Analysis of Polish mutual funds performance: a Markovian approach

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ABSTRACT

The aim of this study is to determine whether mutual funds provide benefits for their clients. The performance of Polish mutual funds has been evaluated in terms of their efficiency, including their potential inertia over time. Moreover, the use of the phenomenon of economies of scale resulting from assets inflow to the fund by means of the Markovian framework has been examined. The results are consistent with the efficient market hypothesis. When assessing the market-adjusted returns, underperformance was noticed in both small and large funds. The smart money effect, recognised in the literature, is not confirmed here; however, there are some noticeable investor reactions, such as the phenomenon of chasing performance.

Key words: Markov chain, smart money effect, effectiveness, performance inertia.

1. Introduction

One of the most discussed issues concerning financial markets in both scientific periodicals and specialized magazines is the efficiency of investment projects. In the area of capital asset management, extensive debates on the efficient market hypothesis have been held since the 1970s. It assumes that financial markets reflect the publicly available information accurately and efficiently. Moreover, no investment strategies based on past prices of financial instruments are capable of providing abnormal returns. It is also believed that there are no investors with access to confidential information permitting generation of abnormal returns operating in the market (Fama, 1970). The human capital theory, which is opposed to the abovementioned hypothesis, provides that portfolio managers might be able to gather, process, and use the data with which

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other investors cannot familiarize themselves. Such an ability permits certain market participants to achieve a competitive advantage.

Investors who can be characterized by such skills include managers employed in investment fund companies. Managers' stock selection abilities should translate into both the achieved performance and its persistence. The literature on the subject matter has developed the term "abnormal return" and has called the phenomenon reflecting the tendency of achieving similar results in consecutive periods by financial intermediaries "performance persistence". Outperformance and performance persistence may have various sources. Apart from variables related directly to human factors, the relevant literature mentions also fund attributes, such as fund size, which can be based on inflow of assets to a fund. It is assumed that large funds, characterized by higher popularity among clients, can employ more skilled, better educated and more experienced managers, whom they will be able to pay more, and the hard-working managers will ensure persisting outperformance in exchange.

The study is an introduction to evaluating the effectiveness of funds operating in a developing market and provides a basis for further surveys and analyses in this area. The aim of this paper is to evaluate mutual funds' performance in the context of examining the efficiency, including its potential inertia over time, and the use of the phenomenon of economies of scale related to assets inflow to a fund. Generally, it is important to determine whether mutual funds are able to provide benefits to their clients and if their performance is a consequence of certain market circumstances. Hence, the analysis of the returns generated by collective investment institutions is particularly significant from the viewpoint of verifying the efficient market hypothesis. Additionally, a distinctive feature of this research is the application of an approach that has still been unpopular in the area of finance, consisting in construction of the Markov chain.

It needs to be also emphasized that the discussed subject matter brings utility values. Evidence of certain dependencies might influence the investment decisions made by individual investors by suggesting a probable potential of effective management of the assets entrusted to financial intermediaries. Mutual funds themselves could reproduce the information about having the appropriate attributes in the media in order to attract new clients.

This paper is composed of five sections. Part two presents a brief review of studies in the area of the discussed issues in the context of evaluating mutual funds' performance. Part three, which is a methodological section, describes the employed research approaches and data used in the analysis. In part four, empirical findings are reported. And the final section consolidates and summarizes the most significant results of the presented research.

2. Previous research

The literature review is focused on identifying a research gap in the area of capital allocation efficiency evaluation. The earliest studies include, for example, works by Sharpe (1964), Lintner (1965), and Mossin (1966), authors of the capital asset pricing model (CAPM). Successive researchers introduced modifications to this model in order to verify various hypotheses, including ones concerned with determining managers' skills as regards selecting securities for investment portfolios (e.g. Fama and French, 1993; Elton et al., 1996; Fung and Hsieh, 2004).

