Determinants of the relationship between government shutdowns and real stock returns

Part I:

Does reliance on government funds make stocks more sensitive to government shutdowns?

The case of the US utilities industry

Part II:

Are small companies more sensitive to the US government shutdowns?

The case of the US stock indexes

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Keywords: Government shutdowns, Financial markets, Granger causality, Government funding, Risk

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Part I

Does reliance on government funds make stocks more sensitive to government shutdowns?

The case of the US utilities industry

Abstract

The effects of government shutdowns on financial markets in the US are still unclear to this day, as they have not garnered enough attention from researchers. The aim of this thesis is to expand the current knowledge on these effects by analyzing how the real returns on the utilities market in the US are Granger caused by government shutdowns. The research results and their comparison to past research give an insight into how reliance on government funding affects the impact of government shutdowns on the industry.

The research is carried out by applying residual bootstrap likelihood ratio (LR) tests on 24-month-long rolling windows, showing how the causality relationship develops through time. The dataset used consists of monthly data on the government shutdown measure developed by Baker et al. (2016), Dow Jones Utilities Average Index, and Consumer Price Index for All Urban Consumers. The research is carried out in-sample in the period of 1985:M1-2018:M12.

The thesis is structured in the following way: 1) introduction, describing the focus of the thesis; 2) literature review, analyzing the available literature on government shutdowns and their effects on the country; 3) research model, describing the data and empirical model applied; 4) empirical results, showing the outcomes of the model and comparing them to past research; 5) limitations and implications for further research; and 6) conclusions, summarizing the outcome of the thesis.

I.1. Introduction

The United States of America is the biggest economic powerhouse in the world, generating almost a quarter of the global GDP (Silver, 2019). While some may argue that the country has plenty of issues that it fails to resolve (such as gun control, racism and extremism, just to mention a few), no one can deny its achievements and success. This makes it no surprise that countries all over the world follow any major events taking place in the US. One of those events is a government shutdown – the main focus of this work.

The political system in the US is dominated by two parties (the Democratic Party and the Republican Party) and is the most prominent example of a two-party system in the world. There are plenty of concerns that this type of political system poses to the country, however here we draw the attention to the instability that is often caused by it. Some of the major decisions in the country require the cooperation and agreement between different government institutions. Having two strong parties in different institutions can sometimes make it tough to come to an agreement, which may have dire consequences.

A government shutdown is an event caused by an inability of the President and Congress to agree on the federal budget. If no new federal budget (or at least temporary continuing resolutions) is issued, the government cannot fund its own activities anymore. Consequently, the country enters into a state of a government shutdown that implies a temporary suspension of nonessential duties, which affects the whole country in many different ways.

21 government shutdowns have taken place in the US at the time of writing this paper; however, the available research on their effects is still very scarce. This brings a lot of unknowns to the table in relation to what to expect from a government shutdown and how to react to it.

One of the areas that is potentially affected by government shutdowns is the financial markets. The uncertainty that shutdowns bring to the country may affect the investors' perception of its financial markets and alter their investment decisions, which, consequently, may create disruptions in the financial markets. Nonetheless, there are very few research works analyzing how government shutdowns impact the US financial markets, therefore this thesis aims to expand the current knowledge on this relationship.

The majority of the research thus far focuses on the effects government shutdowns have on different variables defining the overall US stock markets. However, not much is talked about whether all the US stocks are affected in the same way and magnitude. We believe that the stocks belonging to the industries that are more reliant on government funding would be affected by a funding gap, therefore the work is focused on analyzing the causality relationship between government shutdowns and real stock returns of the utilities industry in the US.

Residual bootstrap likelihood ratio statistics tests are applied on rolling windows consisting of the data on the measure of government shutdowns and the real returns on the Dow Jones Utilities Average Index over the period of the years 1985-2018. The results of the empirical model show whether government shutdowns Granger cause real stock returns of the utilities industry and how this relationship changes over time.

The thesis is structured in the following way: the work starts with a literature review that gives an insight into the available research on government shutdowns and what it says on the effects it has to different areas of the country; it is followed by the research model section that outlines the data and the empirical model it is used in; the empirical results section discusses the results of the applied research model and what the output says about the relationship in question; the limitations and implications for further research provides a critical look into the work and gives some suggestions on how this area of research could be expanded; and, finally, the conclusions give a quick summary of what has been achieved by this research.

I.2. Literature review

I.2.1. Government shutdowns

According to Dollarhide (2019) on Investopedia, a government shutdown is an event when governmental offices carrying nonessential duties close down due to issues related to funding. The main reason for this type of lack of funding usually is a disagreement on federal budget. Each year 13 appropriation bills for the next fiscal year must be passed by Congress and signed by the President until September 30, the end of the current US federal government fiscal year. If failed to do so, continuing resolutions may be issued to buy some additional time for reaching an agreement on federal budget (Kosar, 2004). As has been seen in the past, if Congress and the President cannot agree on neither appropriation acts nor continuing resolutions, some governmental offices must shut down due to a temporary funding gap. As history has shown, the majority of funding gaps lead to a government shutdown, therefore, even though there have been some exceptions in the past, the concepts of a funding gap and a government shutdown will be used interchangeably throughout this paper (Brass, 2013).

The first events in the US resembling a government shutdown were the 1879 Rider Wars in the wake of the Civil War, when the Republican president Rutherford B. Hayes clashed with the 46th Congress controlled by the Democrats regarding the funding of the army and marshals for protecting the voting places in the upcoming elections (Kapsch & Gephardt, 2016). However, the actual government shutdowns do not have a very long history, as Congress did not have enough power over the federal budget until the 1974 Congressional Budget and Impoundment Control Act (further, the Act) was released. The main purpose of the Act was to increase the congressional control over the federal budget and set the major priorities in the national budget as well as to ensure that these priorities are followed (The Senate and House of Representatives of the United States of America, 2012). The US did not have to wait long for a government shutdown to take place after the Act was released, as the President Gerard Ford vetoed the appropriation bill for the Departments of Labor and Health, Education and Welfare in 1976, which led to the first partial government shutdown in US history. This government shutdown lasted for ten days (September 30 – October 11, 1976) and set a perfect example of the difficulties of approving a federal budget, especially in the circumstances where the President and the majority in Congress represent different ideologies (Williams, 2019).

At the time of writing this paper, there have been 21 US government shutdowns in total. While the majority of the shutdowns have been shorter than the first one, some of them took longer to get resolved, the most extreme example being the most recent shutdown – the 2018-2019 partial government shutdown under the presidency of Donald Trump, lasting 34 days (December 22, 2018 – January 25, 2019). (Murse, 2019) The latest government shutdown brought up a lot of discussions about who is affected by these funding gaps and how, and whether they cause any long-term effects on the overall economy of the country. The literature discussing these effects will be analyzed below.

To understand the direct effects of the government shutdowns we need to first look at which governmental offices are considered essential and nonessential, and what a funding gap means for their employees. According to the Memorandum for Heads of Executive

Departments and Agencies released by the Office of Management and Budget Issuance (1990) on October 5, 1990, only the activities that are "authorized by law or that protect life and property" must be sustained during a government shutdown.

As listed by Kosar (2004), these essential services include: national security, benefit payments, medical care, air traffic control, law enforcement, disaster assistance, power distribution, and others. However, even the offices carrying these essential services have to shut down some of their functions together with the nonessential offices. Nonetheless, employees carrying out both essential and nonessential services are affected by a government shutdown, only in different ways.

The nonessential employees are furloughed, what means that they cannot work throughout the shutdown and their salaries are suspended. While there is a possibility for these employees not to be remunerated for the length of the shutdown because they do not carry out their duties during it, historically they have received their salaries for the missed time when federal funding is reinstated. On the other hand, some of the essential employees must continue their duties throughout the shutdown but are still put on a nonpay status and remunerated only after the shutdown has ended (Brass, 2013). This leads to huge numbers of federal workers missing their paychecks. As an example, the latest government shutdown of 2018-2019 affected an estimated 800,000 employees, while most of them still had to carry out their duties without pay (Guina, 2019). Research by CareerBuilder (2017) shows that 78 percent of the US workers lived paycheck to paycheck and had no savings in the year 2017, therefore a long government shutdown can become a major issue for huge numbers of government workers, as they might fail to pay their living expenses and even lose their home because their paychecks are withheld.

It is safe to say that the suspension of the nonessential governmental activities has a significant effect on the country in many different ways. These possible effects highly depend on which appropriation bills have been signed before the end of the fiscal year and which have not, because the majority of government shutdowns are only partial and, thus, only the departments whose appropriation bills have not been signed have to halt their nonessential activities. Nonetheless, it is important to establish that all departments are interrelated, therefore usually none of the major segments of the country stay unaffected. As an example, one may again look at the 2018-2019 partial government shutdown. Even though the Food and Drug Administration (FDA) is assigned to the Department of Health and Human Services, whose appropriation bill had been signed in a timely fashion, a significant amount of funding for its activities is received from the Department of Agriculture, what led to the FDA pausing its inspections on some food products (Luthra, 2019). A research paper by Scallan et al. (2011) shows that 1,351 deaths per year are caused by pathogens from contaminated food, therefore stopping food inspections due to a funding gap may cause danger to consumers and can have gruesome consequences to some of their lives.

The major impacts of the government shutdowns to the overall wellbeing of the country will be discussed below. The majority of the examples relate to the three longest government shutdowns since the year 1985 (December 1995, October 2013, & December 2018 – January 2019) because their effects are the most prominent and long-term. The government shutdown of October 1978 that lasted 18 days is not considered here because, as will be discussed further in the thesis, our data sample starts at the beginning of 1985.

I.2.2. Indirect effects of government shutdowns

I.2.2.1. Healthcare

While all governmental activities focused on protecting life must be sustained during a shutdown, some of the past shutdowns had significant effects on the way the US healthcare system operated during them. There is no clear research focused on the impact the shutdowns have on the healthcare within the US, however some factual information from the past makes it impossible to deny that the funding gaps can have dire consequences on the overall health of the nation, even if all activities meant to protect life are considered to be essential.

During the second and third longest analyzed government shutdowns in the US (December 1995 – January 1996: 21 days; October 2013: 16 days) no new patients were admitted to the National Institutes of Health Clinical Center for clinical research, what might not only have had a tremendous negative impact on potential patients' health because of declined or postponed treatment, but also froze the clinical research for significant periods of time and, thus, pushed back possible medical advancements that could help not only US citizens, but also people all around the world (Kosar, 2004) (McCarthy, 2013). An estimated 200 patients, who also include children having cancer, had to be declined each week of the shutdowns (Plumer, 2013a). This would amount to over 1,000 patients affected in total during the two of the longest government shutdowns. However, no information on the magnitude of the effect on the health of these patients is available, what makes it hard to determine the damages caused by the government shutdowns here.

Similarly to the FDA during the 2018-2019 shutdown, the Centers for Disease Control and Prevention (CDC) was one of the organizations that had to cut down on a lot of expenses during the October 2013 shutdown. Due to the furlough of the employees, the CDC could carry out only a small part of its research on locating and identifying foodborne illness outbreaks. Unfortunately, that coincided with a salmonella outbreak in the US. This did not allow the CDC to react to the outbreak in the most efficient way (Hankel, 2013). That postponed the investigation into the outbreak which could have started only after the federal funding was reinstated. This inability to react fast due to the funding gap did not allow experts to contain the source of the outbreak quickly and, thus, contributed to the illness spreading. This outbreak ended up lasting 17 months, even though it could have been managed significantly faster under different circumstances (Andrews, 2014).

The CDC was again put in an unfavorable situation during the latest government shutdown of December 2018 – January 2019, when it had to suspend the flu-tracking program. The shutdown took place at the peak of a terrible flu season, and, even though the CDC could track the cases of flu in the country during it, it could not carry out some of their research and expertise on the disease (Aleccia et al., 2019). Considering that the estimated number of influenza-caused deaths in the US during the previous flu season (2017-2018) was around 79,000, it is clear that the CDC's expertise is crucial during flu seasons, as it can help to analyze the new strains of the virus and, consequently, to fight the disease (Centers for Disease Control and Prevention, 2018). However, there are no estimates available for the deaths caused by influenza during the 2018-2019 season as of the writing of this thesis.

These are only a few examples of the effects a government shutdown can have on the healthcare in the US. While most of them are affecting the health of the US citizens indirectly, as the major part of the healthcare system falls under the essential governmental duties in order to protect life, a funding gap can make it hard to combat diseases or carry out essential medical research.

I.2.2.2. Public safety

Just like in the case of healthcare in the US, even though the governmental services needed to protect life and property are deemed essential and must be carried out throughout a shutdown, the overall public safety is still affected by funding gaps. Examples of these effects will be illustrated by some historical events and data from the past government shutdowns.

Significant cuts had to be made in law enforcement during the December 1995 government shutdown. While the federal law-enforcement officials were working as usual, the recruitment of new officials was suspended. Among other open positions for officials, there were 400 unfilled spots for border patrol agents that could have been filled only after the new federal budget was approved (Kosar, 2004). This delay in recruitments might not pose a strong threat to the public safety of the country, however it shows that the government could find it hard to increase the power of law enforcement during a government shutdown. That could become an issue in dire situations like extremist attacks whose numbers have now reached the highest rates in the US in the past decades, amounting to 64 and 65 attacks in 2016 and 2017, respectively (Romero, 2018).

During the government shutdown in October 2013, some of the duties carried out by NASA had to be furloughed because they are considered to be nonessential. This meant that the computer system running the Nowcast of Atmospheric Ionizing Radiation System (NAIRAS) had to be closed down as well. While under normal circumstances this would not cause dire consequences, this government shutdown was an exception, as it started at the peak of a solar radiation storm. NAIRAS could not keep track of the radiation levels during the shutdown and take precautionary actions in light of it. Consequently, air crews could not be warned about the location and the rate of the radiation storm, which led to an estimated half a million passengers flying through the affected area and being exposed to high radiation levels that could pose threat to their health and possibly even cause cancer in the future (Tobiska et al. 2013).

Another interesting observation about the effects on public safety of a government shutdown was made by Gil & Macis (2015). While analyzing the crime rates in Washington DC during the October 2013 government shutdown, they have estimated that overall crime rate dropped by 3% in those 16 days. This overall change in the crime rate was driven by two different effects on the crime rates during daytime and nighttime. The crime during the daytime declined by 9%, what is the consequence of fewer people being in the streets due to their duties being furloughed and/or the governmental offices being shut down. However, the crime rates for the night hours increased by 5%, possibly caused by the criminals redirecting their illegal activities from daytime to nighttime. Nonetheless, as mentioned above, the overall crime rate decreased during the government shutdown, which might indicate that government shutdowns cause a drop in crime rates, as the opportunities for committing crimes decrease with a lower active population density. Still, it is important to note that this is research on a single US state during one government shutdown, therefore a more thorough analysis would need to be done historically nationwide to arrive at any conclusive results.

The government shutdowns can also cause a strain on the judicial system within the country. For example, during the October 2013 shutdown some of the civil cases had to be suspended due to the lack of funding for the Justice Department (Plumer, 2013b). Also, at the time of the 2018-2019 shutdown the judicial system stopped paying public defenders and expert witnesses, as they are independent contractors and the courts did not have funds to cover their costs (Smith, 2019). This shows that US citizens can find it hard to protect their rights and be properly represented in court during a shutdown, and that might impede their rights.

Overall, government shutdowns can make it hard to ensure a high-quality public safety, putting people's health and rights in elevated danger, which may affect them for the rest of their lives. However, it is important to point out that a government shutdown can have an indirect positive effect on public safety due to people staying at home more. Nonetheless, that still does not prevent the possible negative effects pointed out above.

I.2.2.3. Tourism

One of the areas that are affected by the government shutdowns the most is tourism, as various national parks, museums, and monuments are considered nonessential and are, thus, closed down in case of a federal budget gap.

According to Mednick (1997), 368 national parks were closed during the December 1995 shutdown losing 7 million visitors. It is estimated that these closures created a loss of around $14.2 million per day to the local communities due to the decrease in tourism revenues. The same can be said about the national museums and monuments which lost 2 million visitors during the shutdown and led to significant losses in tourism revenues. Besides that, around 25,000 visa applications by foreigners went unprocessed each day. This amounts to around 500,000 visas during the shutdown (Kosar, 2004). Considering that an average tourist in the US spent around $1,400 in 1995, the country could have lost around $700 million in tourism revenues due to the unprocessed visas (The World Bank, 2019).

In order to illustrate how government shutdowns can affect tourism revenues in the US, Gabe (2016) analyzed the effect of the October 2013 government shutdown on Acadia National Park and Bar Harbor in Maine. The research shows that Acadia National Park's visitor rates decreased by 76% during the shutdown, which created an overall 13% drop in tourism-related spending. In relation to that Bar Harbor, the local business under the research had 17.1% of its reservations cancelled due to the park's closure. Even though most of the visitors who cancelled their reservations still visited the place after the government shutdown, a decrease of 17.1% can have a significant negative short-term effect on the local businesses.

However, the above example shows only a small part of the picture of the effect of the October 2013 government shutdown. Just like during the December 1995 government shutdown, 401 national parks were shut down for 16 days in 2013 due to a federal funding gap. It has been estimated that this led to a decline of 7.88 million in the number of visitors to the National Park Service (NPS) units, which resulted in a loss of $414 million in tourism revenues in the local communities (Koontz & Meldrum, 2014). These and other similar drops in tourism revenues affect not only the local communities near tourist attractions, but also the tax revenues for the country. However, the overall economic effect will be discussed in another subsection of the work.

But there can be negative effects of government shutdowns on tourism not only in terms of the loss of tourists and the revenues coming from them. During the 2018-2019 government shutdown Joshua Tree National Park continued working, however its activities were sustained by only a few rangers who were not enough to guarantee the security of the national park. The park was vandalized, with some of its trails ruined and trees cut down. The damage was so colossal that it might take 200-300 years to get back to the park's old glory. The national park was even considering closure, however in the end it was announced that it will use its recreation fee revenues to sustain its activities (Boucher, 2019). However, if the closure would have happened, the local community would have been put in huge financial distress, as their financial well-being heavily depends on the 2.8 million tourists that visit the park every year (Wong, 2019).

