"Overreaction Analysis in Stated-Owned Equities"

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I hereby declare that this dissertation is my own original work and has not been submitted before to any institution for assessment purposes. Further, I have acknowledged all sources used and have cited these in the reference section.

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Abstract

The current paper and the corresponding research are focused in overreaction phenomena concerning state-owned enterprises, employing proven and widely-used methodology and statistical tools. State-owned enterprises are a major component of modern economies, crucial to the production of socially important goods and services as well as the promotion of state policies and strategic planning. The analysis in discussion tests for overreaction and overreaction reversal patterns, making use of Cumulative Abnormal Returns and loser-winner portfolios. Research finds indicate an absence of long-term overreaction proof in all portfolios and test-periods, unable to support the claim that state-owned companies are affected by behavioral factors. Results point to a strictly rational behavior for state-owned equities, testimony to the solidity and importance that define state-ownership.

Keywords: Behavioral economics, overreaction, stocks, return, public sector, state-owned

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1. Introduction

Behavioral economics are an intriguing side of modern economics, created as a means of testing and evaluating abnormal behaviors in equity, debt and commodity markets, behaviors that don't comply with the norm of standard economics and mainstream theories. Behavioral economics are the scientific approach to market sentiment and investor psychology, whose impact over short-term fluctuations and long-term market trends is hard to detect and quite difficult to successfully correlate. Behavioral economics have allured a great number of experienced scientific researchers in pursuit of further understanding of psychological factors' effect over economics in general and corresponding markets in particular, resulting in a rich variety of academic papers and reports shedding light to a still ambiguous sector of finance and economic theory and practice. Empirical finds have greatly improved knowledge and expertise in behavioral management of the markets, yet there is still an open field of research analysis in several aspects and sectors of economic activity. Detection of herding and overreaction/underreaction phenomena in certain areas and markets fuels further questions and inquiries into similar but not yet tested economic sectors, such as stated-owned equities.

Stated-owned enterprises are an economic sector that hasn't been thoroughly tested for behavioral economics appliances and phenomena. Purpose of this paper is to check whether stated-owned companies and their equities are prone to psychological factors and to test if they succumb to changing market sentiment in the long-term perspective. State is a catalytic factor in any economy, participating in almost every aspect of daily life and economic activity. Moreover, stated-owned companies are an irreplaceable element of a nation's integrated financial interactions, although varying in size and degree of integration in each different country. Despite the level of importance weighing on stated-owned enterprises, there is currently a disturbing lack in literature covering behavioral economics occurrences in stated-owned entities and scientific attempts to describe the relationship between stated-owned equities and market sentiment. The current paper intends to fill the gap in academic literature concerning stated-owned companies and behavioral economics through accurate scientific research and analytical methodology. Moreover, the current research intends to conclude to crucial and justified information and data for managers and decision makers in stated-owned companies as a means to determine whether stated-owned equities overreact in the long-term time frame in order to facilitate them with tools and knowledge in key areas such as abnormal equity fluctuations, risk management, comparison to private-owned companies,

opportunities and threats in privatization or nationalization efforts and long-term investment policies.

The majority of research in behavioral economics employs statistical tools and methodology in order to provide concrete and reliable results. Overreaction/underreaction analysis follows that trend, mostly producing results from Cumulative Abnormal Returns (CARs) and the Average Cumulative Abnormal Return (ACAR) estimation statistical tools. Additionally, values under test are usually separated into winner and loser portfolios in order to detract useful information backed by t-statistics to further strengthen and validate the out coming data. The statistical tools in discussion have steadily been used in similar research, building the confidence and trust towards the results they offer, accompanied by the reputation and clarity of the papers they produced. Results of the current paper are expected to successfully detect any possible anomalies described as overreaction in stated-owned equities, while providing further answers to the level and extent of those anomalies. Final intention of the paper is to also discuss the nature and effects induced in public management by the presence of any behavioral anomalies.

Chapter one served as an introduction towards the purpose, structure and contribution of the current paper. Chapter two will be a brief description of behavioral economics theory and history of overreaction/underreaction analysis accompanied by a presentation of key literature arguing the subjects in discussion and their appliances in critical economic sectors. Chapter three will be dedicated in sample selection and equities distribution followed by the methodology and statistical tools employed towards the purpose of the research. Produced results with the corresponding interpretation will take place in chapter four with concluding arguments and summary notes placed in the fifth and final chapter.

2. Overreaction & Underreaction

2.1 Theory

Neoclassical economics as expressed by Weintraub (2007) and the rational choice theory by Becker (1976) are based on three pillar assumptions: i) that people make rational choices among different solutions, ii) that people want to maximize utility and firms tend to maximize profits and iii) people act on their own accord making use of all available and relevant information. Further development of neoclassical theory led to the Efficient Market Hypothesis, firstly proposed by Fama (1970), supporting the belief that equities' and stock market movements and trends are the result of rational investment thinking and careful analysis of all existing and freely available related information. The main concept is that stock prices reflect the market factors and macroeconomic factors that form their fundamentals while daily fluctuations are the consequence of new public information and data forcing investors to a re-adjustment of their portfolios and alteration of their perceived future portfolio outlook. Efficient Market Hypothesis describes markets as "faultless", arguing that market trading and price-forming mechanisms are robust and calculated, therefore free of foreign non-financial interactions and change catalysts.

Problems occur though when Efficient Market Hypothesis is unable to relate all stock fluctuations to rational and analytical methodology originating from the fundamentals and underlying value of those stocks. Neoclassical theories deny the possibility of mental and cognitive factors influencing market status and investment policies. Contrary to that denial though, many researchers have concluded to an amassing opposing proof to the Efficient Market Hypothesis and modern neoclassical theory. Bayes' rule violations observed by Kahneman & Tversky (1977) concerning investors' reactions to new data, Shiller's (1981) argument of irrational disagreement in dividends' variation compared to aggregate stock volatility and Basu's (1977) price-earnings ratio (P/E) anomaly describing P/E ratio discordance to future stock returns all point to an observable deficiency in neoclassical theory and the pure rational thinking in economics.

Behavioral economics are attempting to fill that gap, studying the concepts, effects and results derived beyond the enclosures of rationality and attributed to

psychological, social and emotional mechanisms that form the investors' unique characteristics and drive them to a multitude of reactions and decision-forming not always in tandem with the neoclassical maximum utility and profit. The three major themes in behavioral in economics are, as described by Shefrin (2002), : i) heuristic and biased decision making ii) framing by stereotypes, filters and personal boundaries resulting in irrational decisions and iii) market inefficiencies such as mis-pricings and counter-productive procedures that push or drive to abnormal results.

Adam Smith (1761) in his classical economics work mentioned psychological solutions to certain financial behaviors, introducing ideas such as morality, ethics, philosophy and psychology in economic functions. Keynes (1936&1937) in several of his papers was among the first to mention psychological effects in consumption and savings, paving the way for further investigation in those fields. He also identified how optimism and pessimism can affect the investor psychology and consequently change trends in stock markets while Keynes (1930) also included sociological factors that drive investors to certain strategies such as imitation and joining the crowd. Later on, in an attempt to solve the puzzle of equilibrium in markets with rational and partly-rational agents, Rusell & Thaler (1987) argued that rational investors are not enough to guarantee a rational balance in any market when that market also involves quasi-rational investors. Prospect theory by Kahneman & Tversky (1979) described how decisions in diverse risk situations are altered by the perceivable optic of the risk situation and cognitive psychology.

In a different behavioral economics field, Laibson (1997) and Frederick, Loewenstein & O'Donoghue (2002) employing the concept of time discounting expressed the effect that time and value over time are implementing in investor decisions towards irrationality and away from the norm of neoclassical theories. Support to that theory comes from Williams (1956), who held the belief that prices are disproportionately based on short-term earning power instead of long-term dividend yield power. Bounded rationality, as described in papers by Simon (1982) and Kahneman (2003), is another view of behavioral economics, stating that there are limits to human information processing and problem solving, consequently turning investors to adopt rules of thumb and heuristics ways of problem manipulation instead of optimal and careful processing calculations.

Another interesting viewpoint of behavioral economics is the dual system theory, in efforts made by Kahneman (2011) and Samson & Voyer (2012&2014), arguing that

decision making is based on two separate systems in the human brain, i) system 1 an automatic, intuitive, experienced based and mostly unconscious system and ii) system 2 a controlled, reflective, analytical and conscious system. System 1 is more dominant when circumstances such as cognitive busyness, distraction, time pressure, and positive mood occur while system 2 is dominant around decisions of high importance, elevated personal relevance and significant accountability. The dual system theory is the depiction of alterations in decision-making based on spontaneous circumstances and random psychological environment parameters. Scheifler & Summer (1990) in their approach of investor sentiment/limited arbitrage theory added how irrational investors further fuel market trends by getting involved in trend chasing and stop loss investment strategies, a consequence of noise trading and sentimental decisions. Daniel, Hirschleifer & Subrahmanyam (1998) employing self-attribution theory exhibited how private and public information positive correlation leads to empowering investor confidence and overreaction/underreaction phenomena while contradictory public to private information causes abandondment of private information and underreaction.

Behavioral economics phenomena can be detected in two major forms, overreaction/underreaction and herding. Overreaction/underreaction is the idea that in abnormal situations stock prices might move excessively and irrationally over or under their fundamentals and underlying value, correcting afterwards slowly back to their "proper" price. Herding on the other hand is expressed by the disagreement between private information and public stocks trends, resulting in the abandonment of an individual's optimal strategy and joining of the mainstream public information and consequent market movement in violation of contradicting private information.

Debondt & Thaler (1985) were pioneers in overreaction/underreaction analysis, successfully detecting the existence of such phenomena in stock markets using cumulative abnormal returns and winning-losing portfolios. Other contributors in the early overreaction/underreaction theory were Jegadesh & Titman (1993), who were able to predict profitable strategies by using past returns and employing the overreaction/underreaction methodology. Herding on the other hand can be separated in three views according to Devenow and Welch (1996), i) the rational view describing the way investors blindly mimic other investors' actions leading to herding, ii) the near-rational view that includes the heuristic ways in which investors acquire and process information resulting in similar decisions and iii) the rational view in which investors consciously mimic other investors to hide their lack of information or expertise. Moreover, Bikhchandani and Sharma (2001) divided into i)

spurious herding, a result of changes to fundamentals and underlying value of a stock and ii) intentional herding as a deliberate mimic of other investors to exploit their knowledge and experience. Taking into account these developments, it is highly justified to add a third set of factors, next to neoclassical theory's market and macroeconomic factors, that contribute in price formation and changes, the behavioral factors that include market sentiment and investor psychology.

2.2 Literature

Main research focus of the current paper is the overreaction/underreaction analysis. Literature in the field of discussion is quite enriched with a significant number of reports and papers in an extensive coverage of all markets, with intriguingly varying results. Overreaction/underreaction hypothesis consists of three propositions, according to Brown & Harlow (1988) i) Directional effect : extreme movements in stock prices will be followed by subsequent price movements in the opposite direction, ii) Magnitude effect : the more extreme the initial price movements, the greater the following subsequent adjustment will be and iii) Intensity effect : the shorter the time duration of the initial effect, the more extreme the subsequent reversal will be.

