9,397,081	1,910,529,126
GarantiEm. Hay. His. Sen. Gr. EYF	8,717,264	1,900,753,408
HalkPortföy His. Sen. Fonu (HSYF)	9,465,261	1,800,094,553

make two main distinctions by focusing on financial innovation and analyzing the mutual fund industry of Turkey. We include new variable and run separate regression that allow us to compare the determinants of the performance of funds and verify the results.

Table 6 provides results on cross-sectional dependency. Using Pesaran's and Friedman's tool we check cross-sectional dependency. At the 1% level of significance, Pesaran's and Friedman's test strongly repudiate the condition of no cross-sectional dependency. In addition Frees' test repudiates the null hypothesis. All statistical tests display enough evidence to reject the condition of cross-sectional independence.

3.2.1. Model diagnostic
The panel data analysis uses sets of assumptions on the data-originating stream, and calculations will be erroneous if these assumptions do not hold. Therefore, using the statistical techniques, we provide diagnostics for panel regression model.

At the 1% level of significance in the presence of cross-sectional dependency, we use the second-generation unit root test proposed by Pesaran (2003). This test effectively deals with

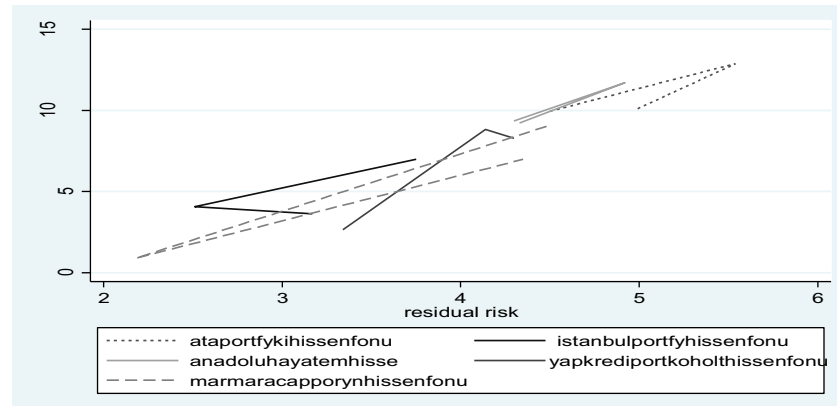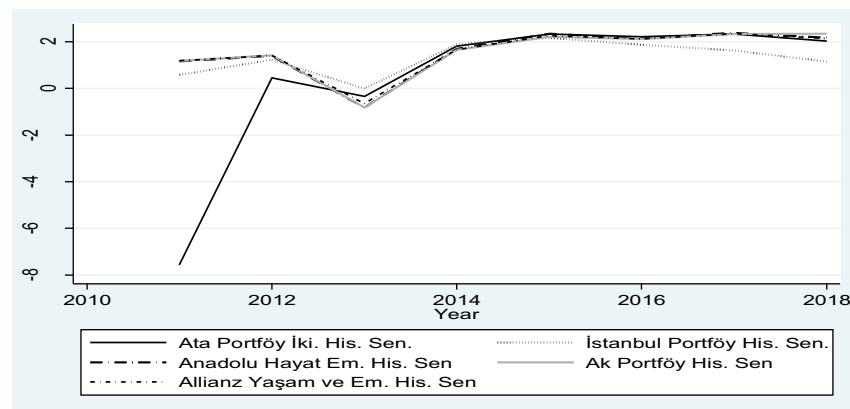**Figure 1. Residual risk/residual return profiles of selected mutual funds.**

Figure 2. Information ratios between 2007 and 2018 for selected mutual funds.

the problem of cross-sectional dependencies. The Table 7 shows unit root results. The Pesaran test results show that all variables are stationary at 0.05 percent significance level.

This Table 8 shows individual and/or time effects of regression analysis. According to the test results, there is evidence of time effect. On the other hand, there is no evidence of individual effect.

