3.2 Fiscal Reforms and Monetary Union

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Second Round of Fiscal Consolidation in European Monetary Union.

Lessons from the Past and the New Fiscal Rules.

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Abstract: The pandemic crisis and the subsequent political turmoil and return of inflation after several decades are demonstrative of the limits of the economic orthodoxy that has prevailed since 1980. The Stability and Growth Pact has been suspended to stave off any unwanted economic consequences of the pandemic. Since then, the debt of the member states of EMU has soared and the fear of a new round of crisis, a debt crisis this time, has been invoked to justify the re-activation of fiscal rules. We attempt to contribute to this discussion by calculating fiscal multipliers in three categories of countries of EMU, namely big and small, open and less open and countries with high and low debt. We use a PVAR model to estimate multipliers for governments final consumption and social benefits. The results indicate large difference both between the three categories and between the different multipliers. These differences in multipliers will affect the speed and the success of any fiscal adjustment program and may eventually lead to **multi-speed fiscal adjustment Europe.**

Keywords: Fiscal Policy, European Monetary Union, Fiscal Multipliers, Debt, Fiscal Rules, VAR model

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1. The economic framework of EMU

During the 1950s and 1960s, Keynesian policies dominated. Low unemployment and high growth were set as the objectives of economic policy. The demand-side policies that the Keynesian state followed, and the need for the government to finance its budget, put pressure on the central bank to follow expansionary policies. This institutional arrangement was blamed for the inflation of the 1970s. During the same decade, the inability of the Keynesian state to fulfil its objectives and the increasing belief that Keynesian policies were responsible for an inflationary bias brought on monetarist ideas as the new paradigm of economic policy. At the heart of the monetarist theory has been the critique of the role of the central bank as a lender of last resort and its inability to lower the unemployment rate below its natural level. Therefore, according to monetarist doctrine, the central bank should only concern itself with controlling price levels and not with financing the government. Thus, monetarists claimed that the central bank must be independent. This seemingly simple idea fundamentally changed economic policy. Since the government would have lost this financing tool, it would have been impossible to finance its expansionary fiscal programme. As a result, governments must streamline their budgets and become more efficient and supportive of the market to find resources to finance their budgets. This idea brought a new economic paradigm that changed both the economic policy and the institutional framework of the Keynesian state.

So, the new institutional arrangements are based on two, complementary, pillars: the independence of central banks and the fiscal prudence of governments. Eventually, this means that fiscal and monetary policy, which are interconnected in the Keynesian economic framework, will be separated, and assigned different tasks. Monetary policy should focus on price stability, and to pursue this task, governments must balance their budgets.

The new economic paradigm, which Paul Volcker initially applied in the US, has been the blueprint for the economic design of European Monetary Union (EMU) and dictates the Maastricht criteria. Even though the first decades succeeded in controlling inflation and boosting economic growth, this theory is heavily criticised, first on theoretical grounds and, more recently, for its ability to tackle economic problems.

As for the former, a few years after the implementation of monetarist theory, a new insight disputed its core argument. At the beginning of the 1990s, a new insight into the effects of fiscal policy appeared with the publication of the seminal paper by Sargent and Wallace (1981), which claimed that even in an economy that follows monetarist assumptions, under certain circumstances, a monetary authority cannot control inflation. This assertion leaves room for the introduction of fiscal policy. This refutes the monetary contention that the price level is primarily controlled by monetary variables. Thus, the fiscal theory of the price level has reignited a long-standing debate in which no consensus exists.

The second critique focused on fiscal policy. The financial and banking crises of 2007–2008 hit developed economies forcefully. National governments attempted to revitalise economies, and particularly the financial system, by providing the necessary financial support. After many years of applying supply-side policies, it was once again time to remember the Keynesian doctrine and the necessity of state intervention to restore economic activity. This was the first round of increasing the fiscal deficit. Some years later, the coronavirus pandemic broke out. Economies floundered again (in a very short time since the financial crisis) under severe stress. National and regional lockdowns shrank economic activity, which was hit simultaneously by

negative demand and supply shocks. This economic downturn has made providing financial support to households and firms an imperative task, leading to a substantial expansion of public spending and deficits. Both crises showed the limits of monetary theory. Fiscal prudence should be abandoned, and monetary policy should push the economy to the zero lower bound. This creates an artificial environment of close-to-zero interest rates for government bonds, thus increasing government borrowing. The crucial issue after the end of the pandemic crisis will be the elimination of excessive budget deficits.

2. The need for fiscal discipline in EMU. Alternative methods

2.1 Why Nations Accumulate Debt

A salient issue of the theory of debt accumulation that should be analyzed is the 'common pool problem'. The common pool problem 'is promising and powerful in explaining the emergence of large and persistent deficits' (Poterba & von Hagen, 1999). This approach pointed out that problems arise when the financing source is a common property. Under this view, anyone has the incentive to take a larger part than its contribution to this common source. Put differently, the common pool problem reveals the free riding behavior. The existing literature on this topic can be divided into three main strands. The first attempts to provide answers to debt accumulation dates to the work of Buchanan and Wagner (1977). The Political Business Cycle explains debt as an effort of governments to manipulate public spending with the purpose of be re-elected. This opportunistic behaviour is based on the assumption that voters do not fully understand the policy implication of large deficits. Thus, they overestimate present consumption and underestimate future tax burden. This 'fiscal illusion' (Alesina & Perotti, 1994) is the basis of debt accumulation. This approach has been criticised on the basis that voters are not deluded by opportunistic politicians. This argument was developed by Rogoff (1990), who pointed out that voters cannot observe the projects undertaken by governments, due to which they cannot properly assess the purpose of deficit creation, but they do observe the increase of debt.

A second strand on the debt accumulation theory posits, in close relation to the first strand, that political parties accumulate debt in an attempt to serve specific interests. This political approach has been highly debated and offered many different interpretations. One of these focused on distinct preferences that politicians have. In an attempt to tie the hand of their successors, political parties create high deficits according to their preferences. Alessina and Tabellini (1990) developed a model with two political parties with different preferences on the composition of public spending. The incumbent has the incentive to spend more on the goods they prefer and passes the cost of repayment into the future government. In the same line of argument, Persson and Svensson (1989) presented a model wherein the officials differ in their views about the optimal size of the budget. Accordingly, the current officials, who prefer a small deficit, would cut taxes to compel the next government to keep the spending down. The more the level of polarisation between political parties the more will be the strength of the predictive power of both models. The empirical test of these theories was the point of numerous articles. To measure the degree of polarisation, Stein et al. (1998) examined the relationship between electoral systems and fiscal performance for countries in Latin America for the period of 1990 – 1995. Findings indicated that countries with more proportional electoral system and more political parties produce larger deficits. Amorin and Borsani (2004) examined a series of indicators, including the ideology of the government, the degree of centralization of budget institutions and election time. Results showed that right-wing governments with stability of

ministers produced balance budgets. Generally, the results illustrated a weak empirical support for the above theories, due to political, legal and economic differences between the countries.

A third strand of theories emphasizes the role of voters. This approach was first presented by Weingast (1981) who related high debt with geographically dispersed interests. Thus, each part claims a bigger share from the budget to satisfy the geographical interest. Similarly, Alessina and Tabellini (2005) pointed out that the same results could be observed in an economy during a boom period. This is because groups with competing interest strive for increased resources and consequently, the debt soars. Distributional conflicts have also provided the grounding for the influential theory of Alesina and Drazen (1991), who elaborated a model where the cost of fiscal stabilisation is unequally shared between different groups. Therefore, each group seeks to avoid the cost of stabilisation. Thus, a 'war of attrition' arises. This situation lasts until one of the groups concedes. This group is considered as the first loser, and afterwards a second round starts involving the remaining groups. Therefore, according to Alessina and Drazen (1991), this conflict is a zero-sum game. Following these authors' work, Velasco (2000) modified the 'war of attrition' approach, pointing out that reforms for fiscal stabilisation are taken when the cost of extra deficit makes delays unfavorable for all groups.

2.2 Debt Monitoring in the Monetary Union

The issue of debt becomes more complicated when the analysis concerns member states of a monetary union. In the case of EMU, several flaws make the need for fiscal cooperation essential for the stability of the union, but they are quite complex. According to Bordo and Jonung (1999) these flaws concern the lack of a lender of last resort, the lack of democratic control and accountability of ECB, the size of EU and the diversity of the economies that make the decision-making procedures difficult and, finally, the absence of central coordination of fiscal policy that makes the union vulnerable to asymmetric shocks. Thus, the need for fiscal prudence is imperative, and the question is whether this task could be achieved either by imposing restrictive numerical fiscal rules, by constructing procedural arrangements (i.e. assigning specific task to institutions such as (common) central bank and/or fiscal institutions) or, finally, by leaving stabilisation to the corrective mechanism of free market. We analyse these alternatives below.

Starting from the last choice, the proponents of market mechanism argued that price signals can provide the incentives to discipline the fiscal behaviour of the governments. For example, in case of an efficient financial market (and ignoring taxation), differences in the nominal interest rates on public debt captures three components, namely the expected risk of currency depreciation, exchange rate risk premium and national default risk premium. Thus, when a country's borrowing becomes more expensive, the signal of the increase in the nominal interest rate of government bonds leads to a more restrictive fiscal position. An alternative market mechanism that could restore fiscal sustainability is the price level. This issue has been discussed in depth in the first part of this thesis, and as was shown, the validity of the price mechanism is controversial. Advocates of market mechanism assume that markets, especially financial markets, are frictionless. Lane (1993) identified four conditions that must be met for market discipline to be effective: The capital market should not be restrictive, lenders should be fully informed on the borrowers' liabilities, the borrowers must respond to the market signals and, finally, there should be no anticipation of bail out. The last condition is critical and has been the focus of much research. For example, Feld et al. (2013) found that, under a credible no-bail out regime risk, the premia of the cantons of Switzerland reduced by about 25 basis

points. Another interesting insight in the field was provided by Bernoth et al. (2012), who analysed the impact of fiscal policy on interest rates in the eurozone and found that spreads of eurozone countries versus Germany and the US were positively correlated by debt and debt service ratio. Thus, credit markets monitor fiscal performance and exert disciplinary pressure on governments (p. 20).

However, markets are anything but perfect. As Lamfalussy (1989) stressed in the Delors Report 'a government may be less responsive in the short run to an increase in the cost of its borrowing resulting from market anticipations of future debt problems because it might feel that higher debt service payments can be met by raising taxes and/or, perhaps, by monetizing the deficit' (p.125). In the case of a monetary union, the fiscal behaviour is based mainly on the solidarity of preserving the stability of the currency. Otherwise, a member state might expect a bail out by ignoring the market signals. This is the main reason for the failure of market discipline. A further implication of market mechanism refers to the inability of the interest to accurately reflect fiscal policy developments. This becomes clearer in times of economic distress as market signals –with regard to prices or interest rates – tend to overreact, or, as the Delors Report put it, 'rather than leading to a gradual adaptation of borrowing costs, market views about the creditworthiness of official borrowers tend to change abruptly and result in the closure of access to market financing' (p. 20). To analyse this, Bergman et al. (2013) conducted a research on the four southwest euro area periphery countries (Portugal, Ireland, Italy and Spain) and found that market signals are unreliable and inconsistent. Aizenman et al. (2011) reached the same conclusion by estimating the pricing of sovereign risk for 60 countries based on fiscal space (debt/tax, deficits/tax) and other economic fundamentals over the years 2005 – 10. Their results indicate that, the market 'price' default risk of countries in the eurozone periphery was higher than the other countries in 2010. This may be partly explained by the fact that the market discounts future, and not current, fiscal developments. Another explanation is the market's inability to effectively assess the risk in the eurozone periphery. De Grauwe and Ji (2013) focused on the relation between the spread of government bonds of the eurozone and the default risks which in turn is determined by several fundamental variables. Among them, the most critical one was the government debt-to-GDP ratio. During the period 2000 – 08, these fundamental variables diverged between countries of the eurozone; yet, the spreads were remarkably close. In the aftermath of the financial crisis, the spread differences are quite divergent at a level that could not be explained by the differences of fundamental variables. Thus, the question is whether the market mispriced the default risk before or after the crisis. This under-estimation (or over-estimation) of default risk makes 'government bond markets in a monetary union are more fragile and more susceptible to self-fulfilling liquidity crises' (DeGrauwe & Ji, 2013, p. 878).

As highlighted above, an alternative for fiscal control through market mechanism are fiscal rules. The design of appropriate fiscal rules has been heavily debated especially after the establishment of European Monetary Union. Based on the relevant literature, we may distinguish two kinds of fiscal rules. First, there are policy rules that are imposed on economic institutions, mainly in the central bank and governments, that seek to balance the economic decision between them. Second, there are specific numerical targets imposed mainly on the governments to avoid fiscal profligacy. In the former case, a schema of policy coordination should be established, while in the latter, monitoring and sanction procedures should be enacted.