As mentioned earlier in this chapter, Debondt & Thaler (1985) were among the first to successfully detect empirical proof for overreaction/underreaction in NYSE and were able to provide future predictions of correcting moves for equities that had demonstrated abnormal behavior in past sessions. Lehman (1990) studied overreaction/underreaction in short-term time frames and concluded in weekly price reversals in a somehow arbitrary function of the market caused possibly by inefficiencies in market liquidity around major price fluctuations. In a similar research in Brazilian stock market, DaCosta & Newton (1994) resulted in sizeable price reversals in 2 year time-periods with a significantly higher extent to the phenomena than US stock markets, also arguing about an asymmetry in the price reversals between overreacted and underreacted equities. Testing a specific industry, that of technology stocks, Akhigbe, Larson & Madura (2002) compared extreme changes in technology stocks with a corresponding non-technology portfolio that demonstrated similar extreme changes the same period. Their results pointed to a unique behavior of the technology equities, which experienced

overreaction/underreaction in a greatly elevated degree in contrast with the corresponding test portfolio.

New information releases have also been vital in overreaction/underreaction analysis. Atkins & Dyl (1990) tested for abnormal stock movements related to the release of favorable or unfavorable information. Their findings pointed to statistically significant abnormal returns and irrational cumulative average abnormal returns the following days after sudden price changes derived of new information. Bremer & Sweeney (1991) in a report about Fortune 500 stocks argued about excess negative 10-days returns that led to respectively excessive positive abnormal returns the following days, attributing the issue to overreaction to negative news with the adjustment-period consisting of two days. In London stock exchange, Spyrou, Kassimatis & Galariotis (2007) found no abnormal reactions after extreme price shocks for large cap equities. Their results though for medium and small cap equities were affirmative towards short-term underreaction instances to both positive and negative market shocks with the authors unable to attribute the situation to either time-related anomalies, bid-ask biases or other catalytic economic fluctuations.

As far as analysts' earnings forecasts, Amir & Ganzach (1998) checked how and in what extent leniency, representativeness and anchoring and adjustment created conditions for overreaction/ underreaction in forecasts about future earnings. The authors' model results indicated that analysts overreacted in forecasts' changes and underreacted in forecasts' revisions. Moreover, they concluded to overreaction results for positive forecast modifications and underreaction for negative forecast modifications. Another outcome of their research was that the levels of overreaction, underreaction and excess optimism were positively correlated with forecast horizon implying a relationship between prediction horizon and prediction bias. Massey & Wu (2005), employing their regime shift analysis and parametric data in a system-neglect hypothesis that investors react mostly to information they directly observe and in a lower degree to the circumstantial environment that sourced that information, validated that hypothesis with results verifying that underreaction instances appeared more commonly in unstable environments with precise information while overreaction was noticeably higher in stable environments with noisy information.

In foreign exchange markets, Parikakis & Syriopoulos (2008) investigated Turkey's Lira, Brazil's Real, UK' Pound and USA's Dollar for overreaction/underreaction

after 1-day extreme fluctuations in their corresponding exchange rates with the Euro. The authors deducted that Lira, Real and Dollar overreacted the days following the extreme movement while the Pound underreacted. Moreover, the authors held the belief that the currency markets under test could yield profits by employing contrarian strategies. Following that research, Anusakumar & Abdullah (2014) in a wide research for 21 currencies and using the same method of testing after 1-day excess fluctuations in exchange rates, were led to positive results considering the existence of overreaction/underreaction. Results from cumulative average abnormal returns also pointed to the presence of investors' over-optimism while there were no differences in levels of overreaction/underreaction between developed markets and emerging markets. Larson & Madura (2001) also concluded that currencies in developing markets were mostly overreacting while those in industrial markets mostly underreacted, adding proof that currencies tended to underreact to the actualization of significant political and economic news while they had overreacted to earlier rumors of the same news.

Commodities markets have similarly been under check for overreaction/underreaction instances. Hsu, Chiang & Liao (2013) found significant evidence in commodities future markets, confirming underreaction hypothesis in agricultural commodities such as softs, grains and livestock and overreaction hypothesis in non-agricultural commodities such as metals and energy commodities. Spyrou (2006) in a research about behavioral economics in Brent crude oil, gold and Robusta coffee contracts, came up with results of overreaction in IPE Brent crude oil futures after positive market shocks, underreaction in CMX gold futures following negative price shocks and finally, investor underreaction in LIFFE Robusta coffee futures after positive price shocks. Author also identified possible arbitrage gains through exploitation of these anomalies and adjusted investment strategies. In a paper for REIT markets, Simpson, Emery & Moreno (2009) realized that dividend announcements led to overreaction and over-optimism among investors, while they also proved that market reaction was based not only on the dividend announcements but also on the monetary policy in effect and the perceived distinction between good or bad announcements.

2.3 State-Owned Equities

The Organization for Economic Co-operation and Development (OECD) definition (2014) for state-owned companies/enterprises announces stated owned companies as any autonomous public entity i) involved in commercial activities and ii) controlled, directly or via other government-controlled institutional units, by the central or federal level of government. A corporation in order to be classified as a state corporation must i) be controlled by another public unit and ii) be a market producer. The OECD definition describes control as the ability to determine the general policy or program of an institutional unit while market producer is the ability to whether or not an institutional unit can charge economically significant prices. The OECD definition does not include companies that are owned by sub-national levels of government, while it also distinguishes to majority-owned enterprises where the state owns more than 50% of the shares and holds effective control of the enterprise and to minority-owned enterprises where the state holds between 10% and 50% of the shares and are therefore considered as partly state-owned enterprises.

The reasons behind state-ownership of a corporation vary across the world but could be concentrated in the following four categories as described by OECD (2014) i) the presence of historic natural monopolies in crucial economic segments such as electricity, telecommunications and transport infrastructure, ii) the steady participation of state control over sectors considered of strategic national interest such as energy resources, iii) the achievement of vital public policy objectives such as public service delivery, public health or transport availability and iv) temporary bailout through equity injections to save key failing companies that are important to a sector or economy of a nation. Others reasons according to PwC (2015) are i) to provide public goods and merit goods beneficial to all society, ii) improvement of labor relations, iii) limited private or foreign control in the domestic economy, iv) improvement of public funds by monopolies and entry barriers, v) increased access to public goods services and vi) encouragement of economic development and industrialization.

The main difference between private and state-owned enterprises is that while private companies' sole purpose is to maximize profits and efficiency of the corporation, state-owned companies are challenged with goals of a much wider aspect, in cases mostly non-commercial as decided by the state's guidance as social

value. Towards those targets, state-owned enterprises are uniquely linked with the ministries and executive authority of their corresponding nation, resulting in enforcement of alternate strategies and formation of attributes that pursue their state-originated long-term objective. The state on the other hand takes all measures available to ensure the success and achievement of its long-term policies and plans. A key characteristic of state ownership is that state-owned companies are often granted with several layers of favorable leverage such as monopoly market status, protection from imported competition, exclusive export promotion deals and regulatory backing, often counter to free market spirit and perfect competition economy status. Some advantages that state-owned companies may enjoy due to their unique relationship with the state are i) direct subsidies, ii) concessionary financing, iii) state-backed guarantees, iv) preferential regulatory treatment, v) exemptions from antitrust enforcement or bankruptcy rules, and vi) other forms of beneficial or supportive state-derived measures. State-owned companies are enterprises with higher levels of corporate governance and corporate social responsibility but due to their state association they are also prone to malpractices such as bribery, corruption, inefficiency, political ties and budgetary restrictions.

State-owned companies are significantly limited in both absolute numbers and economic footprint in industrial and developed countries in comparison to their counterparts in still emerging and developing countries. In a report for OECD, Kowalski, Büge, Sztajerowska & Egeland (2013) noted that in Forbes Global 2000 list with the world's largest listed companies, 10% or 204 of those companies were enterprises in which the state was the sole or major shareholder. Those 204 state-owned companies were spread among 37 countries, with the greater numbers originating from China (70), India (30), Russia (9), United Arab Emirates (9) and Malaysia (8) while their combined sales were up to 3.6 billion US dollars in the 2010-2011 business year and their market capitalization summed up to 4.9 billion US dollars. The eight countries with the higher country state-owned companies' shares (China, United Arab Emirates, Russia, Indonesia, Malaysia, Saudi Arabia, India and Brazil) accounted for more than 20% of total world trade with China's sole figure standing at almost 10%. In another report considering state-owned companies in OECD countries, OECD (2014) mentioned that in 2014 about 2111 state-owned companies employed 6 million people with the value of state-owned companies in the research amassing to 2.2 trillion US dollars. 65 of those companies were majority-owned listed companies, 1611 were majority-owned non-listed companies and the rest 435 were partly-owned companies

Data about sectorial distribution from the OECD report (2014) pointed that, by company value, electricity and gas were 24% of state-owned activity, finance another 24%, transport 14.3%, production and refining of hydrocarbons 14.3%, other utilities 8.8%, telecommunications 3.3% and manufacturing 1.2%. In employment terms for OECD nations, 34% of state-owned companies were in the transport sector, 10% in electricity and gas, 7% in finance, 5% in manufacturing while other utilities were 19% of state-owned companies and other activities a further 20%. In general, state-owned companies are mainly involved in energy, commodities, utilities, transport, manufacturing, financial, telecommunications and services areas with the majority of the companies that are listed being intensive in international trade operations such as energy, commodities, transport and financial sectors while non-listed companies are mostly focused in domestic markets and sectors like utilities, telecommunications and public services. Moreover, emerging and developing countries are mostly related with state-owned companies in commodities, energy, manufacturing and financial sectors while developed and OECD state-owned companies are more active in energy, transport, utilities, financial and manufacturing sectors.

The above statistics underline the value and contribution of state-owned companies while also validating the importance and integration of those companies in any economy, justifying any research and scientific attempt to further enrich literature, knowledge and expertise considering state-owned companies. Top priority should be to provide both investors and managers with crucial and necessary information and therefore lead them to efficient and rewarding decisions which will consequently increase added value for all stakeholders and society in total.

