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Equally Weighted Strategic Allocation and Balanced Funds in Brazil

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ABSTRACT

This article analyzes equally weighted strategic asset allocation portfolios in Brazil between 2004 and 2016 and shows that their average returns are not always statistically greater than those of balanced funds, with significance changing in sub-periods. Fixed-income portfolios frequently outperform balanced funds, whose active management underperforms their declared benchmark portfolios. Balanced funds underperformed probably because they deviated from their investment policy. Transaction costs and other rebalancing frequencies do not change the conclusions. Robustness tests indicate that this evidence is valid out-of-the-sample. Investors can mimic balanced-fund policy and possibly do better by means of indexing according to this policy.

RESUMEN

Este artículo analiza carteras con asignación estratégica de activos con igual peso ponderado, existentes en Brasil entre 2004 y 2016, y muestra que, estadísticamente, el promedio de los retornos no siempre es más alto que los obtenidos por los fondos equilibrados, indicando también cambios importantes durante los sub-períodos. En general, las carteras de renta fija tienen un desempeño mejor al de los fondos equilibrados, cuya gestión tiene un rendimiento inferior al de las carteras de referencia declaradas. Es probable que los fondos equilibrados tengan un desempeño inferior porque se desviaron de su política de inversión. Los costos de transacción y otras frecuencias de reequilibrio no cambian dichas conclusiones. Las pruebas de robustez indican que esta evidencia también es válida fuera de la muestra. De acuerdo con esta política, los inversores pueden imitar la política de los fondos equilibrados y, probablemente, obtener un rendimiento mejor mediante la indexación.

RESUMO

O presente trabalho analisa portfólios de alocação de ativos estratégicos igualmente ponderados no Brasil, entre 2004 e 2016, e mostra que os retornos médios nem sempre são estatisticamente maiores do que os dos fundos balanceados, com mudanças significativas nos sub-períodos. Em geral, os portfólios de renda fixa apresentam desempenho superior àquele dos fundos balanceados, cuja gestão ativa tem desempenho inferior à dos portfólios de benchmark declarados.

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É provável que o desempenho dos fundos balanceados decepcione por apresentarem desvios em relação à sua política de investimento. Os custos das transações e outras frequências de rebalanceamento não alteram as conclusões. Os testes de robustez indicam que essa evidência é válida fora da amostra. Os investidores podem imitar a política dos fundos balanceados e, possivelmente, ter um desempenho melhor mediante indexação de acordo com essa política.

1. Introduction

Investors have to decide how to allocate their capital according to the main asset classes available. An asset class gathers securities of a certain kind, such as domestic equity, international equity, short-term debt (money market or cash) and long-term debt (bonds), for example. Brinson, Hood, and Beebower (1986), amongst others, decompose asset allocation into policy, asset selection, and market timing. The allocation policy constitutes the long-term strategy of a portfolio and corresponds to the typical weights each fund attributes to the asset classes in which it invests. The allocation policy is commonly called strategic allocation. Asset selection consists of choosing the assets in each class. Market timing is the opportunistic adjustment of the weights relative to those set in the investment policy. A tactical allocation is the combination of asset selection and market timing. Strategic allocation corresponds to a passive portfolio management component, such as indexing according to pre-defined asset class proportions and benchmarks and tactical allocation to an active management component (Brinson et al., 1986; Gonçalves, 2006). The importance of strategic allocation has been pointed out by various authors (Brinson et al., 1986; Ibottson, 2010; Swensen, 2009) and motivated this investigation, so this article focuses on this aspect of portfolio management.

The goal of this article is to compare the performance of equally weighted strategic allocation portfolios with balanced funds, which are professionally managed portfolios available to investors, as in Ibbotson and Kaplan (2000), and with commonly followed indices that represent the selected asset classes in Brazil. There is a focus on equally weighted, also called naive, portfolios due to claims from many authors that they display superior results relative to value-weighted portfolios, mostly due to rebalancing (Malladi & Fabozzi, 2017). Other reasons to consider equally weighted portfolios is their ease of implementation for individual investors, which are also the focus of this article. Nevertheless, value weighting is also considered herein. Balanced funds were selected because they declare their intended strategic asset allocation proportions, that is, the proportions of domestic equities and fixed income in their portfolios that represent their investment policy.

In addition, this article also evaluates the success of the professional active management offered by these selected balanced funds, given that they may deviate from their declared investment policy—the passive portfolio management component—when actively managing the fund in order to pursue possible market opportunities. In general, the word portfolio will refer to those portfolios built in this article and fund to the portfolios of mutual and retirement balanced funds available in the market.

This article focuses on ordinary investors, as opposed to qualified or institutional investors, because they are the least equipped to make complex assessments and use sophisticated techniques, thus making them less qualified to actively manage their investments (Swensen, 2009). This focus led to the examination of strategic allocation in portfolios of equally weighted asset classes and balanced funds aimed at that this type of investor. A naive strategic allocation is an approximation of a typical market allocation, which is the portion of the strategic allocation with the greatest power to explain the variation of portfolio returns (Hensel, Ezra, & Ilkiw, 1991). Adopting the "1/N Heuristic" is also a natural tendency when an individual faces simultaneous choice situations (Benartzi & Thaler, 2007; Read & Loewenstein, 1995). In addition, equal weighting is a limit situation when the problem of uncertainty regarding the choice of portfolio optimization parameters (return, variances and covariances) is substantial (Pflug, Pichler, & Wozabal, 2012).

The main contribution of this article is to examine active and passive portfolio management in the context of strategic allocation using balanced funds that are open to investment and aimed at ordinary investors as well as portfolios built herein that adopt an equally weighted strategic allocation in a large emerging market. As far as could be ascertained, there have been no investigations published in scholarly journals with the analytical approach proposed herein about Brazil, although various recent Brazilian studies have analyzed the use of equally weighting to build portfolios composed solely of domestic stocks in the Brazilian market (Battaglia & Leal, 2017; Santiago & Leal, 2015). This paper is akin to Estrada (2014) that performs an analysis of benchmark asset class portfolios in a global context.

Brazil stands out because its level of interest rates is very high. The CDI rate, a repo market indicator, accumulated 350 per cent in the sample period between January 2004 and December 2016. Inflation in the same period was 125 per cent. Contrastingly, an index of inflation-indexed bonds reached 500 per cent, whereas the IBrX-100 stock market index recorded 313 per cent and the S&P500 index attained 127 per cent, in Brazilian currency terms. Thus, the fixed income market in Brazil was very attractive, explaining why most Brazilian investors shy away from the stock market (Cutait, 2015; Dana, 2015). This article, therefore, considers four liquid financial asset classes that are accessible to ordinary investors through instruments available in the

domestic market ("money," "inflation," "domestic stocks," and "international stocks"), considering the 2008 financial crisis as a sub-period. The equally weighted portfolios proposed are combinations of these four asset classes. There is a discussion about the inclusion of real estate investment funds later in the article.

The tests in this article indicate that the equally weighted strategic asset allocation portfolios built here outperformed the selected balanced funds during the sample period in terms of cumulative returns. However, the statistical significance of the differences between average monthly returns of these portfolios and balanced funds changes according to sub-periods. The equally weighted strategic asset allocation portfolio that most often outperformed balanced funds concentrated only on fixed income. These portfolios outperformed balanced funds with statistical significance more frequently. Balanced funds had significantly lower risk-adjusted returns and greater volatility than portfolios formed using the weights that they declared as their benchmark portfolio for the domestic equity and fixed income proportions. These portfolios indexed these asset classes using the same benchmarks employed throughout the article, as detailed later. Thus, balanced fund managers were not successful in their active management efforts, as in Brinson, Singer, and Beebower (1991). Robustness tests examining various initial investment amounts, transaction costs and rebalancing periods do not change these conclusions. There is a discussion of several robustness tests, such as the inclusion of open private retirement funds, considering buy and hold and market value weighted portfolios as alternatives to naive portfolios, as well as additional risk-adjusted performance metrics. These additional tests did not change the reported conclusions. There is evidence that the results persist out-of-the-sample that was obtained with the error in estimates correction for the historical Sharpe Ratio (SR) developed in Kourtis (2016) and performed herein.

This article continues with a brief review of the literature, followed by the presentation of various methodological aspects. The two final sections are a discussion of the results and the conclusions, with practical recommendations for ordinary investors.

2. Literature review

2.1. Asset allocation

Schiozer and Tejerina (2013) affirmed that investors in Brazilian non-exclusive fixed income mutual funds monitor the asset allocation of their funds because the presence of securities affected by the international financial crisis in these portfolios was associated with a negative impact on fund flows. This was not observed in exclusive funds, in which investors have a direct

influence over allocation decisions. They concluded that asset allocation affects the investment decision of individuals in Brazil.

Ibbotson (2010) broke down the returns of a fund or portfolio into three parts: (1) the one corresponding to the overall market movement, which also corresponds to the strategic allocation followed by all market funds, according to Hensel and colleagues (1991); (2) the portion with respect to the specific strategic allocation adopted by a fund; and (3) the active portion, due to asset selection and market timing carried out by the managers of a fund. Brinson and associates (1986) suggested that 93.6% of the variation in pension fund returns was explained by their strategic allocation—their investment policies, which, in large part, correspond to the passive management portion of their portfolio returns. Brinson and colleagues (1991) underscored that the contribution of active management in explaining the variation of returns is practically none and it also increases risk.