Table 9 displays Hausman Test for random or fixed effects. The Hausman test is used to decide which model is statistically appropriate. According to the test results at 5% significance level, the null hypothesis can be rejected. We infer that the random model is a relevant model for the small distance.

Table 10 displays results on Heterocedasticity. Modified Wald test for groupwise heteroskedasticity indicates on the availability of heteroscedasticity at 5 percent significance level. If the errors do not have a constant variance, their mean value is roughly constant; however, their variance is rising systematically with the values of dependent variables.

Table 11 shows the test results for serial correlation. Durbin-Watson and Baltagi-Wu LBI estimators indicate on the availability of positive, consistent correlation in the residuals. This condition shows that the Standard error terms can inflate the model as they will be biased downwards relative to the true standard errors.

**Figure 3. Information ratios.**
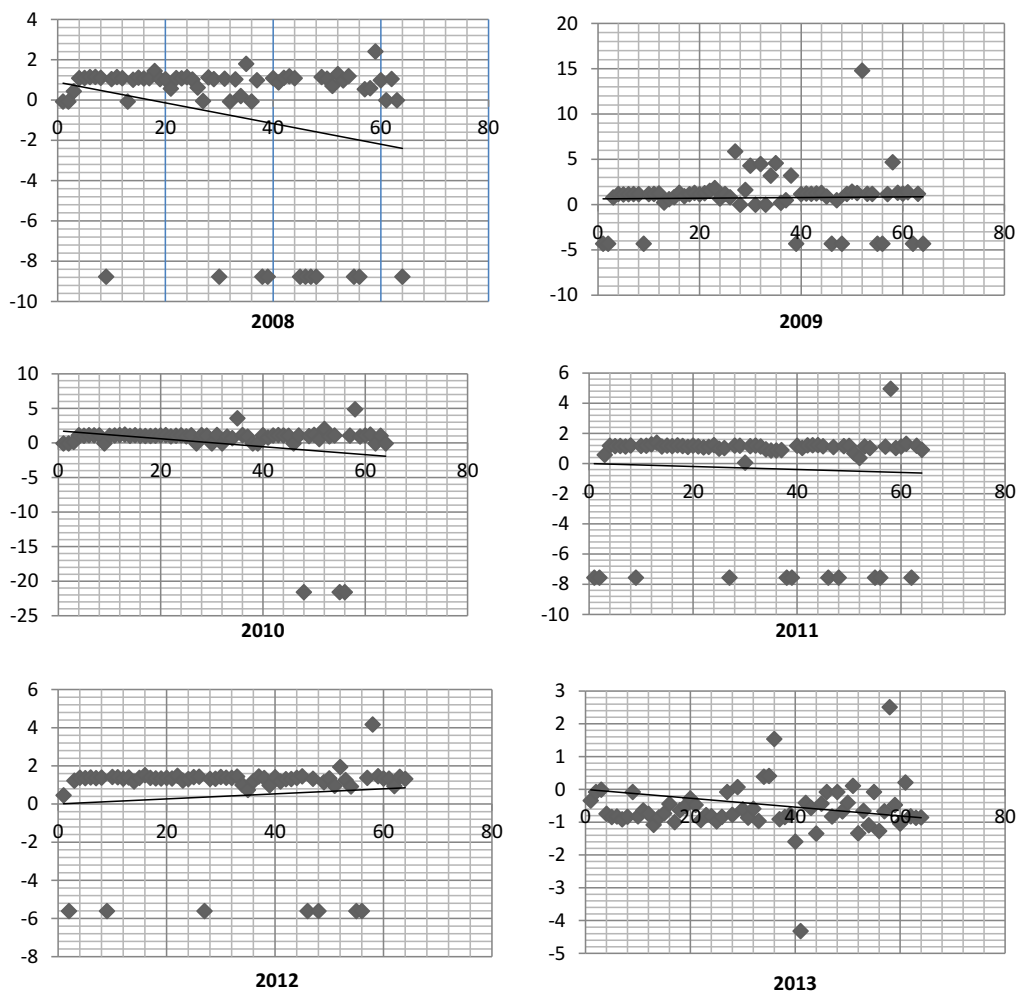
3.2.2. The model and interpretations

The regression model of mutual fund performance has been diagnosed for time effect. Moreover, the model is heteroscedastic and has serial correlation. Therefore, to expel the deviations from assumptions and to mend limitations of the model, we use Arellano (1987), Arellano (1993) standard errors panel data technique.