The published studies provided evidence in favour of the assumption that investment portfolio managers were incapable of generating abnormal returns. For instance, Jensen (1968) noted a certain predictability of investment returns. It concerned achievement of worse performance than the benchmark. As regards later studies, the research by Friend et al. (1970) as well as Henriksson (1984), who noticed the impossibility to obtain results exceeding a certain assumed benchmark, are worth mentioning. The results, in accordance with the efficient market hypothesis, could be observed with the use of risk-adjusted returns and, potentially, allowing for fee-adjusted returns. The publication that shed a new light on the findings of those days was the study by Grinblatt and Titman (1994). The authors emphasized that the evaluation of mutual funds' performance was extremely sensitive to the selection of a stock market index, treated as a benchmark.

More recent studies provided other performance measurement tools (e.g. Ferson and Schadt, 1996) or new research approaches, e.g. Bayesian methods (e.g. Huij and Verbeek, 2007) and bootstrap techniques (e.g. Huij and Derwall, 2008). One of the rare papers evaluating the performance of mutual funds by means of univariate and multivariate regime-switching models was the study by Ayadi et al. (2018). They applied the Markov chain procedure in the Treynor-Mazuy timing model in order to obtain reliable inferences on the market timing ability of Canadian fixed-income fund managers. The authors established that the regime-switching model was superior to univariate models due to the dynamic market conditions and cross-correlations of the funds' portfolios. Their conclusions regarding performance evaluation were multi-threaded.

Nevertheless, the main strand of the relevant literature at the turn of the 21st century was analyses dedicated to performance persistence. It can be defined as an increased propensity for relative repetition of mutual fund performance in consecutive periods. The empirical research carried out in the mid-1990s (e.g. Hendricks et al., 1993) was the first to suggest a relative stability of mutual funds' returns. Other studies additionally attempted to establish whether performance persistence was related to managers' characteristics (e.g. Du et al., 2009) or selection of portfolio components

(e.g. Grinblatt and Titman, 1992). Moreover, researchers asked the question if the mutual funds' performance persistence was a group phenomenon consisting in adopting a common winning investment strategy (cf. Goetzmann and Ibbotson 1994). For instance, Hendricks et al. (1993), who were mentioned above, identified the so-called hot hands effect concerning short-term performance persistence. They proved that, as a general rule, funds generating lower quarterly returns in one-year repeated performance below the benchmark in 4 successive quarters. In the case of winning funds, they found poor evidence for performance persistence in the next period. The persistence was noted also in the medium term, yet it was not as strong as one-year persistence.

More recent studies tried to engage stochastic methods for modeling the dynamics of risk-adjusted performance. One of them was the paper by Fenech et al. (2013), where investment rating migrations of Australian pension funds were measured by means of the Markov approach. The researchers investigated mobility matrices and found that the rating method mattered in terms of both statistics and investment decisions. In turn, Drakos et al. (2015), who also applied the Markov chain, examined whether there was a higher probability for mutual funds to remain in their initial ranking position compared to the probability of funds being characterized by a certain movement in ranking positions. They noted that there was a tendency for repeating performance in the post-ranking periods although the degree of mobility increased over time. Overall, the analyzed U.S. mutual fund market was characterized by a considerable degree of mobility. In summary, no straightforward conclusion was drawn. Performance persistence has been considered a market anomaly to this date.

The finance literature is also evidenced a significantly positive relationship between mutual fund flows and future performance. One of the first authors to discern this phenomenon was Gruber (1996), who noticed that investors had the ability to select funds which would be able to achieve superior performance in the next period. It means that mutual funds with net inflows outperform those with net outflows. As regards investors themselves, it was suggested that there might be informed investors capable of forecasting future investment results based on the information about past returns, who put their savings in funds with better future performance. Similarly, Zheng (1999) confirmed the relation and indicated that funds which received greater net flows outperform their less popular peers in the next period. Both these studies introduced the term "smart-money" effect to the relevant literature and defined it as mutual fund investors' ability to predict short-term performance and invest by moving money from underperformers to funds with better investment results (cf. Wermers, 2003; Sapp and Tiwari, 2004).