While these closures of national parks, museums and monuments might not have a strong impact on the overall US economics, as government shutdowns are temporary events and these sights are not one of the main income sources for the federal government, it is crucial to note that they can be very damaging to the local communities due to the decreases incurred in expected tourism revenues.

I.2.2.4. Social security

The furlough of workers in nonessential governmental offices can have a significant effect on the people who heavily rely on social security benefits and other types of social security provided by the government. Some illustrations for that are provided below.

While the social security benefits were being paid out as usual, both American veterans and American Indians were heavily affected by the December 1995 government shutdown because there was a lag for them receiving their benefits. There were major delays when it came to healthcare services and financial aid to the American veterans throughout the shutdown. The American Indians were put in a similar situation, as general assistance payments were delayed for 53,000 benefit recipients because all the employees for the Department of Interior Bureau of Indian Affairs were furloughed through the entirety of the government shutdown (Kosar, 2004). This can pose a negative effect on the livelihood of the benefit recipients, as research shows that the people living off benefits rarely apply consumption smoothing strategies, meaning that they heavily rely on their paychecks each month (Stephens Jr., 2003).

Both the December 1995 and October 2013 shutdowns saw some of the employees of the Social Security Administration (SSA) being furloughed. While, as mentioned above, this did not delay the payout of social security benefits, a lot of other activities within the SSA were impeded by the shutdowns due to an insufficient number of workers. Those activities included: approving of student loan applications; processing and deciding on disability appeal hearings; processing disability applications and new benefit applications (Eshoo, 2013). While these duties were only delayed, the effects of applications not being processed in time can put people at financial risks, especially students, as they had to pay the average yearly tuition fee of $21,291 in 2013-2014 and a lot of the college students rely on the student loans for that (National Center for Education Statistics, 2018).

None of the social security benefit payments were missed during the 2018-2019 government shutdown either, because they were provided nondiscretionary funding under the appropriation bill signed before the deadline, meaning that none of the Social Security Administration workers were furloughed and the government had the funds assigned for paying out the benefits (Bryant, 2019). Nonetheless, the people relying on social security benefits still could not relax completely. As the appropriation bill for the Department of Agriculture had not been signed when the government entered the shutdown, it was feared that with time the department might run out of funds to support the food stamps program - Supplemental Nutrition Assistance Program (SNAP) (Ghilarducci, 2018). Considering that 38.1 million Americans were receiving food stamps in January 2019, a failure in giving out food stamps could put the food source of millions of people at risk (United States Department of Agriculture, 2019). Luckily, the Department of Agriculture did not run out of food stamps during its funding gap, but it poses the question what could happen in the case of an even longer government shutdown.

It is no surprise why the payment of social security benefits is considered to be an essential duty by the US government, as these benefits affect the most sensitive citizens within the country who often live purely off of their monthly social security benefits. Nonetheless, the above examples show that it is not enough in order to maintain full social security within the US, as there are some people relying on other benefits and other governmental services for social security, some of which are furloughed. Even the slightest disruption in the social security system can change the quality of life of the most vulnerable people, therefore the government should review whether any additional activities should be reclassified to be essential.

I.2.2.5. National economy

As could be well expected from as significant of a national event as a government shutdown, it can have some effects on the national economy in the US. While some of the economic effects have already been discussed above in terms of tourism and social security benefits, it is important to investigate the overall impact of federal funding gaps on the economic situation within the country.

The report by the Congressional Budget Office (2019) summarizes the overall estimated effect of the 2018-2019 partial government shutdown on the economic well-being of the US. It was estimated that the shutdown had a negative effect of $3 billion on the gross domestic product (GDP) for 2018 and reduced the potential GDP for the first quarter of 2019 by $8 billion. Considering that the initial estimate of the US total GDP after the shutdown was $20.5 trillion in 2018, this effect of the longest government shutdown on the overall economy of the country is negligible (Bureau of Economic Analysis, 2019). Nonetheless, even if the overall economy is not highly hurt by a shutdown, it does not mean that nobody is affected by it financially. The main causes of this slight drop in the GDP due to the government shutdown (delays in government spending, lower federal employee output, decrease in demand) can be tremendously important and damaging to individuals throughout the country.

Baker & Yannelis (2017) have looked into how the consumption of government workers changed in the light of the October 2013 government shutdown. Their analysis shows that there is an excess sensitivity to the income shock for the employees. This can be explained by the earlier discussed statistics showing that 78 percent of the Americans live paycheck to paycheck (CareerBuilder, 2017). As the paychecks of the governmental employees were postponed by the lengthy shutdown, they had to adjust their consumption in order to survive financially until the funding was reinstated. However, this excess sensitivity was short-termed, as the consumption went back to normal after the government shutdown ended. So how did this excess sensitivity translate into the consumption of the government employees? There was a slight drop in consumption in the second week of the shutdown, and a strong decrease in the third week, as the funding gap was coming to a close. It is important to note that the first week's consumption was unaffected, because the employees received their paychecks for the end of September, which could indicate that a short shutdown would not have an impact on their consumption. Nonetheless, the drop in consumption in the second and third weeks can be explained by people choosing to spend more time at home, as opposed to dining out, going out or shopping. However, their levels of consumption went back to normal as soon as the shutdown ended, proving that these changes are short-termed (Baker & Yannelis, 2017).

Continuing the discussion about the October 2013 government shutdown, it is important to note that the effect on the national GDP from this shutdown was around five times smaller than that of the 2018-2019 shutdown, as the GDP loss for this one was estimated to be $2 billion (Davidson, 2019). The effect is smaller mostly due to the fact that this shut down was considerably shorter, and a shutdown's costs grow exponentially the longer it lasts. However, there was another setback in the US economy that arose during this shutdown – it created a drop in consumer, business, and investor confidence. According to different consumer confidence indices, it dropped to the lowest level within 10 months to 2 years. A low consumer and business confidence can postpone their spending decisions, while a low investor confidence can delay significant investments in capital or debt. While these indices picked up soon after the shutdown, this temporary change could create big difficulties for some companies in case a shutdown lasts longer (Labonte, 2013).

Nonetheless, it can often be hard to estimate the costs of a shutdown accurately, as it is complicated to evaluate the full scope of the negative effects on the productivity of the government workers. One might consider the loss of production during the shutdown due to the furlough of employees as the only negative effect on the overall productivity of the governmental offices, however this point of view does not take the indirect effects into account. As the December 1995 shutdown showed, the morale of the federal workers can plummet as they realize that their employment is not fully stable. Also, being classified as a "nonessential" worker can make one feel unimportant and, thus, decrease their motivation to work. These negative impacts on the morale of the employees may drop the productivity of the governmental workers and this effect can last for considerably longer than the shutdown itself (Trowbridge, 1997). However, more research is necessary in order to determine how impactful this decrease in morale is in order to make strong conclusions regarding its effect on the productivity of the government workers.

Additionally, the data on the December 1995 government shutdown shows that a shutdown has a strong impact on the operations of federal contractors. The government often relies on contractors for goods and services that it cannot produce and provide itself. In order to satisfy the government's demand for those goods and services, it signs contracts with various companies of all sizes which already provide them. However, in the face of a funding gap, the government may fail at fulfilling its side of the contracts when it comes to paying for the goods. As the survey by Signet Banking Corporation (1996) regarding the December 1995 shutdown shows, 63% of the federal contractors went through delays in accounts receivable, 55% of them had to take on additional debt, and 31% of them had to furlough their employees. While the negative effects on the big businesses were not as severe, some of the smaller contractor companies even went bankrupt because of the shutdown, because they have a hard time getting credit and usually have a short cash lifeline. This kind of event can leave a number of people unemployed and can damage their livelihood tremendously (Trowbridge, 1997). It may also cause some additional difficulties to the government itself, as in the case of a contractor going bankrupt, the government needs to find a new contractor that would meet its needs in the same or similar way.

The data acquired for the October 2013 government shutdown goes in line with what was concluded from the December 1995 shutdown regarding employment. While it is not clear how many people lost their jobs purely because of the shutdown, the data shows that about 120,000 jobs were lost during October 2013 (Council of Economic Advisers, 2013). This could have been caused not only by people being fired due to decreased overall demand from the government and consumers, but also by the uncertainty caused by the budget gap. As the research by Aastveit et al. (2013) concludes, when uncertainty is high, the economic activity slows down, and monetary policies are less affective. This means that businesses can be reluctant to hire new people both during the shutdown and soon after it because the country's economic situation is unclear, and it is risky to make significant financial decisions. However, it is important to note that some of this effect on the employment in October 2013 could have come from the debt limit brinkmanship that happened at the same time as the shutdown, so it is hard to estimate solely the impact of the shutdown in these circumstances.

It is hard to make accurate estimations on the effects of a single event on the overall economy of the country; however the above examples do indicate that government shutdowns have a negative impact on the economic situation in the US. On the other hand, this impact is considerably low and short-term. However, even this light effect on the overall economy within the US can make businesses crumble and leave a significant number of citizens unemployed and even put some of them in financial distress.

I.2.2.6. Financial markets

Like in terms of the aforementioned effects of a government shutdown, there is not much research done on the relationship between government shutdowns and the financial markets, and all existing research is very recent. Nonetheless, these papers are crucial to analyze and discuss, as the existing research paves the way for this thesis. There are three main financial variables that the past research is focused on: equity risk premium, stock returns, and their volatility.

Aye et al. (2016a) had the same thoughts as Aastveit et al. (2013) when it comes to the uncertainty and its effect on the markets. This led them to believe that the uncertainty caused by a government shutdown or a debt ceiling can make stock prices drop, as investors postpone their investment decisions and, thus, decrease the overall demand for stocks. In that light they decided to analyze whether a government shutdown or a debt ceiling can predict the equity risk premium. For that they applied the methodology used to predict equity risk premium by Neely et al. (2014), only adding government shutdowns and debt ceilings as two new economic variables together with the previously analyzed 14 economic and 14 technical variables. The information used to represent government shutdowns and debt ceilings in the data set was the monthly data on the percentage of news articles published in over 1000 US newspapers on Access World News' Newsbank Service mentioning them, a measure developed by Baker et al. (2016). From running a bivariate predictive regression, the authors concluded that the government shutdowns do have some predictive power over equity risk premium, which confirms their assumptions that the uncertainty caused by government shutdowns can have a negative impact on stock prices. However, this research analyses only in-sample predictions and no out-of-sample predictions have been attempted, which is characteristic of other research on the government shutdowns as well, as all the research on this topic is still very fresh.

The findings by Aye et al. (2016a) are in line with the conclusions made by Bekiros et al. (2016) who were analyzing the relationship between the overall economic policy uncertainty and equity risk premium in the US. Their research was focused on how the measure of economic policy uncertainty (EPU), developed by Baker et al. (2016) like the measures used by Aye et al. (2016a), can predict equity risk premium instead of focusing on particular types of events that can cause the uncertainty like Aye et al. (2016a) did. The authors argued that linear predictive models are unreliable and that quantile regression models are superior in estimating the predictive power of EPU. Their claims were proven to be right, as the linear predictive model failed to outperform the model using historical averages for predicting equity risk premium. Furthermore, the quantile regression model gave significantly better results that show that including EPU measure in the model improves the predictability of equity risk premium. As government shutdowns can be seen as a source of economic policy uncertainty, these findings support the results of the research by Bekiros et al. (2016). Additionally, similar research by Balcilar et al. (2015) indicates that this applies not only to the US, as they showed that the local EPU measure can predict the equity risk premium in South Africa. However, it has also showed that the EPU measures of 20 other countries, including the US, do not have significant predictive powers on the South African equity risk premium, which indicates that the economic uncertainty in one country does not affect the financial markets of other countries. All of these findings are important to us, as government shutdowns are a part of EPU, therefore some characteristics applicable to EPU are likely to be carried by government shutdowns as well.

When it comes to the relationship between government shutdowns and stock returns, Aye et al. (2016b) were the first ones to research the predictive power of government shutdowns and debt limits towards real stock returns in the US. This paper used the same data for government shutdowns and debt ceiling as was applied by Aye et al. (2016a). The researchers found that there is no permanent causal link between the variable denoting government shutdowns and real stock returns, as the simple bootstrap LR-test failed to reject the hypothesis of no causal relationship between government shutdowns and real stock returns with the bootstrapped p-value of 52%. However, parameter stability tests have shown that there are structural shocks in the time series data, therefore they added a time-varying model to their research in the form of rolling bootstrap estimations, an approach developed by Balcilar et al. (2016). Applying the time-varying parameter model made it apparent that there is a significant Granger causality between government shutdowns and real stock returns in some 24-month-long periods in the time set. To be precise, the periods with significant values at a 10% level were the ones that ended at the following months: 1995:M6, 1998:M4-1998:M8, 1998:M11-1999:M6, 1999:M12-2000:M11, 2001:M12-2002:M1, 2002:M3, 2005:M2 and 2013:M5-2013:M7. This type of result could have been obtained because government shutdowns are a considerably rare event, and therefore there are few spikes in the government shutdown data that can create significant effects in an extensive sample (1985:M2 – 2013:M9).

Woodard (2015) used a different approach to research the relationship between government shutdowns and stock returns. In order to analyze whether markets are efficient in the light of government shutdowns, she looked at the way the selected 100 companies' stocks performed in terms of risk-adjusted returns 30 days before and after two of the longest government shutdowns to date (1995-1996 and October 2013) were announced. All 100 of the analyzed companies were government contractors at the time of the shutdowns. Her results show that the share prices of the selected baskets of companies dropped significantly at the announcements of a shutdown and continued following a negative trend for the 30 days after the announcements giving negative risk-adjusted returns for investors. This is in line with the weak market efficiency hypothesis, but the results make one question if the semi-strong market efficiency works in these cases, as the stock prices take time to adjust to the news of a government shutdown. However, this research paper lacks analysis of what happens after the 30 days pass, as it is possible that the stock prices pick up and reach their normal levels after the shutdown passes.

Antonakakis et al. (2017) focused on the effects of economic policy uncertainty (EPU), the approach mentioned while discussing the research by Bekiros et al. (2016), as well as 24 particular factors that might cause this uncertainty, including government shutdowns. However, instead, Antonakakis et al. (2017) analyzed their relationship with the US equity market in terms of stock returns and volatility. Similarly to Aye et al. (2016b), the researchers applied the quantile-based causality model developed by Balcilar et al. (2016), as the linear Granger causality test showed few significant relationships between stock returns and uncertainty factors (significant results were obtained only in terms of national security and financial regulation variables), and the Brock-Dechert-Scheinkman (BDS) (Brock et al., 1996) test gave strong evidence of nonlinear relationships between the uncertainty variables and the stock returns. The results obtained by the nonlinear model show that, among other factors, government shutdowns do have significant causality over the US stock returns, as well as predictive powers over the volatility of those returns, however these effects are not prominent over the whole sample. Nonetheless, it is useful to look into other research on the relationship between government shutdowns and volatility.

Even though the research by Toparli & Balcilar (2016) was mostly based on oil markets, they did analyze how different risks spill over to the stock market, in terms of volatility, as well. They evaluated whether the risk transmits into the oil markets, stock markets, and oil-related CDS markets in relation to eight major events in the period of 01.06.2004 – 02.02.2016, including the US government shutdown of October 2013. By applying the multivariate conditional volatility model and the volatility impulse response function on the volatility index (VIX) and one-month option volatility estimate (MOVE) they have concluded that, while there were events that affected the volatility of the stock market more (e.g. Lehman Brother bankruptcy and Greece debt crisis), the government shutdown did have a negative impact on it. However, it is important to note that this impact seems to exist only in the short-run, as the negative effect dies down in the middle-run. The effect of the government shutdown was the weakest in the long run, which could be explained by the markets going back to normal as the funding was secured again. This is consistent with the effects of government shutdowns on the national economy, healthcare, social security and other areas discussed in the previous subsections, as most of them were affected by funding gaps only in the short run as well.

In addition, there has been some research carried out in terms of more specific parts of the financial markets. These research papers will be discussed below.

Antonanakis et al. (2016) looked into how the economic policy uncertainty and its components, including government shutdowns, can affect the real returns on sustainable investments. The authors used the US Dow Jones Sustainability Index (DJSI) as a representation of sustainable investments, while the economic policy uncertainty and its components, including government shutdowns, were represented by the newspaper coverage estimates already discussed here in relation to other research papers. Strong proof for nonlinearity was found in this paper as well, therefore causality-in-quantiles model was applied here, like in many other papers in relation to the government shutdowns. When the model was applied, some significant causality effects were obtained, including a negative effect from the overall economic policy uncertainty measure. However, the authors did not find a significant causality relationship between government shutdowns and real returns from sustainable investments. That is different from the results regarding real returns on S&P500 index, where a negative relationship with government shutdowns could be seen in some subsamples. This could indicate that the investors in sustainable markets are not hurt by the shutdowns, however more research should be done to determine the reason behind no significant relationship being present.

Another interesting research in relation to government shutdowns was done by Abraham (2014). She investigated how government shutdowns affect the futures market prices by analyzing the S&P500 Futures Market. Unlike the majority of the research discussed above, this paper uses a dummy variable in the dataset to represent the months a government shutdown was in action. The author formed two regressions (non-logged and logged) which also included variables like unemployment rate, GDP, level of real investment, inflation rate, treasury bill rate, and consumer confidence. Both regressions indicated that a government shutdown has a positive effect on the future market prices. While the positive relationship can seem strange at first, the author provides a couple of possible explanations for it. Firstly, some investors may believe that the stock prices will increase after the shutdown, as the markets go back to normal, therefore they might buy futures during the shutdown while the stock prices are low. Secondly, as already shown by other works of research, a government shutdown causes uncertainty, so investors might invest in the futures market to hedge the possible future risk. Even though this research gives a useful insight into the relationship between government shutdowns and the futures market, it did not consider the possibility that the other variables included in the regressions could have been correlated with government shutdowns, as the previous subsections of literature review has shown that variables such as unemployment rate, GDP and level of real investment can be affected by government shutdowns. If there was any correlation between the variables in the data used, it could have created biased results, therefore these conclusions have to be considered with caution.

