ABSTRACT

A stop-loss order is a method that can be used by investors to limit downside risk and can be explained by investors’ loss aversion. Loss aversion refers to the widely studied psychological phenomenon where expected losses have a greater impact on the investors’ preferences than expected gains. The use of stop-loss rules allows for this asymmetric profile. The stop loss hypothesis, also, states that higher returns can be obtained by limiting the downside risk of long positions. A stop-loss order can be established at a percentage of the asset value that grows over time as it rises, stopping if the asset value starts to go down (trailing stop-loss order). In this work, it is used trailing stop-loss orders (with a difference to the asset market value of 3%) with long positions in financial markets. After being stopped out in a down market, the re-entry rule is to buy the asset again as soon as the market grows by at least 3%. Whenever the portfolio is sold out by applying the trailing stop-loss rule, the investment is held in cash until the trigger is set off. In this article the rules are applied to some European countries, namely Germany, France, Spain, and Greece during the financial crisis, to make an empirical validation of trailing stop-loss rules and re-entry rules for these markets. It was found that the followed strategy presents mixed results, proving to beat the buy-and-hold strategy in some scenarios of rising and falling prices. But the most important result is to generate fewer losses in very volatile scenarios such as Greece in 2014.

Keywords: crisis, financial markets, re-entry strategy, trailing stop-loss order.

I. INTRODUCTION

Technical trading rules are commonly used as a method to generate buying/selling signals in financial markets (Taylor, 2014). There is a large set of technical trading rules, some of them based on quite simple procedures and others based on sophisticated statistical and numerical methodologies.

The performance of technical trading rules can vary over time and over market environments, which is consistent with the adaptive market hypothesis (Taylor, 2014; Lo, 2004). The main idea behind this belief is that the same trading rule in different environments can lead to opposite results (Lo, 2004, Kim et al., 2011; Taylor, 2014; Neely et al., 2014). Hence, the performance of technical trading rules can only be empirically validated in some particular markets or particular market environments.

During the past years, Europe has been hit by an unprecedented financial crisis. However, the crisis was not reflected equally in all countries. Typically, the northern countries were less affected (for instance Germany and France) than the countries in Southern Europe (such as Spain and Greece) (Islam, 2016; Gros, et al., 2014). So, I decided to empirically test a set of technical trading rules in the crisis environment, but in these two types of financial markets with opposite behaviors.

In this work, I use different technical trading rules to generate buying and selling signals. For the selling signal, the main idea is to study the use of trailing stop-loss orders. The buying signal is, mostly, a re-entry strategy (after the first entrance). Accordingly, after being stop-out by the market, it’s needed to establish a rule that will enable a reentry into the market. The rules used to generate the buy/sell signals were chosen because they are likely to promote a successful investment strategy during a financial crisis environment.

In this article, I apply trailing stop-loss rules and re-entry strategies in some European markets during the financial crisis, namely Germany, France, Spain, and Greece. These strategies were employed in a one-year investment period between 2012 and 2015, to make an empirical validation of trailing stop-loss rules and re-entry strategies in two of the least affected and two of the most affected European countries.

In section II, I make a brief presentation of the theory behind the stop-loss hypothesis, and re-entry strategies. In section III it presents the data and methodology, and finally, in section IV, I show the results, which suggest that trailing stop-loss rules should be considered in investment strategies applied to these European financial markets. Section V concludes.

II. LITERATURE OVERVIEW

A stop-loss order is a method that can be used by investors to limit their downside risk. The use of stop-loss orders is explained by investors’ loss aversion (Montier, 2007; Zhu & Zhang, 2010; Tooth, 2014). Loss aversion refers to the widely studied psychological phenomenon which implies that losses have a more significant impact on investors’ preferences than gains. Risk aversion is mainly caused by loss aversion (Zhu & Zhang, 2010). Therefore, investors have asymmetric...
preferences on risk: they would like to limit the loss while maintaining the potential return. The use of stop-loss rules allows for this asymmetric profile.