This result, however, has been contested by more recent evidence that basically states that what Brinson and researchers (1986) found was the joint effect of the two strategic allocation components: the overall market component and the specific strategic allocation of each fund (Ibbotson, 2010). Hensel and associates (1991), for instance, divided strategic allocation into two policies: the specific policy of each fund or portfolio and the one typically followed by all market funds, also known as naive or market movement allocation policy. The authors indicate that 94.15% of the variation in returns is explained by market movements and not by the specific policy of a fund, which explains only 0.50% of the variation in returns, while active management accounts for 0.54%. This evidence suggests that an equally weighted strategic allocation may produce a satisfactory performance, provided it does not deviate too far from the typical market allocation. It also states that the overall market movement explains the bulk of returns, while the specific strategic allocation of a fund and its active management efforts are not very important. Xiong, Ibbotson, Idzorek, and Chen (2010) also show that most of the returns of balanced funds are due to the overall market movement.

Thus, in this article, equally weighted strategic allocation portfolios are a way to represent the average strategic allocation of multi-strategy funds—those that mix more than one asset class, such as balanced funds. The differences in returns between equally weighted portfolios and balanced funds reflect whether fund specific strategic allocations and their active management contributed to their return differences. Additional indexed portfolios formed in a way to track the stock and fixed income proportions declared by balanced funds will reflect whether their active management was successful relative to their stated investment policy.

Explaining fund return variation is one thing but explaining differences in fund returns is another issue. Ibbotson (2010) argued that strategic allocation explains much less of fund return differences. They assert that strategic

allocation explains about 40% of the variation of returns between balanced funds and that this level of explanation is influenced by the degree of active management. Xiong and colleagues (2010) claimed that this percentage is also sample dependent. In other words, the type of fund and the period sampled influence these results and percentages vary substantially.

Campbell and Viceira (2002) argued that the most adequate strategic allocation varies according to the profile of each investor and that the risk perception of long-term investors may be very different from that of short-term ones. They also suggested that individual income influences risk perception, as it alters the sensitivity of consumption to changes in portfolio returns. In addition, these perceptions change over time. It is thus necessary to consider the range of asset classes that enable investors to choose those that best fit their profile.

Campbell and Viceira (2002), Hensel and associates (1991), Ibbotson (2010), and Ibbotson and Kaplan (2000) claimed that a proper evaluation of strategic allocations should employ adequate benchmarks and that these should be the average strategic allocation of portfolios and funds in a market. These authors endorsed the empirical choice made in this article to investigate a set of equally weighted strategic allocation portfolios, which represent the average market strategic allocation herein, relative to balanced funds, which can be considered as actively managed strategic allocation portfolios.

2.2. Naive strategies

Many efforts have been made to develop techniques that maximize risk-adjusted investment returns, beginning with Markowitz (1952). The main advantage of these techniques is that they consider the historical information available and are supported by economic and statistical models. However, one should take into account the costs of obtaining data and the employment of highly qualified labor to implement the models. The entry parameters estimated from the historical time series may introduce serious problems into the estimates (Kritzman et al., 2010; Pflug et al., 2012; Santiago & Leal, 2015). In addition, these techniques are based on questionable economic assumptions of agent rationality (Benartzi & Thaler, 2007). Finally, one can cite some common problems related to the practical application of some of these techniques, such as requiring large short sales or a large initial investment in order to build an adequate portfolio.

In contrast, some scholars and even market participants defend naive investment strategies. One of the most common is the "1/N Heuristic," which corresponds to the tendency of individuals to distribute their funds equally between the available alternatives. Duchin and Levy (2009) reminded us that the Talmud already preached that a man should allocate a third of his assets in merchandise, a third in money and a third in land. Read and Loewenstein

(1995) pointed out that people naturally exhibit a strong diversification bias when facing simultaneous choice situations. Benartzi and Thaler (2001, 2007) suggested that people tend to unconsciously use the 1/N heuristic when deciding how to allocate funds destined to their private pension plans.

Ferman, Lersch, and Yoshinaga (2017) asserted that investors expose themselves to additional risk when they overweight the stocks of the companies where they work in their portfolio and, therefore, under-diversify. This is true even for companies that do not pay stock related compensation. There is a risk that these investors incorrectly believe that they have superior information about their companies and thus bear an additional and unnecessary risk. This choice affects their performance and supports the argument that equally weighted allocation portfolios could be a suitable alternative because allocation derives from a mechanical rule instead of a decision based on potentially incorrect beliefs.

Equal weighting has advantages and disadvantages. A negative aspect is that it does not consider the information available, which could supposedly be used to obtain a better result. In addition, these portfolios tend to deviate rapidly from their original strategic allocation. As positive points, one may say that the 1/N heuristic is simple and less costly to implement. Moreover, it is not biased, as it does not depend on past information, which may be very different from future results, and benefits from reversion to the mean, as the necessary rebalancing naturally forces investors to sell high and buy low (Duchin & Levy, 2009; Kritzman et al., 2010). It is important to point out that this article does not claim that equally weighted strategic allocation portfolios are better than the optimized alternatives. It simply considers them as an adequate proxy for the average market strategic allocation in an empirical exercise focusing on non-professional individual investors.

Optimized portfolio selection strategies do not easily and unequivocally outperform equally weighted portfolios, in Brazil and elsewhere (Battaglia & Leal, 2017; Duchin & Levy, 2009; Kourtis, 2015; Malladi & Fabozzi, 2017), and individuals use this heuristics in many practical situations (Benartzi & Thaler, 2007). In this second case, there could be an insurmountable amount of uncertainty in other decision models that individuals could use. Pflug and associates (2012) argued that equally weighted portfolios are a rational limit solution to portfolio allocation. These authors sustain that the lack of accuracy in modelling the distribution of random asset returns, which they call ambiguity, leads to the outperformance of equally weighted schemes. They provided a theoretical justification for the use of equally weighted portfolios in the presence of distribution ambiguity. Kourtis (2015) asserted that the instability of optimized portfolios over time, after transaction costs, leads to their inferiority relative to equally weighted portfolios. Optimized portfolio instability coupled with rebalancing leads to these results.

Malladi and Fabozzi (2017), moreover, asserted that equally weighted stock portfolios are more robust relative to other price or value-weighted strategies because they do not rely on expected average returns. These authors offered a theoretical framework to the equal-weighed versus value-weighted equity portfolio model and employ simulations as well as historical data to demonstrate that equally weighted stock portfolios outperform value-weighted strategies largely due to their regular rebalancing, even after transaction costs.

This review of the literature supports the employment of naïve strategic allocation, given the conclusion that the typical or market movements component of the asset allocation policy explain the variation in returns in large measure. Equally weighted allocation may achieve a reasonable result provided its weights are not substantially distinct from those adopted in a typical market policy. In addition, the various strategic allocation portfolios proposed seek to take into account the diversity of individual risk profiles.

3. Methodology

3.1. Asset class proxies and fund selection

The proposal is to create six portfolios to assess equally weighted strategic allocation in historical terms. These portfolios represent possible typical policies that Hensel and colleagues (1991) defined as naive allocation or market movement policies. The performance of these portfolios is compared to that of indices that represent asset classes and selected balanced funds that combine passive and active management during the 13-year period between January 2004 and December 2016. The initial date was chosen due to the availability of the Anbima Market Index Series B (IMA-B) historical series data computed by the Brazilian Financial and Capital Market Entities Association (Anbima). The IMA-B index represents inflation-indexed treasury bonds as well as this asset class in general. The end of the period was the last full year of data collection.

The historical series of nominal monthly returns of all return series come from Bloomberg® and the monthly series of the dollar selling rate on the last day of each month from the Central Bank of Brazil (series code: PTAX800). Monthly returns are the percentage change in the value of the asset or index between the end of the previous month and the end of the month considered.

The base case used monthly rebalancing and the entire sample period, in addition to the sub-periods before (January 2004–June 2008) and after (July 2009–December 2016) the 2008 global financial crisis. The twelve months from July 2008 to June 2009 were considered the crisis period and excluded from the sub-period analysis. Alternative cases included changes in rebalancing frequencies and transaction costs.

Equally weighted portfolio building was a computation of its average return for each rebalancing period using the rebalancing frequency return. For example, for monthly rebalancing, the equally weighted portfolio return in each month is the average of the monthly returns of the indices that represent each asset class included in the portfolio. For quarterly rebalancing, the return in the quarter of each index that represents each asset class included in the equally weighted portfolio is computed and the return of the equally weighted portfolio in the quarter is the average of the quarter returns of each one of these indices. This method is similar for all other rebalancing frequencies. The discussions about how each asset class and transaction costs were implemented come later in this methodology section.