However, further studies (e.g. Frazzini and Lamont, 2006; Friesen and Sapp, 2007) noticed, contrary to what Gruber and Zheng argued, that a large group of investors

were less informed and less sophisticated than it would seem. Their activities in the form of investments in funds generated poor performance in the long run. The mentioned authors stated that fund net flows resulted in the so-called "dumb money" effect and investors themselves had low timing abilities, i.e. an average individual investor made wrong investment decisions most of the time. Teo and Woo (2001) also obtained evidence of the "dumb money" effect, which was reflected in high inflow funds underperforming low inflow funds over multi-year time periods. To the authors' best knowledge, there are very few papers in the smart money area to use stochastic methods. One of them is the study by Steffi Yang (2004), who developed a Markovian model of smart money chasing past winning funds. It was found that investors were sensitive to fund performance, in particular when funds could beat the market.

It should be highlighted that empirical investigations concerning mutual funds from the CEE countries where researchers use Markov-switching models are scare. The authors are familiar with only one paper in the relevant Polish (cf. Włodarczyk and Skrodzka, 2013) and one Romanian (Badea et al., 2019) literature analyzing efficiency of a limited number of local investment funds. Therefore, this study tries to fill the existing research gap and provides an opportunity to verify the potential market anomalies in developing economies, which might differ from the ones encountered in developed ones.

3. Data and methodological background

3.1. The scope and sources of data

The data used in this study was derived from a database which was created for the purpose of a research project conducted earlier and has still been updated. The data sources include publically available and specifically ordered information coming from reports prepared by the Chamber of Fund and Asset Management (IZFiA) and AnalizyOnline, respectively. Information about 46 Polish open-end mutual funds operating continuously between January 2010 and September 2018 was gathered for the purpose of verifying specific research hypotheses. The study was conducted for a homogeneous group of domestic equity funds with defined investment objectives. The starting point in this research was the values of the quarterly rates of return achieved by these entities. The funds' performance was compared to the values of the rates of return on benchmark being the local index of the securities market (the Warsaw Stock Exchange Index). It enables the calculation of market-adjusted returns. We decided to use market-adjusted returns instead of three- or four-factor models because of the lack of an appropriate data library or topical and downloadable databases containing fundamental factors (i.e. size, value, momentum) in Poland. The decision to resign from weekly or monthly data arose from a relatively high number of observations

usually indicating extremely small differences in the value between weekly or monthly rates of return of funds and benchmark (cf. Grinblatt and Titman, 1989). The annual values of assets under management also provided useful information, yet only with respect to the possibility to classify funds to the appropriate subsample in terms of fund size. Furthermore, the additional data included the quarterly values of net asset inflows to the portfolio. Due to the constraints on the volume of this paper, it was decided to omit the well-known formulas of the applied measures: the market-adjusted return and the inflow rate.

In order to capture the characteristics of the analyzed study sample, we decided to present the applied variables for the entire study in brief. Summary statistics across sub-samples or in yearly periods are available from the authors of this paper at request. A description of the variables is shown in Table 1.

Table 1. Summary statistics for the applied variables

Variable	Mean	St. Dev.	Median	Min	Max	Q1	Q3
Return	-0.005	0.040	-0.007	-0.164	0.202	-0.028	0.014
Size*	410.5	727.7	158.4	2.5	5,089.5	76.5	411.7
Flow	1.017	0.217	0.984	0.403	3.531	0.923	1.061

Note: * values are expressed in PLN million.

As shown in Table 1, the sample of mutual funds is characterized by underperformance – the mean value of return equals -0.005. However, quite a large deviation from the mean is noticeable. The dominance of several entities whose asset values are disproportionately higher than those of the remaining funds in total can be noticed in the entire Polish mutual fund market. Hence, the distribution of the size variable is moderately or even highly positively skewed with a leptokurtic distribution. The last variable, flow, is partly affected by the size factor. Therefore, as the market developed over successive years, assets inflow was observable.

3.2. Hypotheses and methodological approach

There are many methods for the evaluation of fund performance in the finance literature. This article presents an analytical approach that can be used for the effectiveness evaluation of a consequence of certain market circumstances. Our research procedure consists of two parts. First, the efficiency of investment funds was analyzed against the return on benchmark. In this case, efficiency means the difference between the returns of a given fund in period *t* and the returns on the main local market index in the same period. The main Warsaw Stock Exchange Index (WIG) was employed as the benchmark. A similar approach was applied in some publications in finance. For instance, Abdymomunov and Morley (2011) examined time variation in multifactor models of asset returns, especially book-to-market and momentum

mimicking portfolios across stock market volatility regimes. As indicated previously, they employed market and portfolio returns using a two-state Markov-switching process.