3. Data and Methodology

3.1 Data

Data for the overreaction analysis consists of daily returns for 184 state-owned enterprises (Appendix), alongside with daily returns for 30 stock exchanges' main indexes towards the purpose of calculating abnormal returns for the state-owned equities. In the current paper, state-owned companies are companies that are majority owned, directly or indirectly, by the central government of each

corresponding country. The above statement describes companies whose major shareholder, owner of over 50.01% of the available stocks, is a central government through ministries, legal entities, state conglomerates, sovereign investment funds and investment wealth funds. The sample does not include companies owned by local governments or companies that do not fulfill the state-ownership criterion throughout the period under test, while a crucial prerequisite is the free and unobstructed trading of the state enterprises' equities in a public stock exchange, allowing thus the possibility of sentimental influence over the stocks' performance.
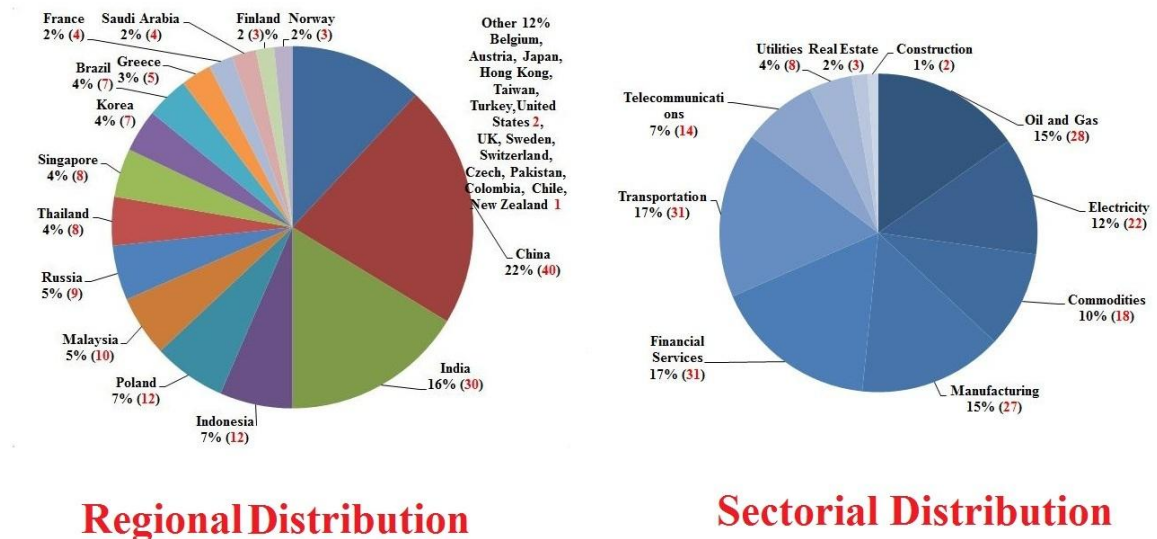
Figure 1. Sectorial and Regional Sample Distribution by Company Numbers, Percentages (in black) and Absolute Numbers (in red)

Source. Author's Calculations

Sample forms from companies involved in a great variety of economic sectors and industries, among which : i) oil and gas industry, companies that focus on oil and gas upstream and downstream activities such as exploration, drilling, processing, storage and distribution of oil and gas and their immediate products, ii) electricity, enterprises that either produce and distribute electricity or build and manage power grids, iii) commodities, companies which are involved in the exploration, mining and processing of commodities such as coal, iron ore, copper, gold, bauxite, steel and other common, industrial or rare earth materials, iv) manufacturing, companies that operate in manufacturing industries such as construction equipment, machinery, fabricated products, transport vehicles, chemicals, fertilizers and others v) transportation, including airline companies, shipping companies, railway companies,

logistics companies, port or airport managing companies and city transport services, vi) financial services, mostly banks operating in commercial, investment and development economic fields as well as insurance companies and other financial services, vii) telecommunications, enterprises that offer land or mobile telecommunication services, internet suppliers and network managing companies, viii) utilities, companies that are involved in water distribution and management, sewage management, post service companies and other crucial public services, ix) real estate, companies that manage and operate state-owned real estate and any other state property and x) construction, companies that undertake major construction projects and manage construction equipment. Sample regional and sectorial distribution details using absolute numbers of companies can be found in figure 1.

Regional Distribution

Sectorial Distribution
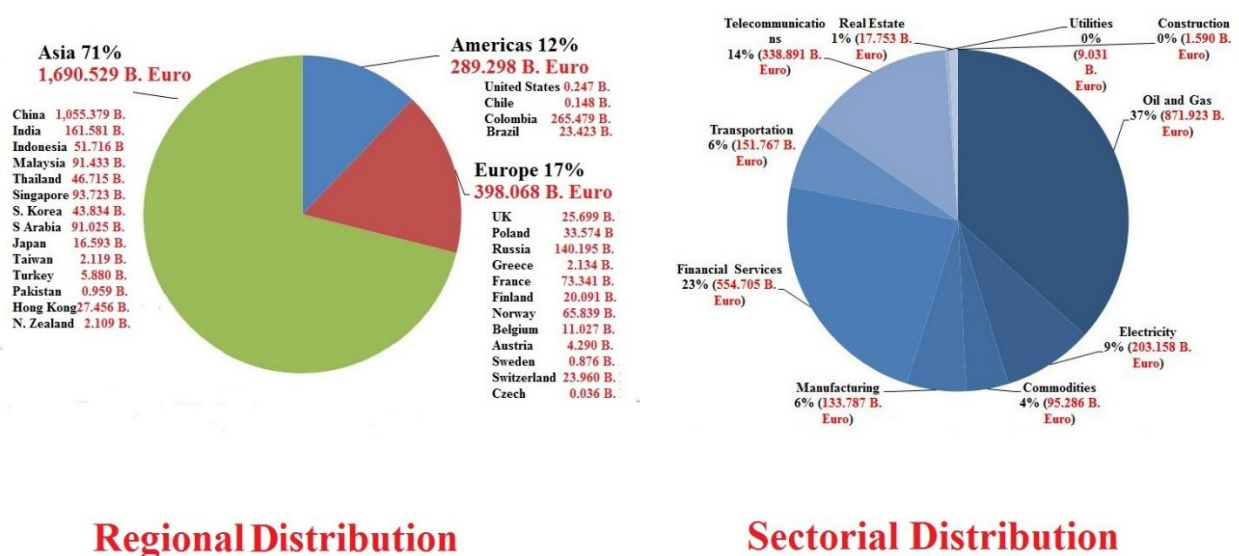
Figure 2. Sectorial and Regional Sample Distribution by Market Capitalization, Percentages (in black) and Absolute Numbers (in red)

Source. Author's Calculations

Sample data consists of state-owned enterprises from three main regional areas, Asia, Europe and Americas. Asia includes companies listed in stock exchanges in China, India, Indonesia, Thailand, Malaysia, Singapore, S. Arabia, Hong Kong and others. European companies are traded in stock exchanges in all around the European continent such as Russia, Poland, France, Greece, Norway, Finland and others while Americas companies are traded in stock exchanges in countries such as Brazil, United States, Colombia and Chile. In market valuation terms, sample

companies amassed to a market capitalization of 2,377,897,005,882.00 € or $2,581,682,779,286.09 at the end of the test period, December 31st of 2015. Calculations were conducted by adding up individual market capitalization figures employing the currency rates at they stood at the end of the test period, December 31st of 2015. The majority of the sampled companies, by capitalization values, is located in Asia with a market capitalization worth of 1,690,529,192,991.20 €, while sampled companies in Europe were worth 398,068,981,916.00 € and those in Americas 289,298,830,980.00 €. In sectorial sample distribution by capitalization standards, the leading industry is that of oil and gas with a market capitalization of 871,923,382,131.79 €, trailed by financial services with a market valuation of 554,705,904,757.49 € and telecommunications industry with a market capitalization of 338,891,502,996.78 €, followed by the other industries with smaller figures. More detailed info for sample distribution by market capitalization is grouped in figure 2.

Sample period is the time-period starting January of 2004 and ending in December 2015. That concludes to over 550,000 daily returns for the 184 state-owned enterprises under research with about another 90,000 values of daily returns originating from the 30 main stock indexes covering the test-period. The described chronic length of the sample is considered important in order to provide the necessary supporting mainframe for long-term scientific analysis and to guarantee that sample includes data from three separate sub-periods. These are the periods before the major financial crisis in 2008, the period around the financial crisis in 2008 and the period after the financial crisis in 2008. Analysis and empirical finds of three separate and unique sub-periods are crucial in detecting any abnormal behaviors of state-owned enterprises during different economic and financial environments such as economic growth and prosperity, market turmoil in conjunction with economic trough and long-term volatility characterized by anemic growth. Sample data will be organized into two-year non-overlapping groups with the first group (2004-2005) serving solely as the first portfolio formation period while the following 5 chronic groups (2006-2007, 2008-2009, 2010-2011, 2012-2013, 2014-2015) will be both groups under overreaction analysis with portfolios formed in the previous chronic period and portfolio formation periods for the upcoming overreaction analysis.

3.2 Methodology

The majority of overreaction/underreaction scientific analysis employs statistical tools such as Cumulative Abnormal Returns (CARs) and the formation of winner/loser portfolios based on previous CAR performance of individual stocks, as well as t-statistics to validate and strengthen the significance of provided results. The historical background of the methodology in discussion originates in the work from overreaction/underreaction pioneers Debondt & Thaler (1985) as has been mentioned earlier. Abnormal Returns calculation is a useful determinant to gauge abnormal movements of a stock relative to a benchmark index, most commonly the stock market main index, allowing consequently the detection of any possible behavioral phenomena. Moreover, Cumulative Abnormal Returns serve the purpose of providing long-termed empirical finds for behavioral phenomena as they provide crucial information of long-term stock trends and long-term reversal tendencies of overreacting or underreacting stocks. On the other hand, separation to winner and loser portfolios is mandatory, as it facilitates the observation of unequal trends among stocks that are positively overreacting and stocks that are negatively overreacting. Successful detection of dissimilar fluctuations among upward and downward moving stocks, in conjunction with any possible external data and economic shocks, is a great indicator for the reasons that cause the behavioral economics motions.

Daily stock returns are calculated using the typical formula for return estimation, which is:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \% \ (1)$$

- $R_{i,t}$ is the return of stock i at time t
- $P_{i,t}$ is the price of stock i at time t
- $P_{i,t-1}$ is the price of stock i at time t-1

The same formula is applied in calculating daily stock exchanges' main index return:

$$R_{M,t} = \frac{P_{M,t} - P_{M,t-1}}{P_{M,t-1}} \% \quad (2)$$

- $R_{M,t}$ is the return of stock market main index M at time t
- $P_{M,t}$ is the price of stock market main index M at time t
- $P_{M,t-1}$ is the price of stock market main index M at time t-1

Following the calculation of stocks' and indexes' returns (1) & (2) is the estimation of the difference among the two, the Abnormal Return (3) of each stock compared to the main index of the stock exchange in which it is publically listed. The main difficulty of the current paper lies to the fact that sampled state-owned enterprises are listed in stock exchanges all around the world. That implies that Abnormal Returns for each stock have to be estimated by employment of their corresponding main index, thus increasing the complexity and absolute number of necessary calculations, not impossible though as depicted in a paper published by Baytas and Cakici (1999).