The equally weighted strategic allocation portfolios were compared with the returns offered by the Interfinancial Certificates of Deposit (CDI), IMA-B, Bovespa Index (Ibovespa), Brazil Index (IBrX or IBrX 100), Standard and Poor's 500 Index (S&P500), Anbima Hedge Funds Index (IHFA) and six balanced funds. The CDI rate is an average repo rate that is widely used in Brazil as a market and investment benchmark. Anbima publishes the IHFA and its purpose is to serve as benchmark for the Brazilian hedge fund industry. It is composed of the mutual funds classified by Anbima as "Multimarket" that are open to ordinary investors and which charge an incentive fee, among other selection criteria, and are weighted according to their net assets. All Brazilian mutual funds must mark-to-market daily, and fund share values are posted daily as well; thus, the hedge fund industry in Brazil differs from that in the United States in at least two key aspects: transparency and liquidity. Brazilian mutual funds comprising the hedge fund index (IHFA) mark-to-market daily and have redemption periods much shorter than those of US hedge funds (rarely longer than 60 days). Brazilian Securities Commission regulations define the "multimarket" fund category as that in which funds may invest in several asset classes, such as stocks, fixed income, commodities, derivatives, currencies, for example, with no obligation to concentrate in any of them. Multimarket mutual funds considered as "hedge funds" may require very high initial investments and target solely qualified investors. As this article considers multi-asset-class benchmarks and focuses on the ordinary individual investor, these funds were not considered as an additional asset class. Yet, the IHFA index was included in the analysis to contrast the equally weighted strategic allocation portfolios created herein to a benchmark for Brazilian hedge funds. Criteria are adopted to eliminate repetitions in the IHFA, such as the exclusion of balanced funds and funds of funds that already comprise the index.

Anbima is the primary Brazilian fund data provider to other databases and follows this legal categorization to organize funds in its database. The six Brazilian funds classified by Anbima as "Balanced Multimarket" funds and which were open to new investors were selected from the 43 mutual funds

listed in this category in the consolidated investment fund records published by Anbima in December 2015. The rest of the funds were exclusive, closed or information about them could not be found at the investment management company website, suggesting that they were not available to ordinary investors. Thus, it is not possible to expand the mutual fund sample, as the search was exhaustive to the extent of data availability. In addition, it was decided not to include a fund that started in October 2009 and whose period of returns would therefore not be fully included at least in the second sub-period.

All balanced funds in Brazil fall under the category of multimarket funds because they contain more than one asset class (nominally domestic equity and fixed income) and may freely set the target proportions of stocks and fixed income that they pursue, and are not subject to legal concentration limits on specific asset classes. What distinguishes them from other multimarket funds is that they declare a target strategic allocation (investment policy) as their benchmark, that is, the proportions in domestic equity and domestic fixed income, while other multimarket funds do not set or publicize these goals. Yet, balanced fund managers may deviate from their declared asset class benchmark proportions. Balanced funds, therefore, are not passively managed because they do not implement an indexation scheme.

The funds selected were Bradesco FICFI Multimercado Golden Profit Moderado (F1), Caixa FI Multimercado Renda Variável 30 Longo Prazo (F2), Western Asset Multirenda 10 FICFI Multimercado (F3), Western Asset Multirenda 20 FICFI Multimercado (F4), Western Asset Multirenda 30 FICFI Multimercado (F5), and Bradesco Prime FICFI Multimercado Mix (F6). Fund F6 is included only in the analysis of the post-crisis period because it began in December 2007. The funds selected charged management but not incentive, entry or exit fees. These funds specify the percentage and the benchmark of each asset class that they should be compared with and did not use leverage. Their actual percentage allocation could deviate from those declared for each asset class benchmark as a result of active management. Thus, their declared benchmark portfolio is always indexed to the CDI and the Ibovespa stock index according to proportions that these funds declare. Benchmark portfolios for each balanced fund were built in the same way used to build equally weighted strategic allocation portfolios, as described before. The only difference is that the CDI and Ibovespa index proportions are not the same and are equal to those declared by each fund as their proper benchmark portfolio.

In order to increase the fund sample, an additional Bloomberg© search revealed price data for 43 balanced open private retirement funds. Open private retirement funds are open to any investor through the commercial banking and investment platforms network, but are actually an insurance product, in contrast to closed retirement schemes, that are sponsored by companies or other organizations and open only their employees or affiliated

members. The open private retirement funds determine the returns of investors in this insurance product and comprise the actuarial reserve of the insurance companies. Open private retirement funds are private because they are not part of the public government run retirement system. Open private retirement funds are not managed under the same regulations as balanced mutual funds because prudence rules adopted in retirement regulations impose additional constraints on managers. Given these contrasts relative to mutual funds, the inclusion of these funds contributes to reduce the influence of the profile of individual managers. Open private retirement funds will be called retirement funds from here on. There were 17 balanced retirement funds with data for the whole sample period (156 months) and the first sub-period (54 months) and 32 with data for the second sub-period (90 months). Bertucci, Bernardes, and Brandão (2006) argued that strategic asset allocation decisions of retirement funds are mostly associated to consistency with their actuarial goals than with performance per se; thus, the addition of open retirement funds to the sample accounts for diversity in manager profiles.

3.2. Asset classes

"Money" (M), "inflation" (I), "domestic stocks" (DS) and "international stocks" (IS) were the four asset classes selected to comprise the equally weighted portfolios aimed at ordinary individual investors. This selection is consistent with those made in the international literature, both theoretical and empirical. Campbell and Viceira (2002) used equities, long-term bonds (indexed and nominal), and cash (or short-term bonds) in their theoretical exploits of strategic asset allocation for households. They do not consider alternative assets. Estrada (2014) empirically discussed portfolio benchmarks that include several asset classes, similar to those employed in our article, but does not consider alternative assets as well. His benchmark portfolios derive from literature that he cites as well as from those adopted by professional investors, such as the Norges Fund (the Norwegian sovereign fund). The author considered stocks and bonds in most benchmark portfolios as well as cash and gold in a few. In Brazil, Brito and Brito (2006) also included repo operations, fixed-rate debt securities (in contrast to the dominant floating rate debt securities in Brazil) and exchange rate-linked securities in a list of possible asset classes for wealth management. However, the first two are practically the same as those used to represent fixed income in this article and the foreign currency debt securities are less common among ordinary individual investors; as such, it was decided to use the four classes presented above. It is worthwhile mentioning that we consulted a private banker from a large and prestigious US investment bank. This institution uses equity, fixed income, and alternatives as its main asset classes and divides them up into many sub-classes, such as value, growth, large, small, international and emerging

for equities, short and long-term bonds, as well as high yield, inflation indexed and emerging for bonds, and real estate funds, commodities, private equity, and absolute return funds for alternative assets. Thus, our choice of asset classes is not inconsistent with the major asset classes that practitioners consider in the United States. Finally, this section will close with a discussion about the empirical difficulties with the real estate asset class in Brazil.

"Money" (M) corresponded to low-risk and high-liquidity assets. Liquidity preference and the allocation between risk-free and risky assets has been the basis for the first asset pricing models developed in the 1960s. The most popular type of mutual funds in Brazil are those that Anbima classifies as indexed according to the CDI rate and they are representative of this class. An investigation in the Quantum Axis database showed that the CDI return could be very close to the one offered by existing CDI indexed funds on 25 April 2015, with a minimum investment of less than R$ 20,000 (about US$ 6,700) and easily accessible to ordinary investors. This analysis, thus, uses the CDI rate to represent class M in order to avoid arbitrarily selecting a specific CDI indexed fund. The CDI rate is a prime rate that is an average of repo market transaction rates between Brazilian banks. Even though it closely follows, both in value and variation, the average for Brazilian short-term Treasury securities rates, the CDI rate became widely used in Brazil as a market and investment benchmark and is commonly reported by multimarket funds as one of their benchmarks. Such funds, rarely report the average Brazilian short-term Treasury rate. Thus, this prime rate from the Brazilian money market was an obvious choice to benchmark the "money" asset class.

The "inflation" class (I) is composed of inflation-indexed assets and displays lower liquidity, higher volatility and longer maturities. Investors may select inflation-indexed treasury and corporate bonds or a fund of these securities to invest in this asset class. The IMA-B index was selected in this article to avoid choosing a specific bond or fund. This index tracks the change in market prices of a theoretical portfolio of all inflation indexed treasury bonds outstanding. The IMA-B is also used as a common benchmark by many Brazilian inflation-indexed funds as well as multimarket funds and for investment assessment in general. Individual investors may easily invest in Brazilian inflation-indexed Treasury bonds through a platform called Treasury Direct. Thus, an index of such bonds is representative of returns that individual investors can attain and reflects the cost-of-living adjusted performance that these longer-term securities offer. Inflation indexed Brazilian Treasury bonds are issued for maturities of 10, 20, or even 30 years. Campbell and Viceira (2002) sustained the importance of this asset class in long-term asset allocations of individuals.

Investors may hold the "domestic stocks" (DS) asset class in their portfolios by means of a fund indexed to one of the domestic market indexes. The Securities, Commodities and Futures Exchange (BM&FBovespa) publishes

four broad-based market indices: IBrX 100, Brazil 50 Index (IBrX 50), Brazil Broad-Based Index (IBrA) and Ibovespa, with the latter being the most widely followed. This analysis will employ the Ibovespa and IBrX 100 indices to represent this asset class, as they have the most investment vehicles for small investors and also to avoid the arbitrary selection of a specific stock index fund.