Considering the former, the coordination between fiscal and monetary policy confronts the externalities –positive or negative – that fiscal policy may impose in other countries of a monetary union. Examples of positive externality are public goods that a country finances,

which may have positive spill-over effects on another country. Another example of positive externality is the fiscal expansion of a country, which increases consumption and imports, thereby supporting exports and production and diminishing unemployment in other economies. Examples of negative externalities include other economies potentially suffering from increases in interest rates and the cost of a government's borrowing due to the fiscal expansion of a country. One way to tackle these externalities is to assign specific tasks on (common) central bank and/or the governments as an instrument to avoid excessive debts. According to Dixit and Lambertini (2003), the agreement between the central bank and fiscal authorities on the appropriate level of inflation and output reassures ideal equilibrium 'without the need for monetary commitment, irrespective of which authority moves first and despite any disagreement about the relative weights of the two set of objectives' (p. 13). Under this framework any additional fiscal rules may be proved counterproductive. The importance of fiscal policy was further highlighted by Kirsanova et al. (2007). According to them, if output increases in one country in the monetary union and falls in another country, then inflation will gradually appear in the first country. This inflation inertia will diminish the real interest rate which, in turn, will further increase output and inflation. Given that the nominal interest rate does not change, the monetary policy will not change either. Therefore, fiscal policy is the only way to stabilise an economy. Moreover, due to lower interest rate, real government debt will decrease leaving room for further increase in government spending. Thus, the reaction of fiscal policy to debt will be proved inflationary. Again, constraints on fiscal policy might be counterproductive – fiscal policy provides a valid policy for inflation and output but is destabilising when reacting to a government's debt changes. The effects of fiscal policy on output and debt sustainability has also been examined by Furceri and Mourougane (2010). Based on empirical evidence, they found that an increase in public investments increases the GDP by 1,1%. The same results were derived by public consumption as well, though in a smaller degree, and public transfers have the smallest impact on GDP. As far as taxes are concerned, a decrease in tax wage increases employment and output by 0,4% in the first year while in the long run the impact vanishes and also increases the debt-to-GDP ratio by 0.8% after 10 years. Finally, a cut in consumption tax increases the GDP by 0,25%. In sum, fiscal policy is an effective tool to boost economy; however, the impact varies according to the fiscal instrument. The above analysis highlights the effects of fiscal policy and provides the theoretical framework for the coordination of fiscal and monetary policy.

A further implication of monetary union is the response to shocks. If shocks are not idiosyncratic, the response of fiscal and/or monetary authority could be reacted uniformly and support the economy. In the opposite case, a country needs to fully control fiscal and monetary policies to respond appropriately to fiscal shocks. The loss of monetary autonomy due to participation in a monetary union may prove to be precarious. Thus, the appropriate reaction of economic policy is determined by the relations between fiscal and monetary policies. A strand of literature attempts to shed light on the issue of coordination between fiscal and monetary policy. Kooper and Kempf (2000) distinguished three cases. In the first case, the fiscal policy is constrained, and the stabilisation policy is undertaken by the central bank, which has the authority to print and allocate money in decentralised fiscal authorities. This case is optimal under the condition of identical shocks between economies. The second case involves both the fiscal and monetary policy being constrained. Adding more constraints does not improve the welfare as stabilisation tools are completely lacking. Finally, if fiscal authorities decide their fiscal policy in a non-cooperative manner and the central bank passively finances their debt, the result will be high inflation. Along the same lines, Beetsma and Limburg (1995) pointed out that when the central bank is unable to commit and the government is myopic (i.e. the fiscal policy does not reflect the preference of the society), monetary unification leads to excessive debt. Thus, the second-best solution is to make the central bank more conservative

(i.e. attach higher priority to price stability). If the central bank is conservative and governments are myopic, further fiscal restraints should be imposed. A different angle of the relations between common central banks and governments was given by Beetsma and Bovenger (1995) who introduced the size of a monetary union as an explanatory variable of the coordination of fiscal and monetary policies. In particular, as monetary union becomes larger, the fiscal position of specific member states to create inflation in a monetary union diminishes. This will discipline the fiscal behaviour of member states and improve welfare as it restrains inflation, public spending and public debt. However, this model does not introduce the relevant magnitude of each economy, i.e. the fiscal position of big economies may influence inflation on a larger scope and determine monetary decisions or fiscal rules. This is the central hypothesis that this thesis attempts to highlight.

The above discussion presents the choices and tasks that should be assigned in monetary (central bank) and fiscal (governments) policies so that a monetary union can enable the improvement of welfare. An alternative to framing economic policy decisions is to set fiscal rules. In most cases this is done through numerical targets that each country of a monetary union must follow. The debt ceiling rules must be simple and straightforward. Moreover, they must be accompanied by monitoring procedures that do not create considerable bureaucratic cost. Finally, a necessary supplement of the fiscal rules are the sanctions that must be imposed on the countries that violate the rules. All three elements of fiscal policy described above are necessary and sufficient conditions for the efficient functioning of a monetary union. However, the competence to successfully establish such a framework is questionable and has led to a lively debate. Nevertheless, even if fiscal rules are well established, a further issue concerns the cost of imposing fiscal constraint in the member countries of a monetary union, jeopardising in this manner their economic viability. All things considered, fiscal design is at the core of monetary unions; yet, guaranteeing the stability of currency and economic efficiency is far from being an easy task. This is because numerical targets create incentives of achieving them at any cost. In his ten commandments of fiscal rules in EMU, Buiter (2003) elucidated the characteristics of fiscal rules, namely that fiscal rules should be simple, ensure solvency, be neutral, establish efficient coordination between government and central banks, avoid cyclical behaviour, be achievable in the long-run, be efficient both in EU and member states level, be credible, ensure enforceability and allow for differences in economic structure and initial conditions. As seen, Buiter (2003) did not refer to elasticity in the case of dire economic conditions. What was ruled out instead was the cyclical behaviour of fiscal policy. In this manner, fiscal policy serves the need of stability of the monetary union but not the stability of a particular economy. On the other hand, the idiosyncratic character of fiscal policy spreads negative externalities in the monetary union. Inman (1996) identified six characteristics for the success of fiscal rules, namely there must be ex post deficit accounting, the policies must be suspended by a simple majority rule, enforced by a politically independent authority, allow the participation of all member to the monitoring of the violation of rules, be accompanied by sanctions and, finally, with costly amendments of the rules. Thus, the balance of dealing with asymmetric shocks and the preservation of the stability of a monetary union is the bet that fiscal design must win. This balance should take into consideration the trade-offs between simplicity and flexibility, simplicity and adequacy as well as flexibility and enforceability. (Buti & van den Noord, 2004). Even if fiscal rules are appropriately designed and have all the above-mentioned characteristics, there are several exogenous features that might open a window for breaching those rules (Von Hagen, 2002). The use of off-budget funds allows a government to deviate from fiscal rules and serve special interests. Further, fiscal rules might be diverted by certain exogenous economic developments that affect public spending and taxes i.e. the indexation may increase public spending. Moreover, some spending is difficult to be managed because they are either mandatory from non-financial laws or inelastic (e.g. defence spending).

The exact definition of the constituent elements of a budget should be made a part of fiscal rules (i.e. what should be included in the public spending, how deficit and debt are calculated etc.). This will avoid substitution of debt instruments (Von Hagen, 1991) as governments bypass fiscal rules. Kiewiet and Szakalay (1996) identified that the borrowing of constraints is associated with the larger debt of sub-central entities (municipalities). A final substitution effect was analysed by Von Hagen and Eichengreen (1996), who found that central governments tend to have a higher debt-to-GDP ratio when strict numerical constraints are imposed in the sub-government. In the case of a monetary union, if taxes are in the control of the member states, the no-bail-out rules should be strong and straightforward. This is because if taxes remain decentralised, any sub-central government has the financial means to collect revenues to service its own debt. Otherwise sub-central governments will ask either for financing or for a bail out. This will further increase free-riding behaviour on the part of sub-central governments.

The above discussion reveals that fiscal rules involve not only economic issues but also the political environment, the administrative structure and social preferences. The above discussion attempted to separately analyse the three aspects of fiscal policy (namely institutional cooperation, numerical tasks and market mechanism); yet, they should not be perceived as distinct. In the real world, these aspects act concurrently. Thus, the question is whether they act appropriately. The key issue to assess fiscal policy in the framework of a monetary union is to examine whether shocks are idiosyncratic or affect the monetary union altogether. In the first case and under strict no-bail-out rules, as in the case of EMU, individual member states are left with only one option – to implement pro-cyclical fiscal policies in case of violation of the fiscal rules. On the other hand, if shocks affect the monetary union altogether, the options are to activate a general escape clause or to bail out or both. In the case of a bail out, the fiscal rules will not be violated but institutional cooperation should be re-defined, and central banks should act together with fiscal authorities so that expansionary policies are fully effective. On the other hand, the former option restores fiscal policy at a national level. This might jeopardise the stability of the currency if member states overreact. When fiscal rules are re-activated, fiscal consolidation might prove a difficult task. Under this circumstance, stringent fiscal rules will force member states to pro-cyclical measures that might prove ineffective both for member states and for the union in total. A crucial issue is to examine whether it is possible to impose front-loaded programmes of fiscal adjustments to all countries of a monetary union and how this will affect the union as a whole. This was the working case of this thesis.

3. The fiscal adjustments program of Greece. Pros and cons

Shortly after the financial crisis of 2007–2008, the fear that fiscal diversion might endanger the fiscal sustainability of Eurozone countries, thus leading to a debt crisis, led to fiscal austerity measures. The high debt of the southern countries, together with their structural problems, initiated economic adjustment programmes that imposed front-loaded fiscal measures with the task of dealing with high debt and enhancing the confidence of local economies. Therefore, countries should rapidly engage in fiscal consolidation efforts in a recessionary environment. These measures reached unparalleled levels in the case of Greece. Moreover, the Economic Adjustment Programmes applied in Spain, Portugal, Ireland and Greece, and the general framework of fiscal austerity, created negative spillover effects throughout the European economy (IMF, 2010). Fiscal contraction targeted compliance with the numerical tasks of 3% for public deficit and 60% of public debt imposed in the reformed Stability, Coordination and Governance Treaty signed in 2012, which forced countries to achieve 1/20 of the yearly

adjustment until 2032 to reach the target. Under these developments, the dilemma that many economies faced concerned the attainment of long-term fiscal sustainability, on the one hand, and the avoidance of a deep recession that fiscal efforts created.

Briefly, the task of the Fiscal Adjustment Programmes is twofold: in the short run, to provide the necessary funding in the economies to avoid default, and in the long run, to implement structural changes. Both of these tasks have positive and negative aspects, which we will discuss in the context of the Greek case.

To avoid default, the International Monetary Fund and the EU agreed to provide financial assistance to Greece. The ESM and EFSF provided loans to Greece at much lower interest rates and with exceptionally long maturities compared to what the market would offer. These favourable lending terms have generated considerable budgetary savings, facilitating fiscal consolidation. Yet, the programme was front-loaded, which means that fiscal measures should be taken en masse in the first years of the programme. This eventually caused a deep recession.

On the other hand, structural reforms, though necessary, have been blamed for being poorly designed. The emphasis was placed on labour market liberalisation. A decrease in labour costs per unit of output is usually good for competitiveness and exports. Yet, exports are mostly affected by structural competitiveness and not price competitiveness. Further, decreases in wages brought about a profound decline in output due to a decrease in aggregate demand. Moreover, low wages were not affecting prices due to rigidities in the goods market. In other words, liberalisation should first aim at the goods market. These problems were addressed by Blanchard and Leigh (2013, 2014) and the International Monetary Fund (IMF, 2010) in their influential research, which showed that larger-than-expected fiscal consolidation was associated with lower growth rates. Barrel et al. (2012) also attempted to analyse the effects of fiscal consolidation on the size of the debt stock, the political will to deal with the size of the debt, and the costs of consolidation. Based on a series of simulations using the National Institute Global Econometric Model (NiGEM) in 18 OECD economies, it was found that fiscal multipliers are negative when fiscal policy is restrictive because it reduces growth in the short run in almost all countries. A lower debt stock reduces pressure on real interest rates and, consequently, may increase output in the long term. The larger the economy, the greater the effect. Finally, there is wide agreement that the programme was based on incorrect assumptions about fiscal multipliers.