Daily Abnormal Returns for stocks are calculated through the following equation:

$$AR_{i,t} = R_{i,t} - R_{M,t} \quad (3)$$

- $AR_{i,t}$ is the Abnormal Return of stock i at time t
- $R_{i,t}$ is the return of stock i at time t (1)
- $R_{M,t}$ is the return of the corresponding to stock i market index M at time t (2)

The next step in overreaction analysis is to compute the stocks' Cumulative Abnormal Returns in two-year time periods as a tool to both evaluate the performance of prior test-period generated winner and loser portfolios and also form the new winner and loser portfolios for the upcoming test period. Cumulative Abnormal Returns are calculated as:

$$CAR_i = \sum_{i=1}^{730} AR_{i,t} \quad (4)$$

- CAR_i describes the Cumulative Abnormal Return of stock i
- $\sum_{i=0}^{n} AR_{i,t}$ is the sum of Abnormal Returns (3) for stock i for day 1 to day 730, a two-year time period

Purpose of the current paper is to test long time-stretching performance of state-owned equities and detect behavioral phenomena that influence the equities' performance in a long-term time horizon. Towards that goal, Cumulative Abnormal Returns (4) are calculated in two-year intervals that do not overlap, while winner and loser portfolios will also be under test for two-year periods. Taking in consideration research data extends from 2004 to 2015, which concludes in the formation of 5 forming periods and 5 test-periods which are as follows:

Set	Formation Period	Test Period
1	2004-2005	2006-2007
2	2006-2007	2008-2009
3	2008-2009	2010-2011
4	2010-2011	2012-2013
5	2012-2013	2014-2015

Using the same methodology for portfolio formation as Soares & Serra (2005) have in their research for the Portuguese stock exchange, each of the winner and loser portfolios under test will consist of the top 20% performing equities and the bottom 20% performing equities of the corresponding formation period respectively, the significant proportion of stocks under test allowing for more reliable and solid results. Moreover, to better depict the general trend of portfolios under test, Average Cumulative Abnormal Returns (5) will be employed using the below equation, as seen in Spyrou, Kassimatis and Galariotis (2007) :

$$ACAR_{i,t} = \frac{1}{N}\sum_{i-1}^{N} CAR_{i,t} \text{ (5)}$$

- $ACAR_{i,t}$ is the Average Cumulative Abnormal Return for portfolio i
- N is the number of Cumulative Abnormal Returns that form portfolio i
- $CAR_{i,t}$ is the Cumulative Average Return (4) of stocks forming portfolio i

The overreaction hypothesis predicts that after the formation period, stocks that were assigned to the winner portfolio due to high positive Cumulative Abnormal Returns will reverse their trend and exhibit negative Cumulative Abnormal Returns in the upcoming test period, thus Average Cumulative Abnormal Return for the test period should be negative, $ACAR_{W,t} < 0$. Similarly, in the same case of overreaction hypothesis stocks assigned to the loser portfolio due to low negative Cumulative Abnormal Returns in the formation period ought to later adjust their returns and demonstrate upward movement resulting in a positive Average Cumulative Abnormal Return in the test period, $ACAR_{L,t} > 0$. The immediate implication of the reversal of overreaction phenomena is that the loser portfolio would outperform the winner portfolio and consequently ($ACAR_{L,t} - ACAR_{W,t}$) > 0. To provide statistical significance for the difference between $ACAR_{L,t}$ - $ACAR_{W,t}$, DeBondt and Thaler (1985) utilized t-statistics, and more specifically the t-test.

The main problem with the simple t-test though, is that it assumes samples of equal size and more importantly same variance, thus providing less accurate and statistically important results if those two criteria are not fulfilled. In order to overcome the current problem, overreaction analysis will employ an alternate t-test, the Satterthwaite-Welch t-test. The main benefit for the Satterthwaite-Welch t-test is that it provides more reliable results with the assumption of normality for the samples but without the pre-request for equal sizes and same variance for both samples. The main difference in methodology is that is estimates the equality of the means (Average Cumulative Abnormal Returns) using separate standard deviations (8) for the two independent samples and not a pooled one (6). More specifically, in the simple T-Student test the estimation formula is as:

$$t = \frac{ACAR_L - ACAR_W}{s_P \sqrt{\frac{2}{n}}} \quad (6)$$

where the pooled standard deviation S_P (7) originates from the following calculation:

$$S_P = \sqrt{\frac{s_L^2 + s_W^2}{2}} \quad (7)$$

On the other hand, the Satterthwaite-Welch t-test formula (8) is as follows, with the main alteration to the Student t-test located in the denominator which consists of the two separate portfolio's standard deviations and not a pooled one.

$$t = \frac{ACAR_L - ACAR_W}{\sqrt{\frac{s_L^2}{N_L} + \frac{s_W^2}{N_W}}} \quad (8)$$

In all t-test equations:

- $ACAR_L$ is the Average Cumulative Abnormal Return of loser portfolio
- $ACAR_W$ is the Average Cumulative Abnormal Return of winner portfolio
- s_L^2 is the standard deviation of loser portfolio
- s_W^2 is the standard deviation of winner portfolio
- n is the equal number of values in each portfolio
- N_L is the number of values in loser portfolio
- N_W is the number of values in winner portfolio

The null and the alternative hypothesis for the Satterthwaite-Welch t-test which is employed in the current research are:

$$H_0: ACAR_L = ACAR_W$$

$$H_1: ACAR_L \neq ACAR_W$$

Significant t-values (8) in the difference between $ACAR_{L,t} - ACAR_{W,t}$ would indicate that the average returns of the two portfolios are not equal. A positive and statistically important result in t-values would support the hypothesis of overreaction phenomena, implying that the performance of the loser portfolio is better that the winner portfolio, due to the fact that the loser portfolio is correcting its previous negative overreaction with an upward trend while winner portfolio is retreating to negative levels correcting its positive overreaction.

Further concern about the normality of sample distributions justifies the use of further tests, non-parametric ones, which guarantee the statistical importance for tests for equality regarding samples that might not fulfill the criterion of normal distributions. Equities and stock market indexes do not always follow a rational behavior considering their trends, and can therefore exhibit extreme values from time to time, consequently resulting in samples that are not evenly distributed. Moreover, the estimation for abnormal returns that employs both stocks and stock indexes could further amplify the problematic nature of stocks' fluctuations and result in even more irregular samples. The main solution addressing the problem of uncertainty in the normality of the samples is the utilization of non-parametric tests, and more specifically the Matt-Whitney U-test. The Matt-Whitney U-test disregards the necessity for normal distributions and the key difference is the focus in the use of medians of samples instead of their means, while also involving summation of ranks (9), as below:

$$U = n_L n_W + \frac{n_L(n_L+1)}{2} - \sum R_i \quad (9)$$

- n_L is the number of values in loser portfolio
- n_W is the number of values in winner portfolio

- $\sum R_i$ is the ranks of loser portfolio

The null and the alternative hypothesis for the Matt-Whitney U-test are as follows:

$$H_0: MCAR_L = MCAR_W$$

$$H_1: MCAR_L \neq MCAR_W$$

Statistically important positive and above critical values results for Median Cumulative Abnormal Results U-tests (9) would point to uneven, and positive towards loser portfolio, performance for the two portfolios. That could be an immediate result of reversal patterns of prior upward and downward trends respectively, feeding the probability for overreaction phenomena having taken place during the formation period of the corresponding portfolios, consequently allowing the rational claim for such phenomena.

4. Results

Results of the overreaction analysis concerning state-owned enterprises are quite interesting and open to interpretation. Average Cumulative Abnormal Returns (5) are in general ambiguous as they do not present clear and distinctive behavioral trends for state-owned equity returns at any of the test-periods, thus not allowing the proposal for successful detection of long-term overreaction phenomena and the subsequent portfolio reversal movements for state-owned companies under investigation. In order to successfully support the overreaction claim, loser portfolios in test-periods should have outperformed the corresponding winner portfolios, as a correcting procedure to the abnormal previous time-frame movements that led to their classification to loser and winner portfolios respectively. Additionally, loser portfolios should have ideally reacted with positive Average Cumulative Abnormal Returns adjusting their previous negative results, while on the other hand winner portfolios should have resulted to negative Average Cumulative Abnormal Returns as a reversing consequence of their formal abnormal positive returns. Empirical finds though do not depict such phenomena. Moreover, t-statistics tests (6) & (9) also negate the possibility for concrete evidence supporting overreaction detection and stock reversal movements, with t-statistics and p-values

not concluding to statistically important justification for the null hypothesis or overreaction detection either.
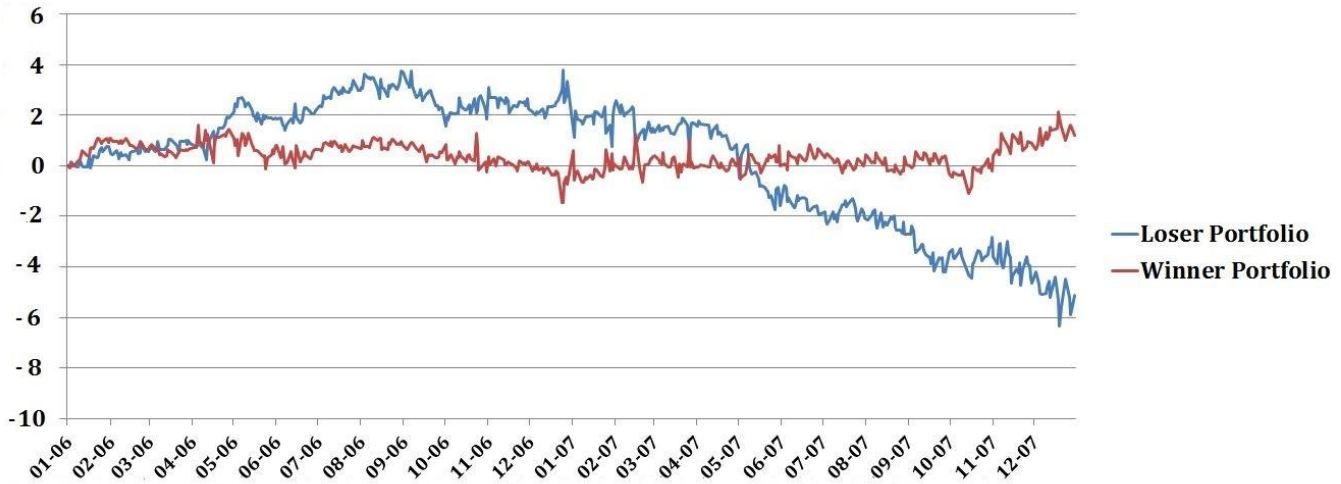
Figure 3. Daily Average Cumulative Abnormal Return for Loser and Winner Portfolios, Test Period: 2006-2007.

Source. Author's Calculations

More specifically, figure 3 presents loser and winner portfolios' Average Cumulative Abnormal Returns (5) for test-period 2006-2007. In the time period under discussion, winner portfolio follows a solid neutral behavior, with Average Cumulative Abnormal Returns steadily fluctuated around zero, a pattern that cannot be described as a reversal movement to any possible former overreacting returns. During the same test-period, loser portfolio at first follows an upward motion which is sustained for about a year starting Q2 2006 to Q2 2007 but then corrects that development by falling to negative Average Cumulative Abnormal Returns for the remaining of the test-period. The conclusion of those trends is that, although loser portfolio might experienced a short-term overreaction occurrence, neither of the two portfolios seems to be reversing their former formation period abnormal returns in the long-term 2 year time-frame, denying the possibility for overreaction phenomena in the portfolio formation period of 2004-2005, while winner portfolio carries on outperforming loser portfolio in the test-period as well ($ACAR_L$-$ACAR_W < 0$)[1].

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[1] Table 1, Row 1, Author's Calculations

Figure 4. Daily Average Cumulative Abnormal Return for Loser and Winner Portfolios, Test Period: 2008-2009.