The calculation methodology of the Ibovespa changed in January 2014. The former method used a liquidity-based weighting and could produce unusual situations in which the weight in the index of a stock whose price was in free fall would actually increase due to an increase in its trading volume. The index became a market capitalization weighted index and liquidity metrics are part of the inclusion criteria in the index portfolio (another one is not being a penny stock). The market capitalization considered for the weighting is solely that of the free-floating stocks. Free floating stocks are those available for trading and the number of free floating stocks is declared by companies according to Brazilian market regulation. Usually, stocks belonging to the controlling bloc are not considered part of the free float. This new methodology removed the former inconsistency from the liquidity weighting and came into force partially in January 2014 and fully in May 2014. The IBrX 100 was also used as an alternative to the Ibovespa because it is market capitalization weighted and did not exhibit the problem described above, even though its correlation with the Ibovespa is 0.97 during the sample period. While the IBrX 100 includes 100 stocks, the Ibovespa does not have a previously set number of stocks and includes those that pass its inclusion criteria. Currently the Ibovespa contains 58 stocks. Both the Ibovespa and the IBrX 100 are total return indices.

The last asset class to be analyzed is "international stocks" (IS). This is an alternative to the DS class for investors who wish to invest abroad. For ordinary investors the simplest way of investing in international stock markets would be through a domestic mutual fund that concentrates most of its investments abroad or an exchange-traded fund (ETF) indexed to a global stock index. However, the only two ETFs available by the end of 2016 on the Brazilian exchange were indexed to the S&P500 and were launched 02/27/2015 and 04/30/2014. Because there were no ETFs in the domestic market indexed by other international indices, there was no suitable vehicle to proxy for the entire sampled period. Furthermore, the domestically available S&P500 ETFs were restricted to qualified investors (those with more than R $1 million available to invest, or about US $333,000). Importantly, however, there are mutual funds available to ordinary individual investors that are S&P 500-indexed. These funds are currently available on well-known investment platforms targeting these investors. Some offer currency hedged returns. Thus, this asset class is available for these investors, and the S&P 500 index was chosen to represent this asset class and its dollar returns were converted

into Brazilian real returns, but not hedged for currency risk. In other words, the returns reported here are the compounded returns of S&P 500 in dollar terms with the US dollar exchange rate. The S&P 500 is not the perfect proxy for an international stock asset class; however, the presence of stocks from other countries is still trivial in the Brazilian market.

The simulation prior to 2014 is not without purpose even after admitting that only a very small portion of retail investors at this time would be positioned in this asset class and that mutual funds and ETFs indexing to the S&P 500 are a relatively new product. The inclusion of the international stocks asset class is more of an exercise regarding future strategic asset allocation decisions because these are now more easily available. It is also consistent with not including a hedge fund asset class because, as stated before, these funds target qualified investors instead of ordinary individual investors.

Finally, the real estate asset class deserves some commentary. The key reason for this class to be left out is the absence of adequate proxies. The Index of Real Estate Investment Funds (IFIX) was initiated in January 2011 and follows a portfolio of funds of this type traded in the Brazilian securities exchange. Even though this index seemed to be the best proxy for this asset class, particularly for individual investors, its time series is too short and is inconsistent with the selection criteria for balanced funds and indices (such as IMA-B and IHFA). Additionally, the daily trading volume of the Real Estate Investment Funds underlying the index was miniscule: US $1.7 million on December 2016.

Alternatively, the IGMI-C is the first indicator of profitability of the Brazilian commercial real estate market, according to their producers (IBRE/FGV/RJ). Though launched in 2011, it dates back to 2000. However, this index is computed quarterly, not monthly, and does not include residential real estate, which is an important segment for individual investors. Another problem with this index is that it is not a "real time" index. For example, the second quarter of 2017 index (end of June 2017) was not posted until August 3 of that year, rendering its use in financial assets portfolios problematic. The index value for the end of September was still not published in mid-October. Thus, given these limitations, the ensuing analysis considers only portfolios of financial assets. The robustness section includes comments on the results with portfolios including these two real estate indicators.

3.3. Equally weighted strategic allocation portfolios

Table 1 shows the six equally weighted strategic allocation portfolios built herein. The asset classes included in each portfolio make up portfolios that reflect different risk profiles. All portfolios contain class M because all investors are expected to allocate a portion of their funds in the most conservative asset class in order to have a certain level of liquidity. Cutait (2015) cited

Table 1. Weights of each asset class in the equally weighted portfolios.

Portfolio	Money	Inflation	Domestic stocks	International stocks
P1	1/2	–	½	–
P2	1/2	–	–	1/2
P3	1/2	1/2	–	–
P4	1/3	1/3	1/3	–
P5	1/3	1/3	–	1/3
P6	1/4	1/4	¼	1/4

studies that show that Brazilians allocate most of their funds in less risky assets and invest only a small part in the stock market. There are two versions of portfolios containing domestic stocks (P1, P4, and P6)—one with the Ibovespa and the other with the IBrX 100. Portfolio rebalancing occurred every month, quarter, four months, six months, or year. Rebalancing frequency affected portfolio returns and transaction costs.

3.4. Performance assessment

The equally weighted strategic allocation portfolios were compared with the returns offered by the CDI, IMA-B, Ibovespa, IBrX 100, S&P500, IHFA, and the six selected balanced funds. There were comparisons with buy and hold (B&H) and market-value weighted portfolios as well. The performance of all portfolios was compared with the benchmarks using descriptive statistics of cumulative returns, the return-to-risk quotient, the SR for the Ibovespa or CDI and the Sortino ratio relative to the Ibovespa. The return-to-risk coefficient was calculated by dividing the average monthly return by the standard deviation of monthly returns during the period. The generalized SR used the Ibovespa as a benchmark (Sharpe, 1994) and was calculated as in Equation 1, where $\overline{ER_i}$ is the average excess return of stock i and σ_i represents the standard deviation of this excess return. The SR was also calculated relative to the CDI using the same procedure as in Equation 1. Sharpe (1994) showed that the result of multiplying the SR by the square root of the number observations is equivalent to Student's t statistic, thus facilitating statistical significance tests. The Sortino ratio is a modification of the SR that considers only negative returns when calculating the standard deviation of excess returns (Sortino & Price, 1994). The Sortino ratio was calculated for the Ibovespa, and Equation 2 illustrates its calculation, where $ER_{i,t}$ is the excess return relative to the Ibovespa of stock i in period t, and T is the total number of observations during the period. Alexander and Sheedy (2015) defined the Adjusted SR (ASR_i) as in Equation 3, which considers the skewness (Asy_i) and kurtosis ($Kurt_i$) of the return distributions.

$$SR_i = \frac{\overline{ER_i}}{\sigma_i} \tag{1}$$

$$Sort_i = \frac{\overline{ER_i}}{\sqrt{\frac{\sum \left[min\left(0, ER_{i,t}\right)\right]^2}{T}}} \tag{2}$$

$$ASR_i = SR_i \times \left[1 + \frac{Asy_i}{6} \times SR_i - \left(\frac{Kurt_i - 3}{24}\right) \times SR_i^2\right] \tag{3}$$

Kourtis (2016) developed an error in estimates correction for the historical SR. These corrected Sharpe ratios address the issue of persistence of the results out-of-the-sample. The author offers an approximation equation for the expected out-of-sample squared SR (SSR) portrayed in Equation 4. This measure represents the out-of-sample performance of the tangent Markowitz portfolio, which offers the maximum SR. It is not possible to know if the SR estimated from historical returns is a reasonable approximation of the maximum SR of the tangent portfolio due to the errors in estimates problem. Kourtis (2016) uses Equation 5 to obtain an estimator of the squared SR of the tangent portfolio using the sample SR, where p is a portfolio, N its number of assets, T the number of historical observations.

$$\overline{SSR_p} \approx \widetilde{SR_p^2} - \frac{(N-1)\widetilde{SR_p^2}}{N + T \times \widetilde{SR_p^2}} - \frac{2(N-1)T \times \widetilde{SR_p^4}}{\left(N + T \times \widetilde{SR_p^2}\right)^3} \tag{4}$$

$$\widetilde{SR_p^2} = max\left\{SR_p^2 - \frac{N}{T}, \frac{2}{N+2} SR_p^2\right\} \tag{5}$$

3.5. Income tax and other transaction costs

Returns net of transaction costs were calculated considering the vehicle individual investors would use. The "money" asset class, represented by the CDI, was considered as if it were a CDI money market fund, and taxes are withheld at the source at a rate of 15% in May and November, and on redemption, according to Brazilian taxation rules. Taxation of Brazilian funds is the same for all investors regardless of income, other personal characteristics and invested amount. Fund administrators pay the taxes on behalf of investors twice a year by redeeming the necessary number of shares. Investors have no control over this procedure. The impact of a management fee is discussed next.

The "inflation" class, represented by the IMA-B, was considered, for the purpose of transaction costs, as being the same as a Treasury bond purchase undertaken through a broker and custodian by means of the Treasury Direct system because this would be a simple and cheap way for an investor to implement it. Thus, there was a custody fee of 0.30% of the total amount (0.15% every six months), broker's fee of 0.25% a year of the total amount,

and an income tax rate of 15% on capital gains paid at the time of sale. Once again, this tax is withheld and paid by the custodian broker on behalf of investors and is the same for all domestic investors. The fee charged by the broker was the median broker's fee on August 28, 2015, according to the BM&FBovespa.