4. Empirical Evidence

From the financial crisis of 2007-8 there has been an increasing interest to re-estimate fiscal multipliers and examine the factors that may affect the size of multipliers at the same time. We may find two broad categories of factors that affect multipliers – business cycle and structural factors. Starting from the former, the recession caused by the financial crises of 2007-–08 offered a new framework to re-estimate fiscal multipliers. There were several studies that showed that fiscal multipliers are higher during recession than in normal times. Moreover, there has been an interest to identify and analyse the leading factors that affect the size of fiscal multipliers.

In our study we develop a PVAR model to estimate fiscal multipliers. We divide the 19 member-states of EMU in three categories, and we calculate multipliers for each category:

1. Big and Small countries. The size of the country is a core variable because if the mechanism and rules of fiscal discipline are the same for each country and the multiplier is found to be dependent on the size of a country, then it would be easier for some countries to restore its fiscal position, while for some countries, either fiscal austerity must last longer or fiscal discipline must be more dire and consequently more recessionary. To address this issue, we construct a new variable. We define the size as the nominal GDP of each country as a share of the GDP of the whole monetary union, and then we calculate an average for the period 2002–2019 for each country.

2. Countries with high debt and countries with low debt. This variable is straightforward. In order to analyse the impact of debt on fiscal multipliers, we distinguish two levels of debt to GDP ratios – countries with debt to GDP ratio less than 60%, and countries with debt to GDP ratio above 60%. This choice follows Maastricht criterion for debt level. This has also been justified by the influential work of Rogoff and Reinhart (2010). Rogoff and Reinhart showed that low levels of external debt (below 60%) do not impede economic growth whereas when debt to GDP levels exceeds 90%, economic growth is slowed. According to this analysis, we present a table with the average Debt/GDP ratio during the period 2002–2019 for the 19 member states of EMU.

3. Open and less open countries. We use the World Bank's indicator for trade openness for two reasons: its simplicity and its straightforward results. Thus, we calculate (import + export)/GDP for each country of EMU and take the average for the period 2002–2019.

We summarize our findings in the below table.

TABLE 1 Classification of Countries

SIZE		**DEBT**		**TRADE OPENESS**	
Big	**Small**	**Greater than 60%**	**Less than 60%**	**Open**	**Less Open**
Germany, France, Italy, Spain, Netherlands	Belgium, Austria, Ireland, Greece, Finland, Portugal, Slovakia, Luxemburg, Slovenia, Lithuania, Latvia, Cyprus, Estonia, and Malta	Portugal, Belgium, Greece and Italy, Germany, Spain, France, Austria, Malta, Cyprus, and Ireland	Finland, Slovakia, Netherlands, Slovenia, Luxembourg, Lithuania, Latvia, and Estonia	Slovakia, Slovenia, Netherlands, Malta, Luxembourg, Ireland, Estonia, Belgium	Germany, France, Italy, Spain, Austria, Greece, Finland, Portugal, Lithuania, Latvia, Cyprus,

4.1 Calculation of Fiscal Multiplier

Fiscal multiplier is defined as the change in real output caused by a one-unit increase in a fiscal variable. The magnitude of multipliers can vary drastically across time horizons. Following Blanchard and Perotti (2002), the impact multiplier is measured as:

$k_t = \frac{IRF_{(dg-dy)_t}}{IRF_{(dg-dg)_t} * b_1}$ and the cumulative multiplier is defined as $k_t = \frac{CIRF_{(dg-dy)_t}}{CIRF_{(dg-dg)_t} * b_2}$

Where, $IRF_{(dg-dy)_t}$ is the IRF of GDP growth rate to a shock to government spending or social sector spending growth rate at time t.

$IRF_{(dg-dg)_t}$ is the response of government spending or social sector spending growth rate to its own shock at time t.

b_1 is the ratio of government spending to GDP ratio, on average over various countries for the entire period.

b_2 is the ratio of social sector spending to GDP ratio, on average over various countries for the entire period.

The prefix C is for cumulative response and T denotes an extended time period.

Cumulative multiplier at time T measures the outcome of fiscal policy at a longer forecast horizon and can be termed as long-run multiplier. The study takes an extended time period of 10 years to report the long-run multiplier.

4.2 The Dataset

We use yearly data for the period 2002–2019. We choose this period because the new currency was introduced in EMU in 2002 and we extend the period until 2019 to avoid including data from the turbulent time of the pandemic crisis. The entire dataset is collected from AMECO.

All data are in real terms with some of them being found in real terms and other is transformed in real terms using GDP deflator.

The table below explain the data (in parenthesis are the codes of the variables from AMECO's dataset).

Our attempt is to estimate the impact of government's final consumption expenditures and social benefits expenditures (both as defined in the table above), controlling for exogenous key variables, namely debt to GDP ratio, openness, and size of the country. This choice has both theoretical and practical justification. The former is based on the relevant literature. Most of the research in the field of fiscal multipliers has included debt to GDP ratio, openness, labour market rigidities, business cycle phase, exchange rate regime and development. More analytically, the effect of the level of public debt to government's consumption multiplier has been analysed by Ilzetzki et al. (2013), Hory (2016), Deskar-Skrbic and Simovic (2015), and Contreras Banco and Battelle (2014). The effect of trade openness to fiscal multipliers has also draw the attention of economist (e.g. Ilzetzki et al. (2013), Deskar-Skrbic and Simovic (2015), Deskar-Skrbic et al. (2014), Kraay 2013, OECD (2009), Silva et al. (2013). Labour market rigidities has been analysed by Cole and Ohanian (2004) and Gorodnichenko et al. (2014).

After financial crises a new insight for the determinant of fiscal multipliers has developed. The business cycle proved to had a significant effect on the size of multipliers (Kraay 2013, OECD (2009), Silva et al. (2013), Corsetti et al. (2012), Muir and Weber (2013). Fiscal Multipliers has also been affected by exchange rate regime as analysed by Ilzetzki et al. (2013), Kraay 2013, Contreras Banco and Battelle (2014). Another determinant of fiscal multipliers is development which has been the focus of the research of Ilzetzki et al. (2013), Kraay 2013, Contreras Banco and Battelle (2014), Hory (2016). Furthermore, our research seek to shed light on the diversification of the European economies and these factors are indicative of this diversification. Moreover our choice to include these factors was justified also by our research results which shows that these three factors affect significantly multipliers.

For each group we run the appropriate test (stationarity, stability, Akaike information criterion-AIC-, Bayesian information criterion -BIC-, Hannan–Quinn information criterion -HQ) and compute both government's final consumption expenditures and social benefits expenditure multiplier for each group separately and then we compare the results.

TABLE 2 Summary of the Findings

	Short-Run Fiscal Multipliers (Impact Multipliers) for the First Period after the fiscal shock											
	SIZE				**TRADE OPENESS**				**DEBT to GDP ratio**			
	Big Countries		*Small Countries*		*Open Countries*		*Less Open Countries*		*High Debt Countries*		*Low Debt Countries*	
	Impact	*Cumulative*	*Impact*	*Cumulative*	*Impact*	*Cumulative*	*Impact*	*Cumulative*	*Impact*	*Cumulative*	*Impact*	*Cumulative*
Final Consumption Multiplier	**0,36**	**0,1**	**5,45**	**-0,4**	**-0,78**	**-0,05**	**0,14**	**0,019**	**1,3**	**0,34**	**6,82**	**0,6**
Social Benefits Multiplier	**0,35**	**0,12**	**-0,47**	**-0,13**	**0,82**	**0,2**	**-0,004**	**-0,001**	**2,86**	**0,62**	**2,81**	**-0,4**

As the above table indicates final consumption multiplier is higher in small, less open and low debt countries. These findings are in accordance both with the relevant literature and the economic theory. Small economies are easier to mobilise factors of production, less open economies are characterised by smaller externalities of fiscal policy (i.e. less imports) and finally low debt countries have less expenses for servicing their debt.

As for the social benefits expenditures we see the opposite results that is, social benefits multipliers are higher in big, open, and high debt countries. Yet the differences among the countries are smaller. This could be explained on the ground that social benefits are targeted towards a specific group of households which have distinctive and peculiar characteristics. More precisely, these households are, possibly, excluded from financial sector and any money allowance from the government is saved rather than spend, having thus, minor, or even negative impact on economic activity. Further, these household spend their limited income in services or in some primary goods that both are produced domestically. This kind of spendings have limited effects on imports.

In some cases, we report negative multiplier. As for the final consumption multiplier in open economies multiplier is negative. This is in accordance with economic theory given the high volume of imports. On the other hand, social benefit multiplier is negative in less open and small economies. A possible explanation for this is that in both groups of countries social benefits deprive resources from development. This crowding-out effect makes multipliers negative.

As for the size of multipliers findings showed, insignificant size of social benefits multiplier in big, small and less open economies. Moreover, in less open economies also final consumption multiplier is around zero. Yet in low debt countries both social expenditures and final consumption multipliers are high, while only final consumption multiplier is high in high debt and small countries.

5. Conclusion The problems of applying fiscal consolidation. Lessons to be learned

As the economies return to normality, there will be an urgent need for tackling the problem of debt. Especially in the European Monetary Union, fiscal consolidation is imperative, given that the sound fiscal position of the countries guarantees the stability of the common currency. The effort to return to a viable fiscal position rests on the fiscal framework. Yet, common fiscal rules would not be suitable for all countries, given that *the effectiveness and impact of fiscal policy depend on several factors*, *there are different frameworks for fiscal monitoring and EMU's fiscal design has several drawbacks*, and *the fiscal multipliers that determine the potency of fiscal policy vary substantially across member-states* (which is the focus of our analysis) .

So, apply identical fiscal rules to different countries could ultimately revive the old discussion of the two-speed Europe, this time in the sense of not development but fiscal adjustment (**the multi-speed fiscal adjustment Europe)**. If this comes true, then the European Union will face new 'exits' or a new round of fiscal austerity and perhaps severe recession in some countries. The only way out is a new economic paradigm with sustainable, fair, and equal development for all countries of the EMU.

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Pitfalls in interpreting the predictive power of technical trading rules in capital markets. An empirical investigation for the Athens Stock Exchange.

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Abstract

A typical way of testing the efficient market hypothesis is to compare the performance of technical trading rules with the buy and hold strategy performance. We investigate the predictive power of the moving average and the exponentially weighted moving average trading rules, as well as in conjunction with the weak-form market efficiency hypothesis. Utilizing Athens Stock Exchange (ASE) data, we simulate scenarios for both perfect market and real market conditions, considering the precise transaction costs levy on investors. Empirical findings show that, without transaction costs the hypothesis of weak-form efficiency is rejected with both trading rules. However, in real economy scenarios the trading rules' performance is reversed, while for the majority of the investors the hypothesis of weak-form market efficiency on the ASE is not rejected. Furthermore, reforming the tax policy on ASE may revive private investors' interest in domestic equity investment, and make ASE more informationally efficient.

Keywords: Athens Stock Exchange, Technical Trading Rules, Technical Analysis, Market Efficiency, Transaction Costs, Number of Transactions.

JEL classification: C22, G11, G14, G17

1. Introduction

The efficient market hypothesis is a fundamental economic theory that has been gaining prominence since the mid-1960s, and is one of the most fundamental concepts in modern finance for both its theoretical merit and its implications for investing. Although market efficiency is defined differently by different authors (e.g., Beaver 1981; Black 1986; Malkiel 1992; Milionis 2007; Rubinstein 1975), it is the definition due to Fama (1970: 388) that has become the established one. According to this definition, a market is efficient if "…security prices at any point in time "fully reflect" all available information.". The classic categorization of the available information introduced by Roberts (1959) and adopted by Fama (1970), classifies efficiency as weak-form, when the information set includes past prices, semi-strong, when the information set includes all publicly available information, and strong-form, when the information set includes all publicly or privately available information. In the so-called tests for return predictability (Fama 1991) the available information set, in addition to past prices, may also include firm specific characteristics (e.g., the firm size, the price-earnings ratio, the book to market value ratio and the dividend yield), macroeconomic variables (e.g., variables related to term structure of interest rates and unexpected inflation), or even calendar effects (Fama 1991). In an efficient market the results from tests of return predictability should not reject the null hypothesis of no predictability.

Until the early 1990s the general conclusion that was coming out from the results of most empirical tests on market efficiency was that, with few exceptions, the hypothesis that capital markets are efficient was not rejected, at least at its weak and semi-strong form (Elton and Gruber 1995; Fama 1970; Fama 1991). However, in more recent research work (from early to mid-1990s) the hypothesis of efficient markets, even in its weak form, was quite frequently rejected. A battery of methodological approaches had been used for the empirical testing of weak-form market efficiency (WFME) (Fama 1970; Fama 1991), which may be classified into two main categories: (a) purely statistical-econometric tests; (b) tests based on trading rules of technical analysis.