Source. Author's Calculations

Figure 4, describing empirical finds for test-period 2008-2009 is slightly harder to interpret, presenting an increased level of Average Cumulative Abnormal Returns (5) volatility. Winner portfolio is mostly in negative territory in this time-period, although demonstrating upward and downward successive variations over the 2 year time-period, not fulfilling though the criteria for a distinctive long-term reversal movement of possible overreaction-rooted abnormal returns in the formation period. Loser portfolio on the other hand is characterized by a severe negative movement in Q4 of 2008 which is later reversed in H2 of 2009, a possible short-term overreaction taking place due to the climax of the financial crisis of 2008, but not a long-term reversal trend of any overreaction phenomena that might occurred during the formation period of 2006-2007. Figure 4 does not depict the expected patterns that would support the existence of overreaction in equity returns during 2006-2007, with winner portfolio again marginally outperforming loser portfolio ($ACAR_L - ACAR_W < 0$)[2].
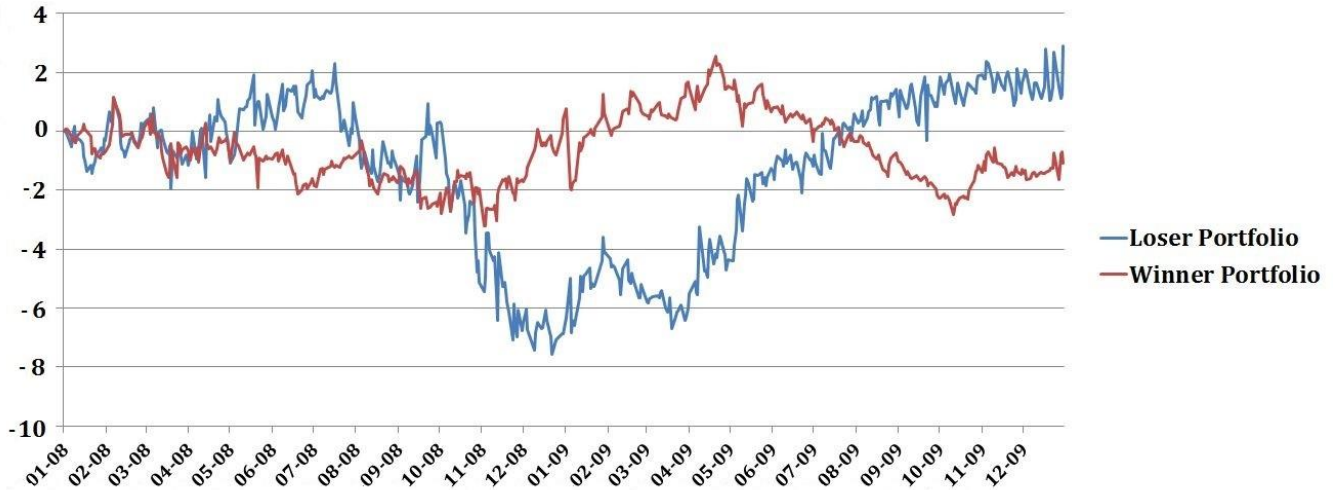
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[2] Table 1, Row 2, Author's Calculations

Figure 5. Daily Average Cumulative Abnormal Return for Loser and Winner Portfolios, Test Period: 2010-2011.

Source. Author's Calculations

The next figure, figure 5, concerns results for test-period 2010-2011. During this time-period, both portfolios demonstrate a more even behavior. More specifically, winner portfolio Average Cumulative Abnormal Returns move slightly over or under the zero benchmark, not following a sustained long-term pattern. Consequently, winner portfolio finds do not qualify as any reaction or reversal of previous abnormal returns. Loser portfolio falls under the same category, although a shorter-term negative course during 2010 is succeeded by an upward movement towards positive Average Cumulative Abnormal Returns all throughout 2011. In the long-term character of the overreaction analysis under discussion though, loser portfolio does not imply any correction to former overreaction occurrences during the portfolio formation period as it fails to provide a long-term positive pattern required to be classified as a reversal phenomenon. Yet again, during this test-period winner portfolio outperforms the corresponding loser portfolio ($ACAR_L$-$ACAR_W <$ 0)[3].
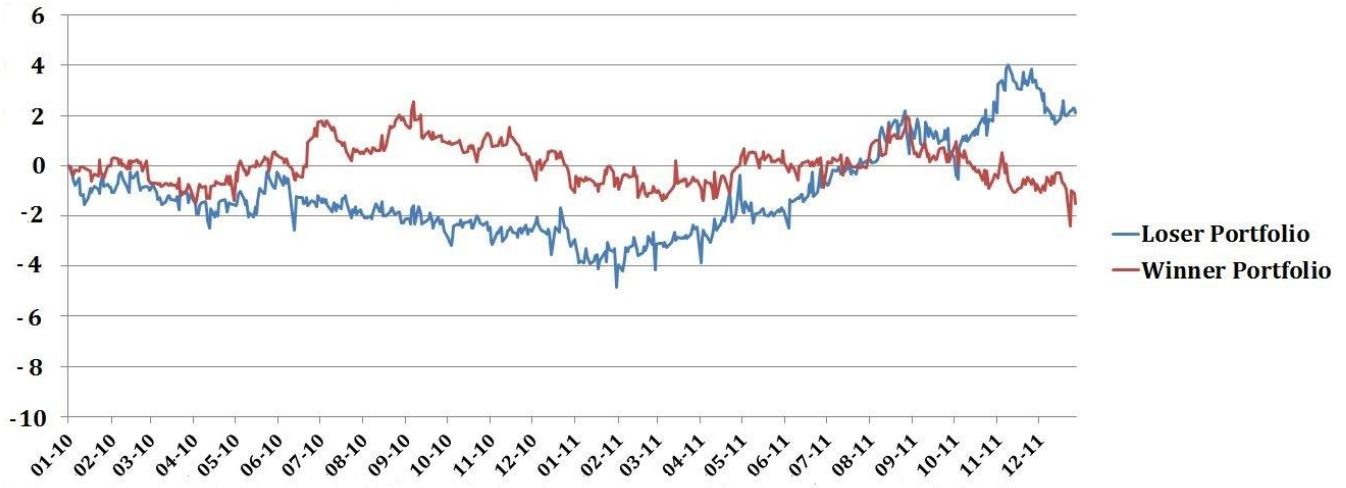
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[3] Table 1, Row 3, Author's Calculations

Figure 6. Daily Average Cumulative Abnormal Return for Loser and Winner Portfolios, Test Period: 2012-2013.

Source. Author's Calculations

Results for test-period 2012-2013, as depicted in figure 6, differ between the two portfolios under enquiry. In this test-period, winner portfolio Average Cumulative Abnormal Returns progress can be described as a steady and gradual motion, characterized by a low-degree increasing course without any major interruptions in that course. The direction of that movement towards positive values though is quite opposite to the expected one in cases of reversal of overreaction phenomena in the formation period. Loser portfolio also fails to move towards the anticipated area. Average Cumulative Abnormal Returns for loser portfolio are in positive territory at the first half of the test-period, turning over to negative values though during Q3 of 2013. That development underlines the fact that loser portfolio performance cannot be categorized as overreaction reversal behavior, thus implying that no overreaction occurred during the formation period for loser portfolio, as deducted by winner portfolio behavior also. The outperformance of winner portfolio compared to loser portfolio is also evidenced at the 2012-2013 test-period ($ACAR_L - ACAR_W < 0$)[4].
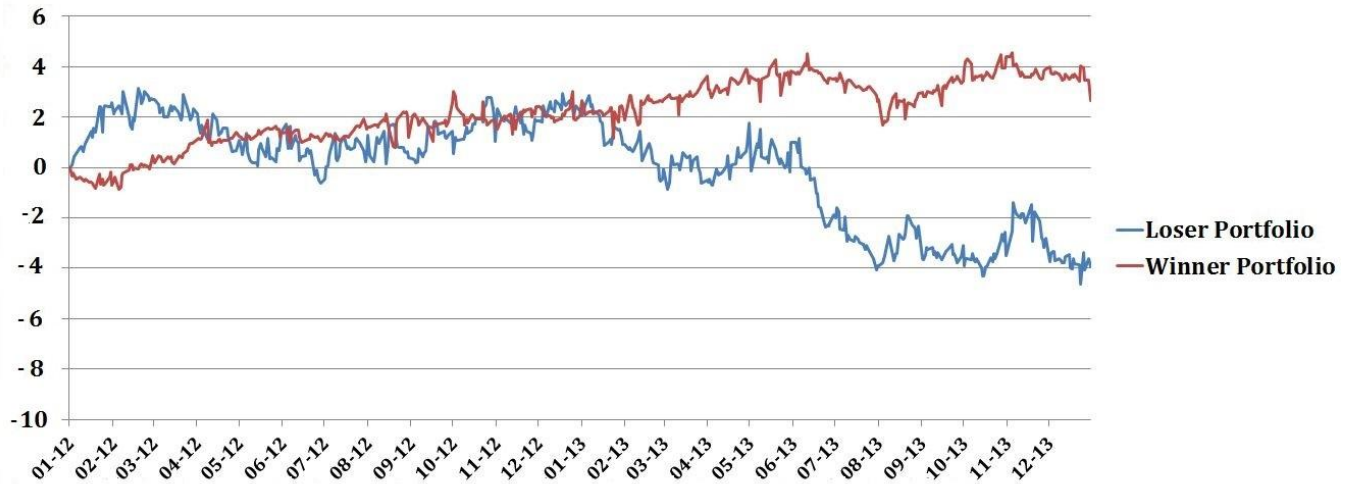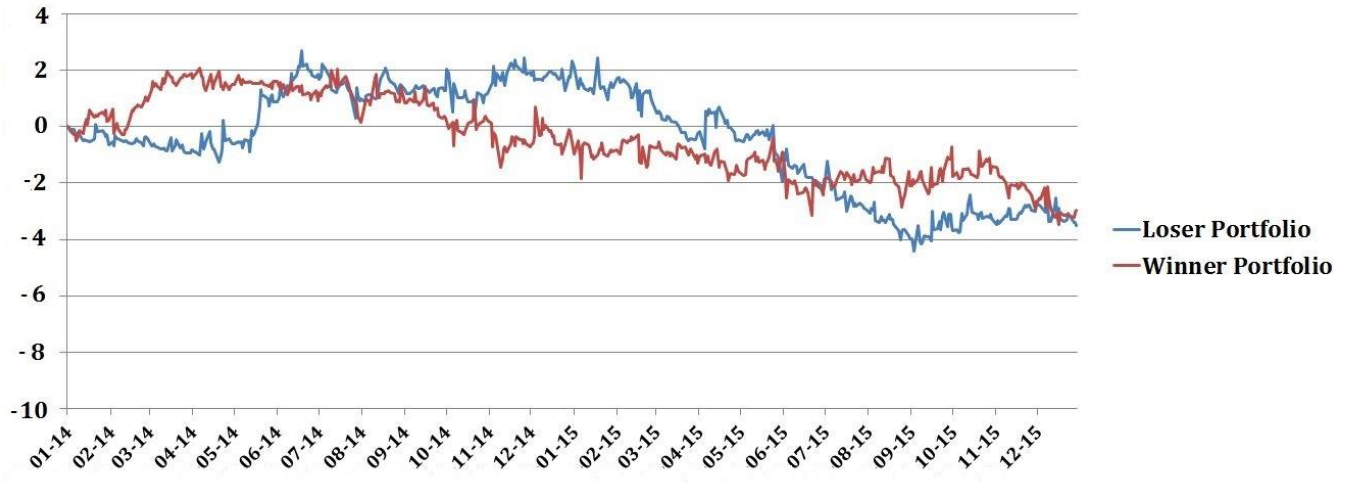
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[4] Table 1, Row 4, Author's Calculations

Figure 7. Daily Average Cumulative Abnormal Return for Loser and Winner Portfolios, Test Period: 2014-2015.