It was considered that the easiest way for an investor to invest in the "domestic stocks" class, represented by the Ibovespa or IBrX 100, would be through an ETF. Small investors have easy access to these assets, which often track the indices better than the analogous indexed funds, due partly to their lower management fees (Borges, Eid, & Yoshinaga, 2012). Because ETFs trade like stocks, the following were considered: fixed monthly custody fee of R $6.90; fixed brokerage fee of R $14.90 on each buy or sell trade; Services Tax (ISS) of 3.5% charged on the brokerage fee; fees relative to settlement, and registration of 0.0325% of the total amount involved in the trade; and the 15% income tax charged on capital gains obtained on sales of over R $20,000 (about US $6,667). The investor is responsible to pay any capital gains tax at the end of the month following the sale. A small financial transactions tax (0.005%) is withheld and paid by the broker on behalf of the investor in order to indicate to the tax authorities that the selling investor may be liable for capital gains tax and to file a capital gains declaration with their annual tax return. The 3.5% Services Tax is an average of the rate charged in São Paulo (5%) and Rio de Janeiro (2%), the two largest cities in the country. The brokerage and monthly custody fees are a fair reflection of what the main brokerage firms charge. The study did not consider the variable brokerage fee, as brokerage firms do not usually charge it. The initial investment amounts were considered net of brokerage costs related to the purchase of the ETF.

Finally, in the case of the "international stocks" class, represented by the S&P500, it would be easier to invest in it through a multimarket fund, as the two ETFs linked to this index available in the local market targeted qualified investors at the time of the writing of this article. Income tax on capital gains was charged at the same rate as the "money" class. The impact of a possible management fee is discussed below. Balanced funds are taxed at exactly the same rate as classes M and IS, using the same procedures outlined.

Whenever rebalancing occurred, simulations of the transactions that would have to be made in order to re-establish the strategic allocation's initial weights were performed, in addition to deducting costs depending on each case. In order to avoid excessive transaction costs, a five per cent tolerance was considered for strategic allocation weights. For example, if a portfolio had a strategic allocation of 50% in class A and 50% in class B, it would not be rebalanced if the allocation when rebalancing was undertaken was 54% in A and 46% in B. If, on another occasion, the allocation was 56% in A and 44% in B, the portfolio would then be rebalanced. In the case of

portfolios composed of three or four asset classes, if only one of them was outside the tolerance band, the whole portfolio would have to be rebalanced.

All investments were redeemed at the end of the last month of the analysis, with the deduction of income tax and all other costs that had not yet been deducted, according to their specific rules. Thus, although a decline in returns in the last month of the period was to be expected, it was less pronounced in the case of investments in funds, because most of the income tax had already been deducted at regular intervals. Fund returns would suffer compared with those of securities if redemptions did not occur at the end of the period, because they would have paid most of the income tax due, while an ETF, for example, would not have paid anything.

4. Results

The first section analyzes the base case, with portfolios rebalanced every month without transaction costs. The following section discusses other rebalancing periods and various robustness tests while the final section presents the impact of transaction costs.

4.1. Base case

Table 2 presents cumulative returns and descriptive statistics for the monthly asset class returns, equally weighted strategic allocation portfolios, and balanced funds, including the top three (to save space) performing retirement balanced funds, during the January 2004–December 2016 period (156 months), as well as some risk-adjusted return measures. Fund returns in Brazil are originally reported net of expenses and management fees, but not net of income tax.

The CDI had the best return-to-risk ratio. There was no clear superiority of portfolios over funds when considering return-to-risk profiles. None exhibited an SR significantly greater than zero for a significance level of 5%, except that of the IBrX 100 relative to the Ibovespa. The risk-adjusted returns of portfolios did not differ from the CDI or Ibovespa. All funds had a negative SR relative to the Ibovespa and CDI, with five of them exhibiting significance. The SR of the portfolios relative to the Ibovespa did not display significance. Investment performance measured by the Sortino ratio was similar. The performance of the top three balanced retirement funds for the full period is inferior to those of the equally weighted strategic allocation portfolios (except for P2), even though they performed better than the balanced mutual funds. The presence of retirement balanced funds helps to reduce any effects stemming from the profile of managers of the six balanced mutual funds.

The statistical tests in Table 2 refer to average monthly returns, but cumulative returns should also be examined as they show the increase in investor

Table 2. Descriptive statistics of monthly returns.

Asset	Cumulative return (%)	Geometric average (%)	Arithmetic average (%)	Median (%)	Maximum (%)	Minimum (%)	Std. dev.	Return-to-risk	SR Ibovespa	SR CDI	Sortino Ibovespa
IMA-B	500.03	1.16	1.17	1.30	6.08	−4.52	0.0187	0.63	0.05	0.11	0.08
P3	423.44	1.14	1.07	1.12	3.59	−1.97	0.0095	1.12	0.04	0.11	0.05
P4-IBrX	414.73	1.06	1.08	1.16	7.48	−9.26	0.0241	0.45	0.05	0.05	0.09
P1-IBrX	366.07	0.99	1.04	1.00	9.88	−11.97	0.0316	0.34	0.05	0.02	0.08
CDI	350.61	0.97	0.97	0.94	1.65	0.48	0.0025	3.93	0.02	–	0.03
P4	349.38	0.97	1.00	1.05	7.81	−9.15	0.0251	0.40	0.03	0.01	0.05
P6-IBrX	336.86	0.95	0.97	1.22	6.18	−9.00	0.0203	0.48	0.02	0.00	0.03
IBrX 100	312.81	0.91	1.11	1.13	18.34	−25.11	0.0630	0.18	0.19*	0.02	0.33
P5	312.34	0.91	0.92	0.93	5.14	−3.63	0.0148	0.62	0.01	−0.03	0.01
P6	295.19	0.88	0.91	0.94	6.34	−8.92	0.0206	0.44	0.01	−0.03	0.01
P1	279.86	0.85	0.91	0.89	9.06	−11.81	0.0328	0.28	0.02	−0.02	0.03
R5	272.45	0.85	0.85	0.89	2.63	−1.18	0.0068	1.25	−0.00	−0.19*	−0.00
R7	271.59	0.84	0.85	0.89	2.65	−1.14	0.0068	1.25	−0.00	−0.19*	−0.00
R21	234.66	0.78	0.80	0.84	7.48	−6.76	0.0220	0.36	−0.01	−0.08	−0.02
P2	232.87	0.77	0.80	0.77	7.43	−4.88	0.0223	0.36	−0.01	−0.08	−0.01
F3	229.26	0.77	0.77	0.72	3.26	−2.50	0.0088	0.88	−0.01	−0.24*	−0.02
F4	220.18	0.75	0.76	0.70	5.17	−5.10	0.0162	0.47	−0.02	−0.13	−0.03
F2	219.91	0.75	0.76	0.82	5.38	−3.02	0.0120	0.63	−0.02	−0.18*	−0.03
F5	214.31	0.74	0.76	0.70	7.08	−7.70	0.0239	0.32	−0.02	−0.09	−0.03
F1	186.98	0.68	0.69	0.66	4.12	−3.01	0.0130	0.53	−0.03	−0.22*	−0.04
Ibovespa	170.85	0.64	0.85	0.66	16.97	−24.80	0.0654	0.13	–	−0.02	–
S&P500	127.13	0.53	0.63	0.41	14.04	−10.70	0.0449	0.14	−0.03	−0.08	−0.04

Note: Monthly returns between January 2004 and December 2016 (156 months). The S&P500 returns are in Brazilian currency (BRL). Returns of funds are net of expenses and management fees, but not of income and capital gains tax. The sampled funds are Bradesco FICFI Multimercado Golden Profit Moderado (F1), Caixa FI Multimercado Renda Variável 30 Longo Prazo (F2), Western Asset Multirenda 10 FICFI Multimercado (F3), Western Asset Multirenda 20 FICFI Multimercado (F4) and Western Asset Multirenda 30 FICFI Multimercado (F5). P1 (1/2 CDI and 1/2 Ibovespa), P2 (1/2 CDI and 1/2 S&P500), P3 (1/2 CDI and 1/2 IMA-B), P4 (1/3 CDI, 1/3 IMA-B, 1/3 Ibovespa), P5 (1/3 CDI, 1/3 IMA-B, 1/3 S&P500) and P6 (1/4 CDI, 1/4 IMA-B, 1/4 Ibovespa, 1/4 S&P500) are monthly rebalanced equally weighted portfolios. P1-IBrX, P4-IBrX and P6-IBrX use the IBrX-100 in lieu of the Ibovespa index. Return-to-risk is the ratio of the monthly arithmetic average return and its standard deviation. The SR Ibovespa and Sortino are defined in Equations 1 and 2 considering excess returns relative to the Ibovespa. The SR CDI was computed analogously to Equation 1. *indicates significance at the five per cent level of a two-tailed t-test.

wealth in the period. The IMA-B registered the largest cumulative return and the Ibovespa and S&P500 stock indices the lowest. Fixed income had a larger cumulative return than stocks during the period, and the equal weighted strategic allocation portfolio with the highest cumulative return (P3), with half allocated in the CDI and half in the IMA-B, reflects this. All the portfolios recorded better cumulative returns than the funds (except P2), Ibovespa and S&P500, and the balanced retirement funds fared better their mutual counterparts.

The cumulative returns in Table 2 show that the equal weighting adopted in the strategic allocation of portfolios achieved better results than those of balanced funds. All balanced mutual funds declared that their strategic allocation should be benchmarked in greater proportion relative to the CDI (between 70% and 90%) than the Ibovespa. However, all balanced mutual funds registered cumulative returns lower than P1 (half in CDI and half in Ibovespa). F1, for example, placed last among funds and portfolios, despite declaring a benchmark of 85% in the CDI, which should have led to considerably better performance than most other funds and portfolios.