The panel estimations of equity mutual funds in Turkey show that various financial innovative products have different impact on their performance. An overall significance of the model is R^2 $=0.2700$, indicating that financial innovation reveals 27 percent of changes in dependent variable. Clearly, there are other factors that are not investigated in this research. In particular, new products associated with technological advancement such as internet banking and mobile banking are positively related to fund performance. The calculations show that a one-standard deviation increase in internet banking and mobile banking is associated with an increase in performance of mutual funds by 16 basis points and 24 basis points, respectively. On the other hand, we reveal strong evidence of a positive relation between the number of commercial banks and funds' performance. The empirical results show that a one-standard deviation increase in the number of commercial banks per 100,000 adults is associated with an increase in performance of mutual funds by 127 basis points.

Figure 3. Continued.
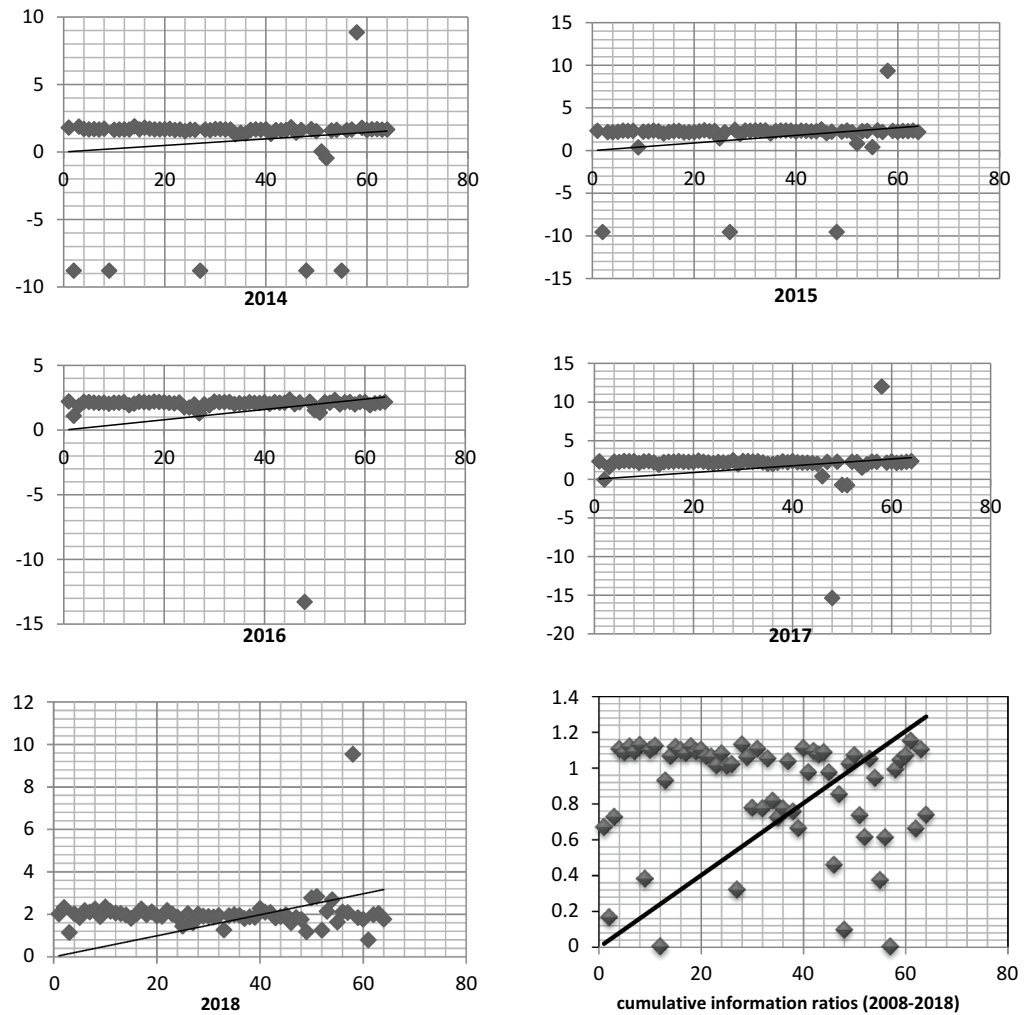
The fund size has a statistically significant and positive impact on performance in the sample of Turkey mutual funds. These effects are economically significant if we take into consideration the average performance for all funds is getting close to one. Moreover, this result is consistent with most academic literature that finds evidence of positive relationship between the performance and size. For example, Chen et al. (2004) report statistically significant and positive relationship between performance and fund size. This estimate shows economies of scale to Turkey funds that is funds with larger portfolios appear to have better risk-adjusted performance than funds with smaller portfolios.