All in all, there is not a lot of past research on the way government shutdowns affect the financial markets. As can be seen above, some of the papers come to different conclusions, especially in terms of returns on equity, therefore this thesis is focused on analyzing the relationship between government shutdowns and real stock returns. In order to catch this relationship in the most efficient way, a single industry will be analyzed, and its choice will be discussed below.

I.2.3. Choice of research subject

The past research on stock returns has been focused on the overall US stock market, often represented by S&P 500 Index that corresponds to the 500 biggest companies on the US stock exchanges. While it can illustrate how the major US stocks perform historically, it would be biased to say that it provides an insight into the whole US stock market, as there were 3,618 domestic companies listed on the US stock exchanges at the end of 2017, and the number of listed domestic companies had peaked at 7,607 at the end of 1997 (Ritter, 2019). Therefore, it is important to ask whether the results from the previously discussed papers apply for the whole US stock market or if various segments of the stock market or even various stocks would show different results.

Furthermore, it can be questioned whether the largest listed companies are as sensitive to government shutdowns as the smaller companies or specific industries. It is undeniable that big companies can have strong ties to the government through some contracting work; 4 out of 5 top US government contractors (Lockheed Martin, The Boeing Company, Raytheon, Northrop Grumman Corporation) are among the 500 biggest listed companies, which are included in the S&P500 index (Ferriere, 2018). However, the majority of these large companies do not have to rely on the government to survive and can easily sustain their operations in case it goes into a shutdown. Needless to say, that cannot be said about all other companies.

As already discussed above, the survey conducted by Signet Banking Corporation (1996) after the December 1995 government shutdown showed that government contractors have been severely affected by the shutdown in a negative way. 55% of the surveyed contractors claimed that they had to take on additional debt because of difficulties to keep up their activities as usual. While according to the theorem developed by Modigliani & Miller (1958), the additional debt would not have an effect on the value of the companies, as it claims that the capital structure has no impact on the value of the company, the Modigliani-Miller theorem holds only under the perfect market assumptions including no taxes or transaction costs and is unrealistic in real life. However, some others are claiming that taking on additional debt can increase the value of the company by signaling to investors. Research shows that increasing the leverage of a company can increase its value, as the investors believe that by taking on additional debt the company shows that it has no issues with financing its activities and the added leverage will allow the company to finance its projects that will create additional value (Ross, 1977).

Nonetheless, it is questionable whether increasing the leverage during the times of economic uncertainty would send the same signal to the investors. It could instead indicate that the company is struggling to survive the period of uncertainty, which would show the company's instability and the possibility that its risk of default has increased. This could raise concerns for the investors and, in turn, damage the market value of the company (Gourio, 2013). In addition, the survey by Signet Banking Corporation (1996) showed that 31% of the contractors had to furlough their employees, and this again could not have passed unnoticed by the investors and could have possibly sent a negative signal to them.

In light of all of the above, a question arises whether there is any specific industry that would reflect the possible financial effects of a government shutdown better than S&P500 index and would provide more significant results than the past research has. While it would not be possible to determine which industry would be affected the most without a thorough research into all of them, doing that is out of the scope of this research. Instead, it has been decided to investigate which industries receive the most funding from the US government. This has been chosen as the criteria for choosing the industry of interest because we believe that a government shutdown would hurt such industries the most, as their funding would be affected by it, which could cause disruptions in the activities of the companies within those industries.

In order to determine which industries receive the most funding from the government, it is useful to look into the Subsidy Tracker, a database developed by Good Jobs First (2019) that includes data on the subsidies attributed to companies by the US government. While the data is not exhaustive, it reaches as far back as 1976 and gives a good overall look on which industries receive the most subsidies. The summary for the major industries reveals that the industry receiving the most subsidies is *Utilities and Power Generation* whose subsidy value amount to $37,921,177,164 over 3,199 subsidies awarded to the industry. The second industry by received subsidies is *Aerospace and Military Contracting* whose subsidies amount to $24,266,949,096. That is a 36% lower amount than the one attributed to *Utilities and Power Generation*, which shows how significant the amount awarded to the *Utilities and Power Generation* industry is. Additionally, more than half ($14,523,117,926) of the subsidies attributed to the *Aerospace and Military Contracting* industry were issued to one company, Boeing, which casts doubt on how important subsidies are to other companies within the industry. These considerations provide one with substantial reasoning to choose the *Utilities and Power Generation* industry (further, utilities industry) to be the focus of this study.

We want to focus this research on only one dependent variable, as has been done in most of the past research, therefore it has been decided to base this piece of research on analyzing the relationship between government shutdowns and real returns on the Dow Jones Utility Average Index, an index representing the price-weighted average of the 15 biggest utility companies in the US, which was created in 1929 as a consequence of the utilities industry being excluded from the Dow Jones Industrial Average Index. Unfortunately, the Dow Jones Utility Average Index does not include smaller companies within the US, however focusing on an industry that is highly connected to the government funds should provide significant insight into the possible effects of government shutdowns on financial markets.

Similar to past research, it is expected that the results will show that the real stock returns in the utilities industry are not affected by government shutdowns in the long run, but that there will be significant results on the negative effects of government shutdowns during the periods of higher uncertainty. The data and methodology used to test these expectations will be discussed in the upcoming section of the paper.

I.3. Research model

I.3.1. Data

In order to run the research model described below in the methodology section, data representing the US government shutdowns and real returns on the utility market will be needed. This section will be focused on how these sets of data were obtained and describing them.

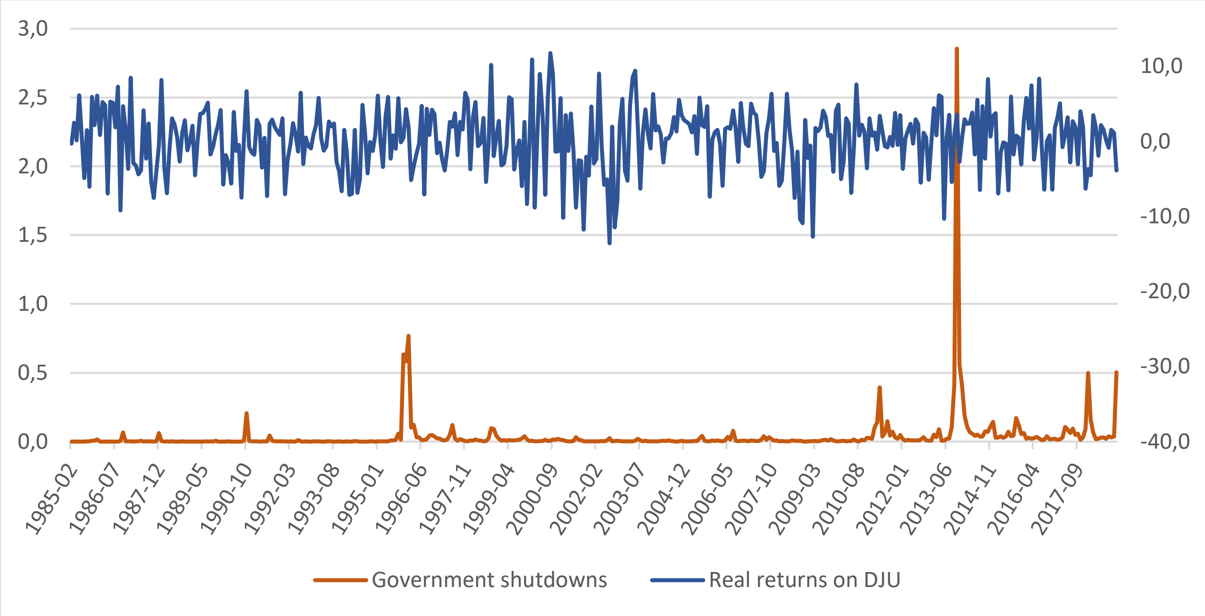
Two main options how to define a government shutdown in the data can be seen while looking into the previous pieces of research: a dummy variable for the months where a government shutdown took place, or the government shutdown index from Economic Policy Uncertainty (2019). The latter option is derived as the percentage of news articles published in over 1000 US newspapers on Access World News' Newsbank Service mentioning "government shutdown." This option was chosen to represent the US government shutdowns in this thesis, as it includes not only the months that the shutdowns took place, but also the months when they were a topical issue. This means that the data represents not only the event of a shutdown, but also the risk of it happening. That is useful for our research, as it is possible that the effect of a government shutdown on the stock market is translated into the real returns before the shutdown even starts, as the rational investors already anticipate a shutdown and, thus, invest their money based on this anticipation. A dummy variable could not reflect such information, therefore it is assumed to be not appropriate for this research.

To calculate real returns on the utility market, two sets of data are used: monthly values for the Dow Jones Utility Average Index (DJU) and for the seasonally adjusted Consumer Price Index for All Urban Consumers (CPI-U). The data on the DJU index was obtained from Yahoo Finance (2019), and the information on the seasonally adjusted CPI-U was obtained from Federal Reserve Bank of St. Louis (2019). As mentioned before, the DJU index was chosen as a representation of the US company stocks within the industry that is the most reliant on government funds – *Utilities and Power Generation*. Seasonally adjusted CPI-U was chosen as the best representation of inflation in the US, as it removes the effect of the most intensive spending seasons from the price levels within the country. In order to obtain the real stock returns of the utility market, firstly, the discretely compounded monthly returns on both indexes were calculated, which in turn gave us the nominal return rate on the DJU index and the US inflation rate. These rates were used to obtain the real return rate on the utilities market based on the following formula:

$$Real\ return\ rate = \left(\frac{1 + Nominal\ rate}{1 + Inflation\ rate}\right) - 1$$

The data used in this thesis captures the period of 1985:M1 – 2018:M12. These boundaries were defined by the availability of data on the government shutdown index, as it does not reach further back than the year 1985, and no data on the first months of the year 2019 were available as of the writing of this thesis. Also, it is important to note that the final data set starts at 1985:M2, as the first data point (1985:M1) of the DJU and CPI-U indexes were used to calculate the real return rate for 1985:M2, therefore the whole data set includes 407 observations in each time series. The time series data is plotted in Figure 1 which shows the percentage value of articles mentioning government shutdowns on the left axes and the real return on the DJU index.

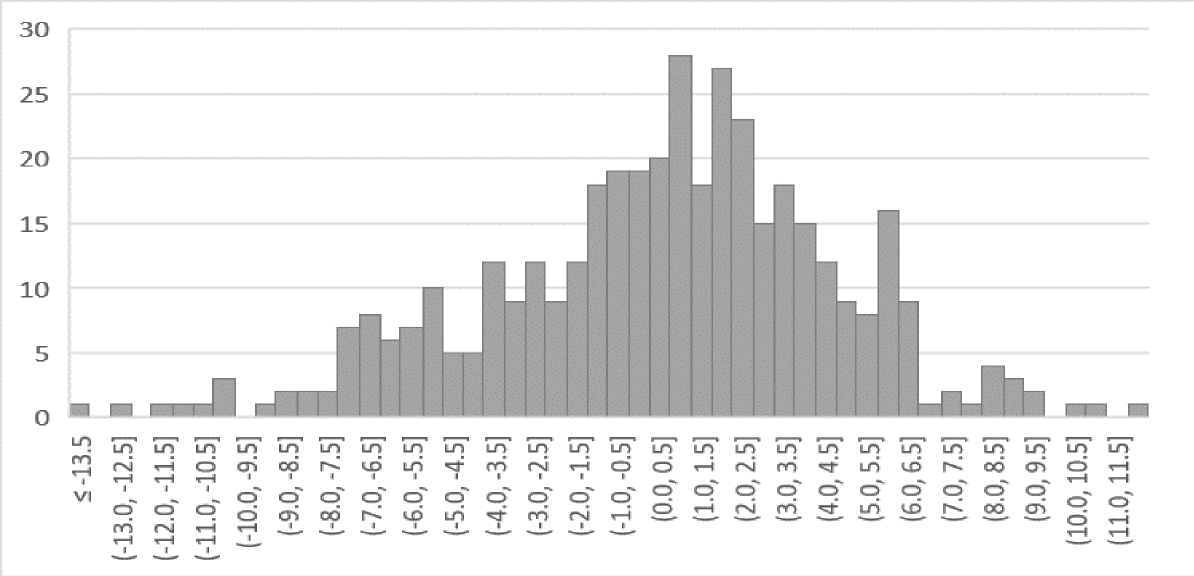
Figure 1 Time series of the government shutdown index (left axis) and real returns on the Dow Jones Utility Average Index (right axis) (in percentages)



It can be seen that the government shutdown index takes values of zero or close to zero in the majority of the datapoints (251 out of 407 observations take a value of <0.01%), which can be explained by government shutdowns being relatively rare events. There is very little talk about government shutdowns when the risk of one happening is very low, therefore there are no articles mentioning it being published. Government shutdowns are usually talked about only around the time of the federal budgeting process and only when there is political uncertainty that can cause disagreements that may lead to a funding gap. However, there are some obvious jumps in the data, the most notable ones being in the periods of 1995:M11-1996:M2, 2013:M9-2014:M1, and 2018:M12 (no information on the development of this jump is available as of the writing of this thesis). These are clearly in line with the three longest government shutdowns to date: the December 1995, October 2013 & December 2018 – January 2019 government shutdowns. This confirms the assumption that there is more talk about and, consequently, more articles about government shutdowns as the risk of one happening increases.

At first glance the time series on the real returns on the DJU index looks similar to a white noise process, as it varies around the value of zero, however, analysis of its statistics shows otherwise. The distribution of the monthly values of the real returns over our sample is slightly negatively skewed with its skewness being equal to -0.396. This is characterized by the time series having more values on the left side of the distribution with the tail on that side

Figure 2 - Distribution of monthly real returns on the Dow Jones Utility Average Index (in percentages)



being longer than the right tail and its mean being to the left of the peak of the distribution. The distribution of the monthly real returns is also leptokurtic as it has positive excess kurtosis of 0.285. This indicates that the distribution has fat tails and has more observations far from the mean than normally distributed data would. These statistics corroborate the conclusions that can be made from running a Jarque-Bera test on the time series. The Jarque-Bera test statistic calculated from the data on the real returns is equal to 12.042 which is far away from zero, which allows us to reject the null hypothesis of the data being normally distributed at p-value<0.01 (Jarque & Bera, 1987). All of this can be seen purely by looking at the histogram of the monthly real returns on the DJU index shown in Figure 2.

It is interesting that this data includes the period before, and the beginning of, the 2018-2019 government shutdown, which has not yet been analyzed by other researchers, however, unfortunately, the data on the government shutdown index is not yet available for the beginning of the year 2019, therefore it is not possible to evaluate the full effects of the longest government shutdown to date and its aftermath.

The next section discusses the methodology which was applied to analyze this data and the relationship between government shutdowns and real returns on the utility industry.

I.3.2. Methodology

After looking into the previous research on the relationship between the US government shutdowns and financial markets, it was decided to apply an adjusted version of the empirical model used by Aye et al. (2016b) which was based on the model developed by Balcilar et al. (2010) and Balcilar & Ozdemir (2013).

While the empirical model by Balcilar & Ozdemir (2013) was focused on testing two-way Granger causality, Aye et al. (2016b) adjusted the model to test one-way Granger causality. In theory, the existence of Granger causality means that information on one variable improves the forecasts of another variable (Granger, 1988). This also means that having information on the first variable can help in predicting the future values of the second variable. The adjusted version was chosen for this thesis because, like the authors of this adjusted empirical model, we assume that the government shutdowns are exogenous, meaning that the real returns have no causal effect on the government shutdowns. This assumption is implemented into the model by restricting the bivariate vector autoregression (VAR(p)) model, which will be discussed further in this section, by setting the coefficient φ_{12} to be equal to zero.

The thesis analyses the causality relationship between the US government shutdowns and real returns on the DJU index. This is done by applying two main Granger non-causality tests: Wald test and Likelihood ratio (LR) test. These tests are conducted in relation to a bivariate VAR(p) model stated below:

$$\begin{bmatrix} Gov\_shut_t \\ DJU\_real_t \end{bmatrix} = \begin{bmatrix} \varphi_{10} \\ \varphi_{20} \end{bmatrix} + \begin{bmatrix} \varphi_{11}(L) & 0 \\ \varphi_{21}(L) & \varphi_{22}(L) \end{bmatrix} \begin{bmatrix} Gov\_shut_t \\ DJU\_real_t \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix}$$

where Gov_shut_t is the government shutdown index at time t; DJU_real_t is the real return on the DJU index at time tφ_{10} and φ_{20} are constants; $\varphi_{ij}(L) = \sum_{k=1}^{p+1} \varphi_{ij,k} L^k,\ i,j = 1{,}2$, where $\varphi_{ij,k}$ is the autoregressive coefficient denoting the effect the k-times lagged value of variable j has on the variable i at time t, and L represents the lag operator as in $L^k y_{i,t} = y_{i,t-k,}\ i = 1{,}2$; ε_{1t} and ε_{2t} are uncorrelated residuals at time t. The null hypothesis that government has no Granger causality effect on the real returns on the DJU index is tested by setting φ_{21} coefficients equal to zero:

$$H_o: \varphi_{21,1} = \varphi_{21,2} = \cdots = \varphi_{21,p} = 0$$

If the null hypothesis is rejected, the government shutdowns Granger cause real returns on the DJU index, meaning that the government shutdowns have an effect on the utilities stock market and carries some predictive power over their real returns.

The lag order of the VAR(p) model is chosen in relation to three information criteria: Akaike (AIC), Hannan-Quin (HQIC), and Schwartz (SIC). Information criteria are more appropriate tools for choosing the most suitable model as opposed to choosing the model that maximizes R^2, because they decrease the risk of overfitting the model and mistaking noise in the data for significant relationships between variables. Information criteria are calculated for each VAR(p) model up to lag 10 and the model that minimizes the information criteria is chosen as the best-fitting model. The limit of the number of lags is set to 10 because models with high numbers of parameters are problematic to work with. It is possible that each criterion may indicate different optimal lag orders, as each of them applies different penalties for the loss of degrees of freedom, therefore, if that turns out to be the case in our research, the one indicated by HQIC is applied, as the penalty in HQIC lies somewhere between the ones in AIC and SIC (Guidolin & Pedio, 2018).