The research on the efficacy of stop-loss strategies is scarce and mostly focused on U.S. stock market (Klement, 2013). Table I summarize the principal theoretical findings on this subject.

| TABLE I: PRINCIPAL THEORETICAL FINDINGS |
|-----------------------------------------|
| Study                                    | Conclusions                                      |
| Lei & Li (2009)                          | The importance of stop-loss strategies comes from risk reduction and not from return enhancement. |
| Clare et al. (2013)                      | Simple stop-loss strategies do not add value to a portfolio. |
| Klement (2013)                           | Trailing stop-loss strategies can enhance absolute and risk-adjusted returns. Stop-loss rules on maxmeasures portfolio selection strategy do not add value to a portfolio. |
| Tooth (2014)                             | Simple stop-loss strategies lead to low returns, but, if it used in longer sampling frequencies, the returns will be enhanced. |
| Kaminski & Lo (2014)                     |                                                                                             |

Source: Researcher, 2022.

According to Lei & Li (2009), the stop-loss rules help investors to reduce risk by automatically selling losing assets. They conclude that these rules allow investors to reduce investment risk although not contribute to an increased return.

Clare et al. (2013) compared some technical trading rules within the S&P500 index, giving special attention to moving average (MA) and stop-loss trading rules, concluding that simple stop-loss strategies do not add value to a portfolio.

By extending previous works on stop-loss rules by adding additional rules for re-entering the market, Klement (2013, pp. 44) states that “the value of stop-losses can be assessed only when re-entry rules are considered jointly with stop-loss rules”. By analyzing the joint effect of stop-loss and re-entry rules, the author found that stop-loss rules reduce volatility and excessive losses, besides the evidence on return improvement is mixed.

Tooth (2014) tested whether stop-loss rules could limit downside risk and improve long-term portfolio growth. By applying stop-losses to the maxmeasures portfolio selection strategy, and bootstrapped backtest of arbitrary strategies on the S&P500 between 1969 and 2012, the author concluded that the use of such rules does not add value to a portfolio.

Kaminski & Lo (2014) proposed a simple analytical framework to evaluate the add-up value by stop-loss rules on the expected return and volatility of a portfolio. Focusing on daily futures price data, they provided empirical evidence that, with longer sampling frequencies, some stop-loss policies boost the expected return while reducing volatility.

The studies presented above, despite having some contradictory results, allow considering that the simultaneous use of stop-loss and re-entry rules could lead to both, risk reduction and return enhancement.

A stop-loss order is an attempt to shield the investment strategy, namely by not allowing the investment value to fall below a specific value specified in advance. The stop-loss order can protect a position previously taken into the market, with a fixed floor (simple stop-loss order).

In a spot market, in the event of a bear market, investors will not take long positions, so, stop-loss orders are mostly used when the direction of the market is unclear (Tooth, 2014; Shefrin & Statman, 1985), like during a crisis.

The determination of the floor can vary but usually depends on the investors’ ability to accept losses. Typically, the stop is established with two factors taken into consideration: the amount of money that will be lost if the stop is achieved and the asset spot price volatility (Teweles et al., 1987; Tooth, 2014). Tooth (2014) considered that a 7-8% stop-loss has become largely accepted in financial markets, after the seminal work of O’Neil (1988).

The simple stop-loss order settles on a straightforward proposition: a floor (F) is established, usually at some level below the purchase price, which is the minimum value the portfolio can take. The initial investment is fully applied to the risky asset. The floor value is compared with the portfolio value, Pt, over time. In this comparison, two different situations may happen:

1. \( P_t < F \) the application in the stock remains unchanged.
2. \( P_t > F \) the stock is immediately sold out.

Commonly the floor is settled at a level below the purchase price, for long positions taken on the risky asset. The primary objective is to avoid significant losses by establishing a previous loss limit based on the initial invested capital (simple stop-loss) The major issue surrounding simple stop-loss orders is that it is impossible to obtain a profit with its use unless the market grows overall the investment periods.