Source. Author's Calculations

In the final test period of 2014-2015, presented in figure 7, both portfolios are described by an unlikely similar behavior, making justification of overreaction phenomena quite improbable. In the time-period under discussion, both winner and loser portfolios' Average Cumulative Abnormal Returns (5) are marginally over or under the zero benchmark in a mirrored course, up until Q2 of 2015 when both portfolios move towards negative values until the end of the test-period. Loser portfolio results rule out the possibility of being described as evidence for overreaction in the formation period as they fail to form a clear reversal behavior of the previous positive abnormal returns during formation period. On the other hand, winner portfolio is towards the anticipated trajectory of negative Average Cumulative Abnormal Returns, as figure 7 depicts a steady negative course for winner portfolio after Q3 of 2014. The behavior of winner portfolio could be considered as subtle hints of a positive overreaction for the portfolio's equities during the formation period. Quite interesting is also the fact that, for the first time, loser portfolio outperforms winner portfolio ($ACAR_L$-$ACAR_W$ <0)[5], a key element necessary to successfully describe the motion of winner portfolio as a reversal behavior for prior overreaction behavior that might took place during the formation period.

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[5] Table 1, Row 5, Author's Calculations

As discussed in earlier sections, overreaction analysis requires some key empirical finds to successfully outline the detection of overreaction phenomena. Those include positive Average Cumulative Return for loser portfolios, negative Average Cumulative Return for loser portfolios, while loser portfolios ought to outperform winner portfolios ($ACAR_L$-$ACAR_W$ >0) as loser portfolios should have corrected positively their former negative abnormal performance and winner portfolios should have reversed negatively their prior positive abnormal results, all due to overreaction basis. T-statistics should also provide information concerning the statistical importance of fluctuations in the equality of Average Cumulative Abnormal Returns and Median Cumulative Abnormal Returns between loser and winner portfolios of each test-period, signifying the possibility of uneven performance that could be originated by reversal patterns and overreaction during portfolio formation periods. Table 1 serves as a collection of all needed information.

Formation Period	Test Period	ACAR$_L$	ACAR$_W$	ACAR$_L$-ACAR$_W$	Satterthwaite-Welch t-test (6)	MCAR$_L$	MCAR$_W$	MCAR$_L$-MCAR$_W$	Mann-Whitney U-test (9)
2004-2005	2006-2007	0.032149	0.037297	-0.005148	-0.5731 (0.5666)	0.110606	0.006213	0.104393	11.4702 (0.0000)
2006-2007	2008-2009	-0.133609	-0.065922	-0.067687	-4.7726 (0.0000)	-0.107764	-0.057387	-0.050377	12.8386 (0.0000)
2008-2009	2010-2011	-0.112644	0.007673	-0.120317	-10.2961 (0.0000)	-0.015645	0.017345	-0.032990	9.9980 (0.0000)
2010-2011	2012-2013	0.005647	0.219269	-0.213622	-12.8440 (0.0000)	0.016480	0.022143	-0.005663	6.3282 (0.0000)
2012-2013	2014-2015	-0.040398	-0.043501	0.003103	0.1856 (0.8527)	-0.014147	0.015083	-0.029230	12.2955 (0.0000)

Table 1. Results of Test of Equality and t-statistics.

Source. Author's Calculations

ACAR$_L$ values in column 3 indicate to an average negative behavior for loser portfolio in test-periods 2008-2009, 2010-2011 and 2014-2015, contrary to expectations for a characteristically positive overreaction reversal for those portfolios. The remaining two test-periods, 2006-2007 and 2012-2013, are in tandem with the anticipated correction pattern of positive Average Cumulative Abnormal Returns for loser portfolios, hinting that overreaction roots might be the case. That belief is quickly negated though when ACAR$_W$ values are taken into consideration. Average Cumulative Abnormal Returns for winner portfolios (column 4) in test-periods 2006-2007 and 2012-2013 are also positive, ruling out the possibility of describing their behavior as a turn-around of overreacting effects during the formation period. The remaining ACAR$_W$ values are also positive for test-period 2010-2011, not allowing overreaction claims, contrary to negative values for test-periods 2008-2009 and 2014-2015 which could be described as candidates for successful overreaction detection. That does not derive though from results for the difference between performance of loser and winner portfolios (column 5) which has to be positive ACAR$_L$-ACAR$_W$ >0. The only time-period that loser portfolio outperforms winner portfolio, crucial element for overreaction detection, is test-period 2014-2015 which in turn fails to achieve the positive Average Cumulative Abnormal Returns for loser portfolio. The main conclusion is that none of the five test-periods achieves all criteria needed to undoubtedly argue about overreaction phenomena considering state-owned equities.

Analysis taking in consideration Median Cumulative Abnormal Returns instead of means (Average Cumulative Abnormal Returns), provides almost identical results to those of means analysis, supporting the same pattern of deductions, with two exceptions. More specifically, in test-periods 2008-2009, 2010-2011 and 2012- 2013 MCAR$_L$ signs match those of ACAR$_L$ while MCAR$_W$ sighs also mimic those of ACAR$_W$. More importantly, the differences in performance between loser and winner portfolios (MCAR$_L$-MCAR$_W$ <0) are also negative in the three test-periods in discussion, thus allowing the further strengthening of the Average Cumulative Abnormal Returns empirical finds. The alterations mentioned earlier are focused in test-period 2007-2008, where the performance of loser portfolio out yields that of winner portfolio (MCAR$_L$-MCAR$_W$ >0), and test-period 2014-2015 where MCAR$_W$ is positive in contrast with ACAR$_W$ being negative, with the consequent effect of

reversing the relationship between loser and winner portfolio, with $MCAR_L$-$MCAR_W$ being negative contrary to $ACAR_W$-$ACAR_L$ which is positive. Those dissimilarities though do not affect in any way the main outline of the research results. That judgement is based on the fact that independently to either mean analysis or median analysis, no test-period fulfills all criteria needed - positive outcome for loser portfolio, negative result for winner portfolio, loser portfolio outperforming winner portfolio - for a reasonable argument about overreaction phenomena and reversal patterns.

Results from t-statistics provide more evidence towards the purpose of the current overreaction analysis. In more detail, t-values for the Satterthwaite-Welch t-test (6) support the conclusion that Average Cumulative Abnormal Returns for loser and winner are marginally close to equality in 2006-2007 and 2014-2015 time-periods, since t-values presenting the difference between the means adjusted to variance are up to -0.5731 for test-period 2006-2007 and 0.1856 for test-period. Those differences are close to equality between the two portfolios, while p-values are 0.5666 for test-period 2006-2007 and 0.8527 for test-period 2014-2015. p-values analysis indicates that the equality of the loser and winner portfolios in the two test-periods under discussion is statistically significant, leading to the acceptance of the null hypothesis that the means (Average Cumulative Abnormal Returns) of the two portfolios are close to equality. The statistical approval for the null hypothesis for test-periods 2006-2007 and 2014-2015 is a clear indication that there was no reversal pattern characterizing the two portfolios, thus disallowing any argument about overreaction effects during the formation period of those portfolios. Concerning the other three test-periods, t-values are far from being described indications for equality between Average Cumulative Abnormal Returns for loser and winner portfolios. Numbers such as -4.7726 for test-period 2008-2009, -10.2961 for test-period 2010-2011 and -12.8440 for test period 2012-2013 not only rule out the possibility of equality between the means of the two portfolios and the rejection of the null hypothesis, but their negative values also underline the fact that loser portfolio was highly outperformed by winner portfolio, a completely contradictory behavior to that expected in cases of overreaction phenomena. As a conclusion, Satterthwaite-Welch t-test results do not provide distinctive evidence for overreaction in state-owned equities during the test-period.

The next step is the analysis of results originated from the Matt-Whitney U-test. The outcome of the current test clearly indicates that there are significant differences between the medians of loser and winner portfolios in all test-periods. More specifically, the adjusted for variance results (u-values (9)) for Median Cumulative Abnormal Returns are 11.4702 for test-period 2006-2007, 12.8386 for test-period 2008-2009, 9.9980 for test-period 2010-2011, 6.3282 for test-period 2012-2013 and 12.2955 for test-period 2014-2015. These values indicate that there is no equality between the medians of the corresponding loser and winner portfolios, pointing to the fact that loser and winner portfolios follow different trajectories that conclude to unequal medians in the Matt-Whitney U-test. Taking into account p-values which are zero for all test-periods, the null hypothesis has to be rejected for all cases of the overreaction taste. The crucial and key component in the analysis is the solid evidence of winner portfolios outperforming loser portfolios, thus negating the possibility for justification for reversal trends that are considered the crucial sign for overreaction phenomena in the formation period. The final outcome from the Matt-Whitney U-test is once more the rejection of overreaction argument concerning state-owned equities.

5. Conclusions

The driving reason behind the current paper was to provide further understanding for state-ownership and its possible effect on the subsequent state-owned equities. The main goal was to test and provide solid evidence in support of the claim that psychological factors and market sentiment can influence and alter the trajectory of state-owned equities, playing a pivotal role in their future development and progress. Empirical finds of the overreaction analysis are expected to provide investors, managers and public figures with crucial information considering state-owned equities and clarify possible reasons that affect their fluctuations, allowing them to make better decisions and plan crucial and strategic future areas for development areas to the benefit of state-owned companies and the common good that state-owned enterprises are bound to serve. Moreover, overreaction analysis intends to be a significant contribution to existing literature concerning behavioral economics, a relatively fresh but also important branch of modern economics, adding intriguing and up to date knowledge in the scientific community.

In order to successfully commit to and justify the outcome of the paper, research was conducted through employment of widely-used and time-tested statistical tools and methodology, in order to guarantee the validity of research results and empirical finds. Sentimental factors and psychological reasons would be revealed by utilization of abnormal returns and cumulative abnormal returns, describing the relationship between stocks' motions relative to their stock market index. In addition to that, stocks were assigned to loser and winner portfolios, in an attempt to identify dissimilar patterns and reactions to their former trends, allowing in such way the detection of overreaction phenomena during the portfolio formation period. Further support towards the solidarity and clarity of the results was commissioned by the use of t-tests, whose contribution is vital and critical in all academic research.