It is crucial to point out that in order to carry out Granger non-causality tests, the time series on which these tests are run have to be stationary. If these tests are run on nonstationary data, the tests will be misspecified and will provide faulty results (Papana et al., 2014). Therefore, stationarity tests must be performed on the time series analyzed, before we run any model for determining causality effects. Three different stationarity tests are used in this thesis: Philips-Perron, Augmented Dickey-Fuller, and Kwiatkowski–Phillips–Schmidt–Shin tests. While the first two are tested against the null hypothesis of a unit root (meaning that the rejection of the null hypothesis indicates that the time series is stationary), the latter tests the time series against the null hypothesis of stationarity (meaning that the rejection of the null hypothesis indicates that the time series is nonstationary, thus Granger non-causality tests cannot be applied on it) (Carrion-i-Silvestre & Sansó, 2006). However, even if all of these tests indicate that the time series are stationary, there may be other data characteristics that can cause issues in testing causality relationships.

Another potential issue was pointed out by Balcilar et al. (2010) – the parameters in the VAR(p) model may be unstable, as they can depend on the sample period of the data used. This might become an issue if the time series has structural breaks that change the patterns of the data. This is very likely in the case of government shutdowns, as they are relatively rare events, therefore it is possible that their effect would not be prominent throughout a long sample of a time series. In order to determine whether the VAR(p) model is stable and if it experiences any structural shocks, the Sup-F, Ave-F and Exp-F stability tests developed by Andrews (1993) and Andrews and Ploberger (1994) are applied. Running these tests shows whether the parameters of the model are stable in the short run. The Sup-F, Ave-F and Exp-F tests use LR statistics to test a model with constant parameters against a model with a structural break in the parameters at a particular point in time. This LR test is repeated for every point in time in the data to find any possible structural breaks which, if included, would improve the initial model. The Sup-F test's null hypothesis assumes that the parameters are constant against a sharp shift in parameters, while the null hypotheses for Exp-F and Ave-F assumes that the parameters are defined by a martingale process as opposed to evolving over time, therefore rejecting the null hypotheses will indicate that the model parameters are not stable, and they experience structural shocks, therefore the Granger causality effect might be significant only in particular periods of time in the sample.

However, Andrews (1993) recommends not using the full interval (0,1) of the sample in these tests, as that would lead to the tests overemphasizing any structural changes in the beginning and the end of the sample against structural breaks in the middle of the sample. Consequently, like in Aye et al. (2016b), it was decided to apply the suggestion by Andrews (1993) of restricting the interval by cutting off 15% of the values on both sides and using these tests on the fraction of the sample in the interval of [0.15, 0.85].

In the case of unstable parameters of a VAR(p) model, an approach to test the Granger causality for different periods of time has to be implemented. For those purposes, rolling window subsamples for the data are created and the Granger noncausality tests are run for each of them separately to determine the periods during which the government shutdowns Granger cause the real returns on the DJU index. Each subsample represents the set of values at times $t = \tau - l + 1, \tau - l, \tau - l - 1, \dots , \tau$, where $\tau = l, l + 1, \dots , T - 1, T$; l is the lenght of the rolling window; and T is the size of the full sample. This means that in total $T - l + 1$ windows are created from of the initial sample.

Selecting the right window size can be tricky, because there are no strict guidelines for how to choose the most optimal window size, and the process of choosing it becomes a balancing game (Pesaran & Timmermann, 2005). A large window is able to provide higher precision of estimates as it has more values available for determining a relationship. However, having a large sample increases the probability of the parameters being unstable, as the longer the period analyzed is – the more likely it is to catch one or more structural breaks in it. A small window, on the other hand, increases the representativeness of the parameters, as they are calculated over a shorter period of time, thus it is easier to avoid structural breaks inside of the sample. Unfortunately, choosing a small window also decreases the precision of estimates due to having fewer values that can be used for evaluating the causal relationships between parameters. Therefore, it is important to find the right window length to get the best of both worlds. Taking the example of Aye et al. (2016b), 24 months long rolling windows are used in this thesis as well.

After creating the rolling windows for the data on government shutdowns and real returns on the DJU index, Granger noncausality tests have to be run on each of them to determine whether government shutdowns carry any predictive power over the real returns on the DJU index during any of the in-sample periods. For that purpose, residual based bootstrapping will be applied on LR statistics tests for each of the windows. This empirical model has been chosen because it works even when parameters are unstable and can help in avoiding pre-test bias, meaning that even if the initial test on the full sample of the data does not provide desired results, other approaches should be tried to see if these desired effects can be witnessed by adjusting the prior tests (Giles & Giles, 1993). While an in-depth explanation of how residual based bootstrapped LR statistics work is provided by Balcilar & Ozdemir (2013), a summary of the model is provided below.

Firstly, two bivariate VAR(p) process are run: the first one (further: partially restricted VAR(p)) assumes that government shutdowns Granger causes real returns on the DJU index ($\varphi_{21} \neq 0$), the second one (further: fully restricted VAR(p)) represents the null hypothesis and assumes that government shutdowns do not Granger cause real returns on the DJU index ($\varphi_{21} = 0$). It is important to note that Balcilar & Ozdemir (2013) use unrestricted and restricted VAR(p) models instead, however in our case both of the models used are restricted, as we have made an assumption of government shutdowns being exogenous which led us to restricting both of the models by setting the coefficient φ_{12} to be equal to zero. Two matrices of residuals are obtained from these VAR(p) processes and are denoted η_p and η_r, respectively. The covariance matrices of these residuals are then calculated as $S_p = \eta_p' \eta_p$ and $S_r = \eta_r' \eta_r$. These covariance matrices are then used to obtain the modified-LR statistics as

$$LR = (T - m)\left(\frac{detS_r}{detS_p}\right)$$

where T is the sample size; $m = 2 \times (2(p + 1) + 1) + p + 1$; and det is the determinant of the matrix. The LR statistic follows the asymptotic χ^2 distribution with p degrees of freedom, and the p-value can be obtained from applying it.

The fully restricted model residuals are then sampled with replacement and are applied on the partially restricted model specifications and estimated parameters to create a new sample. This resampling provides us with a model defined as

$$Y^* = \hat{B}Z^* + \eta^*$$

where η^* are i.i.d. observations $\eta_1^*, \eta_2^*, \dots, \eta_T^*$ that were drawn from the mean adjusted fully restricted model residuals $(\eta_r - \bar{\eta}_r)$ with replacement where the probability of each residual in the resampling process is equal to 1/T. LR^* is then calculated in the same way by employing the residuals obtained while applying the above formula, so it could be compared to the earlier-calculated LR statistic comparing the fully restricted model to the partially restricted model.

The same procedure as discussed in the previous paragraph is then run for N_b times, where N_b is the number of bootstrap repetitions. As suggested by Davidson & MacKinnon (1999), p-values are chosen to test the null hypothesis where the p-value is determined as $Prob^*(LR^* \geq LR)$. If the p-value is lower than 0.1, we reject the null hypothesis and conclude that the government shutdowns Granger cause the real return on the DJU index in that subsample. All of the above has to be applied to each of the rolling windows in order to get the full scope of the Granger causality effect over time.

Another important aspect of the residual based bootstrapped LR test is choosing the number of bootstrap repetitions, N_b. While, just like for selecting the length of rolling windows, there are no strict rules for how to choose the optimal number of bootstraps, looking into past research can give useful insight into it. As pointed out by Balcilar & Ozdemir (2013), Horowitz (1994) used as little as $N_b = 100$ in his research, however Davidson & MacKinnon (1998) applied a significantly higher N_b which reached 1,000 repetitions. Nonetheless, Balcilar et al. (2010), as well as other works like Balcilar & Ozdemir (2013), Aye (2015), Shahbaz et al. (2016), increased their N_b to 2,000 repetitions. However, here it was decided to use $N_b = 599$, the rule of thumb recommended by Wilcox (2010) because it provides a high amount of variability while not overworking the data.

Finally, the data for each of the significant subsamples is applied to the partially restricted VAR(1) model. This allows us to evaluate the magnitude and the sign of the causality relationship between the government shutdown index and the real returns on the DJU index. While the results of these regressions may not be very precise due to the subsamples being relatively small, looking at the parameters and their tendencies can provide us with a deeper insight into the overall relationship we are interested in.

Overall, the empirical model described in this section gives an in-depth look into the characteristics of the time series data analyzed and the in-sample Granger causality between the US government shutdowns and the real returns on the utilities industry. However, this means that the model comes to conclusions only about the in-sample forecasting and does not provide any information about the possibility of forecasting out-of-sample real returns based on the data on the government shutdowns. Such analysis would require a separate extensive research and is out of the scope of this thesis.

The next section will report the results obtained by applying this empirical model on the data described earlier and will discuss what they reveal in terms of our subject of interest – the causal relationship between the US government shutdowns and the real returns on the DJU index.

I.4. Empirical results

Having our methodology and data in place, we apply them step by step, while analyzing and discussing the implications of each result we receive along the way, as conclusions on some tests in our research determine what models can be and must be applied on our data in order to receive significant and unbiased results.

As mentioned in the methodology part, we start our research off with unit root tests, as they have to be run on the data before employing any Granger non-causality tests in order to make sure that the times series on government shutdowns and real returns on the DJU index is stationary and a VAR(p) model can be applied to it. Philips-Perron (PP), Augmented Dickey-Fuller (ADF), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests are run on both time series in three different ways: with no intercept or trend; with an intercept but no trend; with an intercept and a trend. The results of the tests are reported in Table 1.

All values of PP and ADF tests on both time series are significant at 1% significance level. That indicates that the null hypothesis of the time series having unit roots is strongly rejected and, thus, both time series are stationary. As discussed in the methodology part, KPSS test works in a different way where the null hypothesis claims that the data is stationary and,

Table 1 - Units root and stationarity tests on time series of the government shutdown index and real returns on the Dow Jones Utility Average Index

	Government shutdown index			Real returns on the DJU index		
	- Intercept - Trend	+ Intercept - Trend	+ Intercept + Trend	- Intercept - Trend	+ Intercept - Trend	+ Intercept + Trend
PP	-13.066***	-13.452***	-13.665***	-19.689***	-19.735***	-19.716***
ADF	-6.490***	-7.053***	-7.400***	-7.621***	-7.700***	-7.701***
KPSS	1.199*	0.533**	0.092	0.401	0.049	0.031

Note: ***, **, * denote significance at 1%, 5%, 10% level, respectively

therefore, rejecting it would imply the existence of unit roots in the time series. Here, the data on real returns on the DJU index provides insignificant values in all cases, suggesting that we cannot reject the possibility of the time series being stationary. However, an issue arises when we look at the KPSS statistics for government shutdown index. Just like in the case of the real returns, the KPSS test with an intercept and a trend indicates that the government shutdown index is stationary, however that cannot be said in both KPSS tests where the trend is removed, where the null hypothesis can be rejected at 10% significance level if the intercept is excluded and at 5% significance level in the test including the intercept. Nonetheless, considering that PP and ADF give strongly significant results on the stationarity of the time series and KPSS tests only in some cases give results that are not as strongly significant, we will treat the time series of the government shutdown index as stationary as well in future tests and models.

After determining that we are working with stationary data, we can attempt to run Wald and LR tests on the time series to determine whether government shutdowns Granger cause real returns on the DJU index. However, the optimal lag length of the VAR(p) model has to be chosen first. The results of information criteria for each lag up to lag 10 are reported in Table 2.

The minimized information criteria are in bold in Table 2. Luckily, all three information criteria (AIC, HQIC, SBIC) indicate that the optimal lag length for the VAR(p) model is equal to 1, therefore the following partially restricted VAR(1) model will be applied in this research:

$$Gov_{shut_t} = \varphi_{10} + \varphi_{11} Gov_{shut_{t-1}} + \varepsilon_{1t}$$

$$DJU\_real_t = \varphi_{20} + \varphi_{21} Gov\_shut_{t-1} + \varphi_{22} DJU\_real_{t-1} + \varepsilon_{2t}$$

Table 2 - Information criteria for VAR(p) model for the government shutdown index and real returns on the Dow Jones Utilities Average Index

	Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7	Lag 8	Lag 9	Lag 10
AIC	**-1.9280**	-1.9275	-1.9268	-1.9249	-1.9249	-1.9247	-1.9237	-1.9221	-1.9209	-1.9199
HQIX	**-1.9257**	-1.9235	-1.9213	-1.9177	-1.9162	-1.9143	-1.9118	-1.9086	-1.9058	-1.9033
SBIC	**-1.9221**	-1.9175	-1.9128	-1.9068	-1.9029	-1.8986	-1.8936	-1.8880	-1.8828	-1.8778

Having the VAR(1) model set, we can apply Wald and LR tests on the time series, where we compare the fully restricted model, in which we set another restriction of $\varphi_{21} = 0$ as the representation of the null hypothesis of Granger noncausality between government shutdowns and real returns on the DJU index, against the partially restricted model. Both singular and bootstrapped tests with $N_b = 599$ are applied to the full sample in order to improve the precision of the tests and their results are show in Table 3.

Consistently with the results from Aye et al. (2016b) in relation to the real returns on the S&P500 index, the results of Wald and LR tests indicate that the government shutdown index does not Granger cause the real returns on the DJU index over our full sample, meaning that we cannot predict the real returns on the DJU index in-sample from the data on the government shutdown index. We arrive at this conclusion because the p-values in both tests are extremely high, which leads us to not rejecting the null hypothesis of no Granger causality. Nonetheless, as discussed in the methodology section, it is likely that our model has structural breaks in it, as Figure 1 clearly illustrates that there are major changes in the way the government shutdown time series behaves over time, having low values for relatively long periods of time and experiencing occasional short sharp jumps at other times. However, one cannot determine visually if a model has structural breaks in it, therefore we apply stability tests to see if there is any potential in looking into separate periods as opposed to the full sample when we talk about Granger causality of government shutdowns over real returns on the DJU index.

The stability of the VAR(1) model is tested by applying the Sup-F, Ave-F and Exp-F tests developed by Andrews (1993) and Andrews and Ploberger (1994) to the LR bootstrapped parameters. A restriction on the sample of parameters is applied, by trimming off 15% values on both sides of the sample and, therefore, using the sample representing the interval of [0.15, 0.85]. The tests results are shown in Table 4 below.

Table 3 - Granger noncausality tests on the full sample of the government shutdown index and real returns on the Dow Jones Utility Average Index

	Test statistics	p-value	Bootstrap p-value
Wald test	0.133	0.876	0.883
LR test	0.089	0.765	0.780

Table 4 - Parameter stability test statistics for the government shutdowns index and the Dow Jones Utilities Average Index in VAR(1) model

	VAR(1) model	
	Statistics	p-value
Sup-F	41.532	<0.01
Exp-F	16.633	<0.01
Ave-F	12.031	<0.01

The results in Table 4 indicate that the p-values for all of the statistics are minuscule (<0.01), which allows us to reject the null hypotheses for these three tests. Rejecting the null hypothesis of Sup-F test means that there is at least one sharp structural change in parameters of the VAR(1) model and, consequently, in the causal relationship between the government shutdowns and real returns on the DJU index. Rejecting the null hypotheses of Exp-F and Ave-F leads to a similar conclusion, as it signifies that the parameters of the VAR(1) model is not constant and evolves with time (Andrews & Ploberger, 1994). These conclusions suggest that there are structural breaks in the parameters of the model and there is a possibility that the government shutdowns can predict real returns on the DJU index in some certain periods, despite there not being a constant significant relationship between them.

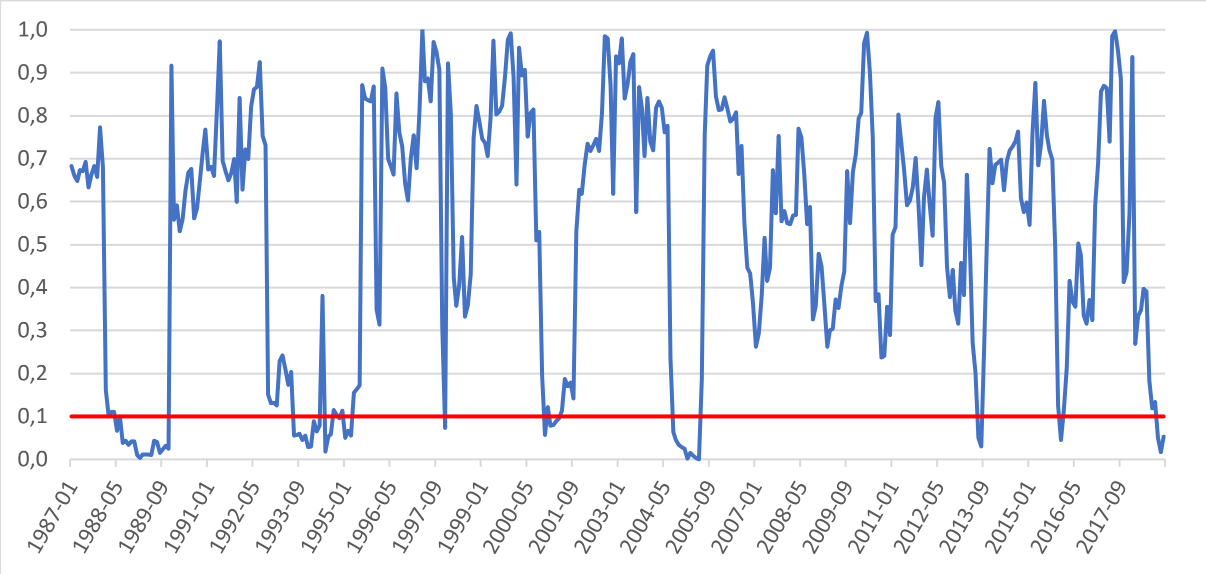
In order to move on with the empirical model, we need to form rolling windows for the bootstrap LR test. As discussed earlier, it has been chosen to create rolling windows with lag length $l = 24$. Having the sample of 407 observations for each time series, we can form the total of $T - l + 1 = 407 - 24 + 1 = 384$ rolling windows, each including 24 observations of both government shutdown index and real return on the DJU index. Each of the rolling windows is further denoted by the last month in it, e.g. the first rolling window, representing the period 1985:M2-1987:M1, is denoted as 1987:M1.