When an investor is loss averse, his/her anxiety overgrows in the event of a negative return. Sometimes the investor can sell the position too soon, resulting in a loss. This early selling position motivated the loss aversion, implying that the investor will not benefit from a recovery of the market, after their short-term loss. If one such investor uses trailing stop-loss orders instead, he/she can benefit from an increasing market, having the added “emotional comfort” benefit of knowing that the investment has a floor below which it will not go down (Klement, 2013).

Additionally, the protection can be held with a moving floor, usually, a percentage of the asset value that grows over time as the asset rises, stopping at the maximum price level when it starts to drop down (trailing stop-loss order). The order will allow the floor to increase over time as the market grows, enabling profit if the growth lasts for some (but not necessarily all) of the investment period. Once again, the percentage is established according to the investor’s capacity of accepting losses.

In this work, stop-loss orders with long positions in financial markets will be used. The goal is to apply the methodology in spot markets which, often, do not allow taking short sell positions. Thus, only long market positions will be taken. The stop-loss hypothesis states that by limiting the downside of long positions, higher returns will be achieved (Tooth, 2014; O’Neil, 1988). Hence, these orders are particularly relevant in a crisis environment and should be more effective in countries with financial problems (like Spain and Greece) over richer countries (such as France and Germany).

As stated by Klement (2013) most of the previous work on stop-loss trading rules did not allow re-entry into the market. By avoiding a re-entry, the profit of such a strategy is severely restricted as it is not possible to profit from later recoveries.
on the market. That is why it is so important to have a rule that enables a re-entry into the market. In a downturn of the market, the asset is immediately sold, but with the re-entry rule it can be rebought in a recovery.

As has been done by Klement (2013), I decided to apply a similar approach to test trailing stop-loss and re-entry rules simultaneously. The methodology employs a procedure based on cumulative past returns, the sell (trailing stop-loss) and buy (re-entry) signals are:

\[
P_t = \begin{cases} 
0 & \text{if } R_t < \gamma \text{ and } P_{t-1} = 1 \\
1 & \text{if } R_t \geq \delta \text{ and } P_{t-1} = 0 
\end{cases}
\]

where \( R_t \) is the cumulative return on the asset, since the last portfolio recomposition, \( \gamma \) is the maximum percentage amount that the cumulative return can go down, and \( \delta \) is the minimum percentage the market must recover before re-entering the market. After being stopped out in a down market, the re-entry rule that was applied is straightforward: to rebuy the asset as soon as the market grows by, at least, \( \delta \). This re-entry rule was selected because it will permit gains even if the market does not grow much over the sample period. Given that the sample period goes between 2012-2015, during a financial crisis, the existence of significant rises in prices is not expected to happen.

III. DATA AND METHODOLOGY

To simulate the investment portfolio strategies, I used some European markets, namely, Germany and France (two of the countries least affected by the financial crisis in Europe) and Spain and Greece (two of the countries most affected by the financial crisis in Europe) on the sample period of 2012–2015.

In this simulation stock indexes were used instead of stocks, meaning that I am testing the market (market risk) and not a specific stock (with specific risk). Thus, I focused on well-known indexes of Germany (Dax 30), France (CAC 40), Spain (IBEX 35), and Greece (ASE).

Daily returns were calculated over a one-year holding period. Whenever the portfolio was sold out by the application of the stop-loss rule, the investment was held in cash until the trigger was set off and the asset was repurchased as follows:

i) The position is stopped out by the trailing stop-loss order, at a 3% level; Sell signal.

ii) After being stopped out if the markets grow at least 3% a re-entry on the market is purchased. Buy signal.

Our methodology employs a procedure in which the investor updates their portfolio, after the initial investment, only if:

i) the position is stopped out by the trailing stop-loss order.

ii) After being stopped out, the markets grow at least 3%.