Table 6. Cross-sectional dependency		
Pesaran's test of cross sectional independence	**Value = 42.655**	**Pr = 0.0000**
Friedman's test of cross sectional independence	Value = 196.797	Pr = 0.0000
Frees' test of crosssectional independence	alpha = 0.05	Critical value: 0.4325

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Table 7. Unit root test results	
Variables	**Unit root tests results**
Information Ratio	−4.2772 (0.0000)
Financial Innovation	−7.1025 (0.0000)
Change in Automated teller machines	−9.3323 (0.0000)
Commercial bank branches	−5.8688 (0.0000)
Internet Banking	−28.6574 (0.0000)
Total portfolio value of investment funds	−13.6983 (0.0000)
Mobile Banking	−17.1025 (0.0000)

Table 8. Individual and/or time effects test results	
chi2(2) = 180.11	**Prob> chi2 = 0.0000**
chibar2(01) = 0.00	Prob≥ chibar2 = 1.0000

Table 9. Hausman test for random or fixed effects
Ho: difference in coefficients not systematic
chi2(6) = (b-B)'[(V_b-V_B)^(−1)](b-B)
Prob>chi2 = 1.0000

Table 10. Test for heteroscedasticity
H0: sigma(i)^2 = sigma^2 for all i
chi2 (64) = 25,274.57
Prob>chi2 = 0.0000

Table 11. Test for serial correlation
H0: No AR(1)) in the following specification for the error terms AR(1) disturbances
F test that all u_i = 0: F(63,378) = 3.62 Prob> F = 0.000
Durbin-Watson = 1.489157
Baltagi-Wu LBI = 1.8468092

The results for financial research and development (FRD) support a very different relationship. Surprisingly, FRD is negatively related to fund performance. The FRD coefficient is statistically significant and negative with t-statistic of −2.50. One possible explanation of this result is that the FRD spending is fully reflected on mutual fund industry. On the other hand, change in the number of automated teller machines (ATMs) is adversely related to fund performance. The ATM coefficient is negative and statistically significant with t-statistic of −2.41.

Table 12. Regression of mutual fund performance: role of financial innovation and total portfolio value

	Information ratio		
R² 0.2700			
Prob>F 0.0000		t-statistics	Observations
FRD	−2.649512** (0.013)	−2.50	512
ATM	−89.99191** (0.016)	−2.41	512
CBB	127.0684** (0.041)	2.05	512
IB	16.56686** (0.039)	2.07	512
FPV	18.6598** (0.017)	2.39	512
MB	24.749** (0.023)	2.28	512
constant		2.98	

Table 12 reports panel regressions of the performance of open–end actively managed equity funds in 2011–2018. The dependent variable is the yearly information ratios estimated using monthly fund returns in Turkish Liras. Explanatory variables include financial novelty characteristics such as research and developments in financial sector (FRD), automated teller machines per 100,000 adults (ATM), and commercial bank branches per 100,000 adults (CBB), internet banking/change in volume of financial transactions (IB), mobile banking (MB), and fund's characteristics such as total portfolio value of mutual funds (FPV). We use total portfolio value of mutual funds as a proxy variable that represent the level of a mutual fund industry development and concentration.