After creating the rolling windows, we apply the bootstrap LR tests on each of them as described in the methodology section. The previously defined VAR(1) model, used in the full sample Wald and LR tests, is considered to be the partially restricted model here, while the fully restricted model is one that includes the additional restriction of $\varphi_{21} = 0$ that defines the Granger noncausality relationship we want to test against. The residuals of the fully restricted VAR(1) model are resampled with replacement for the total of $N_b = 599$ times for each of the windows. These bootstrapped samples are then used in LR tests and the bootstrapped p-values of each of the windows are shown in Figure 3.

As can be seen in Figure 3, the bootstrap p-values tend to be considerably high for the majority of the rolling windows, as the total of 228 windows have bootstrap p-values that are even >0.50. This is in line with the extremely high bootstrap p-value of 0.780 obtained from the LR test over the full sample. These results indicate that most of the time we cannot reject the null hypothesis that government shutdowns do not Granger cause real returns on the DJU index. However, if we look at the red line that illustrates the 10% significance level, we can clearly see that some of the 24-month-long periods give bootstrap p-values that are below the red line and, thus, are significant enough to reject the null hypothesis of no Granger causality effect of government shutdowns over real returns on the DJU index. The bootstrap p-values of 57 out of 384 (14.84%) windows are significant at 10% level and these periods are: 1988:M5, 1988:M7-1989:M11, 1993:M7-1994:M4, 1994:M6-1994:M8, 1994:M11, 1995:M1-1995:M3, 1997:M12, 2000:M11, 2001:M1-2001:M4, 2004:M8-2005:M5, 2013:M7-2013:M8, 2015:M12, 2018:M10-2018:M12. Additionally, 33 (8.59%) of these windows are significant at 5% level, and 5 (1.30%) of them (1989:M1, 2005:M1, 2005:M3-2005:M5) are significant even at 1% level. That means that in each of the 24-month-long periods, denoted by the listed months, the real returns on the DJU index could be predicted in-sample by looking at the percentage of articles mentioning government shutdowns during the previous month.

As mentioned before, the empirical test used is heavily based on Aye et al. (2016b) where the bootstrapped LR test was applied on the real returns on S&P500 index representing the overall US stock market as opposed to the DJU index representing the US utilities stock market. Therefore, we believe that it would be crucial to compare our results to the ones received by Aye et al. (2016b) to see whether there is any difference in how government shutdowns affect the industry that heavily relies on government funding. It has already been stated in the literature review section that Aye et al. (2016b) obtained p-values lower than 0.1 in the following windows: 1998:M4-1998:M8, 1998:M11-1999:M3, 1999:M5-1999:M6, 2000:M1-2000:M11, 2001:M12-2002:M3, 2005:M2-2005:M3, and 2013:M5-2013:M7. That

Figure 3 - Rolling window bootstrap p-values of LR statistics testing the null hypothesis of $\varphi_{21} = 0$ in restricted VAR(1) model



means that 32 out of 321 (9.97%) tested windows gave p-values that were low enough to reject the possibility of no Granger relationship.

If we compare these results to the ones obtained by us while focusing on the DJU index instead of S&P500 index, we can see that the utilities market is affected by government shutdowns more often than the overall market. That can be concluded from the comparison of the percentage of the windows during which there is significant evidence of government shutdowns Granger causing real returns on indexes. The real returns on the DJU index are caused by government shutdowns almost 5% more often than the real returns on S&P500 index (14.84% vs 9.97%), which could imply that the utilities stock market is affected by government shutdowns more often and more easily than the overall stock market in the US. Unfortunately, Aye et al. (2016b) do not report which windows give significant results at 5% and 1% levels, therefore we cannot compare results obtained at lower significance levels. Additionally, we cannot make any strong conclusions about the magnitude of the effect government shutdowns have on the DJU index vs S&P500 index, as we have no information about the size of the parameters defining the relationship between government shutdowns and real returns on the S&P500 index from Aye et al. (2016b).

Surprisingly enough, only three of the rolling windows (2000:M11, 2005:M2 and 2005:M3) analyzed in both papers indicate a significant Granger causality effect of government shutdowns on real returns. Even more interestingly – there have been no government shutdowns during or near those periods of time. That raises the questions of why the DJU and S&P500 indexes would be affected by government shutdowns during different periods of time and what determines the periods they are affected in. If we look at the list of all government shutdowns in Table 5 and compare the dates of the government shutdowns to the periods with significant Granger relationships, we can see that in some cases there were government shutdowns taking place within the 24 months preceding the month the rolling window was denoted with (e.g. the rolling window of 1988:M5 includes the government shutdowns of October 1986 and December 1987, and the rolling window of 2018:M12 includes the government shutdown of February 2018 and the beginning of the government shutdown December 2018 – January 2019), however this seems to be an exception rather than a rule. Alternatively, Bekiros et al. (2016) suggest that the way markets react to government shutdowns depend on the way the markets are performing at that time overall. If the stock market is performing well, it will not be as affected by uncertainties in economic policy, because investors expect the markets to continue growing. However, if the stock markets are already experiencing difficulties, the additional uncertainty in terms of the risk of a government shutdown can cause even more concern to the investors. Nonetheless, a separate piece of research that would focus on how to distinguish between the periods during which government shutdowns could Granger cause real returns and what characterize those periods should be carried out in order to determine the reasons behind such a mismatch between results on different indexes.

We can also compare our results to the ones obtained by Antonanakis et al. (2016) in relation to sustainable investments represented by the Dow Jones Sustainability Index (DJSI). While both works considered and tested the possibility of a causal relationship outside of the full sample models, no causal relationship between government shutdowns and real returns on the DJSI was found, even while looking at different quantiles of the data. However, Antonanakis et al. (2016) applied the significance level of 5% in their research, therefore we have no information whether any of the results were significant at the 10% level. It is important to point out that the DJSI does not represent one single industry, but instead includes the stocks of the most sustainable companies in every industry (Robeco, 2019). As the results in terms of sustainable investments are different from the ones obtained by Aye et al. (2016b) in relation to the overall stock market, it could imply that there are other

Table 5 - The US government shutdowns and their length (Murse, 2019)

Start Date	End Date	Length
September 30, 1976	October 11, 1976	10 days
September 30, 1977	October 13, 1977	12 days
October 31, 1977	November 9, 1977	8 days
November 30, 1977	December 9, 1977	8 days
September 30, 1978	October 18, 1978	18 days
September 30, 1979	October 12, 1979	11 days
November 20, 1981	November 23, 1981	2 days
September 30, 1982	October 2, 1982	1 days
December 17, 1982	December 21, 1982	3 days
November 10, 1983	November 14, 1983	3 days
September 30, 1984	October 3, 1984	2 days
October 3, 1984	October 5, 1984	1 days
October 16, 1986	October 18, 1986	1 days
December 18, 1987	December 20, 1987	1 days
October 5, 1990	October 9, 1990	3 days
November 13, 1995	November 19, 1995	5 days
December 15, 1995	January 6, 1996	21 days
October 1, 2013	October 17, 2013	16 days
January 20, 2018	January 22, 2018	3 days
February 9, 2018	February 9, 2018	1 day
December 22, 2018	January 25, 2019	35 days

characteristics besides the reliance on government funds that affect the impact of government shutdowns on real stock returns.

Lastly, we applied the partially restricted VAR(1) model on each of the periods that carried significant evidence of government shutdowns Granger causing real returns on the DJU index. The magnitude and the significance of the φ_{21} parameter varies over the periods, even reaching the high of -1,843.678 during the period of 1992:M7-1994:M6. While it's hard to report the values of φ_{21} for each significant rolling window, it is important to point out that overall the parameter tends to be negative, which indicates that news about government shutdowns can have a negative effect on real returns on the DJU index, and that can be interpreted as the risk of a government shutdown causing a drop in real returns.

The average value of φ_{21} over the periods with significant Granger causality effect is -156.205 which means that in these cases a one percent increase in the government shutdown index decreases the real returns on the DJU index by 156.205%. This effect might look massive, especially as it is impossible for an index to drop by over 100%, as that would mean that the index would have to become negative, what would indicate the stocks included in the index to have negative prices, which does not happen in real life. However, as our data on government shutdown index shows, it is highly unlikely that the index reaches even close to 1%. The only historical example of the index exceeding 1% is 2013:M10, when the government shutdowns index reached 2.855%, however none of the rolling windows that included 2013:M10 showed significant Granger causality effect, therefore it should not affect our conclusions. Nonetheless, overall, the government shutdown index carries very small values that are close to zero most of the time, as illustrated in Figure 1, because the index represents the percentage of articles mentioning government shutdowns in over 1000 US newspapers that cover a lot of different topics, which makes it very hard for a single subject to garner the attention of one percent of articles over a month. Consequently, even a small increase in the government shutdown index can indicate an increase in the risk of one happening and, thus, decrease the real returns on the DJU index over 150 times more.

So what do all of these results tell us? If we look at the whole sample of the available data in full, we cannot see any Granger causality effect of government shutdown index on real returns on the DJU index. That can be interpreted as government shutdowns not being able to predict real returns on the utilities stock market in the long run. There are two main reasons that could explain this lack of a significant relationship between them over a long time sample. Firstly, the literature review has shown that the economic effects of a government shutdown are relatively low. Therefore, the investors believe that a government shutdown is a temporary source of instability and that its economic effects are not strong enough to significantly affect their investments in the long run (Abraham, 2014). Secondly, as seen in Table 5, government shutdowns are relatively rare and short events. It is hard to catch the effect of a rare event in a long sample time series, as there are other more likely factors whose effects outshine the one from government shutdowns. This gave us incentives to look at shorter periods instead to see if the relationship between government shutdowns and utilities stock market changes if we look at shorter subsamples of the time series.

The rolling window bootstrapping likelihood ratio (LR) approach proves to us that there are 24-month-long periods of time where this Granger causality effect is existent. This suggests that government shutdowns might be used by investors to predict future real returns on utilities stock market in the short run. That can be caused by the fact that, even though a government shutdown does not hurt the country's economy strongly, it creates short-term uncertainty in the markets, which might in turn slow down or even halt the trading activities of some investors or households until the situation is resolved and their confidence in the markets is restored (Antonanakis, 2017). As the VAR(1) model applications on the significant periods show, this slowdown translates into a negative effect on real returns on the stock market and, here, utilities stock market in particular, as the demand for the stocks decreases due to the slowdown in investment activities.

The comparison to the results obtained in relation to the S&P500 index (Aye et al, 2016b) shows that these predictions can be used for the utilities stock market more often and more accurately than for the overall stock market. This can possibly be interpreted as an industry heavily reliant on government subsidies being more sensitive and responsive to government shutdowns or the risk of one happening than the overall market in the US. The possible reason for that is the risk of a government shutdown raising uncertainty on whether the companies would receive their subsidies in time and in full, as disruptions in that area may negatively affect the activities of the companies and, consequently, their value in the investors' eyes. Therefore, investors wait until the situation is resolved and they can be certain about the effects these disruptions have had on the companies. Nonetheless, as government shutdowns tend to be short and government activities are restored quickly, this affects the industry only in the short run. On the other hand, the S&P500 index, which was chosen to represent the whole market in past research, consists of the biggest companies on the US stock market, which suggests that it is not as sensitive to economic uncertainties because, even if there is a federal funding gap, large companies can fund their activities without additional trouble even if the governmental support and subsidies are absent for a while, which cannot always be said about smaller companies as evident from Signet Banking Corporation (1996), discussed in the literature review section.

Further, we will discuss limitations that frame our research as well as implications for further research that could expand the knowledge on the relationship between government shutdowns and financial markets.

I.5. Limitations and implications for further research

While the results gave a good insight into the relationship between government shutdowns and real returns on the utilities market, the scope of the research is limited and there are potential ways to expand it or improve it. The main limitations and suggestions on how to expand this area of research are going to be discussed in order to show what next steps could be taken in case of anyone being interested in digging deeper into this relationship.

One of the main limitations of this type of research has been already pointed out by Aye et al. (2016b) in relation of the tests being run only in-sample and the empirical model not providing any conclusions regarding how this causal relationship can perform in predicting real returns on the DJU index out-of-sample. While Aye et al. (2016b) mentioned that the next step in research on the causality relationship between government shutdowns and real stock returns would be testing how the obtained estimates would perform at forecasting out-of-sample, we disagree with this notion because applying the results, which are significant only in some periods, to predict the real returns over the whole outer sample would lead us to making faulty conclusions on the predictive power of government shutdowns.

In order to apply the results of this thesis in real life or out-of-sample for predicting the real returns of utilities stock market, one needs to be able to identify the periods in which government shutdowns Granger cause real returns as they are happening. However, as discussed in the empirical results section, this research does not give any empirical insight into what characteristics define the periods when government shutdowns affected real returns on the DJU index. This leaves us only with speculations regarding what could be the causes of this relationship in specific periods of time. Therefore, this area of research could be expanded by someone analyzing the differences between the periods with significant and insignificant relationship in order to distinguish what leads to this causal relationship impacting the real returns. Some suggestions of the characteristics that could be analyzed in such kind of research are: an event of government shutdown, the level of overall economic uncertainty, bullish vs bearish markets, their volatility. However, this list is not exhaustive, and more characteristics can be added to it.

Another suggestion on how to continue this area of research is analyzing more industries besides the utilities industry. While the main assumption that drove our research is that an industry that relies heavily on government funding is more sensitive to any disruptions in government activities in the form of government shutdowns, we cannot draw any definite conclusions whether or not this assumption is true without analyzing other industries throughout the spectrum of the level of reliance on government funding. Our results of government shutdowns Granger causing real returns in the utilities industry more often than the overall market may indicate that our assumption is correct, but that does not provide us with solid proof. Therefore, this area of research can be expanded by analyzing the Granger causality effect throughout different industries to see how they differ from the results received by us and by Aye et al. (2016b). The results on all different industries could then be compared with each other to determine whether the reliance on government funding or any other characteristics of the industries influence the way their real stock returns are affected by government shutdowns.

Furthermore, another limitation possibly arises from the data used to represent government shutdowns in the empirical model. Even though the estimate of government shutdowns, developed by Baker et al. (2016), as the percentage of articles mentioning government shutdown in over 1000 US newspapers on Access World News' Newsbank Service is widely used in past research, e.g. Aye et al. (2016a), Aye et al. (2016b) and Antonanakis et al. (2016), it comes with its own drawbacks. It is important to understand that the value of this estimate is influenced not only by government shutdowns and their risk, but also by other events in the US and the whole world. That happens because, for example, if there are any other major events or incidents taking place at the same time as a government shutdown, it will have to share all the press attention with those events. This suggests that the government shutdown index is a slightly biased estimator of the risk of a government shutdown. Additionally, the estimator considers only articles in newspapers as opposed to including online news sources as well. This does not cause an issue in the beginning of the analyzed sample, however, as years go by, the circulation of newspapers in the US has been decreasing while the number of views of online articles has been increasing rapidly. This tendency has been especially prominent in the last few years, as Pew Research Center (2018) has estimated that the circulation of weekday newspapers has decreased by almost one forth from 40,420,000 daily newspapers to 30,948,419 in the period of 2014-2017. This suggests that newspaper articles have been losing their significance and must share it with online articles. However, as of the writing of this thesis, that has not been implemented into the government shutdown index, which raises the question whether it is a good estimator for government shutdowns. Nonetheless, to the best of our knowledge, there are currently no available data that represents government shutdowns in a better way, thus the research on government shutdown effects on financial markets could be expanded and improved by developing a more suitable estimator for government shutdowns.

All of the above is only a few examples of how this area of research could be expanded in the future. The above examples show how the relationships between government shutdowns and financial markets in the US is still unclear, which leaves room for further analysis.

I.6. Conclusions

Government shutdowns are a great source of uncertainty and instability that has been revisited by the US politicians in the last decade. This caused the discussions of how government shutdowns affect the country and its citizens to resurface and revealed that not much is known on the impacts of government shutdowns.

This thesis focuses on expanding the currently available research on what effects government shutdowns have on financial markets in the US by analyzing the causality relationship between government shutdowns and real stock returns of the utilities industry, thus giving an insight into whether the reliance on government funding impacts the way industries are affected by government shutdowns.

Our results from the residual bootstrapped likelihood ratio tests show that, even though there is no constant causality relationship between government shutdowns and real stock returns of the utilities industry, the rolling window approach indicates government shutdowns being able to predict these real returns significantly in some periods of time. While our research does not analyze what characterize the periods with these significant negative causality relationships and leaves this for further research, we could see that almost 15% of the periods give strong evidence of a causality relationship between government shutdowns and real stock returns of the utilities industry, which is considerably higher than the results obtained by Aye et al. (2016b) in relation to the overall US stock market (~10%). These results are in line with our assumption of the reliance on government funds making stocks more sensitive to government shutdowns, however more research on different industries with various levels of government subsidies has to be conducted in order to make any final conclusions about that.

Overall, the relationship between government shutdowns and real stock returns is so multifaceted that it is hard to contain it in one piece of research. However, we believe that this work flips another page towards defining how government shutdowns affect financial markets in the US.

Part II

Are small companies more sensitive to the US government shutdowns?

The case of the US stock indexes

Abstract

The topicality of government shutdowns has been growing significantly over the last few decades, as these events have become more frequent and longer. While there has been some research carried out on how government shutdowns affect the country, the current research on the relationship between government shutdowns and financial markets is relatively sparse, and therefore it is unclear whether government shutdowns have any significant effects on financial markets and, if so, what determines the magnitude of these effects. This paper focuses on analyzing the Granger causality effect that government shutdowns may have on real stock returns in the US and whether the size of the company has any impact on the magnitude of this effect.

Residual bootstrap likelihood ratio tests are carried out on 24-month-long rolling windows which consist of data on the following three stock indexes, representing small-cap, mid-cap and large-cap companies, respectively: S&P SmallCap 600, S&P MidCap 400, and S&P 500. The Granger causality relationship is tested for each of the rolling windows filled with monthly data on government shutdown index developed by Baker et al. (2016) and real returns on its respective index. The research covers the period of the years 1985-2018 (except for S&P SmallCap 600, which covers the period of the years 1989-2018).