The choice of 3% (a much lower percentage than the typical 7-8% accepted in this type of work – Teweles et al., 1987; Tooth, 2014) concerns the fact that Europe is facing an unprecedented financial crisis, which justifies lowering the accepted risk limit. The use of 3% for all markets, contradicts previous studies that advocate that the rules depend, in addition to investor risk aversion, on the level of market volatility (Teweles et al., 1987; Tooth, 2014). However, this choice was made to improve the comparability. That means that the rules are not flexible or adjusted to the performance of the market which can lead to poor performance. However, this approach will guarantee a methodology that can easily be used by any investor as it does not require advanced technical knowledge.

Transaction costs, in financial markets, are expenses incurred when buying or selling an asset. Trading costs might be so high that strategies using high-frequency trading rules, such as stop-loss orders, can prove unprofitable (Keim & Madhavan, 1995). Thus, the inclusion of transaction costs in this research is essential to establish the consistency of the results. Transaction costs include commissions, exchange, and other fees, bid/ask spreads, market impact costs, and taxes. They are usually segmented into direct and indirect costs. By direct costs, commissions, exchange, and other fees are referred to, while the remaining are indirect costs. Since the latter is difficult to quantify and there is no consensus in the literature on how to determine them, they are not often considered.

“Despite the increasingly prominent role of transaction costs in both practice and research, estimates of transaction costs are not always available or, where available, subject to considerable expense and error.” (Lesmond et al., 1999, pp. 1114). Therefore, the quantification of trading costs is critical for consideration in this study and, by consequence, to the reliability of my findings. Moreover, the impact of transaction costs depends on the asset involved in the transaction. I have therefore established to use the transaction costs charged by one online broker, ActivoBank, as it is easily reachable on the internet and because it works with the major stock exchanges in the world. The transaction costs that the broker charges can be found in Table II.

| Country | Cost | Minimum Charge |
|---------|------|----------------|
| France  | 0.15%| € 15           |
| Germany | 0.15%| € 20           |
| Spain   | 0.15%| € 20           |
| Greece  | 0.25%| € 25           |

Source: https://www.activobank.pt/PDF/precario_op_titulos.pdf.

The use of these transaction costs means that it was not considered indirect costs like several other researchers, such as Fifield et al. (2005), for instance.

The hypotheses to be tested are:

Hypothesis 1) the use of trailing stop-loss orders with a re-entry strategy will lead to portfolio returns that will exceed the returns of a buy and hold strategy on the same asset, in a rising market.

Hypothesis 2) the use of trailing stop-loss orders with a re-entry strategy will lead to portfolio returns that will exceed the returns of a buy and hold strategy on the same asset, in a drawdown market.

Hypothesis 3) the use of trailing stop-loss orders and re-entry strategy will lead to higher portfolio returns in the financial markets of the countries less affected by the crisis.
IV. RESULTS

To be able to compare the markets under study, a summary of the descriptive statistics of the annual stock indexes is presented in Table III.

### TABLE III: DESCRIPTIVE STATISTICS

|       | 2012     | 2013     | 2014     | 2015     |
|-------|----------|----------|----------|----------|
| Germany |          |          |          |          |
| Max    | 7655.71  | 9552.16  | 10014.9  | 12326.7  |
| Min    | 5900.18  | 7418.36  | 8354.97  | 9325.05  |
| Medium | 6840.41  | 8247.06  | 9470.69  | 10869.1  |
| SDeviation | 428.84  | 527.39   | 316.04   | 697.32   |
| GrowRate | 28.86%    | 25.64%   | 4.38%    | 10.9%    |
| France |          |          |          |          |
| Max    | 3674.26  | 4320.68  | 4595.05  | 5268.91  |
| Min    | 2950.47  | 3595.63  | 3918.62  | 4083.50  |
| Medium | 3349.73  | 3951.37  | 4333.76  | 4827.17  |
| SDeviation | 180.01  | 212.47   | 132.42   | 252.60   |
| GrowRate | 13%       | 18%      | 10.8%    | 8.53%    |
| Spain  |          |          |          |          |
| Max    | 8902.1   | 10037.8  | 11187.8  | 11866.4  |
| Min    | 5956.3   | 7553.2   | 9669.7   | 9291.4   |
| Medium | 7624.7   | 8684.4   | 10455.8  | 10660.2  |
| SDeviation | 750.3    | 654.8    | 352.9    | 650.8    |
| GrowRate | 6.38%    | 21.42%   | 5.32%    | -7.79%   |
| Greece |          |          |          |          |
| Max    | 912.70   | 1228.23  | 1369.56  | 937.96   |
| Min    | 476.36   | 800.91   | 816.15   | 559.79   |
| Medium | 712.37   | 999.31   | 1148.02  | 737.81   |
| SDeviation | 105.16   | 111.23   | 141.95   | 81.00    |
| GrowRate | 34.76%   | 28.06%   | -31.4%   | -24.5%   |