The group of results that were produced proved to be quite contrary to earlier expectations. Portfolio separation and Cumulative Abnormal Returns generated no evidence towards the foundation of overreaction phenomena across all test-periods. Average Cumulative Abnormal Returns did not exhibit reversal patterns, thus neutralizing the possibility for earlier overreaction in state-owned stocks under test. Compliantly to that, t-statistics test such as the Satterthwaite-Welch t-test and Matt-Whitney U-test failed to provide statistical importance to tests of equality between loser and winner portfolios in favor of overreaction, the lack of which allowed the possibility the unevenness of portfolios could be originated by overreaction during portfolio formation, only for that possibility to be ruled out by the absence of the necessary criteria that would characteristically signify reversal patterns in the behavior of loser and winner portfolios. Finds of the research are in contrast with the majority of academic papers and scientific conclusions arguing about behavioral economics and overreaction in specific. That raises further questions about the unique outcome of the current overreaction analysis in state-owned enterprises.

The possible reasons behind the odd divergence of state-owned equities from the norm of other industries and markets could derive from the nature of state-owned equities and the effects it produces. As such reasons we could include i) state-ownership shapes a distinctive attribute to state-owned enterprises, that of trust. Investors could perceive state companies as solid and firm institutions governed by long-term policies and experienced managers, granting them with a level of invulnerability to market shocks and extreme movements that define overreaction and affect widely other industries and companies, ii) state-ownership has the consequence that the majority of stocks is not free to be traded in stock exchanges. Shallow markets and the clustering of state-owned stocks in relatively few share-

holders would indeed make it improbable for state-owned stocks to succumb to market sentiment and psychological factors, neutralizing the effect of market shocks and extremities. The above subjects could be interesting research areas, along with shorter - oriented overreaction analysis that could yield a different set of results and more intriguing background information. Comparison of the market behavior of state-owned equities to that of their private counterparts would also be an interesting field of research. State-owned enterprises are crucial elements of modern intertwined economies and research that sheds light into their role and contribution to their economy will always be a welcomed area of further research.

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7. Appendix

Sampled state-owned equities (End of 2015 valuations)

Company	Sector	Country	Years	Capitalization	Currency
Americas					
Banco do Brasil S.A.	Financial Services	Brazil	2004-2015	41.124.600.000,00	Brazil Real
Banco do Nordeste do Brasil S.A.	Financial Services	Brazil	2004-2015	1.059.300.000,00	Brazil Real
CEMIG	Electricity	Brazil	2004-2015	5.133.997.600,00	Brazil Real
Companhia de Saneamento Basico-Sabesp	Utilities	Brazil	2004-2015	12.938.844.300,00	Brazil Real
Eletrobras	Electricity	Brazil	2004-2015	2.771.193.600,00	Brazil Real
Petróleo Brasileiro S.A. - Petrobras	Oil and Gas	Brazil	2004-2015	37.520.000.000,00	Brazil Real
Telecomunicações Brasileiras S.A.	Telecommunications	Brazil	2004-2015	242.526.000,00	Brazil Real
Zona Franca de Iquique SA	Financial Services	Chile	2004-2015	114.079.341.818,00	Chile Pesos
Ecopetrol SA	Oil and Gas	Colombia(NYSE)	2008-2015	288.251.200.000,00	USD
CSS Industries Inc	Manufacturing	United States	2004-2015	257.690.400,00	USD
Tennessee Valley Authority	Utilities	United States	2004-2015	11.006.000,00	USD

Company	Sector	Country	Years	Capitalization	Currency
Asia					
Air China Limited	Transportation	China(HKSE)	2004-2015	28.500.000.000,00	HK Dollar
Aluminum Corporation of China Limited	Commodities	China	2004-2015	54.471.200.000,00	Yuan
Bank of China Limited	Financial Services	China	2006-2015	847.174.800.000,00	Yuan
Baoshan Iron & Steel Co	Commodities	China	2004-2015	91.902.600.000,00	Yuan
Beijing North Star Company	Financial Services	China(HKSE)	2004-2015	1.824.111.600,00	HK Dollar
China BlueChemical Ltd	Manufacturing	China(HKSE)	2006-2015	3.770.100.000,00	HK Dollar
China Coal Energy Company Limited	Commodities	China	2008-2015	55.499.000.000,00	Yuan
China Construction Bank	Financial Services	China(HKSE)	2005-2015	1.271.821.800.000,00	HK Dollar
China Eastern Airlines Corporation	Transportation	China	2004-2015	69.859.800.000,00	Yuan
China Everbright Limited	Financial Services	China(HKSE)	2004-2015	29.946.800.000,00	HK Dollar
China Merchants Holdings	Transportation	China(HKSE)	2004-2015	63.570.000.000,00	HK Dollar
China Mobile Ltd	Telecommunications	China(HKSE)	2004-2015	1.790.976.000.000,00	HK Dollar
China Petroleum & Chemical Corp	Oil and Gas	China	2004-2015	473.977.600.000,00	Yuan
China Power International Dev	Electricity	China(HKSE)	2004-2015	32.604.800.000,00	HK Dollar
China Shenhua	Oil and Gas	China	2007-2015	246.855.300.000,00	Yuan
China Shipping Container Lines Co Ltd	Transportation	China(HKSE)	2004-2015	8.062.500.000,00	HK Dollar
China State Shipbuilding Co	Manufacturing	China	2004-2015	48.079.200.000,00	Yuan
China Telecom Corp.	Telecommunications	China(HKSE)	2004-2015	50.523.200.000,00	HK Dollar
China United Network Communications	Telecommunications	China	2004-2015	13.122.800.000,00	Yuan
CITIC Limited	Financial Services	China(HKSE)	2004-2015	400.860.200.000,00	HK Dollar
CNOOC Ltd	Oil and Gas	China(HKSE)	2004-2015	365.237.000.000,00	HK Dollar
COSCO Pacific Limited	Transportation	China(HKSE)	2004-2015	25.245.000.000,00	HK Dollar
CSSC Offshore & Marine Engg Group Co Ltd	Manufacturing	China	2004-2015	32.586.524.000,00	Yuan
Datang International Power Generation Co	Electricity	China(HKSE)	2004-2015	7.934.800.000,00	HK Dollar
Datang Telecom Technology	Telecommunications	China	2004-2015	21.761.653.000,00	Yuan
Founder Technology Group Corp	Manufacturing	China	2004-2015	13.534.200.000,00	Yuan

GD Power Development Co	Electricity	China	2004-2015	77.421.000.000,00	Yuan
Hainan Airlines Co	Transportation	China	2004-2015	46.059.000.000,00	Yuan
Hua Xia Bank Co	Financial Services	China	2004-2015	130.097.300.000,00	Yuan
Huadian Power International Corp	Electricity	China	2005-2015	55.420.000.000,00	Yuan
Huaneng Power International Inc	Electricity	China	2004-2015	91.655.000.000,00	Yuan
Jiangsu Expressway Co	Manufacturing	China	2004-2015	33.425.000.000,00	Yuan
PetroChina Company Limited	Oil and Gas	China	2007-2015	1.352.032.000.000,00	Yuan
PICC Property & Casualty Co	Financial Services	China(HKSE)	2004-2015	71.944.000.000,00	HK Dollar
SDIC Power	Manufacturing	China	2004-2015	56.696.500.000,00	Yuan
Shandong Iron and Steel Co Ltd	Commodities	China	2004-2015	26.186.200.000,00	Yuan
Shanghai Electric Power Company Limited	Manufacturing	China	2004-2015	31.500.800.000,00	Yuan
Sinopec Shanghai Petrochemical Co	Oil and Gas	China	2004-2015	47.377.000.000,00	Yuan
Tianjin Port Company Limited	Transportation	China	2004-2015	18.837.600.000,00	Yuan
Yanzhou Coal Mining Co Ltd	Commodities	China	2004-2015	27.972.000.000,00	Yuan
Guangshen Railway Company	Transportation	Hong Kong	2004-2015	5.505.500.000,00	HK Dollar
MTR Corporation Limited	Transportation	Hong Kong	2004-2015	225.610.000.000,00	HK Dollar
Balmer Lawrie and Co Ltd	Manufacturing	India	2004-2015	17.499.000.000,00	Indian Rupee
BEML Ltd	Manufacturing	India	2004-2015	53.557.368.000,00	Indian Rupee
Bharat Electronics Ltd	Manufacturing	India	2004-2015	327.936.000.000,00	Indian Rupee
Bharat Petroleum Corp	Oil and Gas	India	2004-2015	644.951.206.000,00	Indian Rupee
Bharat Heavy Electricals Limited	Manufacturing	India	2004-2015	415.275.000.000,00	Indian Rupee
Chennai Petroleum Corporation Limited	Oil and Gas	India	2004-2015	29.714.990.500,00	Indian Rupee
Coal India Limited	Commodities	India	2010-2015	2.073.276.000.000,00	Indian Rupee
Container Corporation of India	Transportation	India	2004-2015	256.093.095.000,00	Indian Rupee
Dredging Corporation of India Ltd	Transportation	India	2004-2015	10.690.400.000,00	Indian Rupee
Engineers India	Manufacturing	India	2004-2015	81.236.234.000,00	Indian Rupee
Gas Authority of India	Oil and Gas	India	2004-2015	477.456.500.000,00	Indian Rupee

Limited					
Hindustan Copper Ltd	Commodities	India	2004-2015	54.402.936.000,00	Indian Rupee
Hindustan Petroleum Corporation	Oil and Gas	India	2004-2015	284.432.268.500,00	Indian Rupee
Indian Oil Corporation	Oil and Gas	India	2004-2015	1.040.769.000.000,00	Indian Rupee
Mahanagar Telephone Nigam	Telecommunications	India	2004-2015	13.986.000.000,00	Indian Rupee
National Aluminium Company	Commodities	India	2004-2015	103.200.000.000,00	Indian Rupee
National Fertilizers Limited	Manufacturing	India	2006-2015	14.251.349.000,00	Indian Rupee
National Mineral Development Corporation	Commodities	India	2004-2015	357.192.000.000,00	Indian Rupee
Neyveli Lignite Corporation	Commodities	India	2004-2015	136.920.000.000,00	Indian Rupee
NHPC Limited	Electricity	India	2009-2015	232.470.000.000,00	Indian Rupee
NTPC Limited	Electricity	India	2004-2015	1.197.900.000.000,00	Indian Rupee
Oil & Natural Gas Corporation Limited	Oil and Gas	India	2004-2015	2.053.972.000.000,00	Indian Rupee
Oil India Limited	Oil and Gas	India	2009-2015	235.646.880.000,00	Indian Rupee
Power Finance Corporation	Financial Services	India	2009-2015	265.188.000.000,00	Indian Rupee
Power Grid Corporation of India	Electricity	India	2007-2015	741.352.500.000,00	Indian Rupee
Rashtriya Chemicals & Fertilizers Ltd	Manufacturing	India	2004-2015	27.225.901.500,00	Indian Rupee
Rural Electrification Corporation Limited	Financial Services	India	2008-2015	223.610.317.000,00	Indian Rupee
Shipping Corporation of India	Transportation	India	2004-2015	43.529.010.000,00	Indian Rupee
State Trading Corporation of India Ltd.	Financial Services	India	2004-2015	9.684.000.000,00	Indian Rupee
Steel Authority of India Limited	Commodities	India	2004-2015	201.131.000.000,00	Indian Rupee
Adhi Karya	Construction	Indonesia	2005-2015	7.618.400.000.000,00	Indonesian Rupiah
Aneka Tambang	Commodities	Indonesia	2005-2015	7.545.420.000.000,00	Indonesian Rupiah
Bank Mandiri	Financial Services	Indonesia	2005-2015	215.802.500.000.000,00	Indonesian Rupiah
Bank Negara Indonesia	Financial Services	Indonesia	2005-2015	91.616.400.000.000,00	Indonesian Rupiah
Bank Rakyat Indonesia	Financial Services	Indonesia	2005-2015	279.455.500.000.000,00	Indonesian Rupiah