This essay is divided into five parts: 1) introduction; 2) literature review; 3) research model; 4) results; and 5) conclusions.

II.1. Introduction

Politics are a place filled with countless different interests and opinions, therefore one of the main tasks of any politician is balancing all of them in order to achieve their own goal. There is no surprise that when many politicians are fighting for what each of them believes in, it leads to clashing aims, which may sometimes put the whole country in jeopardy. US government shutdowns are one of the examples of when differences in opinions can negatively affect many civilians.

Everyone knows that the US political system is considered to be a two-party system, as the majority of the political space is taken up by two parties: the Democratic Party and the Republican Party. These two parties are constantly trying to win against each other and have as much power in their hands as possible. However, due to this battle it often happens that each of the parties have the majority position in different institutions. That two most important institutions in this light are the President and the Congress. This creates an issue during the process of approving a new federal budget, as both the President and the Congress must agree on the budget in order for it to be released. The history has proven that they have failed to have such an agreement 21 times as of writing this thesis, forcing the government to shut down until an agreement was made. This puts the country into the state of stagnation, where many of the governmental institutions have to suspend their services until their budget is reinstated.

While the last few decades have shown that government shutdowns are a significant part of the political life in the US, the amount of research done on that is relatively sparse. Even the research that is available as of writing this thesis is not fully conclusive and do not give a good insight into how government shutdowns affect the whole country.

This paper is going to focus on how government shutdowns affect the financial markets in the US. While there is some available research on the relationship between government shutdowns and some parts of the financial markets, it seems like different parts of the financial markets react to government shutdowns differently. Therefore, it has been decided to focus this research on analyzing one of the potential variables that may affect this relationship – the size of a company. For that purpose, the Granger causality relationship between government shutdowns and real returns on S&P 500, S&P MidCap 400 and S&P SmallCap 600 will be analyzed. That will be done by carrying out a residual bootstrap likelihood ratio statistics tests on each of the indexes over the period of the years 1985-2018 and comparing the results.

II.2. Literature review

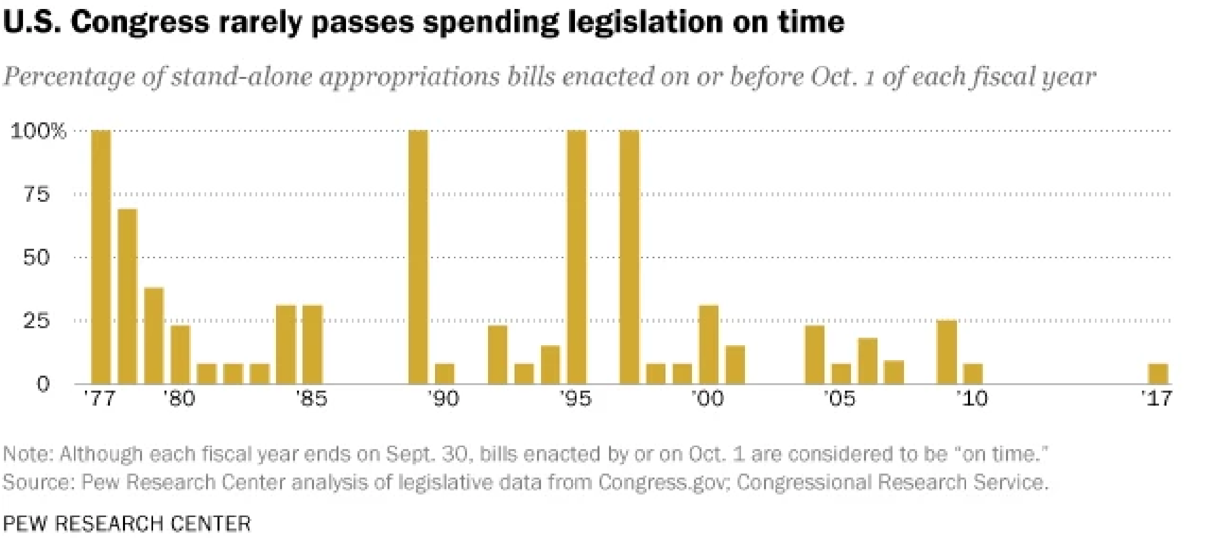
II.2.1. Government shutdowns

Government shutdown is an event when a lack of funding forces some of the governmental offices close down until the funding is reinstated. This usually (but not always) happens once the federal budget is not approved by the end of the fiscal year and the country has to enter a new fiscal year without a set budget (Dollarhide, 2019). While the government offices that are closed may vary in relation to which parts of the budget have not been approved, only the activities that are considered to be non-essential under the Memorandum for Heads of Executive Departments and Agencies released by the Office of Management and Budget Issuance (1990) can be suspended. These exclude any activities that are meant to protect life and property of the US citizens.

Government shutdowns are an issue that has never been as relevant as in the past few years. On the contrary, they are a very recent historical development, the first one happening only on September 30, 1976. However, that does not mean that there have been no issues with approving the US federal budget in the past. The only reason the US did not experience a government shutdown until 1970s was the lack of power Congress had over the federal budget. This power increased with the release of the 1974 Congressional Budget and Impoundment Control Act, as it introduced the structure where Congress has to pass and the President has to sign 13 appropriation bills, meaning that a consensus between both sides must be achieved (The Senate and House of Representatives of the United States of America, 2012).

Throughout the years passing appropriation bills has proven to be a difficult task, as the Figure 4 below shows that the Congress has passed all bills on time only in four years since 1977 as of 2018: 1977, 1989, 1995 and 1997. In some years, continuing resolutions have been used as a quick fix for the federal budget gap, however this solution does not always prove to be successful. As of writing this paper, there have been 21 government shutdowns in the US. While some of them have lasted only one day and were quickly resolved, the longest ones

Figure 4 Percentage of stand-alone appropriations bills enacted on or before Oct. 1 of each fiscal year (Pew Research Centre, 2018)



have lasted 18 (October 1978 government shutdown), 21 (December 1995 – January 1996 government shutdown) and even 35 (December 2018 – January 2019 government shutdown) days, indicating that a government shutdown can disrupt the system for significant amounts of time (Murse, 2019).

But why should we treat government shutdowns as an issue? Government shutdown is an event that affects many parts of the society, including some very vulnerable ones. Many different effects of the government shutdowns on various parts of the society, including healthcare, public safety, tourism, social security, national economics and financial markets, have been summarized in Part I, but due to the limitations of this work we focus only on the effects on the US economy and financial markets.

II.2.2. Effects of government shutdowns

As mentioned before, in the case of a federal budget gap some nonessential governmental activities are suspended until a budget for the new fiscal year is approved or until a continuing resolution is released to buy some additional time for approving the budget. It is important to note that only the activities falling under the executive departments with no signed appropriation bill (or continuing resolution) have to be suspended, meaning that majority of the times in the past the government shutdowns were only partial. However, even a partial government shutdown can affect significant amounts of federal workers. The most recent government shutdown of December 2018 – January 2019 has affected around 800,000 federal employees, some of them being furloughed, as their activities were deemed to be unnecessary in the case of a government shutdown, and others having to work without pay, as their activities were considered to be essential, but there was no money allocated to sustain them (Rein & Fischer-Baum, 2019).

The impact of suspended activities and paychecks on the lives of federal workers may not be significant in the case of a one-day-long government shutdown, but the longer one lasts – the bigger is the effect on their short-term income. In a survey by Budetti et al. (1999), where 54 million of working-age people in the US were asked about their financial situation and access to health care, around 34% of the respondents claimed that their income is just enough or not enough to cover their basic costs back in 1999. This situation has not changed for the better. A study by CareerBuilder (2017) shows that 78% of the US workers are living from paycheck to paycheck, while 71% of the workers say that they are in debt. Additionally, 56% of the workers in debt claim that they believe that their debt in unmanageable and will follow them their whole lives. Considering the findings by both of these studies, we can see that no matter the decade – any disruption in receiving one's paycheck can raise difficulties in paying their bills and may even lead to them taking up some extra debt that they cannot handle. This means that furloughing federal workers or making them work without pay for a longer period of time can put their lives jeopardy.

However, federal employees are not the only ones who can be negatively affected by a government shutdown. A federal budget gap increases economic uncertainty throughout the country and may affect the stability of many companies, especially government contractors. While a big contractor company can go through these events without any significant effects, some of the smaller contractors even went bankrupt. A survey by Signet Banking Corporation (1996) in relation to December 1995 government shutdown, which lasted 21 days, showed that 63% of the federal contractors had delays in their accounts receivable, leading to 55% of them taking up some extra debt and 31% of them furloughing or firing some of their employees. This happens due to the fact that the government cannot pay these contractors until the federal funding is reinstated, therefore the contractors are not paid for their products and services in time. Some of them are already in vulnerable financial situations and rely heavily on the federal funds, and this may lead to them being unable to pay their employees, suppliers and/or debtors.

The negative effects on the well-being of federal employees and contractors are the most evident direct economic effects on the country which, coupled together with effects on other parts of the society (e.g. tourism), leave an impact on the overall US economy, however the negative effect on GDP is not as big as one might expect. While it is hard to calculate the pure effect of a government shutdown to the national GDP, as there are many other events that affect the overall economy during a year or quarter, there are some estimate in relation to some of the latest government shutdowns. The government shutdown of October 2013 (lasting 16 days) is estimated to have decreased the real GDP of the fourth quarter of 2013 by 0.3% (Labonte, 2015). This is a rather miniscule effect, considering that there was a federal budget gap for the duration of once sixth of the whole quarter. Furthermore, the government shutdown of December 2018 – January 2019 has affected two separate quarters, but the impacts on the real GDP during both of them are estimated to be minuscule: 0.1% during the fourth quarter of 2018; 0.3% during the first quarter of 2019 (Bureau of Economic Analysis, 2019). Considering that this was the longest government shutdown to date (35 days), we can safely say that their effect on the GDP is not significant enough to inflict fear. Nonetheless, we cannot discredit the negative impact it may still have on individual people and companies, as the government should care about each and one of them.

When it comes to the financial markets, there has been relatively little research as of writing this paper on how government shutdowns affect them. The rest of the literature review will be focused on discussing the earlier findings about the relationship between government shutdowns and will set the stage for the rest of the paper.

Currently available research regarding the financial markets has been considering government shutdowns in two different ways: as a unique event with its own characteristics (often analyzed together with events of a debt ceiling) or as a characteristic of economic policy uncertainty (EPU). This type of research has been mostly focused on three different financial variables: equity risk premium, stock returns, and volatility. We will start discussing past papers with research in relation to equity risk premium.

Aye et al. (2016a) have carried out a research on equity risk premium and whether government shutdowns or debt ceilings have any predictive power over them, in light of their hypothesis that these events create economic uncertainty which might discourage investors from making any investment actions for the duration of the events. This could have a negative effect on the demand for stocks and, thus, affect their prices and, in consequence, risk premiums. Methodology by Neely et al. (2014) for predicting equity risk premium was applied in their work. The model was adjusted by adding government shutdowns and debt ceilings to the equation as two additional two economic variables next to the 14 economic and 14 technical variables that had already been defined by Neely et al. (2014). The government shutdown and debt ceiling variables were represented by the estimates developed and first applied by Baker et al. (2016). The variables were defined as the monthly percentage of new articles in US newspapers available on Access World News' Newsbank Service which mention "government shutdown" or "debt ceiling", respectively. The set of newspapers available in the data is higher than 1000. The equity risk premium analyzed in Aye et al. (2016a) was based on S&P 500 and the difference between its return and the return on a risk-free three-month Treasury bill rate. Carrying out a bivariate predictive regression lead to a conclusion that government shutdowns can have negative effect on stock prices and have significant predictive power over equity risk premium.

While Bekiros et al. (2016) chose to research the relationship between the economic policy uncertainty and equity risk premium (represented by S&P 500 index), some of their findings can be applied to the events of government shutdowns, as the developers of the EPU measure consider government shutdowns as a possible cause of the uncertainty (Baker et al., 2016). Bekiros et al. (2016) argued that linear predictive models are not as successful as quantile regression models at determining the predictive power that EPU has over equity risk premium, and their claims proved to be right, as the model using historical averages provided the authors with more significant and reliable results than the applied linear model. Besides that, the research has shown that including EPU in a predictive model for equity risk premium improves its predictive power, meaning that EPU has significant effect on the financial markets and their risks.

The findings by Bekiros et al. (2016) are in line with what had been found by Balcilar et al. (2015) in relation to equity risk premium in South Africa. Their research lead to the results showing that indicate that there is a predictive relationship between EPU and equity risk premium in South Africa. On the other hand, they have also analyzed whether the South African EPU has any predictive power over the equity risk premium in 20 other countries (including the US) and found no significant relationships there. That might indicate that the

EPU of one country affects its own equity risk premium but leaves the other countries untouched, however more research would be needed to draw any strong conclusions regarding that.

Moving on from equity risk premium to real stock returns, Aye et al. (2016b) kicked-off this area of research by (similarly to Aye et al. (2016a)) analyzing the predictive power government shutdowns and debt ceilings have over real returns on S&P 500 index. The measures of government shutdowns and debt ceilings remained the same as in their previous research, but the applied methodology has been changed. As the simple bootstrap LR-test failed to reject the null hypothesis indicating no causal relationship between government shutdowns and real stock returns, the researchers concluded that there is no permanent relationship between these events and stock returns. However, they did not end their research there. They continued by applying stability tests to their data, which indicated that there are structural shocks in the dataset and a time-varying model must used instead of a simple model. This led to them applying the time-varying model of rolling bootstrap estimations, which was developed and tested in similar research by Balcilar et al. (2016). This framework allowed Aye et al. (2016b) to find significant Granger causality links between government shutdowns and real stock returns in the following 24-month-long periods: 1995:M6, 1998:M4-1998:M8, 1998:M11-1999:M6, 1999:M12-2000:M11, 2001:M12-2002:M1, 2002:M3, 2005:M2 and 2013:M5-2013:M7. It is important to mention that the significance level used here was 10%, and there is no information given on which of the periods indicated significant causality relationship at 5% and 1% levels. Nonetheless, while the results show an unstable causality relationship between government shutdowns and real stock returns, it may be explained by the fact that government shutdowns are relatively rare event and only five of them took place in the applied sample (1985:M2 – 2013:M9).

A different approach to researching the relationship between government shutdowns and stock returns has been chosen by Woodard (2015). Unlike the majority of the research related to government shutdowns, instead using the dataset of returns on S&P 500 index she selected 100 US government contractors and analyzed their risk-adjusted returns 30 days before and 30 days after the announcements of 1995-1996 and October 2013 government shutdowns, the two longest government shutdowns at the time, in order to test the market efficiency hypotheses. While not indicating any significant changes before the announcements of government shutdowns, the results did show the share prices of the selected companies experienced a significant drop when the shutdowns were announced. Furthermore, the share prices continued decreasing for the 30 days after the announcements. In the end, these drops led to negative risk-adjusted returns for investors who had put their money into the government contractor companies. These findings are in support of the weak market efficiency hypothesis, but no clear conclusions could be made in regard to the semi-strong market efficiency hypothesis, as it took time for the stock prices to fully reflect the effect of the event of a government shutdown. Additionally, due to the restrictions of the research, we cannot how much time it takes for the stock prices to fully adjust, as well as we have no information on whether these drops in stock prices are permanent or if they are temporary fluctuations that are reversed as more time passes.

Antonakakis et al. (2017) carried out a research on how the economic policy uncertainty and 24 different factors that may cause it affect two very important parameters of the financial markets: stock returns and volatility (represented by monthly data on S&P500 index). As one of the 24 factors used by Antonakakis et al. (2017) is government shutdowns, their results can give us another good insight into the relationship between government shutdowns and financial markets. While the researchers did try to apply a linear causality test, it proved to provide mostly insignificant results over the dataset of 24 factors. However, carrying out the Brock-Dechert-Scheinkman test (Brock et al., 1996) on the dataset revealed strong evidence for nonlinear relationships, which led the researchers to applying the same quantile-based causality model as Aye et al. (2016b) did. The model gave the results showing that government shutdowns have significant predictive power over US stock returns as well as their volatility, and that government shutdowns can cause changes in them, but only in some periods of time.

Sometimes even research mainly focused on other markets can have some useful findings in relation to the overall financial markets. That is the case with the research by Toparli & Balcilar (2016) who in their paper on the relationship between various risk-inducing events and oil markets decided to include additional tests to determine the relationships between those events and the volatility index (VIX) and one-month option volatility estimate (MOVE). As the paper focused on major events during the period between 01.06.2004 and 02.02.2016, the US government shutdown of October 2013 was included in the scope of the research. The multivariate conditional volatility model and the volatility impulse response function has shown that the government shutdown did have a negative impact on the volatility of the financial markets, however it was small and relatively short-term compared to the effects of the other analyzed events. From this we could make an assumption that government shutdowns affect the volatility of the US financial markets only temporarily, but it is important to note that this is based on the data on only one of 21 government shutdowns, so it is risky to make any strong conclusions in relation to the statement.

There have been other researches in relation to government shutdowns that have been directed at only some particular parts of the financial markets. Antonanakis et al. (2016) is a great example of that, as they focused their work on the way economic policy uncertainty and its components, such as government shutdowns, affect the real returns on sustainable investments. The US Dow Jones Sustainability Index (DJSI) was chosen to represent sustainable investments, while the EPU and its components were represented by the earlier mentioned estimates developed by Baker et al. (2016). Like in other abovementioned papers, the causality-in-quantiles model was applied here, as strong proof of nonlinearity was found. Interestingly enough, Antonanakis et al. (2016) did not find a significant relationship between government shutdowns and real returns on sustainable investments, which gives us a different view than the research by Aye et al. (2016b) in relation to S&P500 index. This can be interpreted as a sign that different parts of the financial markets react differently to government shutdowns.