In the first category market efficiency cannot be tested per se but jointly with an assumed asset pricing model that produces the conditional expectations of asset returns. However, the evaluation of this test runs into a joint hypothesis problem. A possible finding of anomalies in the prices of an asset cannot be certainly attributed solely to market inefficiency, but doubts will always be raised whether the anomalies are due, in whole or in part, to an inappropriate asset pricing model. In the second category, in order to overcome the impasse of the above problem, returns derived by employing trading rules are directly compared with the corresponding buy and hold returns. Technical analysts believe that trading rules have predictive power and this stems from the fact that such rules could capture in an empirical way non-linear dependencies in the time series of asset returns the exact nature of which is unknown. Following this approach, the efficient market hypothesis in its weak form becomes less dependent on a pricing model, as the only assumption that is made is that prices follow a submartingale process (i.e., $E(R_{t+1} \mid \Phi_t) \geq 0$ where E is the expected value operator and $E(R_{t+1} \mid \Phi_t)$ is the expected return at time t+1 given the available information up to time t (Φ_t)). As Fama (1970) notes, it is desirable for many reasons to directly test the profitability of various trading rules.

Although early work on testing efficiency using technical trading rules indicated non-rejection of WFME (Cowles 1934; Fama and Blume 1966) and the academic work was sparse, there was a resurgence of research after the influential paper of Brock *et al.* (1992) in which predictive power in the technical trading rules was documented. It is noteworthy that a conclusion drawn from the work of many scholars is that the predictability of technical trading rules has been weakened when applied to more recent data so that the WFME can no longer be rejected in most markets since the late 1990s. This is reasonable given the self-destructive nature of the trading rules: once they are revealed publicly, they lose their predictive power. However, this is not the case with other newly launched markets such as the cryptocurrency market where empirical evidence shows that the typical trading rules are still effective (Corbeta *et al.* 2019). Further, there is empirical evidence that modified versions of the standard trading rules may substantially improve their predictive power especially in less developed markets and in lower capitalization (Ma *et al.* 2021; Marshall *et al.* 2017; Miralles-Quiros *et al.* 2019; Papailias and Thomakos 2015). It may also be the case that this weakening of predictive power may be due to the evolving nature of efficiency (Urquhart *et al.* 2015). We stress that although most of these more recent studies acknowledge that their conclusions may be affected by the various transaction costs, only a few of them explicitly include, to some extent, transaction costs in their analysis (e.g., Marshall *et al.* 2017), while others leave this matter for future research (Papailias and Thomakos 2015).

Among the rules of technical analysis, which are mathematically well defined in the sense of Neftci (1991), the one most frequently employed by researchers to test for market efficiency is the moving average (MA). Indeed, the MA rule has been used extensively by many researchers and for many capital, exchange rate, and cryptocurrency markets (e.g., Brock *et al.* 1992; Cai *et al.* 2005; Corbeta *et al.* 2019; Hudson *et al.* 1996; Kwon and Kish 2002; Luukka *et al.* 2016; Miralles-Quiros *et al.* 2019; Olson 2004; Papailias and Thomakos 2015).

The most common MA version uses two moving averages, each with a different range, calculated from the time series of the prices of a security or an index:

$$MAS_t = \left(\frac{1}{M}\sum_{i=0}^{M-1}\theta_i B^i P_t\right) \qquad (1)$$

$$MAL_t = \left(\frac{1}{N}\sum_{i=0}^{N-1}\theta_i B^i P_t\right) \; with\; N > M, \qquad (2)$$

where MAS_t represents the relatively shorter MA with length M calculated at time t and MAL_t represents the relatively longer MA with length N. P_t is the stock or index price at time t, θ_i are non-time varying parameters, and B is the backward shift operator. Buy signals are generated at the times τ_j^B, where:

$$\tau_j^B \equiv inf\{t: t > \tau_j^B, MAS_t - MAL_t > DP_{t-1}\} \qquad (3)$$

Sell signals are generated at the times τ_j^S, where:

$$\tau_j^S \equiv inf\{t: t > \tau_j^S, MAS_t - MAL_t < -DP_{t-1}\} \qquad (4)$$

The initial times τ_0^B and τ_0^S are set equal to zero and D is the so-called "band" (a pre-specified non-negative constant).

A more specialized trading rule employed frequently from market analysts is the exponentially weighted moving average (EWMA). Although there are numerous versions of EWMA trading rule (e.g., Luukka *et al.* 2016; Papailias and Thomakos 2015), in this study we use a MA-based version. Specifically, EWMA is calculated from the time series of the prices of a security or an index:

$$EWMA_t = aP_t + (1-a)EWMA_{t-1} \quad \text{with } 0 < \alpha < 1\,, \qquad (5)$$

where $EWMA_t$ represents the EWMA calculated at time t and P_t is the stock or index price at time t. Alpha (α) is a weight parameter and the initial value of $EWMA_0 = P_0$. Buy signals are generated at the times τ_j^B, where:

$$\tau_j^B \equiv inf\{t: t > \tau_j^B,\ P_t - EWMA_t > DP_{t-1}\} \qquad (6)$$

Sell signals are generated at the times τ_j^S, where:

$$\tau_j^S \equiv inf\{t: t > \tau_j^S,\ P_t - EWMA_t < -DP_{t-1}\} \qquad (7)$$

The initial times τ_0^B and τ_0^S are set equal to zero and D is the so-called "band" (a pre-specified non-negative constant).

Regarding the choice of the length of the two MAs of the rule, most published studies use specific combinations of the shorter and the longer MA (e.g., Brock *et al.* 1992; Hudson *et al.* 1996; Mills 1997; Miralles-Quiros *et al.* 2019; Papailias and Thomakos 2015). This is the case for the choice of the alpha level of the exponentially weighted moving average trading rule (e.g., Luukka *et al.* 2016). The combinations for the MA and alpha for the EWMA that are typically chosen are those most used by market analysts and their choice is, at least to some extent, arbitrary.

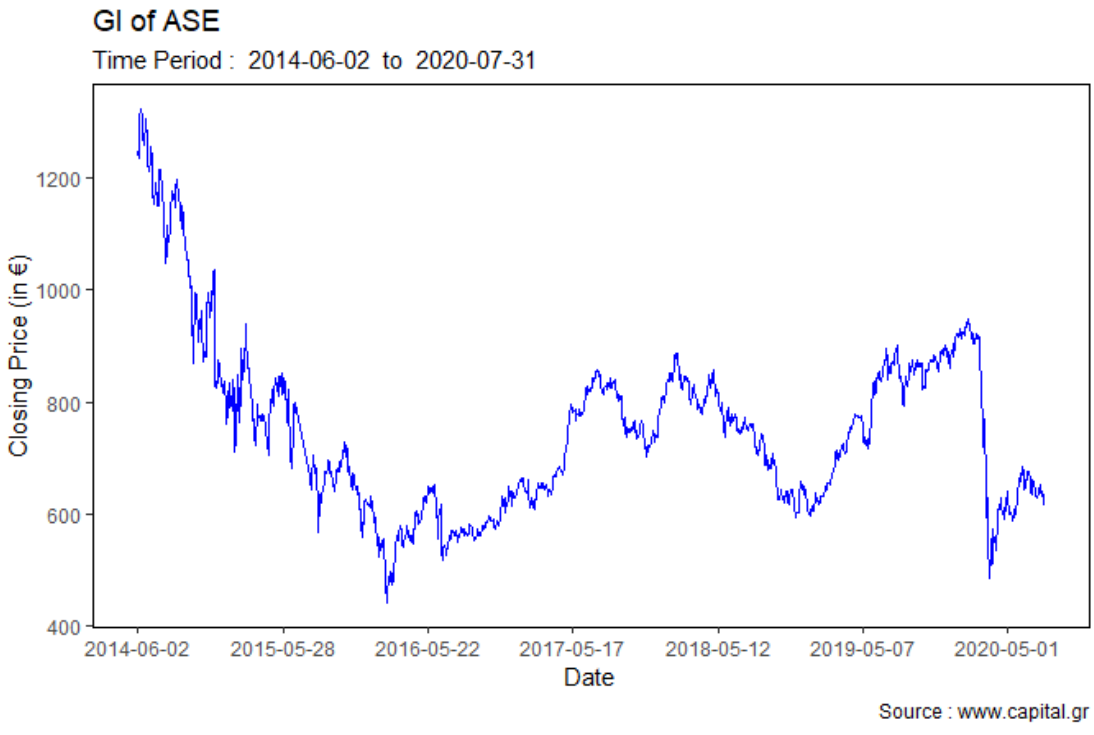
In this work we first employ the traditional simple MA technical trading rule and consider successive returns using MAs at all lengths. We also adopt the exponentially weighted moving average trading rule and take into account successive returns using all alpha values, in order to compare both rules assessed predictive performance. Additionally, aiming at covering a research gap observed in other similar studies, we undertake an in-depth analysis of the effect of transaction costs by taking into account the precise transaction costs and fees existing in reality, simulating scenarios for various types of investors. The Athens Stock Exchange (ASE henceforth), will be the capital market of our exclusive focus. Specifically, in order to simulate actual ASE conditions, we create various investor identity scenarios, as the level of transaction costs varies between investors. This approach has some considerable advantages, as it can serve multiple research purposes. More specifically, at first, we aim to examine the predictive power of both trading rules per se, as well as in conjunction with the weak-form market efficiency hypothesis in a frictionless scenario of no transaction costs and fees. Furthermore, we repeat the same above investigation through real economy simulated scenarios, in which investors are categorized according to the true transaction costs and fees they pay. This is necessary because transaction costs may affect significantly and unevenly the performance of both trading rules, due to potentially different number of transactions signaled by each rule. In addition, we discuss the implications that our results may have for the policy makers.

The structure of the paper is as follows: in section 2 we quote some information about ASE and describe the data; in section 3 we explain our methodological approach; in section 4 we present and analyze our results. In section 5 we summarize and conclude.

2. Market and Data

The data set used in this study consists of daily closing prices of the General Index (hereafter GI) of the Athens Stock Exchange for the period 02 June 2014 to 31 July 2020. The ASE, although joined the choruses of the developed markets in 2001, on 21 March 2016 it was downgraded to the category of advanced developing markets by the FTSE rating agency. This downgrade was attributed both to the imposed capital controls in 2015 and to the suspension of the ASE for five weeks in the summer of the same year, as well as the ongoing instability of the Hellenic economy. Consequently, the beginning of the period under review finds GI above 1,000 points, but on a sharply downward trend. Since mid-October 2014, GI has been below 1,000 units and by the end of the examined period fluctuates between 400 and 900 units. In this period of prolonged recession, the sharp decline recorded in the index in February 2020 is evident, due to the new financial crisis triggered by the pandemic crisis of covid-19 virus. As a result of all the above is on the one hand the loss of GI value by 50.4% at the end of the examined period, and on the other a standard deviation of closing prices as high as 155.72 units. Figure 1 shows the course of GI in the specific time period of six years.

Figure 1. *Chart of Athens Stock Exchange General Index*



A sub-period of about 4 years was then examined, from 24 February 2016 to 16 March 2020, during which the price of GI closed very close to its starting price and the corresponding standard deviation recorded at 111.00 units. The choice of this sub-period is intended to decouple the results from a specific path of GI and possible return metric bias in the assessment of trading rules performance. Therefore, we examined a period of six years during which the GI closed with significant losses and a sub-period of four years during which the price of GI closed at its initial level, despite intermediate fluctuations.

The choice of the specific period of six years, which is shorter as compared to the period considered in similar studies, serves the assumption that during the period in which the trading rule requires the liquidation of the investment capital the latter is immediately deposited in a bank current account with no interest rate. This approximation is reasonable, due to the extremely low interest rates that prevailed in the period under study (2014-2020).

In order to simulate real economy conditions, giving a comprehensive approach to the present study, the returns from the application of the trading rules MA and EWMA were also calculated taking into account the true transaction costs and fees inherent in the Hellenic secondary capital market. Fixed and variable costs on the value of transactions, as well as taxation, are imposed on all economic entities that trade on ASE. In particular, these charges include transaction costs, settlement costs, liquidation costs, other stock market charges and fees (sales tax), the percentage and fixed charges of which are the same for all traders. However, in addition to the above charges, traders in ASE are also charged with a commission on the transactions, the amount of which ranges from 0% to 1% and depends on the transactor's status.

Therefore, five scenarios were considered in the returns of each trading rule. The first scenario represents the theoretical case of a perfect market, where commission, transaction costs and taxation are nonexistent. The following four scenarios reflect actual market conditions. So, the second scenario calculates the returns for an ASE member, who will apply this technique to part of its capital. Stock market members, have zero commission on transactions as they trade for their own benefit. The third scenario represents institutional investors, for whom the commission on transactions is determined on the basis of private agreements and is estimated to be below 0.2%. In the fourth scenario, a professional private investor is represented, who faces a reduced transaction commission, i.e., indicatively 0.4% to 0.5%. The fifth and final scenario represents the small private investor, who is subject to the maximum charge on the commission per transaction, which amounts up to 1% (in fact, for transactions of very low value the commission is even higher). All reported transaction costs are described in detail in Table 1 below.