Bank Tabungan Negara	Financial Services	Indonesia	2009-2015	13.701.100.000.000,00	Indonesian Rupiah
Krakatau Steel	Commodities	Indonesia	2010-2015	4.620.610.000.000,00	Indonesian Rupiah
Perusahaan Gas Negara	Oil and Gas	Indonesia	2004-2015	66.538.800.000.000,00	Indonesian Rupiah
Semen Indonesia	Commodities	Indonesia	2005-2015	67.602.000.000.000,00	Indonesian Rupiah
Telekomunikasi Indonesia	Telecommunications	Indonesia	2005-2015	304.911.000.000,00	Indonesian Rupiah
Timah	Commodities	Indonesia	2005-2015	3.762.250.000.000,00	Indonesian Rupiah
Wijaya Karya	Construction	Indonesia	2007-2015	16.209.600.000.000,00	Indonesian Rupiah
Japan Tobacco Inc.	Manufacturing	Japan	2004-2015	800.309.000.000,00	Yen
Resona Holdings Inc	Financial Services	Japan	2004-2015	1.371.584.000.000,00	Yen
Grand Korea Leizure	Real Estate	Korea	2009-2015	1.497.012.000.000,00	SK Won
Industrial Bank of Korea	Financial Services	Korea	2004-2015	6.915.741.511.000,00	SK won
Kangwon Land	Real Estate	Korea	2004-2015	7.785.216.000.000,00	SK Won
Korea District Heating	Utilities	Korea	2010-2015	667.008.000.000,00	SK Won
Korea Electric Power	Electricity	Korea	2004-2015	32.098.000.000.000,00	SK Won
Korea Gas	Oil and Gas	Korea	2004-2015	3.229.534.000.000,00	SK Won
Korea Plant Service	Manufacturing	Korea	2004-2015	4.005.000.000.000,00	SK Won
Affin Holdings Berhad	Financial Services	Malaysia	2004-2015	4.539.600.000,00	Malaysian Ringgit
Axiata Group Bhd	Telecommunications	Malaysia	2008-2015	56.536.200.000,00	Malaysian Ringgit
CIMB Group Berhad	Financial Services	Malaysia	2004-2015	38.145.460.000,00	Malaysian Ringgit
Malaysia Airlines	Transportation	Malaysia	2004-2015	8.959.254.000,00	Malaysian Ringgit
Malayan Banking Berhad	Financial Services	Malaysia	2004-2015	82.068.000.000,00	Malaysian Ringgit
MISC Berhad	Transportation	Malaysia	2004-2015	41.790.200.000,00	Malaysian Ringgit
Petronas Gas Bhd	Oil and Gas	Malaysia	2004-2015	44.946.000.000,00	Malaysian Ringgit
Sime Darby Berhad	Real Estate	Malaysia	2004-2015	49.057.500.000,00	Malaysian Ringgit
Telekom Malaysia Berhad	Telecommunications	Malaysia	2004-2015	25.492.800.000,00	Malaysian Ringgit
Tenaga Nasional Bhd	Electricity	Malaysia	2005-2015	75.124.800.000,00	Malaysian Ringgit
Air New Zealand	Transportation	New Zealand	2004-2015	3.354.400.000,00	NZ Dollar

Pakistan State Oil	Oil and Gas	Pakistan (BATS)	2008-2015	110.230.000.000,00	Pakistan Rupee
Riyad Bank	Financial Services	Saudi Arabia	2004-2015	37.260.000.000,00	Saudi Riyal
Saudi Arabian Mining Company	Commodities	Saudi Arabia	2008-2017	38.808.900.000,00	Saudi Riyal
Saudi Basic Industries Corporation	Manufacturing	Saudi Arabia	2004-2015	229.500.000.000,00	Saudi Riyal
Saudi Electricity Company	Electricity	Saudi Arabia	2004-2015	65.510.700.000,00	Saudi Riyal
DBS Group Holdings Ltd	Financial Services	Singapore	2004-2015	41.967.200.000,00	Singapore Dollar
Keppel Corporation Limited	Manufacturing	Singapore	2007-2015	11.866.400.000,00	Singapore Dollar
Neptune Orient Lines Ltd	Transportation	Singapore	2004-2015	3.211.000.000,00	Singapore Dollar
Singapore Airlines Limited	Transportation	Singapore	2004-2015	13.015.200.000,00	Singapore Dollar
Singapore Post Limited	Utilities	Singapore	2004-2015	3.510.000.000,00	Singapore Dollar
Singapore Technologies Engineering Ltd	Manufacturing	Singapore	2004-2015	9.393.600.000,00	Singapore Dollar
Singapore Telecommunications Limited	Telecommunications	Singapore	2004-2015	58.659.200.000,00	Singapore Dollar
SMRT Corp Ltd	Transportation	Singapore	2004-2015	2.280.000.000,00	Singapore Dollar
China Airlines, Ltd	Transportation	Taiwan	2004-2015	65.311.000.000,00	Taiwan Dollar
CSBC Corp Taiwan	Manufacturing	Taiwan	2008-2015	10.670.229.500,00	Taiwan Dollar
Airports of Thailand PCL	Transportation	Thailand	2004-2015	494.780.000.000,00	Thai Baht
Bangkok Metro Public Company Limited	Transportation	Thailand	2006-2015	45.510.000.000,00	Thai Baht
IRPC Public Company Limited	Oil and Gas	Thailand	2005-2015	87.849.000.000,00	Thai Baht
Krung Thai Bank PCL	Financial Services	Thailand	2004-2015	233.466.000.000,00	Thai Baht
Krung Thai Card PCL	Financial Services	Thailand	2004-2015	25.202.882.500,00	Thai Baht
PTT Exploration and Production PCL	Oil and Gas	Thailand	2006-2015	227.282.500.000,00	Thai Baht
PTT Public Company Limited	Oil and Gas	Thailand	2004-2015	697.840.000.000,00	Thai Baht
Thai Airways International PCL	Transportation	Thailand	2004-2015	20.056.000.000,00	Thai Baht

Company	Sector	Country	Years	Capitalization	Currency
Europe					
Oesterreichische Post AG	Utilities	Austria	2006-2015	2.271.706.500,00	Euro
Verbund	Electricity	Austria	2004-2015	2.018.927.800,00	Euro
Belgacom	Telecommunications	Belgium	2004-2015	9.636.900.000,00	Euro
Dexia SA	Financial Services	Belgium	2004-2015	1.390.315.315,00	Euro
Royal Bank of Scotland	Financial Services	Britain	2004-2015	34.879.380.214,00	GB Pound
CEZ	Electricity	Czech	2006-2015	36.864.000,00	Euro
Finnair	Transportation	Finland	2004-2015	692.730.200,00	Euro
Fortum	Electricity	Finland	2004-2015	12.336.110.400,00	Euro
Neste Oil	Oil and Gas	Finland	2005-2015	7.062.504.300,00	Euro
Aeroports de Paris	Transportation	France	2006-2015	10.608.512.000,00	Euro
EDF	Electricity	France	2005-2015	26.060.160.000,00	Euro
Athens Water	Utilities	Greece	2004-2015	532.500.000,00	Euro
Piraeus Port	Transportation	Greece	2004-2015	347.000.000,00	Euro
Public Power Corp.	Electricity	Greece	2004-2015	900.160.000,00	Euro
Thessaloniki Port	Transportation	Greece	2004-2015	242.926.165,00	Euro
Thessaloniki Water	Utilities	Greece	2004-2015	112.386.627,00	Euro
Kongsberg Gruppen	Manufacturing	Norway	2004-2015	17.261.904.761,00	Korona
Statoil	Oil and Gas	Norway (NYSE)	2004-2015	44.392.800.000,00	USD
Telenor	Telecommunications	Norway	2004-2015	222.450.000.000,00	Korona
Bank Ochrony Srodowiska	Financial Services	Poland	2004-2015	390.848.300,00	Polish Zloty
ENEA	Electricity	Poland	2009-2015	4.988.272.000,00	Polish Zloty
Grupa Azoty SA	Manufacturing	Poland	2008-2015	9.870.400.000,00	Polish Zloty
Grupa Lotus	Oil and Gas	Poland	2005-2015	4.991.490.000,00	Polish Zloty
KGHM Polska Miedz SA	Commodities	Poland	2004-2015	12.698.000.000,00	Polish Zloty
Lubelski Wegiel	Commodities	Poland	2009-2015	1.021.871.700,00	Polish Zloty
Polska Grupa Energetyczna	Electricity	Poland	2009-2015	23.917.300.000,00	Polish Zloty
Polskie Gornictwo Naftowe	Oil and Gas	Poland	2006-2015	30.326.000.000,00	Polish Zloty
Powszechna Kasa Oszczednosci	Financial Services	Poland	2004-2015	34.162.500.000,00	Polish Zloty
Ruch Chorzow SA	Utilities	Poland	2010-2015	1.245.000.000,00	Polish Zloty
Zaklady Azotowe Pulawy	Manufacturing	Poland	2005-2015	4.875.600.000,00	Polish Zloty
Zaklady Chemiczne Police	Manufacturing	Poland	2005-2015	2.062.500.000,00	Polish Zloty
Aeroflot	Transportation	Russia	2005-2015	59.466.000.000,00	Ruble

Gazprom	Oil and Gas	Russia	2006-2015	3.127.348.200.000,00	Ruble
Rosneft	Oil and Gas	Russia	2006-2015	2.684.450.000.000,00	Ruble
Rostelekom	Telecommunications	Russia	2004-2015	189.249.500.000,00	Ruble
RusHydro	Electricity	Russia	2006-2015	247.475.130.000,00	Ruble
Sberbank	Financial Services	Russia	2004-2015	2.181.140.400.000,00	Ruble
Surgutneftegaz	Oil and Gas	Russia	2004-2015	1.213.926.750.000,00	Ruble
Transneft	Transportation	Russia	2005-2015	1.400.582.512.000,00	Ruble
United Aircraft Corporation	Manufacturing	Russia	2010-2015	112.033.500.000,00	Ruble
Scandinavian Airlines System	Transportation	Sweden	2004-2015	8.053.952.000,00	Swedish Krona
Swisscom	Telecommunications	Switzerland	2004-2015	26.055.400.000,00	Switzerland Franc
Aselsan Elektronik Sanayi ve Ticaret AS	Manufacturing	Turkey	2004-2015	8.435.000.000,00	Turkish Lira
Turk Hava Yollari AO	Transportation	Turkey	2004-2015	10.198.200.000,00	Turkish Lira