This assumption was considered in Part I, where it was argued that industries that heavily rely on government subsidies may be more vulnerable when faced with a government shutdown than the overall market. In order to get an insight into this assumption, she decided to test the relationship between real returns on the utilities industry (the industry that had received the most US government subsidies at the time of the study) and government shutdowns. The methodology of residual based bootstrapped LR statistics was applied here on the monthly estimate of government shutdowns developed by Baker et al. (2016) in relation to real returns on the Dow Jones Utility Average Index, as the Sup-F, Ave-F and Exp-F stability tests showed strong indications of structural breaks within the data. Applying the LR statistics test over 24-month-long rolling windows has shown that government shutdowns have a causal effect, significant at 10% level, over real returns on the utilities industry during 14.84% of the analyzed periods. 8.59% and 1.30% of the periods had a significant causal effect at 5% and 1% significance levels, respectively. These results are more significant than the ones obtained Aye et al. (2016b) in relation to S&P500 index, which may indicate that the assumption of the reliance on government funding increasing the vulnerability to government shutdowns is true. However, the research does not dig deep on whether it is the reliance on government subsidies that makes the effect of government shutdowns more prominent or if there are any other potential reasons why the utilities industry is more vulnerable to government shutdowns than the overall US financial markets, represented by the S&P500 index.

II.2.3. Choice of research subject

The abovementioned research makes it evident that various sections of the financial markets react to government shutdowns differently, however thus far there is no research providing any significant proof in relation to what determines those differences. Therefore, we hope that this paper will be the first successful attempt at determining one of the market characteristics that influence the magnitude of the effect of government shutdown on real stock returns.

Past research has shown that in many instances smaller companies are more vulnerable to various inner and external instabilities than bigger companies are. It has been argued that one of the reasons why small and medium enterprises (SMEs) are not able to deal with these risks in the most efficient way is the fact that they usually do not have the tools and capabilities to deal with global risks (Clusel et al., 2013). Additionally, small firms are often highly reliant one their larger counterparts due to supplier and partnership contracts, where they do not have as much negotiating power, thus they have to deal with the decisions of made by big companies (Rainnie, 1985). Finally, the financing of SMEs is a lot more limited and less flexible, as these companies carry more risks and do not have the assets to cover their debts at the times of financial struggles, as is evidenced by excessive research all over the world (Ackah & Vuvor, 2013; Govori, 2013; Alhajeri, 2012; Mercy et al., 2015). All of this raises the question if maybe SMEs would be negatively affected by government shutdowns more than big companies, as they are more vulnerable to such kind of risks.

The majority of the previous research on the relationship between government shutdowns and financial markets have been using S&P500 index as a representation of the overall financial markets in the US, however, as pointed out in Part I, the index considers only the biggest listed companies in the US, failing to represent the smaller companies. This might indicate that the findings in terms of S&P500 index do not characterize the overall market, but only the big companies, as some pieces of research on one separate industries do suggest that not the whole market reacts to government shutdowns equally as much. Nonetheless, it does not prove that size of the company is one of the determining factors of the vulnerability towards government shutdowns, therefore this paper will focus on investigating whether small and medium companies are more sensitive to government shutdowns. Considering that there already is more focused research giving diverse results in relation to the relationship with real stock returns that could be used for comparison purposes, this paper will also use the perspective of real stock returns when testing the possible causality relationship between the financial markets and government shutdowns.

In order to look into whether company size has any influence on how government shutdowns affect a company, three stock market indexes will be analyzed in this paper. The first index to be analyzed is, like in the majority of past research, S&P 500 Index, which will represent big companies in this research, as this index contains 500 large-cap companies listed on the US stock markets. The second index used is S&P MidCap 400 Index, which consists of 400 mid-cap (market capitalization between $1.6 billion and $6.8 billion) companies listed on the US stock market. The third index analyzed in this paper is S&P SmallCap 600 Index, which contains 600 small-cap (market capitalization between $450 million and $2.1 billion) companies listed in the US stock market. The relationships between government shutdowns and each of these indexes will be analyzed and their results will be compared in order to determine whether small companies are really more sensitive to such economic policy instabilities. The details on the data itself and the way it is used in the paper is provided below.

II.3. Research model

II.3.1. Data

We start the research model part of the paper by a summary of the data that will be used to test the assumption that the bigger the company is the less it is affected by government shutdowns. Four main sets of data will be used here: one to represent government shutdowns, and three to represent the real returns on the indexes for large-, mid-, and small-cap companies.

Like in a lot of pieces of past research in relation to government shutdowns discussed in the literature review (Aye et al., 2016a; Aye et al., 2016b; Antonakakis et al., 2016; Antonanakis et al., 2017), a monthly government shutdown index from Economic Policy Uncertainty (2019) will be used in this paper. The index shows the fraction of articles in over 1000 US newspapers available on Access World News Newsbank Service that have "government shutdown" mentioned in them. Unlike a dummy variable that would indicate the months that a government shutdown took place in, this set of data is a lot more varied and represents not only the actual events of a government shutdowns, but also an increased risk of one happening (as government shutdown talks often start before the actual budget gap come into effect) as well as its magnitude, as bigger and longer government shutdowns are expected to attract more media attention and have higher risks (which cannot be reflected by a dummy variable). While this estimate is not perfect, as it does not consider the other media sources (especially online news portals that are becoming more and more popular while newspapers are losing their readers (Pew Research Center, 2019)), as of writing this paper there are government shutdown estimates that are better at reflecting its risk.

As previously discussed, S&P 500, S&P MidCap 400, and S&P SmallCap 600 indexes are used in this paper to reflect companies of different sizes, therefore their monthly real returns need to be obtained. The data on monthly indexes is taken from Yahoo Finance (2019), while monthly data for the seasonally adjusted Consumer Price Index for All Urban Consumers (CPI-U) is taken from Federal Reserve Bank of St. Louis (2019). The seasonally adjusted CPI-U is chosen for calculating the monthly inflation rate, as it omits any seasonality that may affect an unadjusted consumer price index. The data on seasonally adjusted CPI-U is used to calculated discretely compounded monthly returns on the index which represents the monthly US inflation rate. Similarly, discretely compounded monthly returns on the three stock indexes are calculated as well to represent the monthly nominal return rate on each of them. The results of all these calculations are then used to calculate monthly real return rates for each of the indexes by applying the following formula:

$$Real\ return\ rate_i = \left(\frac{1 + Nominal\ rate_i}{1 + Inflation\ rate}\right) - 1$$

where *i* represents the following three indexes: S&P 500, S&P MidCap 400, and S&P SmallCap 600.

There are two different periods analyzed in this paper: 1985:M1 – 2018:M12 (for S&P 500 Index and S&P MidCap 400 Index) and 1989:M1 – 2018:M12 (for S&P SmallCap 600 Index). The earliest monthly data used is for 1985:M1, because that is the oldest available data on the government shutdown estimate. The starting date is pushed four years further (1989:M1) for S&P SmallCap 600 Index because this index does not reach further into the past. 2018:M12 was used as the cut-off date in order to have clean data. Considering that we calculate real returns on data here, the final data sets contains monthly returns for periods 1985:M2 – 2018:M12 (407 observations per time series) and 1989:M2 – 2018:M12 (359 observations per time series), respectively. The time series for each of the index together with the time series for government shutdowns are plotted in Figures 5, 6 and 7. The left axis represents the monthly government shutdown index and the right axis represents real returns on stock indexes.

If one looks at the complete time series (1985:M2 – 2018:M12) of monthly government shutdown index, it is easy to notice that it is a time series that tends to have zero/very low values most of the time with some occasional short jumps, some of which are very steep. A deeper look into the data shows that 251 out of 407 government shutdown index observations are lower than 0.01%, which confirms the first impression to be true. This can be interpreted as a confirmation that government shutdowns are relatively rare events, that do not last a long time. If we look more closely into the peaks, we can also see that they mostly coincide with actual government shutdowns (for example, the peak in 2013 can be connected to October 2013 government shutdown), which is a logical trend, considering that government shutdowns are a very topical issues at and around the time of the event and, thus, it attracts more media coverage.

Another insightful observation can be made by looking at the average values for each calendar month for the government shutdown time series. The average index values for the months in the middle of the US fiscal year (February – August) lie in the range between 0.013% and 0.022%, and the average values start increasing at the end of the US fiscal year and carry

Figure 5 Time series of the government shutdown index (left axis) and real returns on S&P 500 Index (right axis)

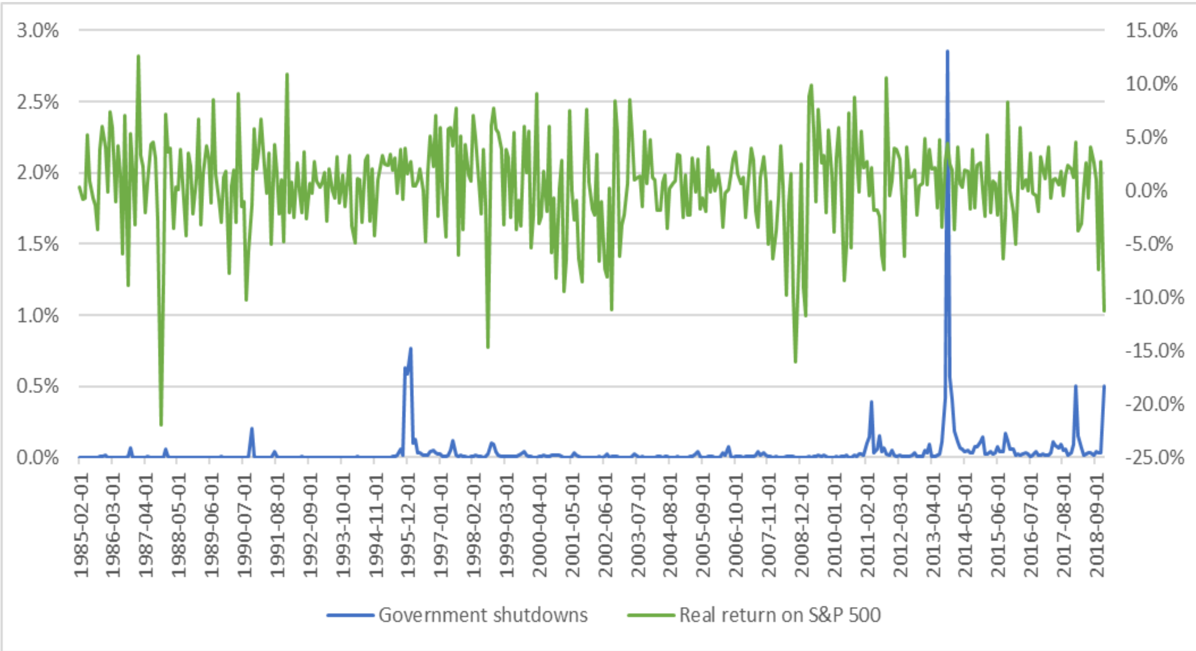
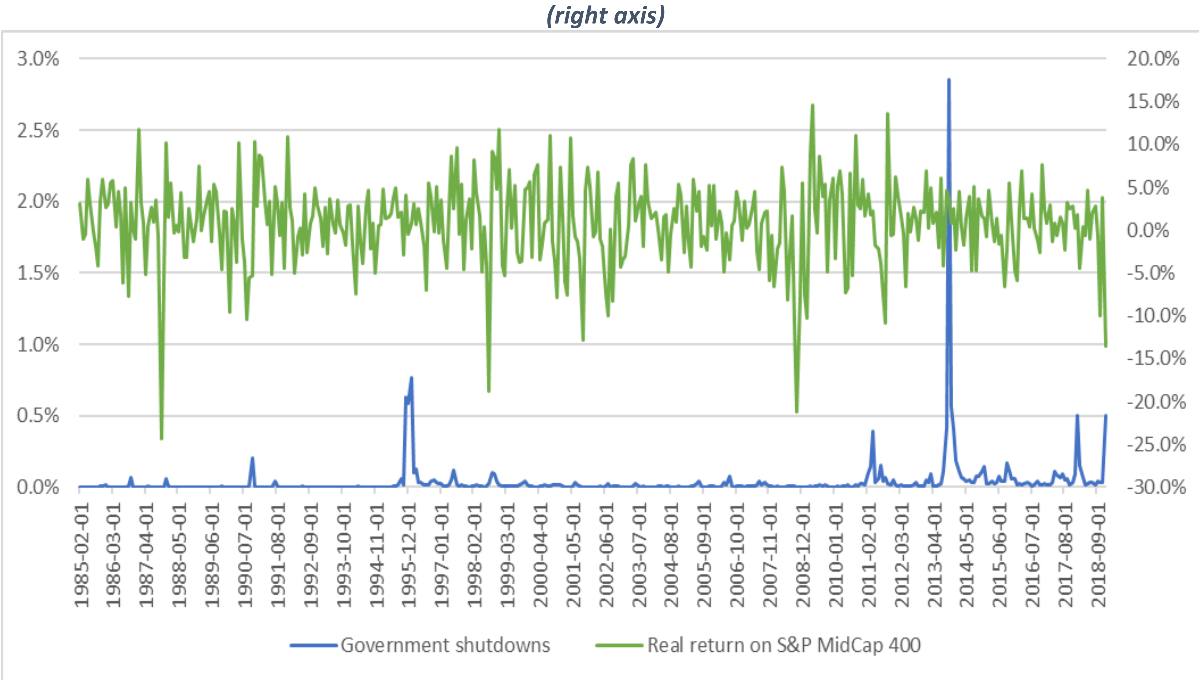


Figure 6 Time series of the government shutdown index (left axis) and real returns on S&P MidCap 400 Index (right axis)



on into the beginning of a new fiscal year: September – 0.037%; October – 0.109%; November – 0.049%; December – 0.061%; and January – 0.051%. This confirms that there is more talk about government shutdowns once the fiscal budget approval process starts and that continues in the beginning of the new fiscal year, as there are often disagreements in relation to the budget which may (and sometimes does) lead to government shutdowns.

Figure 7 Time series of the government shutdown index (left axis) and real returns on S&P SmallCap 600 Index (right axis)

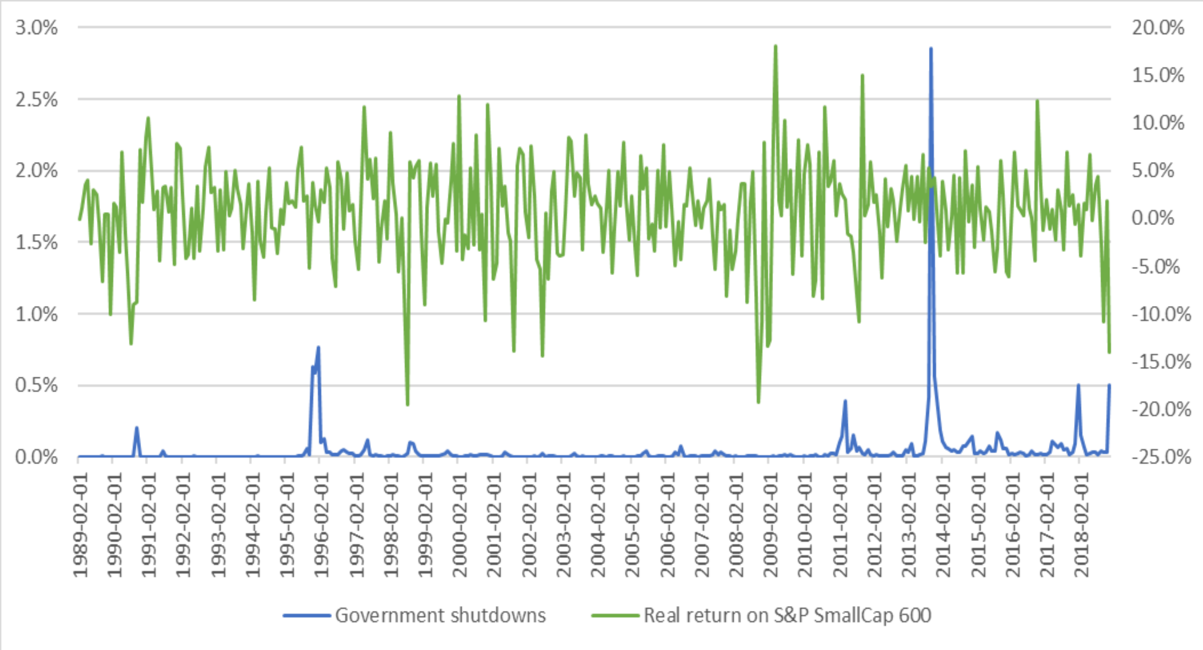
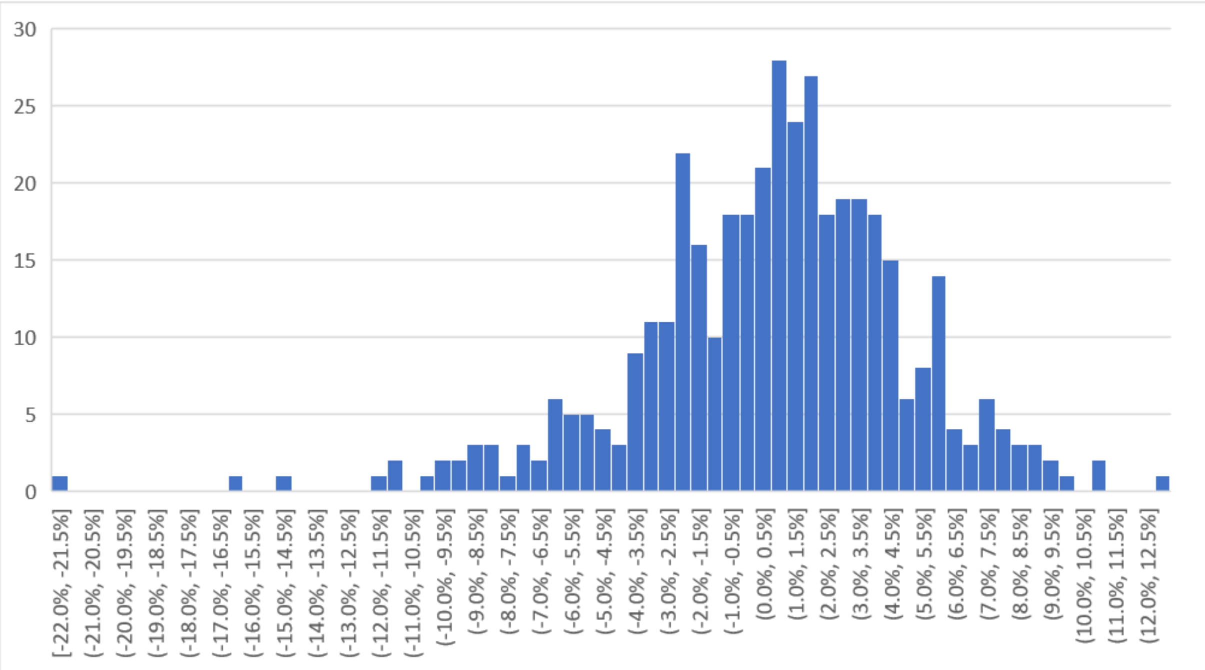


Figure 8 - Distribution of monthly real returns on S&P 500 Index



While the time series of the indexes may resemble white noise processes with a positive mean, looking into the distribution of their real returns suggests otherwise. Figures 8, 9 and 10 visualize the data distributions of the indexes. All three indexes are negatively skewed with skewness of -0.797, -0.801, and -0,519, respectively. That indicates that all of the distributions have longer left tails than right tails, which can be interpreted as the indexes giving abnormal negative real returns significantly more often than abnormal positive real returns.