There are at least three conjectures, not tested herein, for the lower cumulative returns registered by balanced mutual funds compared with the equally weighted strategic allocation portfolios: (1) bad active management decisions due to asset selection or market timing; (2) management fees penalize performance excessively; and (3) managers prioritize risk reduction to try to achieve a better return-to-risk relationship, as suggested by Mendonça, Campani, and Leal (2017).

Table 3 contrasts the selected mutual balanced funds with the performance of portfolios that correspond to the benchmarks and their weights that they declared. F1, for example, declared that it should be compared to 85% of the CDI and 15% of the Ibovespa. Curiously, in risk-adjusted terms, all funds significantly underperformed their respective benchmark portfolios. The standard deviation of five of the six funds was greater than that of their respective benchmark portfolios. This evidence corroborates the conjecture that the selected balanced funds failed to obtain advantages in their tactical deviations from their benchmarks and exhibited a greater volatility than the latter in most cases. The evidence in Table 3 suggests that active management in these funds was not successful.

Table 4 shows the analysis of the p-values of the t-tests for the difference between the average monthly returns of all assets and indices. Panel A of Table 4 indicates that only the average monthly returns of portfolios P3 (solely fixed income) and P4-IBrX 100 (CDI, IMA-B and IBrX 100) were significantly greater than the returns of balanced mutual funds in the total sample period at the 10% level or less. None of the portfolios recorded a positive and significant average return relative to any index. Shapiro-Wilk normality tests, not included in the paper, reject normality for the CDI, IMA-B, F2, P3, P4 IBrX,

Table 3. Comparison of selected balanced funds and their benchmarks.

Asset	CDI (%)	Average (%)	Standard deviation	SI BM
F1	85	0.69	0.0130	−0.52**
F1-BM	–	0.95	0.0101	–
F2	70	0.76	0.0120	−0.13*
F2-BM	–	0.94	0.0198	–
F3	90	0.77	0.0088	−0.73**
F3-BM	–	0.96	0.0070	–
F4	80	0.76	0.0162	−0.45**
F4-BM	–	0.95	0.0133	–
F5	70	0.76	0.0239	−0.29**
F5-BM	–	0.94	0.0198	–
F6	85	0.31	0.0209	−0.26**
F6-BM	–	0.39	0.0177	–

Note: Monthly returns between January 2004 and December 2016 (156 months). Fund F6 began in December 2007 (109 months). Returns are net of expenses and management fees, but not of income and capital gains tax. The sampled funds are Bradesco FICFI Multimercado Golden Profit Moderado (F1), Caixa FI Multimercado Renda Variável 30 Longo Prazo (F2), Western Asset Multirenda 10 FICFI Multimercado (F3), Western Asset Multirenda 20 FICFI Multimercado (F4), Western Asset Multirenda 30 FICFI Multimercado (F5) and Bradesco Prime FICFI Multimercado Mix (F6). CDI indicates the percentage of the fund to be compared to the CDI rate with the remainder corresponding to the Ibovespa, as declared by each fund. F1-BM, for example, is the benchmark portfolio of fund F1 formed by 85 per cent in the CDI and 15 per cent in the Ibovespa. F2-BM to F7-BM were similarly formed. The SI Ibovespa is the Sharpe Index according to Equation 1 and considering excess returns relative to its respective benchmark portfolio. ** and *denote significance at the five and ten per cent levels, respectively, for a two-tailed t-test that the SI BM is different from zero.

P6, and P6 IBrX. A non-parametric test for the median difference between paired observations of the equal-sized distributions (Sign Test) was used as an alternative. This test is appropriate for paired samples, as is the case of the time series of returns in this article, which are of the same size and of a monthly frequency. The null hypothesis of the test is that the median difference is zero. It is possible that this test, given its fewer assumptions about the distributions being tested, may lack statistical power relative to other tests (Snedecor & Cochran, 1989). Significance was actually much more frequent with the non-parametric test. There were far more significant results under the non-parametric median difference test than with the unequal variances two-sided t-test, while the non-parametric test confirmed the results from the vast majority of the t-tests. Thus, Table 4 reports just the parametric test results; the other tests are available upon request.

Panel B of Table 4 shows the same analysis for the period before the global financial crisis. All portfolios exhibited better average monthly returns than those of the S&P500, indicating that investors were harmed by the devaluation of the S&P500 in Brazilian currency, which began at the end of 2004. The P1-IBrX 100 and P4-IBrX 100 portfolios outperformed the CDI at the ten per cent significance level, in addition to some of the selected funds. The P3 and P4 (CDI, IMA-B and Ibovespa) portfolios outperformed fund F2 with statistical significance. Contrastingly, all funds outperformed portfolios P2 and P5 (with the S&P500 instead of the Ibovespa) with statistical significance.

Table 4. P-value of difference tests of average monthly returns between portfolios and benchmarks.

Panel A: January 2004 to December 2016 (156 months)

Asset	Mean	CDI	IMA-B	Ibovespa	S&P500	IBrX 100	F1	F2	F3	F4	F5
Mean	–	0.0097	0.0117	0.0085	0.0063	0.0111	0.0069	0.0076	0.0077	0.0076	0.0076
P1	0.0091	0.83	0.39	0.92	0.52	0.73	0.42	0.57	0.60	0.61	0.65
P2	0.0080	0.34	0.11	0.92	0.67	0.56	0.59	0.83	0.89	0.87	0.90
P3	0.0107	0.20	0.55	0.68	0.23	0.94	0.00	0.01	0.00	0.04	0.14
P4	0.0100	0.89	0.49	0.80	0.37	0.84	0.17	0.27	0.28	0.32	0.40
P5	0.0092	0.70	0.19	0.90	0.43	0.72	0.13	0.27	0.27	0.36	0.48
P6	0.0091	0.70	0.23	0.93	0.48	0.70	0.26	0.43	0.45	0.49	0.58
P1 IBrX	0.0104	0.78	0.65	0.75	0.35	0.90	0.20	0.29	0.30	0.33	0.38
P4 IBrX	0.0108	0.56	0.72	0.68	0.26	0.96	0.07	0.13	0.13	0.17	0.24
P6 IBrX	0.0097	1.00	0.36	0.83	0.39	0.79	0.14	0.26	0.26	0.32	0.41

Panel B: January 2004 to June 2008 (54 months)

Asset	Mean	CDI	IMA-B	Ibovespa	S&P500	IBrX 100	F1	F2	F3	F4	F5
Mean		0.0117	0.0131	0.0219	−0.0077	0.0260	0.0111	0.0098	0.0113	0.0129	0.0146
P1	0.0168	0.23	0.43	0.59	0.00	0.34	0.21	0.11	0.21	0.41	0.68
P2	0.0020	0.00	0.00	0.03	0.10	0.01	0.01	0.01	0.00	0.00	0.00
P3	0.0124	0.53	0.77	0.26	0.00	0.12	0.54	0.06	0.50	0.85	0.53
P4	0.0156	0.22	0.51	0.48	0.00	0.25	0.21	0.08	0.20	0.48	0.83
P5	0.0057	0.00	0.01	0.06	0.02	0.02	0.04	0.04	0.01	0.01	0.02
P6	0.0098	0.73	0.50	0.21	0.00	0.09	0.92	0.74	0.86	0.55	0.37
P1 IBrX	0.0188	0.10	0.23	0.75	0.00	0.46	0.10	0.04	0.09	0.22	0.43
P4 IBrX	0.0169	0.10	0.31	0.58	0.00	0.32	0.11	0.03	0.10	0.29	0.60
P6 IBrX	0.0108	0.73	0.50	0.21	0.00	0.09	0.92	0.74	0.86	0.55	0.37

Panel C: July 2009 to December 2016 (90 months)

Asset	Mean	CDI	IMA-B	Ibovespa	S&P500	IBrX 100	IHFA	F1	F2	F3	F4	F5	F6
Mean		0.0085	0.0105	0.0035	0.0167	0.0059	0.0099	0.0049	0.0062	0.0058	0.0050	0.0044	0.0035
P1	0.0060	0.43	0.23	0.72	0.06	0.98	0.23	0.76	0.95	0.95	0.79	0.68	0.51
P2	0.0127	0.08	0.51	0.18	0.44	0.28	0.28	0.00	0.02	0.01	0.01	0.01	0.00
P3	0.0095	0.33	0.65	0.34	0.14	0.53	0.77	0.01	0.08	0.00	0.01	0.03	0.01
P4	0.0075	0.69	0.34	0.55	0.08	0.79	0.35	0.35	0.65	0.51	0.39	0.34	0.21
P5	0.0119	0.03	0.59	0.19	0.33	0.31	0.25	0.01	0.00	0.00	0.00	0.00	0.00
P6	0.0083	0.51	0.79	0.34	0.18	0.51	0.96	0.04	0.15	0.06	0.05	0.06	0.03
P1 IBrX	0.0098	0.64	0.34	0.59	0.09	0.84	0.36	0.47	0.76	0.64	0.51	0.44	0.29
P4 IBrX	0.0072	0.93	0.46	0.47	0.11	0.69	0.50	0.19	0.44	0.29	0.23	0.21	0.11
P6 IBrX	0.0104	0.31	0.96	0.29	0.21	0.45	0.81	0.02	0.09	0.02	0.02	0.04	0.01