***Table 1**. All types of transaction costs and fees for traders on the Athens Stock Exchange, based on POL.1056 / 28.3.2011.*

Cost Category	*Amount of Charge*
Transaction Commission	Maximum 1.00% on the transaction value
Cost for execution of transaction	0.0125% on the transaction value, plus 0.06€ per order
Settlement, clearing and other charges	0.06% on the transaction value, plus 0.75€ per transferable value
Sales tax	0.20% on the transaction value

3. Methodology

As described in the introduction, in most research studies the statistical testing of the performance, hence the predictive power, of the moving average trading rule is implemented by picking specific combinations of the length of both the shorter and the longer moving averages. This is also the case for the exponentially weighted moving average trading rule, as specific alpha (a) values are considered. Since the choice of the above combinations is considered, at least to some extent, arbitrary Milionis and Papanagiotou (2008) conclude that findings of beating or not the market, employing specific combinations of the MA trading rule, do not provide safe conclusions neither for the predictive capacity of the trading rule nor for the validity of the hypothesis of the WFME. In order to overcome this problem and to ensure the safety of the conclusions to be drawn in this study, all combinations of the short (MAS) with the long (MAL) moving average and the whole range of alpha (α) coefficient are considered, essentially following the same methodology of Milionis and Varlagkas (2021).

Specifically, the short moving average (MAS) is defined with fixed length equal to one, while the length of the long moving average (MAL) varies from 5 to 100 with unit step. Regarding the exponentially weighted moving average trading rule, the alpha (α) coefficient varies from 0.01 to 0.99 with 0.01 step. In the calculation equations both of the moving average and the exponentially weighted moving average (see Equations (1) to (7)), we set all the parameters θ_i equal to one and the "band" D equal to zero. The successive cumulative percentage returns from the above trading rules, in each examined period, for all lengths of the long moving average (likewise for the whole range of alpha) create a series.

At this point it is worth clarifying the impact of both the length of the MA and the alpha value on each trading rule's function. The MA length determines the depth of price history taken into account. In particular, briefness in MAL length means that MA trading rule considers less price history thus, reacts faster in current security's price changes while extensive MAL length considers more price history and therefore the trading rule lags for bigger trends in price movements. Respectively, in EWMA the

magnitude of alpha (α) weight determines how quickly the trading rule adapts to changes in price action. Therefore, for high alpha values the rule gives more weight to current price data and less weight to older price data, responding faster to new changes in security's price movements, and vice versa. Hence, for both trading rules, the faster the response to recent price movements, the more transaction signals are generated, while sluggish responses to price fluctuations entails fewer transaction signals. It follows from the above that consideration of less price history is achieved in the moving average rule with short MAL lengths and in the exponentially weighted moving average rule with high alpha (α) values. Therefore, in order to assess and compare the aforementioned trading rules, we present all exponentially weighted moving average charts reversed, with alpha descending on the x-axis.

Once the series of successive returns of each scenario is generated, the first step towards this analysis is to examine the possible existence of a unit root in order to determine if the series is stationary. In case of stationarity the series will fluctuate with reference to a mean level. Therefore, this mean level from each trading rule can be used as the level of its expected return and then compared to the level of return from the buy and hold strategy. For this comparison to be reliable, a significance test is performed over a 95% confidence interval (details are given in Milionis and Varlagkas 2021).

It is noted that, in order to determine the confidence interval around the trading rule's expected return it is necessary to calculate the variance of the mean level. However, in this case the variance cannot be estimated by the well-known sample mean theorem for random samples, because the series of successive cumulative trading rule returns are strongly interrelated and are not a random sample. To overcome the above problem, the so-called Augmented Sample Mean Theorem (ASMT) was adopted to calculate the variance, which takes into account the linear interdependencies between the sample observations (details are given in Milionis and Papanagiotou 2013).

Regarding the test for the existence of a unit root in the series of returns, the methodology of Milionis and Varlagkas (2021) was followed. Initially, the most common and popular Augmented Dickey-Fuller (ADF) test was used. In order to improve the power of the ADF tests, a modification owing to Elliot *et al.* (1996), the well-known ERS test was also used.

The above methodology was applied for each scenario in both periods with both trading rules, (i.e., the simple moving average and the exponentially weighted moving average). The initial objective is to check and compare the predictive power of the considered trading rules under both perfect market and Hellenic capital market conditions. Nevertheless, the ultimate goal is to reveal the impact of both the true transaction costs and the number of signaled transactions on trading rules performance, as well as on testing the efficient market hypothesis. The results of the examined sub-period (2016 – 2020) are consistent with the conclusions drawn from the whole period, therefore are not presented in section 4 but are available to any interested party upon request.

4. Results and Discussion

Table 2 present the results of the tests for the existence of a unit root in the derived series of successive cumulative returns for each scenario. In some cases, a linear trend was included, as its addition was found to be statistically significant. According to the results, all series of returns are stationary. The vast majority of the series are stationary in the 95% confidence interval, while three of them are stationary in the 90% confidence interval. The comparison of the trading rules' performance with the passive investment strategy is performed at the 95% confidence interval. However, at this point we should note that in the cases where the series of returns is found to have a statistically significant linear trend the result is carried out with reservation.

Table 2. *Unit root test results for both trading rules series of returns.*

Simulated Scenarios	Simple Moving Average	Exponentially Weighted Moving Average
	Result of Stationarity Test	
No Costs & Fees	Stationary series (ADF 90%)	Trend Stationary series (ERS 90%)
ASE Member	Stationary series	Stationary series (ADF 90%)
Skilled Private Investor	Stationary series	Trend Stationary series
Small Private Investor	Stationary series	Trend Stationary series
Institutional Investor	Stationary series	Stationary series

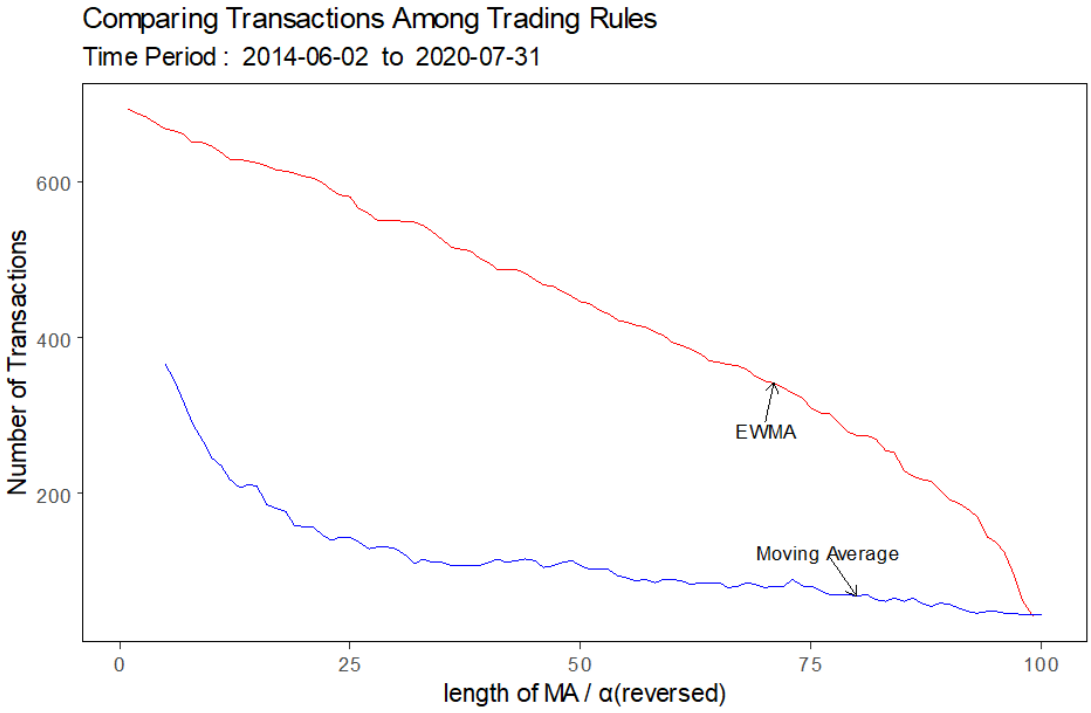
We then examine the level of expected return and the corresponding standard deviation of these trading rules in each simulated scenario. On the basis of the results, which are shown in Table 3, interesting conclusions are drawn. In the absence of fees (taxes) and transaction costs of any kind, the exponentially weighted moving average trading rule has remarkably higher expected return as compared to the moving average rule by 66.86%. In contrast, in real market scenarios, where transaction costs and taxation are involved, the extraordinary returns of the exponentially weighted moving average rule are pulverized. In these scenarios, the EWMA rule produces significant lower returns compared to the moving average, while in the small private investor scenario the expected return of the former means approximately the loss of the entire capital.

The fast decrease of EWMA's expected return, as transaction costs increase, makes the returns of the moving average comparatively higher. This inversion in the "leader" of the expected return is due to the multiple higher number of transactions signaled by the exponentially weighted moving average rule compared to the simple moving average rule for almost all values of alpha (α). For almost all alpha values and the corresponding MAL length, the number of transactions signaled from EWMA is multiple times higher than the MA trading rule. This difference is evident in the comparative chart in Figure 2 showing the number of transactions of each trading rule.

Table 3*. Results of expected return and standard deviation of each trading rule by scenario as well as the passive strategy performance. (* = result with reservation)*

Simulated Scenarios	SMA		EWMA		Buy & Hold Return (%)
	E(R)	σ	E(R)	σ	
No Costs & Fees	-13.11	4.89	53.75*	22.02	-50.40
ASE Member	-29.32	4.25	-34.13	4.95	-50.58
Skilled Private Investor	-57.46	5.05	-90.43*	3.06	-51.08
Small Private Investor	-73.03	4.76	-97.00*	1.84	-51.57
Institutional Investor	-41.89	4.51	-42.95	3.86	-50.76 & -50.61 resp

Figure 2. *Number of transactions of MA and EWMA.*



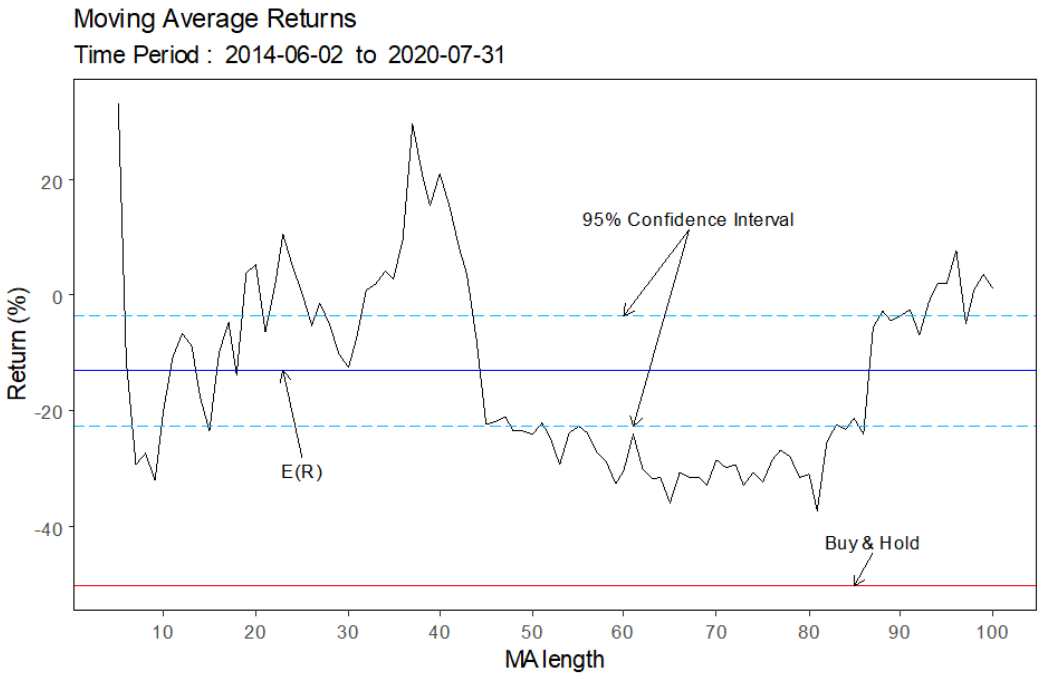
Another difference between the two trading rules is observed in the standard deviation of their series of returns. Comparing the values in Table 3 in the frictionless scenario, the standard deviation of the moving average is substantially smaller than that of the exponentially weighted moving average, whereas this significant difference is absent in the real economy simulated scenarios.