However, the development of this approach served the purpose of determining whether the potential (in)efficiency was the domain of large or small funds. For this purpose, the entire sample was divided into two subsamples. The first of them, concerning large funds, was composed of 10% of the biggest entities in terms of assets held, whereas the second subsample covered the remaining 90% of entities, i.e. smaller funds. It was decided not to apply the traditional division into large vs. small with the use of the median or, for instance, the first and the last quartile due to a relatively significant asymmetry in the statistical distribution of the fund size's data. The approach consisting in examining fund efficiency among large and small entities separately was drawn from the study by Lee and Ward (2001), who investigated the relationship between past and present performance of UK real estate with the use of the Markov chain approach. This leads us to the initial two hypotheses:

Hypothesis 1: *There is a tendency to uniformity of transition probabilities across states in regard to the obtained abnormal returns in two consecutive periods.*

Hypothesis 2: *The transition probabilities across states are the same for performance, regardless of the size of the fund (i.e. identical for large and small funds).*

The second part of this research is dedicated to the issue discussed in the literature as the performance anticipation hypothesis (cf. Alves and Mendes, 2011). In this case, the authors attempted to answer the question whether abnormal returns were related to the mutual fund flow in the previous period. It was decided to analyze the flow–performance relationship by means of a four-state process. As was already mentioned, the authors found no papers in the smart money area using probabilistic methods and therefore they consider this as their contribution to the literature. Therefore, the final hypotheses read:

Hypothesis 3: *There are equal transition probabilities of being visited across states in regard to prior net flows and the subsequent abnormal returns.*

Hypothesis 4: *There is no relationship between past net flows and future performance.*

With regard to the first three hypotheses, it was decided to check the stationary distribution, which could be interpreted as a long run stability of the process. Therefore, the question of how many quarterly periods mutual funds need in order to attain the steady state will be crucial. Moreover, on the basis of observations concerning the issue in question, it is possible to determine whether the employed research procedures are helpful in explaining fund returns.

Taking into account the review of the applied empirical methods discussed in the literature, it was decided to adopt a probabilistic approach, which could be a natural and logical consequence of formulated research questions and the relevant hypotheses.

The chosen research approach was the Markovian framework (e.g. Kemeny and Snell, 1976). The Markov chain is defined as a special stochastic process with a countable state space and transitions at integer times. It could be said that a process $X = (X_t)_{t=1}^{\infty}$ is a Markov chain with the state space S if it takes value in set S and for every $n \in N$, for every $s_1, …, s_n, s_{n+1}$, and for every $t \in \{n, n+1, n+2,...\}$ we have that

$$P(X_{t+1} = s_{n+1} \mid X_t = s_n) = P(X_{t+1} = s_{n+1} \mid X_t = s_n, X_{t-1}=s_{n-1}, …, X_1 = s_1). \qquad (1)$$

From equation (1) we have an immediate interpretation of the Markov chain. Knowing the present state, it can be seen that the past of the process does not provide any further information about its future.

A crucial aspect in dealing with a Markov chain is its transition matrices, i.e. $\mathbf{P}_t$. Each element of transition matrix $\mathbf{P}_t$ corresponds to the estimated probability of transiting from state i to state j across states in t steps. Moreover, it can be said that a Markov chain with transition matrices $\mathbf{P}_t$ is homogeneous if $\mathbf{P}_t$ does not depend on t. More precisely, there exists a matrix $\mathbf{P}$ such that for every t we have that $\mathbf{P}=\mathbf{P}_t$.

A very important type of Markov chains is ergodic Markov chains. These are homogeneous Markov chains for which there exists the so-called stationary distribution, i.e. such a distribution π on S for which we have that

$$\pi = \pi\,\mathbf{P}. \qquad (2)$$

The interpretation of equation (2), i.e. the meaning of an ergodic Markov chain, is very deep. In fact, for ergodic Markov chains, the dependence between being in a state and the initial probability (the choice of initial probabilities) decreases. In particular, there exists a limit of $\mathbf{P}^n$.