Note: The S&P500 returns are in Brazilian currency (BRL). Returns are net of expenses and management fees, but not of income and capital gains tax. The sampled funds are Bradesco FICFI Multimercado Golden Profit Moderado (F1), Caixa FI Multimercado Renda Variável 30 Longo Prazo (F2), Western Asset Multirenda 10 FICFI Multimercado (F3), Western Asset Multirenda 20 FICFI Multimercado (F4), Western Asset Multirenda 30 FICFI Multimercado (F5) and Bradesco Prime FICFI Multimercado Mix (F6). Fund F6 was considered solely in the post crisis period because it initiated in December 2007. IHFA is the Anbima Hedge Fund Index. P1 (1/2 CDI and 1/2 Ibovespa), P2 (1/2 CDI and 1/2 S&P500), P3 (1/2 CDI and 1/2 IMA-B), P4 (1/3 CDI, 1/3 IMA-B, 1/3 Ibovespa), P5 (1/3 CDI, 1/3 IMA-B, 1/3 S&P500) and P6 (1/4 CDI, 1/4 IMA-B, 1/4 Ibovespa, 1/4 S&P500) are monthly rebalanced equally weighted portfolios. P1-IBrX, P4-IBrX and P6-IBrX use the IBrX-100 in lieu of the Ibovespa index. The two-tailed t-test assesses whether the average return of the portfolio is different from that of an index or fund considering unequal variances.

Some portfolios with allocations in domestic stocks performed better than funds and indices (except the S&P500 and CDI in some cases) during the period before July 2008, but not exceptionally so. Portfolios P3 (only fixed income) and P2, P5 and P6 (which include the S&P500) obtained significantly

greater returns than those recorded by funds in the period after the crisis in Panel C of Table 4. Three of the nine portfolios significantly underperformed the S&P500. Non-parametric tests once again presented far more significant results than these t-tests in the two sub-periods and are not reported. The retirement funds in general performed better than the mutual funds in the sub-periods, but the conclusions reported did not change with their inclusion and these sub-period results are not reported.

Finally, additional tests (not included in the article but available upon request) compared the equally weighted strategic allocation portfolios to the benchmark portfolios declared by the balanced funds, which are indexed portfolios that mimic the CDI and Ibovespa according to proportions announced in the allocation policy of each fund. The benchmark portfolios that represent the allocation policy of funds F1 and F5 did not exhibit significantly different average monthly returns from those of equally weighted strategic allocation portfolios. The benchmark portfolio representing the allocation policy of fund F6, available only during the period after the 2008 financial crisis, offered a significantly lower average monthly return than that of the equal weighted strategic allocation portfolios that contained the S&P500 (P2, P5 and P6) or only contained fixed income assets (P3). This result, along with the one exhibited in Table 4, indicates that investors could achieve better results with passively managed portfolios that mimicked the benchmark portfolios of balanced funds, which employ the allocation policy of funds, or equally weighted strategic allocation portfolios.

In sum, the analysis of the sub-periods suggests that it is impossible to generalize the results of specific equally weighted strategic allocation portfolios. Whether individual portfolio returns beat those of funds depends on the period of analysis. Equally weighted strategic allocation portfolios perform as well as passive portfolios that mimic the allocation policies of funds, their benchmark portfolios, or even better in some cases. Funds adopted active strategies, obtaining results that exceeded their benchmarks when the stock market was doing well and falling short of expectations when the stock market had a weak performance. In general, active management attained poor results and investors could have performed better by investing in passively managed portfolios such as the ones described.

4.2. Robustness tests

The Adjusted Sharpe Ratio (*ASRi*) values, defined in Equation 3 and calibrating the influence of higher moments, for the full sample period and the two sub-periods, were basically identical to those of the SR. The monthly return frequency possibly reduced the influence of skewness and kurtosis on the ASR. These results are available upon request.

The corrected SR addresses the possibility of persistence of the results out-of-the-sample and found evidence that is consistent with the expectation that

the results in this article are likely to persist in the future. These results are available upon request. The corrected squared SR is portrayed in Equations 4 and 5 and was proposed in Kourtis (2016). Portfolio rankings using the estimated expected out-of-sample SR and the historical SR are virtually the same. Thus, the initial results according to the historical SR were not substantially affected by errors in estimates.

The rebalancing frequency can be an important factor because portfolios tend to deviate from their initial strategic allocation over time. The results of the base case with monthly rebalancing were reproduced with rebalancing every quarter, four months, six months and year. The sensitivity of portfolio performance to rebalancing frequency was very low. Investors could rebalance the portfolio twice or four times a year and possibly obtain similar results. Additionally, B&H portfolios, implemented as equally weighted strategic portfolios that were not rebalanced throughout the sample period, were tested as alternates to their monthly-rebalanced versions. The performance of the B&H portfolio is generally inferior or similar to that of the monthly rebalanced version of the equally weighted strategic allocation portfolios in this study. This result is consistent with the findings of Malladi and Fabozzi (2017) that attributed to rebalancing the good performance of equally weighted portfolios. These results are not shown here but can be obtained from the authors.

Another alternative to the equally weighted strategic allocation portfolios was to weight them by means of the relative market value of each asset class. Monthly market value figures for the "money," "inflation," and "domestic stocks" asset classes were obtained from the Brazilian Central Bank. "Money" was represented by the sum of the outstanding value of shorter-term zero-coupon treasuries, certificates of deposit and savings accounts. "Inflation" was the total value of treasury bonds, which are virtually all indexed to inflation indices. Corporate bonds do not constitute a large market in Brazil and are generally not available to individual investors. The market value of all domestically traded companies represented the market value of the "domestic stocks" class. The market value of the two ETFs of foreign stocks traded in Brazil indexing the S&P500 are too small to be relevant. Considering the US or global stock market capitalization would not make sense for this weighting for the domestic Brazilian investor. Thus, the "international stocks" asset class was not considered in these robustness tests. Two market-weighted strategic allocation portfolios were computed as alternates to the equally weighted versions using the "money," "inflation," and "domestic stocks" categories (1/3 each), one with the Ibovespa and the other with the IBrX 100 index. The market-weighted portfolios were rebalanced monthly. Their performance results were also inferior to those of the original equally weighted portfolios. These results are not presented here but are available upon request.

A final robustness test was the inclusion of real estate as an additional asset class, despite the limitations of the two benchmarks identified in Brazil.

The IGMI-C index (quarterly from January 2004 through December 2016) and the IFIX index (monthly from January 2011 through December 2016) are the real estate benchmarks. The results for the strategic allocation portfolios that incorporate real estate represented by the IFIX index do not exhibit a performance different from either those of the original equally weighted portfolios or of the asset class indices in the January 2011 through December 2016 period. The same is true for the strategic allocation portfolios that incorporate real estate represented by the IGMI-C index relative to a quarterly rebalanced version of those originally reported in the paper. This index, however, by itself outperformed those representing all other asset classes in the article, suggesting that the performance of the commercial real estate market in Brazil in the period was very good. Interestingly, the estimated quarterly average total return of the IGMI-C index was 0.0346 compared to 0.0277 for the IFIX in the January 2011 through December 2016 period, with a negative correlation between the two indices of −0.15. It seems that the real estate funds in IFIX had quite a different behavior relative to the commercial property underlying the IGMI-C. The IFIX is a suitable benchmark for investors because it is a portfolio of real estate funds, whereas the IGMI-C is an index of estimates of property values and income. These results are also available upon request.

4.3. Transaction costs

Monthly rebalancing with transaction costs was executed only when one of the weights deviated more than five percentage points from the proposed strategic allocation. The results presented in Table 4 were obtained for an initial investment of R $50,000. The same empirical exercise was repeated for initial investments of R $10,000, R $25,000 and R $100,000.

The evidence in Table 5 is consistent with the results depicted before. However, transactions costs had a significant impact on investments. Table 5 shows the percentage reduction of the final cumulative amounts. For example, consider the case of the IMA-B with an initial investment of R $50,000. The investor obtained a gross cumulative return of 500.03%, according to Table 2, which would correspond to a final amount of R $300,015.00 without transaction costs. The corresponding net cumulative return would be 389.77%, or a final amount of R $244,885.00, after transaction costs, a R $55,130.00 (18.4%) reduction in the final amount. It is easy to show that this percentage reduction in the final amount due to transaction costs is equal to $(GCR_i - NCR_i)/(1 + GCR_i)$, where NCR_i is the cumulative return net of transaction costs of asset *i*, presented in Table 5, and GCR_i is the gross cumulative return, shown in Table 2.

The value of the initial investment influenced only the results of domestic stocks due to fixed transaction costs, such as custody and brokerage fees,

Table 5. Impact of transaction costs.