As for the results regarding the weak-form market efficiency hypothesis testing, (i.e., the comparison between the returns of both trading rules against the buy and hold strategy), these are presented graphically in Figures 3 to 10, 12 and 13. In particular, these graphs show the variation of the MA and the EWMA trading rules returns, their expected return with the corresponding 95% confidence interval and the return of the buy and hold strategy in each scenario.

In figures 3 and 4 it is conspicuous that without transaction costs and taxes, the performance of the passive investment strategy is below the lower bound of the

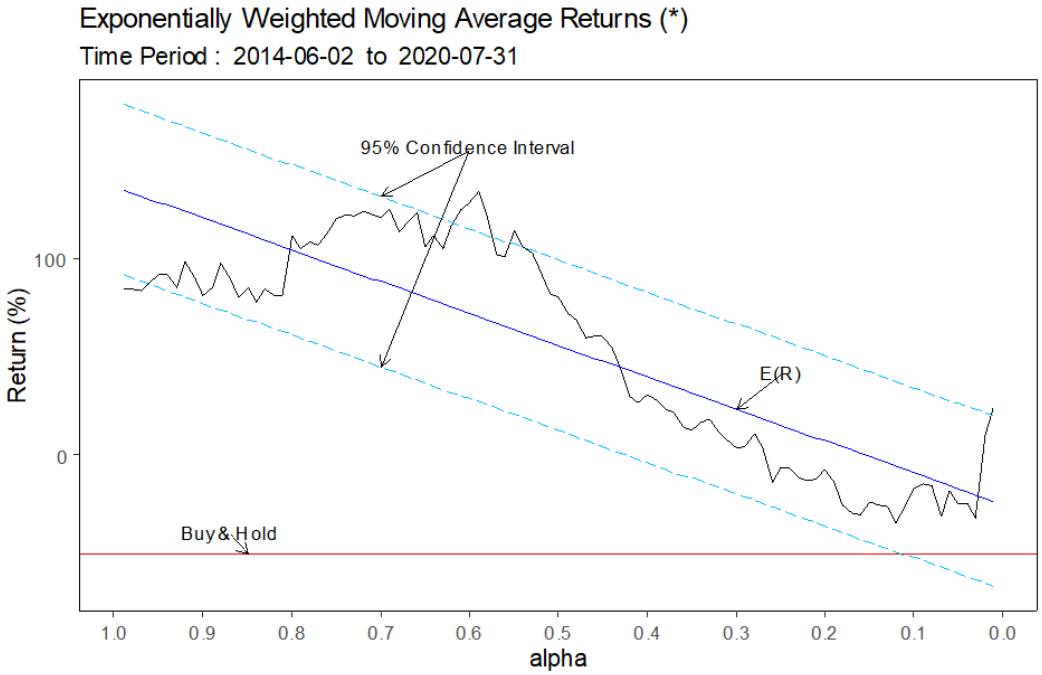
confidence interval of both trading rule's expected return. Partial exception in the above assumption is in exponentially weighted moving average trading rule for alpha values smaller than 0.12, due to the existence of a linear trend. The mean return of the MA is higher than the passive investment strategy by 37.3% while the mean return of the EWMA is strikingly higher than the passive strategy by 104.15%. Therefore, both trading rules, moving average and exponentially weighted moving average, beat the specific market. Consequently, the weak-form market efficiency hypothesis is rejected no matter what trading rule is used.

***Figure 3**. Significance test of MA trading rule for the scenario without transaction costs.*



However, if we focus on the series of each trading rule's successive returns important conclusions can be drawn. Specifically, in the EWMA trading rule, the highest returns are achieved solely with high alpha values ($\alpha > 0.5$). Besides, the existence of positive linear trend in EWMA's returns corroborates the above claim (reversed in figures). Additionally, in Figure 2 the EWMA transactions function is monotonically increasing, thus the higher the value of alpha the higher the number of transactions signaled by the EWMA trading rule. Hence, combining figures 2 and 4, for EWMA trading rule the higher the number of transactions the higher the return. Indeed, a statistically significant positive correlation ($r_{t,r} = 0.85$) was found at 5% significance level between the two variables, the derived number of transaction signals and the returns of the EWMA trading rule. The same phenomenon is clear only on first lengths for the MA trading rule. More precisely, in first six MAL lengths (5 to 10) the returns drop dramatically and simultaneously with the declining number of transactions, but after that length the pronounced swings of the rule's performance are around a certain level, as the series of successive returns is stationary. In addition, the two variables, the number of transactions and the MA's returns, are not statistically significantly correlated.

***Figure 4**. Significance test of EWMA trading rule for the scenario without transaction costs (* = result with reservation).*



Regarding the ASE member simulated scenario the results are not significantly different, in respect to efficient market hypothesis. Taxes and costs in the ASE reduce the expected return of both trading rules, but it is still possible to beat the market. In particular, if a member of the Athens Stock Exchange applies the MA trading rule the mean return is estimated to be 21.2% higher than the passive strategy, while in the case of the EWMA this difference is 16.45%.

Looking at the pattern of the MA series, the decline in returns at short MAL lengths is steeper than the decline at long MAL lengths, as compared to the frictionless scenario. Thus, the returns are more negatively affected in MAL lengths where the number of transactions is higher, due to transaction costs. Moreover, the statistically significant negative correlation found between the returns and the number of signaled transactions ($r_{t,r} = -0.43$) is attributed to the negative impact of the number of transactions on trading rule's return, given the existence of transaction costs. In the frictionless scenario, where the number of transactions is exactly the same, no correlation was found, due to the absence of transaction costs. The same phenomenon holds in EWMA series of returns. In this scenario returns are generally lower as compared to the frictionless scenario, due to transaction costs, but for high alpha values returns are even lower due to higher number of transactions. Additionally, there is no statistically significant correlation between the EWMA trading rule returns and the derived number of transaction signals. We assume that the high positive correlation found in perfect market scenario has now been neutralized, due to the negative impact of transaction costs. Graphs A1 and A2 in the Appendix show the difference in returns between perfect market and ASE member simulated scenarios for each trading rule. In these graphs it is clear that the reduction in returns for both trading rules is greater in the lengths (alpha) where the number of transactions is higher.

Figure 5*. Significance test of MA trading rule for the simulated ASE member scenario.*

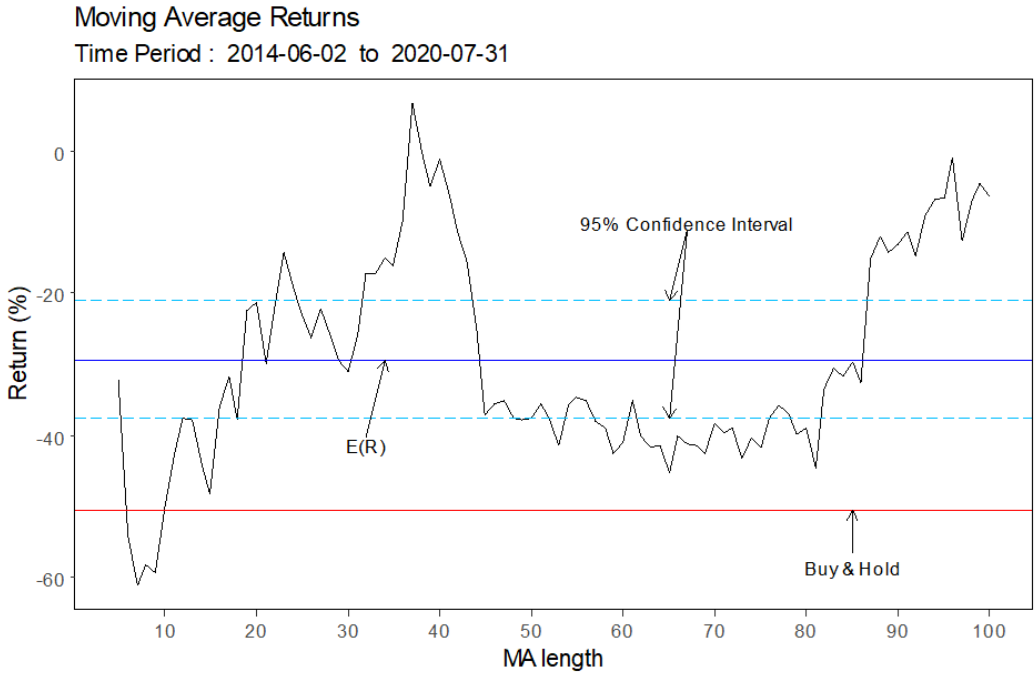
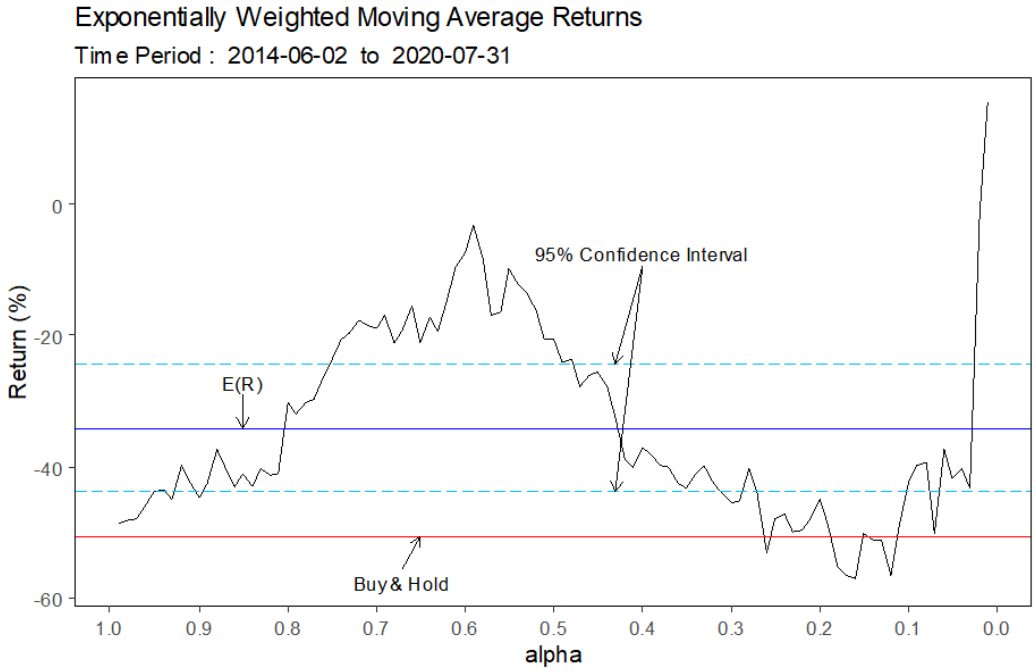


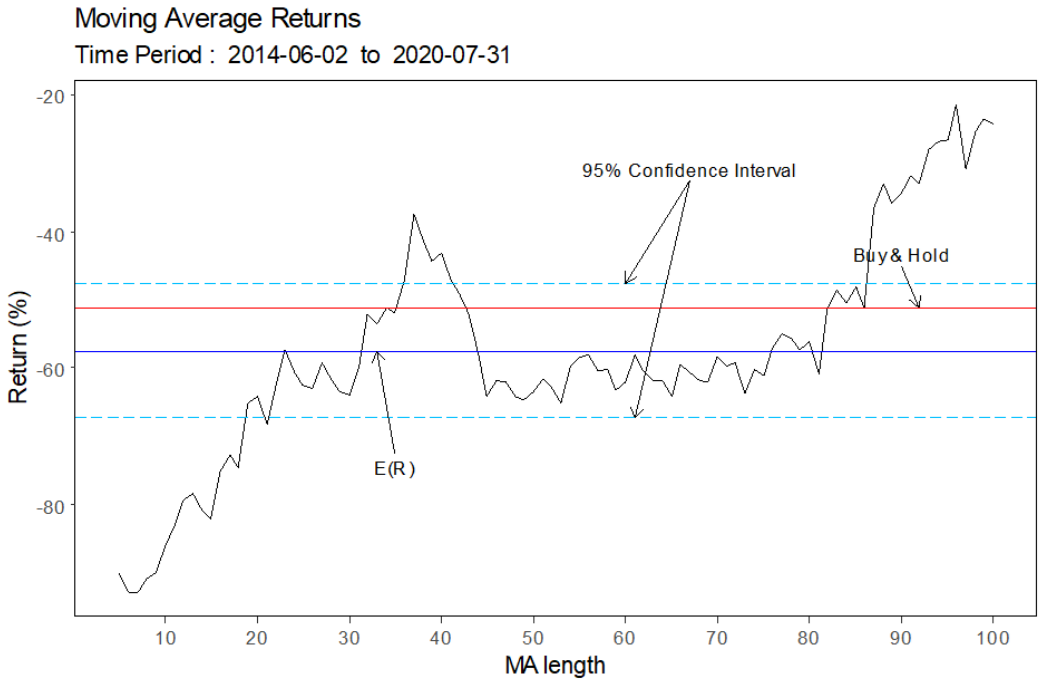
Figure 6*. Significance test of EWMA trading rule for the simulated ASE member scenario.*



As regards the scenarios for private investors, in which a commission on transactions is added to the other charges, the results are fundamentally different in all aspects. In these cases, the return of the buy and hold strategy is higher than the expected return of both trading rules. Specifically, in the case of the professional private investor the performance of the MA trading rule is not statistically different from the

performance of the passive investment strategy, while in the rest cases the performance of both trading rules is lower than the performance of the passive strategy. Therefore, the weak-form efficient market hypothesis is not rejected, in both private investor scenarios with both trading rules. The lowest performance is recorded in the small private investor scenario with the EWMA trading rule. In this case, for high alpha values ($\alpha > 0.5$) the entire capital was exhausted before the end of the considered time period. In particular, the derived transactions by the EWMA rule were terminated before the end of the period considered, as the trading capital was fully exhausted and no further transactions could be executed. This can be also confirmed visually by comparing graphs 11 and 2, focusing on alpha values greater than 0.5, where the number of transactions is lower.