*Parameters are significant at 5% significance level.

**Parameters are significant at 10% significance level.

Table 13. Alternative model on regression of mutual fund performance

	Information Ratio		
R² 0.2746			
Prob>F 0.0000		t-statistics	Observations
FRD	−2.316845 ** (0.067)	−1.87	448
ATM	−79.46709* (0.035)	−2.15	448
CBB	110.5904** (0.072)	1.83	448
IB	−6.876573 * (0.016)	−2.48	448
FPV	15.89251** (0.057)	1.94	448
FCOC	24.749* (0.023)	0.67	448
constant	6.054891		

Table 13 reports panel regressions of the performance of open–end actively managed domestic equity funds in 20,012–2018.The dependent variable is the yearly information ratios estimated using monthly fund returns in Turkish Liras. Explanatory variables include financial novelty characteristics such as research and developments in financial sector (FRD), automated teller machines per 100,000 adults (ATM), commercial bank branches per 100,000 adults (CBB), internet banking/change in volume of financial transactions (IB), futures contracts traded values and options contracts premium values (FCOC) and fund's characteristics such as total portfolio value of mutual funds (FPV).The FCOC values are available for the period 2012–2018. We exclude mobile banking (MB) from the model because of colinearity problem.

*Parameters are significant at 5% significance level.

**Parameters are significant at 10% significance level.

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We provide alternative model of our main findings by including new FCOC variable. Table 6 reports the results of alternative model of the regressions of equity funds performance. The impact of the total values composed of futures traded values and options premium values on the fund's performance is not statistically significant. The results on other explanatory variables are compatible with our main findings except for one notable distinction. The relation between internet banking and performance is now statistically significant but negative. We can address this concern on colinearity and persistent stationarity problems in FCOC variable that can potentially bias the coefficients of explanatory variables.

Conclusion

This study investigates the determinants of mutual fund performance using a large sample of actively managed equity funds in Turkey over 2011–2018 period. The determinants that we include in our analysis are different dimensions of financial innovation. In fact, we include in our analysis broad categories of financial innovative products that arose in Turkey including but not limited to liquidity management products, investment contracts, market structures, institutional organizations and new products associated with technological advancement.

The results from this study show that various financial innovative products have different impact on mutual fund's performance. For example, new products associated with technological advancement such as internet banking and mobile banking are positively related to fund performance. We report that the impact of the total values composed of futures traded values and options premium values on the fund's performance is not statistically significant. Fund characteristics are also important in explaining performance. We have documented that fund size is associated with better performance. This finding is important and indicates on the existence of economies of scale in the Turkey mutual fund industry. Our findings suggest that mutual funds in Turkey seem to face liquidity constraints after diminishing interest rates and improved liquidity conditions around the world triggered by 2008 global financial crisis.

This study shows the pattern of co-movements of information ratios and the degree to which performance indicators for different funds move together has increased over time. The implication is that although performance measures can differ to great extend among the funds in normal periods, they can become highly correlated and decline together during time of severe market turmoil. This can be explained by the fact that the performance indicators are affected by the same systematic risks. We also report that information ratios for most mutual funds are mostly positive and fall within a certain range or display rather asymmetric collocation for 2008–2018 cumulative periods. This result shows that for the period under observation we find that equity mutual funds in Turkey mostly over perform the market. This result shows that the equity mutual funds of Turkey have the ability to stay even with the market.

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