Investment	NCR (%)	Amount reduction (%)	Arithmetic mean (%)	SR Ibovespa
IMA-B	389.77	18.37	1.05	0.04
P4-IBrX	329.49	16.56	0.97	0.04
P3	315.63	20.60	0.92	0.03
P1-IBrX	297.95	14.62	0.93	0.04
CDI	271.82	17.48	0.85	0.01
P4	264.59	18.87	0.86	0.03
P6-IBrX	255.27	18.68	0.84	0.01
IBRX-100	247.71	15.77	1.01	0.16*
P5	226.33	20.86	0.77	0.01
P1	220.39	15.66	0.78	0.00
P6	216.53	19.91	0.76	0.00
F3	181.07	14.64	0.67	−0.02
F2	174.81	14.10	0.66	−0.02
F4	171.08	15.34	0.65	−0.03
P2	165.44	20.26	0.64	0.00
F5	161.42	16.82	0.65	−0.03
F1	147.51	13.75	0.59	−0.04
IBOV	142.64	10.41	0.79	–
S&P500	79.57	20.94	0.47	−0.04

Note: Monthly returns between January 2004 and December 2016 (156 months). The S&P500 returns are in Brazilian currency (BRL). Returns are net of expenses and management fees, but not of income and capital gains tax. The sampled funds are Bradesco FICFI Multimercado Golden Profit Moderado (F1), Caixa FI Multimercado Renda Variável 30 Longo Prazo (F2), Western Asset Multirenda 10 FICFI Multimercado (F3), Western Asset Multirenda 20 FICFI Multimercado (F4) and Western Asset Multirenda 30 FICFI Multimercado (F5). P1 (1/2 CDI and 1/2 Ibovespa), P2 (1/2 CDI and 1/2 S&P500), P3 (1/2 CDI and 1/2 IMA-B), P4 (1/3 CDI, 1/3 IMA-B, 1/3 Ibovespa), P5 (1/3 CDI, 1/3 IMA-B, 1/3 S&P500) and P6 (1/4 CDI, 1/4 IMA-B, 1/4 Ibovespa, 1/4 S&P500) are monthly rebalanced equally weighted portfolios. P1-IBrX, P4-IBrX and P6-IBrX use the IBrX-100 in lieu of the Ibovespa index. Monthly portfolio rebalancing executed only when the actual allocation deviates by more than 5 per cent from the target allocation. The per cent amount reduction due to transaction costs is equal to $(GCR_i - NCR_i)/(1 + GCR_i)$, where NCR_i is the cumulative return net of transaction costs of asset *i*, presented in this table, and GCR_i is the gross cumulative return, shown in Table 2. The SR Ibovespa was defined in Equation 1considering excess returns relative to the Ibovespa. *indicates significance at the ten per cent level.

whereas the transaction costs in the case of the other classes were a percentage of the total or of capital gains. In a real investment situation, it would be wise to consider selling no more than R $20,000 of the ETF that represents the Ibovespa per month in order to avoid capital gains tax. There could be an improvement in the cumulative returns of investments in stocks when the initial investment increases. It is also important to note that smaller initial investments (R $10,000) are perfectly feasible in terms of the investment assessed, which makes them accessible to small investors. This occurs, in part, because the five per cent tolerance for weights avoids excessive rebalancing, which would be costly and unnecessary. Charging management fees of one per cent a year on the CDI and 2% on the S&P500, which were treated as funds, led to reductions of approximately 11% and 20% in their cumulative returns, respectively, but did not change the results of the portfolios. The P6 fund, which was ranked first among all the funds in Table 5, for example, would remain in the same position after deducting management

fees. The analyses using other initial investment amounts are omitted, but can be obtained from the authors.

5. Conclusions

The four asset classes considered were "money," "inflation," "domestic stocks" and "international stocks," represented respectively by the CDI rate and the IMA-B, Ibovespa (or IBrX 100) and S&P500 indices. The analyses herein showed that new equally weighted strategic allocation portfolios using different combinations of these asset classes exhibited higher cumulative returns than selected balanced funds.

There were five occurrences of average monthly equally weighted strategic allocation portfolio returns that were significantly greater than those of funds and no significant negative cases in 45 possible combinations during the total sample period, highlighting the portfolios that include the IMA-B. In contrast, in the period before the global financial crisis, there were seven instances of portfolio average monthly returns that were significantly greater than those of funds, highlighting those that include domestic stocks and the IMA-B, and 12 significant negative cases in 45 possible combinations. Finally, during the period after the crisis, there were 29 occurrences of average monthly equally weighted strategic allocation portfolio returns that were significantly greater than those of funds and no significant negative cases in 54 possible combinations, highlighting those that include international stocks. These results do not allow us to affirm that statistically significant occurrences are consistent over time. The only portfolio that exhibited an average monthly return significantly greater than any of the funds in the two sub-periods was the fixed-income equally weighted strategic allocation portfolio that allocated half in the CDI ("money") and the remainder in the IMA-B ("inflation").

The evidence herein suggests that selected balanced funds deviated from their strategic allocation policy. However, their active management was not successful as it resulted in significantly lower returns than those of benchmark portfolios constructed to track a mix of benchmarks according to the weights of their asset allocation policy, and often with greater volatility. Maybe, fund managers increased their allocation in domestic stocks beyond their target when the stock market was rising, resulting in good returns, but were unsuccessful when the stock market fell during the post-crisis period. We did not test this conjecture in this article.

In general, the evidence in this article indicates that balanced funds did not constitute an attractive alternative for investors because portfolios with passive allocation strategies mimicking the benchmark allocation policy of funds would have been a better alternative than actively managed balanced funds. Portfolios with an equally weighted allocation strategy would have been a

competitive investment, as practically all of them generated a higher cumulative return than that of all funds. The fund that included only the two fixed income classes considered (CDI and IMA-B) never exhibited an average monthly return significantly lower than that of balanced funds and often outperformed them, particularly in the post crisis period. On the other hand, the equally weighted portfolio that includes the CDI, IMA-B and Ibovespa did not achieve average returns greater than those of balanced funds. The equally weighted portfolios that included the S&P500 registered greater average returns than funds only during the post-crisis period.

An international comparison of interest rates shows that Brazilian interest rates are very high. The opportunity cost represented by the CDI rate is hard to beat. The risk-adjusted return offered by the CDI rate is considered a hurdle for the development of financial products in Brazil, given that it eclipses the returns of other investment returns due to their higher risk levels. Dana (2015), for example, supports the conjecture that fixed income is superior to stocks in the Brazilian case, showing that the CDI rate outperformed the stock market most of the time during a recent 21-year period, independently of the size of the analysis window chosen. The good performance of the IMA-B, albeit with greater risk, confirms that fixed income is an excellent option in Brazil, particularly for less sophisticated investors or with fewer resources to risk.

There is no debate that the monetary policy scenario at the beginning of 2018 is one of decreasing interest and inflation rates and that the current interest rates are the lowest in decades. In the short term (one year possibly), several analysts still consider that interest rates will go even lower and that inflation will remain low, by Brazilian standards, and within the Central Bank target of 4.5% per year (±1.5%). However, Brazil faces many serious challenges, including the mounting budget deficits problem (with little room for tax increases) and pension reform during the remainder of President Temer's term, as well as political uncertainty vis-à-vis the economic policy of the new president to be elected by the end of 2018 (some key candidates may follow an expansionist and populist agenda). Thus, it remains to be seen if the descending trend of interest rates will reach a sustainable level of low interest for the next few years or, as it has happened before, it will reverse. Financial institutions have been working with a real neutral interest rate between 4% and 6% per year, which is not low. It may well be that the results in this article, representative of what happened after the Real Plan, may not reflect the future if Brazil enters a long period of lower interest rates.

The empirical exercises undertaken in this article suggest that small investors can rebalance equally weighted strategic allocation portfolios between two and four times a year to reduce transaction costs. Employing allocation tolerance bands can be useful in avoiding excessive rebalancing. It is important for investors to avoid selling more than R $20,000 worth of investments in a

single month to be exempt from capital gains tax. Transaction costs and income tax have a considerable impact on the performance of financial products, but do not affect the feasibility of initial investments amounting to R $10,000, and do not alter the conclusions obtained from results that do not consider them.

The evidence in this article demonstrates the importance of investigating the effectiveness of active management in funds aimed at investors in general. In particular, balanced funds are most common in the form of retirement products and, if they employ active management and are unsuccessful, the results reported herein suggest that investors could obtain better results by replicating the targets of actively managed balanced retirement funds by investing in a portfolio of retirement funds benchmarked against the CDI and Ibovespa, for example, rebalanced a few times a year.

There is a potential for tournament effects among balanced mutual funds (Brown, Harlow, & Starks, 1996). The competitive pressures for a good showing at the end of the year in their category, which could lead to greater cash inflows and fees, may induce managers to take greater risk by deviating from their benchmarks. This is also consistent with the evidence that balanced mutual funds tend to underperform balanced retirement funds, which are subject to more stringent prudential rules and are possibly managed more conservatively. This conjecture was not addressed in this article and could be a possible future line of investigation into such funds and their contrasting performance relative to passive strategic allocation portfolios and retirement funds.

The evidence presented may be useful for other countries. Even though the high real interest rates regime in Brazil has extended for more than twenty years, other large developing economies such as Argentina, Nigeria, Russia, Turkey, and the Ukraine have high interest rates as well and, if they result in high real interest rates, strategic portfolio allocations by investors in those countries may resemble what occurs in Brazil, with large proportions of fixed income assets and little in terms of domestic stocks. This conjecture is a suggestion for future research.

Future studies could also consider assessing other asset classes, such as real estate, whenever longer time series or better proxies are available, and those that are less commonly used by ordinary investors, such as exchange rate-linked bonds and securitized asset funds. Using an allocation tolerance band of ±5% for rebalancing purposes proved to be a good way to avoid excessive rebalancing and costs, and the fine-tuning of this parameter could also be developed in future studies.

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