Source: Researcher, 2022.

Although Spain and Greece were more affected by the financial crisis than Germany and France, it appears that the market that diverges the most, from the average behavior, is the Greek. The latter presents the highest and lowest annual growth rates in all periods under analysis.

Despite the drop felt in all the examined markets, in 2014, the most stable market was the German, followed by the French. The analysis of the maximum, minimum, and average values, as well as the standard deviation, of the stock indexes, confirms that Germany and France markets are the ones with the greatest stability and the smallest annual price fluctuation.

Even though the Spanish market presents a positive difference in its behavior compared to the Greek, it still presents a marked difference in terms of price stability and growth compared to the German and French markets.

The results of the application of the defined strategy, for the buying and selling rules in each of the markets, are presented in Tables IV, V, VI, and VII, for Germany, France, Spain, and Greece, respectively.

As the goal was to test the stop-loss rule empirically, it was necessary to establish whether stop-losses were indeed effective at limiting downside risk. Thus, the tables present the number of holding days, the number of days in and out of the market, and an evaluation of the return achieved in each trade (buying and selling).

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**Source:** Researcher, 2022.

For each market, the periods in which the index was in the portfolio (rising market) are presented, subdivided into periods with gains and losses. In this regard, the periods in which the index was in the portfolio are more in the markets of Southern Europe than of Northern Europe. However, when...
The strategy presented in this article only presented better results than the buy-and-hold strategy in 2015, and for all markets under analysis. However, the positive difference is more marked in the Northern European markets. These results lead to the conclusion that the strategy used here can beat the market in periods of growth (Germany and France) and in periods of decrease (Spain and Greece).

A note should be made for the year of 2014 and the results obtained in the Greek market. For this year the results of the current strategy also beat the buy-and-hold strategy. It should be noted that it was a year in which all the four markets performed poorly, so the result obtained mainly derives from the implementation of the strategy of maintaining the investment in cash for a substantial part of the year. This result confirms the strategy’s ability to avoid losses.

Through Sharpe’s ratio, one can compute the expected return adjusted by the level of risk. The portfolio returns, adjusted for the risk, in the countries less affected by the crisis, still show better performances than those of the countries more affected.

V. CONCLUDING REMARKS

Hypothesis 1) the use of trailing stop-loss orders and re-entry strategy lead to portfolio returns higher than the buy-and-hold strategy on the same asset, in a rising market.

Hypothesis 2) the use of trailing stop-loss orders and re-entry strategy lead to portfolio returns that exceed the returns of a buy-and-hold strategy on the same asset, in a drawdown market.

Hypothesis 3) the use of trailing stop-loss orders and re-entry strategy lead to higher portfolio returns in the financial markets of the countries less affected by the crisis.

The use of trailing stop-loss orders and re-entry strategy were effective at limiting downside risk, and the re-entry rule was also effective to gain upside potential, but that did not occur in all scenarios. This conclusion can be achieved by the mixed results found in different market conditions.

Through Sharpe’s ratio also allow concluding that portfolio returns, in the countries less affected by the crisis, still show better performances than the ones of the countries more affected.

It was found that the followed strategy presents mixed results, proving to beat buy-and-hold strategy in some scenarios of rising and falling prices. But the most important result is to generate fewer losses in very volatile scenarios such as Greece in 2014.

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