***Figure 7**. Significance test of MA trading rule for skilled private investor scenario.*



However, the observed phenomenon on the EWMA trading rule's returns in the frictionless scenario has been fully reversed in both private investor scenarios. Particularly, in these scenarios the highest returns are achieved by the EWMA trading rule exclusively with low alpha values, when the number of transactions is lower. Additionally, in both scenarios a statistically significant negative linear trend was found in the EWMA rule returns. Moreover, a statistically significant negative correlation, at 5% significance level, was found between the EWMA rule's returns and the number of signaled transactions. This correlation was found to be $r_{t,r} = -0.74$ in skilled private investor scenario and $r_{t,r} = -0.68$ in small private investor scenario. Note that the lower negative correlation found in small private investor scenario, as compared to the skilled investor scenario, is due to the termination of the transactions before the end of the considered period.

***Figure 8**. Significance test of EWMA trading rule for skilled private investor scenario (* = result with reservation).*

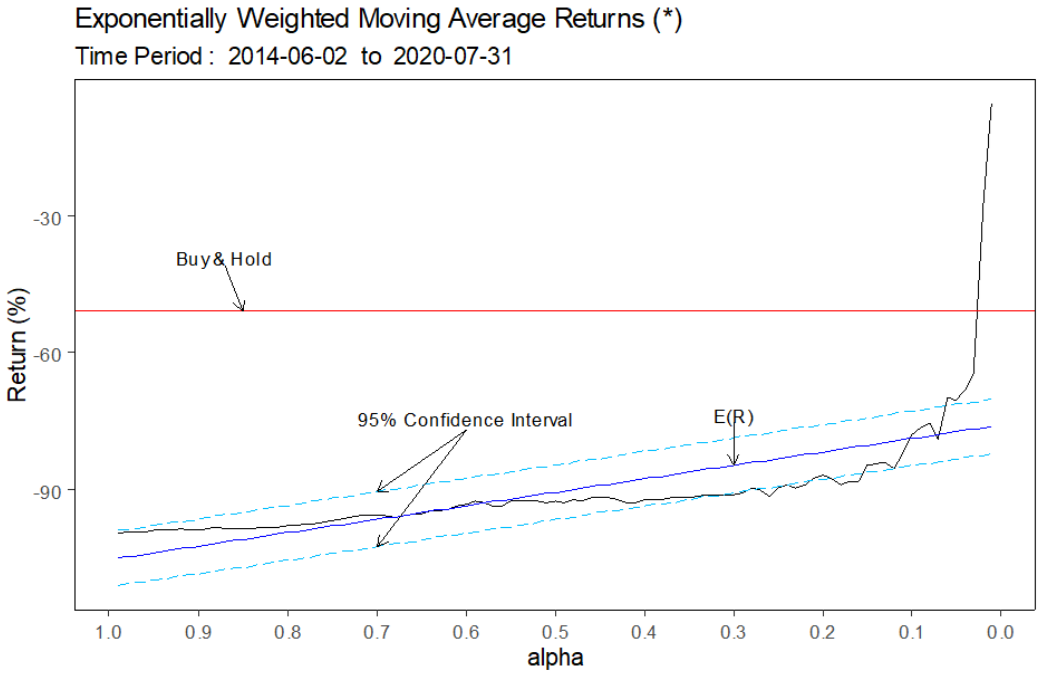
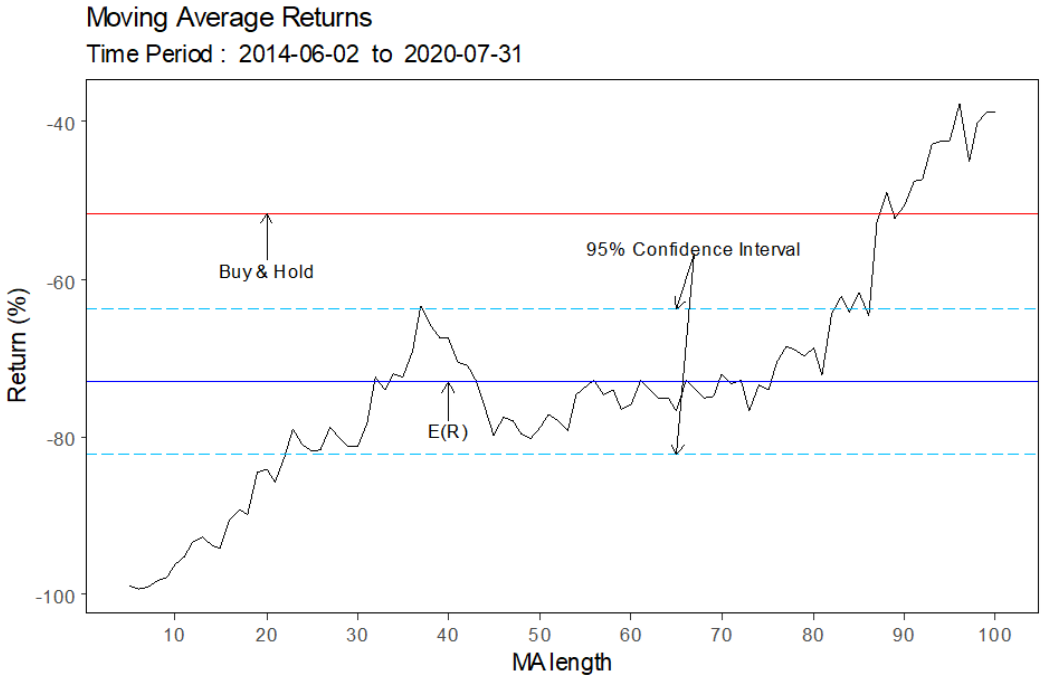


***Figure 9**. Significance test of MA trading rule for small private investor scenario.*



Furthermore, the same above relation holds for the returns of the MA rule. Comparing figures 7 and 9 with the number of transactions in figure 2, it is obvious that higher returns are achieved with longer MAL lengths, namely when the number of transactions is lower. Indeed, a statistically significant high negative correlation, at 5% significance level, was found between the MA rule's returns and the number of signaled transactions. Specifically, in both private investor scenarios, this correlation was found

to be $r_{t,r} = -0.81$. Overall, the higher the number of transactions signaled by the trading rule, the stronger the negative impact of the transaction costs on trading rule's returns.

***Figure 10**. Significance test of EWMA trading rule for small private investor scenario (* = result with reservation).*

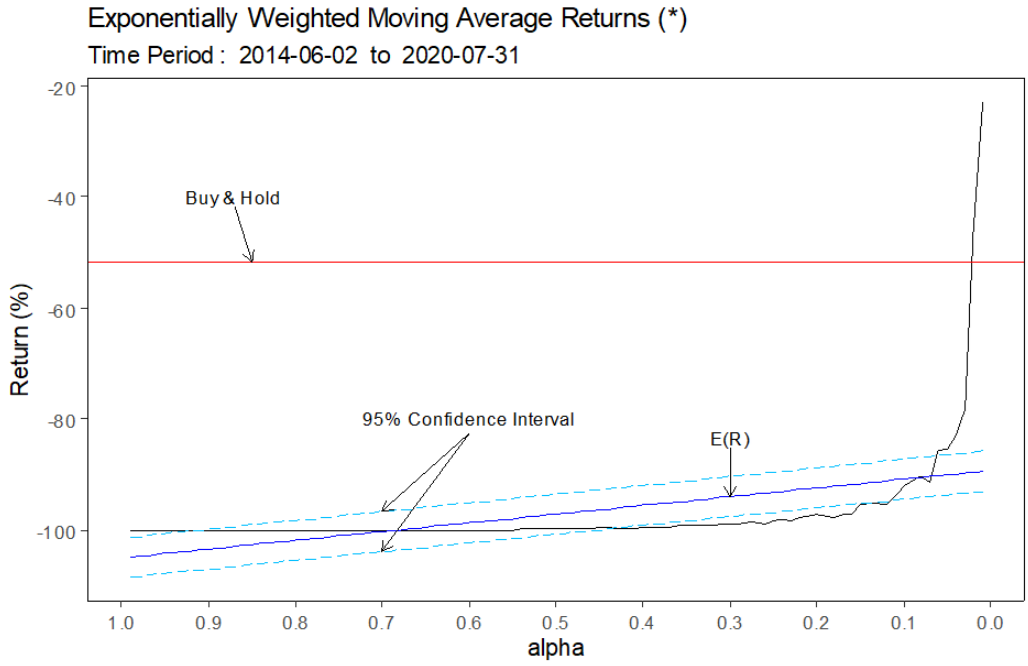
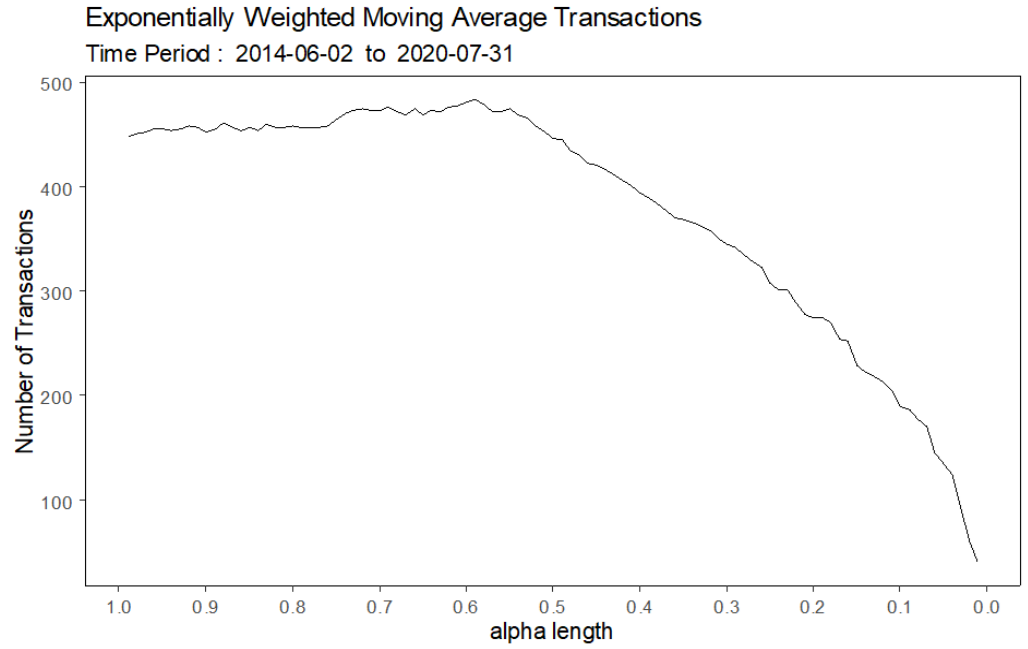


***Figure 11.** Number of transactions of EWMA trading rule for small private investor scenario.*



Finally, in the scenario which represents institutional investors, a different approach was adopted for determining the level of the transactions cost. As the rate of

transactions commission is determined on the basis of private agreements, the maximum percentage level of commission was requested at which the market is marginally beaten by the application of the above trading rules. The current tax on securities' sales and all other variable and fixed costs in ASE have been separately considered, so are not included in the requested percentage. Specifically, an iterative testing procedure was followed that terminates when two conditions are jointly satisfied: (1) maximization at the level of transaction commission, and (2) beat the market marginally at a 95% confidence interval. The maximum level of transaction commission found is 0.185% for MA trading rule and 0.032% for the EWMA trading rule (Figures 12 and 13).