Ergodicity could be defined as the so-called metric transitivity, which is a property of indecomposable measure preserving transformations (cf. Poitras and Heaney, 2015). The abovementioned terms are related to the ergodic hypothesis (EH), which is applied in physics and thermodynamics. Ergodicity is a feature which helps us see that our process has a sort of stability in the long run. In particular, there is in ultimate loss of dependence on the initial states. More precisely, there exists such a limit

$$\mathrm{P} = \lim_{n\to\infty}\mathbf{P}^n$$

that

$$\mathrm{P} = \begin{bmatrix} \pi_1 & \pi_2 & \cdots & \pi_m \\ \cdots & \cdots & \cdots & \cdots \\ \pi_1 & \pi_2 & \cdots & \pi_m \end{bmatrix},$$

where π is a stationary distribution.

In our models, empirical distribution is used for calculating transition probabilities for every process. It is also assumed that the process under examination is homogeneous Markov chains. This assumption facilitates the study of the features of the returns generated by mutual funds. Moreover, it helps the authors find interesting properties of the returns since the applied approach is able to characterize more states of nature than the discussed dichotomies, e.g. outperformance vs. underperformance. The empirical distribution of funds' returns with respect to four subsequent quarters is taken into account.

However, restricting this study only to homogeneous Markov chains imposes major limitations on the authors. Firstly, it is assumed that – knowing the current rate of return of the mutual fund – it can be inferred that there is no significant dependence between past and future states of the analyzed processes. Secondly, the restriction imposed by homogeneity is the situation where there are the same probabilities of changing a state at every time moment. It should be also remembered that the employment of the Markov approach will not provide the information about the power or value of the transition from one state to another; it will only present the direction of the transition. Determining the probability of a change of a state informs the fund customer about what can be expected given specific initial assumptions.

4. Empirical results

As was mentioned, the aim of this study was to evaluate mutual funds' performance in the context of examining the efficiency, including its potential inertia over time, and the use of the phenomenon of economies of scale related to asset inflow to a fund. Hence, it was decided to divide this section into two respective parts. The relevant hypotheses will be verified in successive parts.

4.1. Difference between small and large mutual fund returns

This part presents the results of an analysis of performance in subsamples of small funds (see matrix A) and large funds (see matrix B). The authors try to determine the probabilities of obtaining abnormal returns in the two groups of funds and whether the probabilities differ.

Denote by X_t and Y_t the random variables which take values in the set $\{1, 2\}$. The events $\{X_t = 1\}$ and $\{Y_t = 1\}$ mean that small and large funds, respectively, outperform a benchmark. It is assumed that the processes $X = (X_t)_{t=1}^{\infty}$ and $Y = (Y_t)_{t=1}^{\infty}$ are homogeneous Markov chains with estimated transition matrices:

$$A = (a_{ij})_{i,j=1,2} = (\mathbb{P}(X_t = i \mid X_{t-1} = j))_{i,j=1,2} = \begin{bmatrix} 0.477 & 0.523 \\ 0.351 & 0.649 \end{bmatrix}$$

and

$$B=(b_{ij})_{i,j=1,2}=(P(Y_t=i \mid Y_{t-1}=j))_{i,j=1,2} = \begin{bmatrix} 0.403 & 0.597 \\ 0.370 & 0.630 \end{bmatrix}.$$

The elements of transition matrices *A* and *B* correspond to the estimated probability of transiting from state *i* to state *j* across states (*n* = 2). The first state indicates outperforming funds and the second one – underperforming funds.

The results obtained for both subsamples point to a relative non-uniformity of transition probabilities across states. In the groups of both small and large entities, the probabilities that negative returns will persist are at similar levels (0.630-0.649). This may be related to the existence of the icy hands effect in the performance of Polish mutual funds, which consists in maintaining a portfolio generating a rate of return below the average in consecutive periods (cf. Urbański, 2017; Zamojska, 2011). Minor, yet observable, differences in the probabilities of transiting from the state of positive results to the state of negative market-adjusted returns were recorded among small funds (0.522) and, which was more visible, among large funds (0.597). The findings, termed as underperformance, correspond well with the efficient market theory. Regardless of whether a fund belonged to the group of large or small funds, having obtained outperformance, it definitely more frequently underperformed than repeated its superior returns in the subsequent period. Therefore, Hypothesis 1 needs to be rejected. Moreover, the values of transition probabilities for small and large funds are to a large extent comparable. Therefore, Hypothesis 2 should probably be confirmed.