Given the assumption that institutional investors incur transaction commission below 0.2%, it follows, based on the findings, that they can beat the particular market utilizing the MA rule, whereas this is not accomplished with the EWMA trading rule. Therefore, in the institutional investor scenario the weak-form efficient market hypothesis is rejected only with the MA trading rule. The comparison between the results of the two trading rules in Figures 12 and 13 shows that the moving average rule beats the market with significantly higher transaction costs. In contrast, the exponentially weighted moving average trading rule has a very low (almost zero) tolerance in transaction commission burden to beat the specific market, due to significantly higher number of transactions.

Figure 12. *Institutional investor scenario with MA trading rule.*

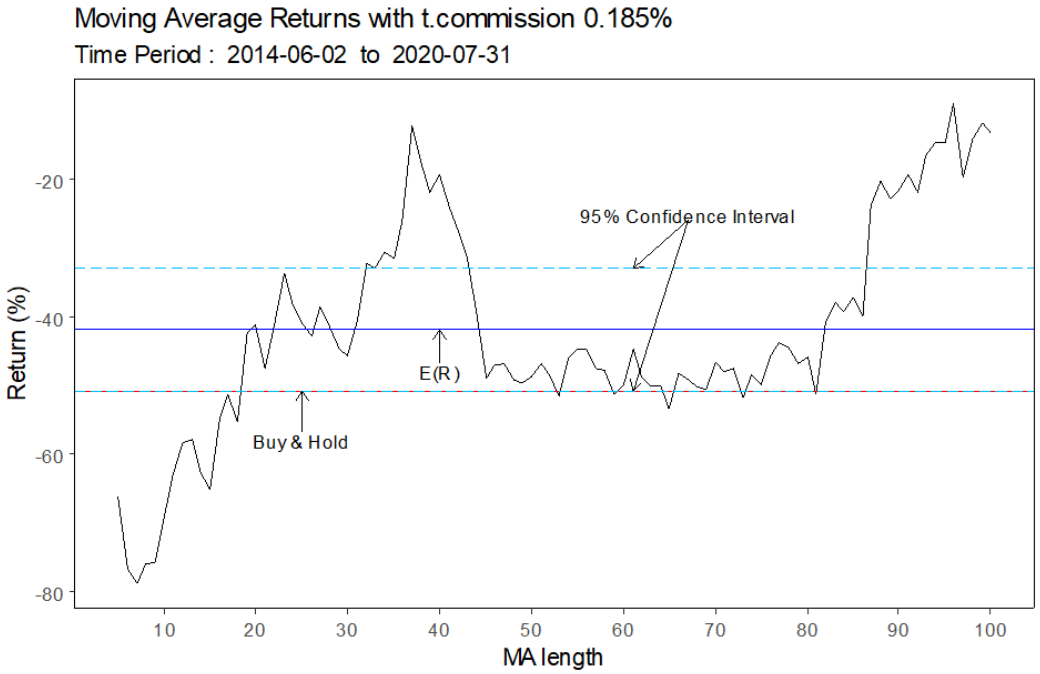
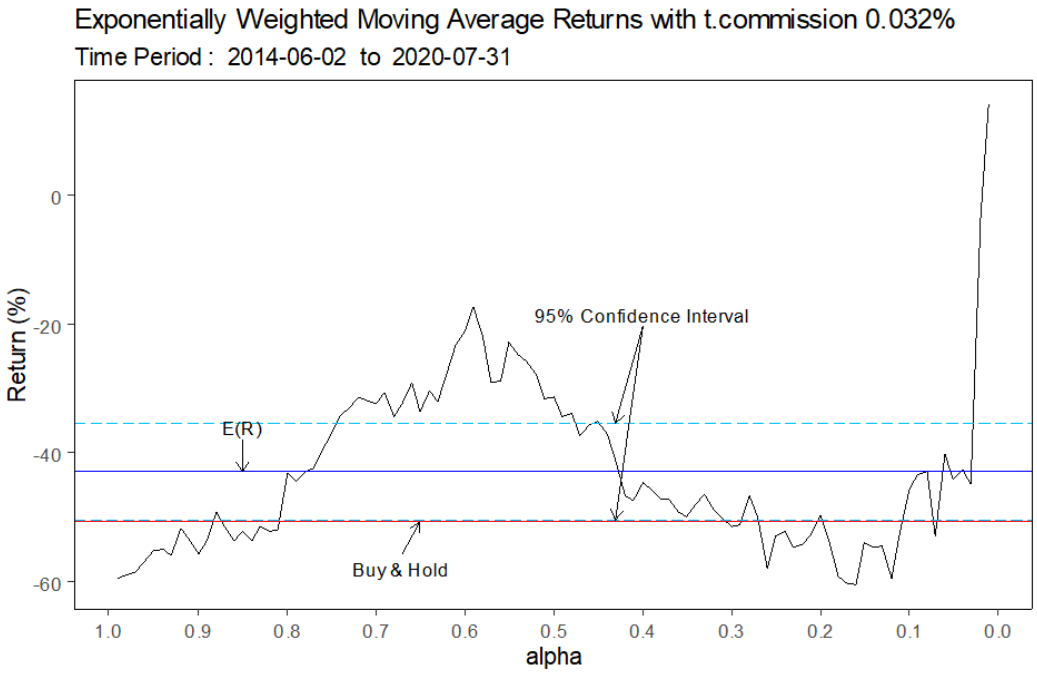


Figure 13*. Institutional investor scenario with EWMA trading rule.*



The results from both trading rules performance, under all simulated scenarios, show that stock market costs and fees on transactions cause a significant reduction in the trading rules expected return. However, it is the level of commission on transactions that plays the decisive role in beating or not the Hellenic capital market, by using the trading rules under consideration. Thus, if we proceeded along the lines of most published literature, we would reject the WFME based on frictionless scenario findings, where no transaction costs and taxation are considered. Also, by estimating approximate transaction costs, which is a common practice in the literature, we would probably reject again the WFME for the Hellenic capital market, as in the case of the ASE member simulated scenario. Conversely, taking into account the precise transaction costs, imposed on investors in the Hellenic capital market, it is found that the expected return of both trading rules varies significantly between perfect market and real economy scenarios, while the WFME is not rejected in the majority of cases. Therefore, even if a trading rule generates remarkable returns in a frictionless scenario, this is not sufficient evidence to reject the weak-form market efficiency, because in real economy conditions the trading rule's returns are most likely faded away.

It follows from all the above that a researcher must be very careful in rejecting or not rejecting the weak-form market efficiency, and should not proceed on both a mechanistic application of trading rules and a superficial interpretation of the results. Given transaction costs, the results reveal that there is a significant negative correlation between the generated number of transactions and the trading rule's returns, implying that it is quite likely that the more transactions signaled by a trading rule, the lower the expected returns. Inversely, in a frictionless scenario, the existence of both a significant positive correlation between the returns of a trading rule and the number of transactions produced, and a linear trend in the series of returns, could play the role of a warning or a rule of thumb against an initial conclusion of rejection of weak-form market efficiency in the particular market. From investors perspective, if the returns of any trading rule

on the ASE are subject to the above specifications, without considering transaction costs, stakeholders should further investigate before adopting the particular trading rule as an investment strategy, as the returns are expected to be significantly lower in real economy conditions.

One issue for policymakers emerged from the comparison between the real economy simulated scenarios. Given the empirical findings and adopting exactly the same technical analysis investment strategy on ASE, private investors expect significantly lower return compared to institutional investors, as the former incur higher total transaction costs. The latter is exclusively attributed to the significantly higher commission rate that private investors have to pay for transactions in ASE securities. From the data presented in Section 2, the estimated difference in commission between institutional and private investors ranges from 0.3% to 0.8% per transaction. Since the commission on transactions is determined solely by the investor's status, the feasibility of reducing other elements of transaction costs should be considered, in order to mitigate the overall transaction costs disparity between domestic private and institutional investors. A tax reduction or exemption for domestic private investors on securities sales on ASE will contribute to this. According to the data reported by the Athens Stock Exchange, during the period considered, the total amount of value of securities' trade sales from domestic private investors was EUR 20.14 billion, with an average monthly value of EUR 275.88 million. Given the current flat tax rate on securities' sales on ASE (0.2%), the total amount of tax due from domestic private investors during the period considered was EUR 40.28 million, with an average monthly value of EUR 0.552 million euros. One option for policy makers to offset the above tax revenue is to increase the securities sales tax for institutional investors and ASE members.

The suggested tax policy can provide multiple benefits for both private investors and the ASE. On the one hand the aforementioned disparity will mitigate, while the speculation trading on ASE will be reduced dramatically. In particular, if the securities sales tax increases from 0.2% to 0.4%, the break-even transaction commission (for marginally beating the market) will be less than 0.09%, so far less institutional investors will succeed in beating ASE employing both trading rules. Therefore, the ability of institutional investors to beat ASE utilizing the considered trading rules will be minimized, hence the particular market will become more informationally efficient. In terms of private investors beating the market, the aforementioned tax exemption has no significant impact on the results presented in Figures 7 to 10. On the other hand, the revised tax policy may resurgence the interest and encourage domestic private investors to invest in ASE. The confidence of these investors has been damaged by repeated crashes in ASE, especially those in 1999 and 2010, and most recently by the latest crisis in 2020 of Covid-19. In recent years, the interest of private investors has increasingly turned to domestic real estate investment, while investment in the domestic stock market has been neglected. The return of domestic private investors to the ASE is most important both for them, as they will achieve portfolio diversification by holding real estate and domestic stock market shares, and for the capital market, as it will be strengthened in terms of liquidity and capitalization. Finally, it is worth noting that Greece has previously applied a reduction in the securities sales tax. After the stock market crash in 1999, the tax on securities sales was reduced from 0.6% to 0.3% in January 2001 in order to increase liquidity in the ASE. In January 2005, the securities sales tax was further reduced from 0.3% to 0.15% to improve the outlook for the ASE.

Therefore, stimulated by the above findings, policy makers might consider revising the policy of imposing a flat tax to all types of ASE investors.

5. Summary and Conclusions

The purpose of this study was to assess the predictive power of two very popular trading rules per se, as well as in conjunction with the weak-form market efficiency hypothesis. The capital market chosen to investigate both trading rules performance was the Athens Stock Exchange, simulating both perfect market and real market conditions.

Empirical findings show that, in the theoretical case where transaction costs are omitted, the predictive power of the exponentially weighted moving average trading rule is remarkably higher than that of the simple moving average. Additionally, both trading rules ensure higher returns compared to the buy and hold strategy, beating the Hellenic capital market. Thus, in this particular case the efficient market hypothesis in its weak-form is rejected.

However, in real economy scenarios, where the precise transaction costs and fees of the Hellenic capital market are considered, it is found that the performance of the trading rules is reversed. This is attributed to the significantly higher number of transactions signaled by the exponentially weighted moving average rule. In terms of efficiency, it is found that an institutional investor can beat the particular market, even marginally, utilizing the moving average rule, whereas this is not accomplished with the exponentially weighted moving average trading rule. In contrast, private investors, both professionals and amateurs, who face higher commission on transactions, not only cannot beat the particular market, but also the returns from applying both trading rules are with statistical significance lower even than those of the passive investment strategy. Overall, given the current transaction costs and in line with the findings of this work, the result on testing the hypothesis of weak-form market efficiency on the Athens Stock Exchange is not rejected for the majority of investors. Therefore, the performance of a trading rule should be assessed in conjunction with both the number of derived transactions and the precise transaction costs incurred, especially when testing on weak-form market efficiency.

The above conclusions insinuate that policy makers might consider revising the policy of imposing a flat tax on all types of ASE investors. An alternative policy would be, for instance, to exempt private investors from securities sale tax, or at least to reduce it, and slightly increase the same sale tax for the rest types of investors. This may, amongst others, revive interest and encourage domestic small private investors to invest in ASE, and the particular market will become more informationally efficient, as far less investors will be able to beat the market. The confidence of domestic private investors has been seriously shaken due to repeated crashes of ASE, especially those in 1999 and 2010.

Regarding efficiency, the analysis of the ASE data showed that the outperformance of a particular trading rule in a frictionless scenario, as compared to either another trading rule or the passive investment strategy, does not provide

sufficient evidence to either reject the weak-form market efficiency hypothesis or conclude that the trading rule at hand is better than its rival.

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Appendix

Figure A1. *Difference in MA returns between perfect market and ASE member simulated scenarios.*

Figure A2. *Difference in EWMA returns between perfect market and ASE member simulated scenarios.*