These two Markov chains are ergodic and their stationary distributions are:

$$\pi^X = [\ \pi_i^X]_{i=1,2} = [0.402 \qquad 0.598],$$
$$\pi^Y = [\ \pi_i^Y]_{i=1,2} = [0.381 \qquad 0.619],$$

respectively.

The interpretation of the values of stationary distributions are as follows. In the long run, the probability that a small fund will be effective is 0.402. Moreover, 18 periods are needed to be near the steady state. For large funds, the situation is similar but the probability that it will be effective in the long run is slightly lesser, i.e. 0.381. Moreover, around 11 periods are needed to be near the steady state. In both cases, it can be seen that the probability that small or large funds will be effective in the long run is distinctly lower than 1/2.

4.2. Smart money effect

The second part of the study investigates whether inflow or outflow is related to beating the market. Precisely, the authors attempt to find the probability of achieving

abnormal returns, measured by means of a market-adjusted return. In this case, they build a Markov chain and try to find an indirect relation between the net flow and performance by computing adequate probabilities.

In the first step, we denote by X_t the random variable which takes values in the set {1, 2, 3, 4}. The events {X_t=1}, {X_t=2}, {X_t=3} and {X_t=4} mean: funds that were outperforming and registered inflows of money; outperforming funds that registered outflows of money; underperforming funds that registered inflows of money; and underperforming funds that registered outflows of money, respectively. We assume that the process $X = (X_t)_{t=1}^{\infty}$ is a homogeneous Markov chain with a transition matrix:

$$C=(c_{ij})_{i,j=1,2,3,4}=(P(X_t=i \mid X_{t-1}=j))_{i,j=1,2,3,4} = \begin{bmatrix} 0.326 & 0.229 & 0.286 & 0.159 \\ 0.134 & 0.270 & 0.344 & 0.251 \\ 0.143 & 0.148 & 0.300 & 0.409 \\ 0.147 & 0.274 & 0.168 & 0.411 \end{bmatrix}.$$

The elements of transition matrix C correspond to the estimated probability of transiting from state i to state j across states ($n = 4$).

The results show that transition probabilities are not uniform. In the case of funds characterized by net inflows, positive returns in the subsequent quarter coincide with a relevant customer response in the form of another asset inflow. For entities implementing such scenarios, the probability of positive performance persistence was 0.326. On the other hand, the probability that asset inflow after a worse period for funds does not mean that positive returns will be recorded later is similar (0.286). As regards funds with turbulence in asset inflow and outflow, i.e. increased redemptions in the previous period, but in the face of obtaining better results in the subsequent quarter, which could also result in a simultaneous inflow of new assets, the noticed probability of deteriorated performance in the subsequent period was 0.344. In the case of negative market-adjusted returns, in turn, regardless of whether there had been asset inflow or outflow, a definite (i.e. the probability was 0.411) outflow of assets from the fund and consistent persistence of negative returns was noticed. This finding can be supported with a higher number of observations assigned to the abovementioned states. These findings seem to be consistent with the results of the first part of the analysis, where funds were usually ineffective (e.g. Perez, 2012). Therefore, they do not permit a straightforward conclusion whether the smart money effect is present in the performance of Polish mutual funds. Nevertheless, certain regularities related to

a relatively strong sensitivity of fund customers to the investment performance achieved by the available forms of investment should be noticed.

The mentioned Markov chain is ergodic and its stationary distribution is as follows:

$$\pi = [0.177 \quad 0.231 \quad 0.265 \quad 0.327].$$

The interpretation of the stationary distribution of the above π is as follows. In the long run, there is no state which has a dominant probability. However, probability of the ineffectiveness of a fund is slightly greater than 1/2. Moreover, the probability that a fund will register outflow of money in the long run is also slightly higher than 1/2. The authors' calculations show that a fund needs about 21 periods to reach stationary distribution.

In order to verify Hypothesis 4, the relationship between past net flows and subsequent performance had to be checked by means of a probability matrix which is not a Markov chain. We denote by X_t the random variable which takes value 1 if a fund is outperforming at time t and -1 if it is underperforming, i.e. if its return is greater than the return of a market portfolio (WIG) and lower than that of WIG, respectively. Denote by Y_t the random variable which takes value 1 and -1 if the fund registers inflow and outflow of money at time t, respectively.

We assume that

$$D=(d_{ij})_{i,j=1,-1}=(P(X_t=i \mid Y_{t-1}=j))_{i,j=1,-1} = \begin{bmatrix} 0.400 & 0.600 \\ 0.407 & 0.593 \end{bmatrix}.$$

In particular, $d_{-1-1} = P(X_t = -1 \mid Y_t = -1) = 0.593$ and $d_{1-1} = P(X_t = 1 \mid Y_t = -1) = 0.600$ mean that if there is inflow or outflow of money at time t-1, then we will have that a fund return is worse than the market portfolio return with the probability of 0.6. In other words, neither purchases nor redemptions of unit shares were able to reverse this unfavorable regularity. Given such considerations, the results seem to be consistent with the effects of the examination of the smart money effect presented in matrix C, and at the same time they confirm the impossibility to generate abnormal returns, which is also consistent with the efficient market theory. Hence, Hypothesis 4 about the lack of the relationship between past net flows and subsequent performance might be confirmed. Nevertheless, the relationship should be also analyzed by means of other research methods.

5. Conclusions

The aim of this study was to evaluate the performance of Polish mutual funds in relation to the examination of efficiency, including its potential inertia over time, and the use of the phenomenon of economies of scale resulting from the net flow of assets.

The study sample consisted of 46 Polish domestic equity funds operating between January 2010 and September 2018. A Markovian framework was applied as the research approach. It was decided to use Markov chains in order to verify the formulated hypotheses. The results provide conclusions consistent with the efficient market theory. A certain inertia of returns concerning non-uniformity of transition probabilities across states, which results from the applied measure of return, could be observed. It is worth mentioning that the calculation of the market-adjusted returns revealed the lack of efficiency both in small and large funds with a slightly higher probability. Moreover, the discussed smart money effect was not detected in the present study, but the dominant funds were those which achieved poorer performance after asset inflow or outflow, regardless of the initial state. Hence, the issue of chasing performance by investors seems to be noticeable. In all cases, 11 and more periods were needed to reach stationary distribution.

In general, it was concluded that mutual funds operating in the analyzed developing market were unable to provide abnormal benefits to their clients. When market-adjusted returns were used, there was a higher probability of achieving underperformance than outperformance in relation to the initial state. Furthermore, the analyzed market circumstances, e.g. the smart money effect, which is recorded in the existing literature, was not confirmed here. The findings should be important for the theory of finance, especially from the viewpoint of verifying the efficient market hypothesis. The results could be also interesting to individual investors in the context of their investment decisions. At the same time, the utility value coming from the study does not seem to be very optimistic for mutual funds and their clients.

It should be emphasized that the study contributes to the current research by applying the Markovian framework. The constructed Markov chains are still unpopular in the field of finance, especially in relation to mutual funds operating in European markets. As was mentioned before, the authors made certain assumptions, e.g. a special stochastic process is homogeneous, which facilitated the study of the features of the rates of return. On the other hand, restricting this study only to homogeneous Markov chains imposed a number of limitations on the authors. Most importantly, past and future states of the examined processes are independent of each other. However, the employed approach proved helpful in explaining the returns generated by funds. The reasonability of its application in future studies in the discussed area also deserves a mention. One of the research perspectives that naturally come to mind in the first place could be that of a martingale approach in the evaluation of mutual fund performance. Subsequent studies should concentrate on the so-called stopping times, which – together with the Doob theorem – can help us calculate the probability that returns will reach fixed levels (cf. Devolder et al., 2012).

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