Figure 9 Distribution of monthly real returns on S&P MidCap 400 Index

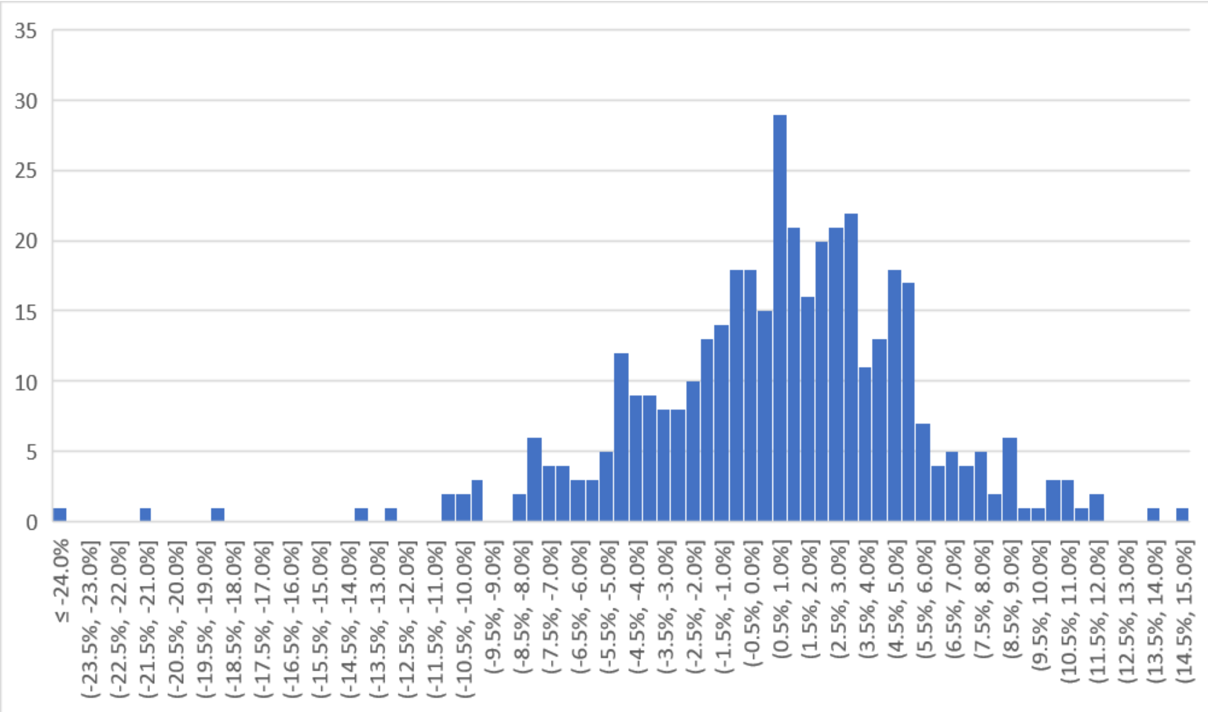
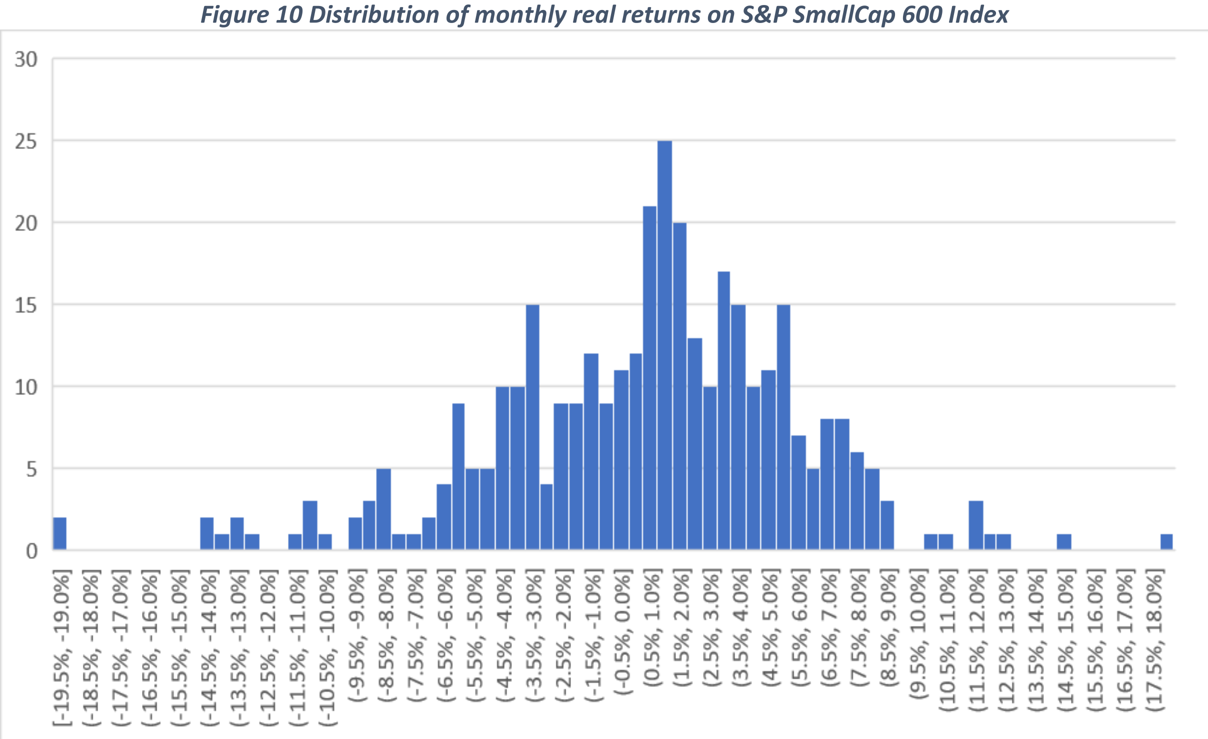


Figure 10 Distribution of monthly real returns on S&P SmallCap 600 Index



Furthermore, the three data distributions have a positive kurtosis of 2.439, 2.982, and 1.328, respectively. That can be interpreted as the distributions having fat tails, meaning that they have more abnormal (very negative or very positive) observations than a normal distribution would. Finally, all this data can be used to apply Jarque-Bera test on the time series. The

Jarque-Bera test statistics for the data set are as follows: S&P 500 – 144.001; S&P MidCap 400 – 194.368; and S&P SmallCap 600 – 42.491. All of the Jarque-Bera statistics are far from zero, which gives us p-values that are minuscule and <0.01 meaning that we reject the null hypotheses of the datasets of all indexes being normally distributed. This proves that they do not follow a normal distribution and, thus, are not Gaussian white noise processes.

II.3.2. Methodology

Similarly to Part I, the empirical model applied by Aye et al. (2016b) is going to be used in this paper. The model is a one-way Granger causality model derived from the two-way Granger causality model by Balcilar & Ozdemir (2013). The theory of two-way Granger causality indicates that the information on the first variable improves the forecast of the second variable and vice versa, while the one-way Granger causality means that one of the variables can improve the forecast of the other variable, but not vice versa (Granger, 1988). The one-way Granger causality is tested in this paper, because it is not expected that real returns on the indexes have any predictive power over government shutdowns, as they do not have influence on the federal budgeting process. In order to reflect this assumption, the bivariate vector autoregression (VAR(p)) model used is restricted by setting the coefficient φ_{12} to zero, as further discussed below.

As our aim is to determine the causality relationships between government shutdowns and three stock indexes (S&P 500; S&P MidCap 400; and S&P SmallCap 600), Wald and Likelihood ratio (LR) test will be applied. They are the two most popular non-causality tests and here they will be run on the following bivariate VAR(p) model:

$$\begin{bmatrix} Gov\_shut_t \\ Index_{x,t} \end{bmatrix} = \begin{bmatrix} \varphi_{x,10} \\ \varphi_{x,20} \end{bmatrix} + \begin{bmatrix} \varphi_{x,11}(L) & 0 \\ \varphi_{x,21}(L) & \varphi_{x,22}(L) \end{bmatrix} \begin{bmatrix} Gov\_shut_t \\ Index_{x,t} \end{bmatrix} + \begin{bmatrix} \varepsilon_{x,1t} \\ \varepsilon_{x,2t} \end{bmatrix}$$

where Gov_shut_t is the government shutdown estimate at time t; $Index_{x,t}$ is the real return on index *x* (S&P 500; S&P MidCap 400; or S&P SmallCap 600) at time t; $\varphi_{x,10}$ and $\varphi_{x,20}$ are constants; $\varphi_{x,ij}(L) = \sum_{k=1}^{p+1} \varphi_{x,ij,k} L^k,\ i,j = 1,2$, where $\varphi_{x,ij,k}$ is the autoregressive coefficient denoting the effect the k-times lagged value of variable j has on the variable i at time t, and L represents the lag operator as in $L^k y_{x,i,t} = y_{i,t-k,}\ i = 1,2$; $\varepsilon_{x,1t}$ and $\varepsilon_{x,2t}$ are uncorrelated residuals at time t.

The tests are run in relation to the null hypotheses claiming that government shutdowns have no Granger causality effect on real return on index *x* and are reflected in the following way:

$$H_{x,o}: \varphi_{x,21,1} = \varphi_{x,21,2} = \cdots = \varphi_{x,21,p} = 0$$

The rejection of a null hypothesis would indicate that government shutdowns do have Granger causality effect over real returns on its respective index and, thus, can be used to improve the prediction of the real returns.

One crucial assumption for the Granger causality tests mentioned above is the stationarity of the time series. That means that the tests cannot be run on nonstationary data, as that can lead to faulty significant results that can derail the research (Papana et al., 2014). To avoid this mistake, three different stationarity tests are applied in this paper before any of the causality tests are run: Philips-Perron, Augmented Dickey-Fuller, and Kwiatkowski–Phillips–Schmidt–Shin tests. It is important to note that the third (KPSS) test differs from the first two (PP and ADF), as they are run against the null hypothesis of a unit root, while KPSS is run against the null hypothesis of stationarity. This means that in the case of a stationary time series, PP and ADF tests reject the null hypothesis and KPPS test does not, and vice versa – if PP and ADF tests do not reject the null hypothesis and KPPS test does – the time series is nonstationary and the Granger non-causality tests cannot be applied.

Three information criteria are used in order to choose the most optimal lag order for each of the VAR(p) model: Akaike (AIC), Hannan-Quin (HQIC), and Schwartz (SIC). The information criteria are calculated for each VAR(p) model up to lag 10. Higher numbers of lags are not considered as big models are difficult to work with and may not add much additional value to the estimates. Afterwards, the lags that minimize the information criteria are chosen for each of the index. Even though we would expect them to be the same, it is important to look at each of the index separately, as their relationship with the government shutdowns may be of a different nature. Finally, in case the information criteria for the same index indicate a different optimal lag order, the optimal lag order by HQIC is applied, because it reflects the middle ground, as the penalty it applies for every additional lag is higher than the one by AIC and lower than the one by SIC (Guidolin & Pedio, 2018).

Getting back to the VAR(p) model and its applicability in this paper, it is important to look into another issue that may affect our data. As it has been noticed in other previous research regarding government shutdowns and financial markets, there is a high likelihood that the parameters in the VAR(p) could be unstable, meaning that there are structural breaks in the data. In such a case, carrying out tests on the whole sample may not give the right view of the data and the relationships within. The approach by Balcilar et al. (2010) will be used in order to conquer this possible issue. Stability tests Sup-F, Ave-F and Exp-F developed by Andrews (2013) and Andrews and Ploberger (1994) are applied to determine if there are any structural breaks within the dataset. These tests include LR statistics to evaluate whether a model with a structural break at any point in the time series overperforms a model with constant parameters. If Sup-F test rejects the null hypothesis, while Exp-F and Ave-F tests cannot reject the null hypothesis, we can say with confidence that there are structural breaks within the data, which might indicate that the Granger causality effect may not be the same throughout the sample and may be prominent only in some of the periods. Like the developer of this model, we restrict the sample of the data to within the interval of [0.15, 0.85] in order to avoid the potential structural breaks in the beginning or the end of the dataset that do not define the whole time series.

If the tests indicate that our model has unstable parameters, we create subsample of the data on the rolling window basis. This allows us to test the Granger causality effect over time by running the Granger noncausality tests on each of the subsample of the time series data for each of the index. Each of the rolling window subsamples consists of data on government shutdown estimate and real returns at times $t = \tau - l + 1, \tau - l, \tau - l - 1, \dots, \tau$, where $\tau = l, l + 1, \dots, T - 1, T$; l is the lenght of the rolling window; and T is the size of the full sample. From this we can determine that in total $T - l + 1$ must be created in order to represent the whole time series and any possible parameter breaks. In order to be able to compare our findings with such research as Aye et al. (2016b) and Part I, we choose the same length of a rolling window $l = 24$.

All of these rolling windows for each of the index then have to be tested for Granger causality. The first instinct is to just use one of the simple Granger noncausality tests. However, this would lead to carrying out tests on small samples of data, which is unlikely to give significant and reliable results. Instead, residual based bootstrapping will be used here on LR statistics tests for each of the rolling windows determined earlier. This model is useful in avoiding pre-test bias while working with unstable parameters, while at the same time can be used on small data sets (in our case – 24-month long time series). The number of bootstrap repetitions applied in this paper is 599, the rule of thumb suggested by Wilcox (2010). A summary of the residual based bootstrapping approach can be found in Part I, while a more detailed explanation can be obtained from Balcilar & Ozdemir (2013).

Finally, applying this model on the data for each of the indexes will give us an insight in the relationships between their real returns and government shutdowns in the form of Granger causality effect and the way these relationships change over time. These findings will then be compared in between the indexes in order to see any tendencies in relation to the size of the firms that each of the indexes contain. If the real returns on S&P SmallCap 600 Index have a stronger and more prominent relationship to the government shutdowns over time than the real returns on S&P 500 and S&P MidCap 400 indexes, we will consider this to be an indication that smaller companies do get impacted by government shutdowns more than the bigger enterprises.

The next section of this paper is dedicated to carrying out the abovementioned methodology on the data that was described in the beginning of the research model section and discussing the obtained results and their implications.

II.4. Empirical results

As we have now discussed the data and the methodology to use in determining the relationship between government shutdowns and real returns on stocks and if this relationship is affected by the size of the companies, the next step is to run the tests and analyze their results. For simplicity purposes, we will use the following abbreviations for the analyzed indexes: S&P 500 – GSPC; S&P MidCap 400 – MID; and S&P SmallCap 600 – SML.

Firstly, we have to test whether the data for government shutdowns and real returns is stationary, as that is the main implication of a VAR(p) model. Three different unit-root tests are run on each data set: Philips-Perron (PP), Augmented Dickey-Fuller (ADF), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS). Tests are run for three different types of models: with no intercept or trend; with an intercept but without trend; without an intercept or trend. The results for these tests are disclosed in Table 6.

If we look only at PP and ADF unit-root tests, there arise no doubt that all four time series are stationary, as all tests reject the null hypothesis of unit-roots at 1% significance level.

Table 6 Units root and stationarity tests on time series of the government shutdown index and real returns on GSPC, MID, and SML indexes

	Government shutdown index			Real returns on the GSPC index		
	- Intercept - Trend	+ Intercept - Trend	+ Intercept + Trend	- Intercept - Trend	+ Intercept - Trend	+ Intercept + Trend
PP			-13.665***			-19.198***
ADF	-6.49***	-7.05***	-7.40***	-7.72***	-8.08***	-8.11***
KPSS	1.199*	0.533**	0.092	2.330	0.134	0.068
	Real returns on the MID index			**Real returns on the SML index**		
	- Intercept - Trend	+ Intercept - Trend	+ Intercept + Trend	- Intercept - Trend	+ Intercept - Trend	+ Intercept + Trend
PP			-18.457***			-17.466***
ADF	-8.48***	-9.20***	-9.23***	-8.51***	-9.01***	-9.00***
KPSS	3.390***	0.076	0.022	1.83**	0.0263	0.0250

Note: ***, **, * denote significance at 1%, 5%, 10% level, respectively

However, KPSS tests show some inconsistent results throughout the data. The test statistics on VAR(p) model with no intercept or trend for government shutdown, MID and SML indexes reject the null hypothesis of stationarity at 10%, 1% and 5% significance levels, respectively. Additionally, the test with an intercept but without a trend for government shutdown index also rejects the null hypothesis of stationarity at 5% significance level. These results may indicate that the data is not perfectly

stationary, however, considering the highly significant results in PP and ADF tests, we conclude that the data is stationary and eligible for applying VAR(p) model.

The next step in our research is to determine which VAR(p) models are the optimal ones to analyze the relationship between government shutdowns and the real returns on each of the stock indexes. Information criteria for all the pairs of time series up to lap 10 have been calculated and are disclosed in Table 7.

The values in bold represent the minimized information criteria for each of the VAR(p) models to be analyzed. Conveniently for us, lag 1 is indicated as the optimal lag length for all the indexes by all three information criteria (AIC, HQIC, SBIC). That means that with confidence we can use the following partially restricted VAR(1) model for all of our indexes in the next steps of the research:

Table 7 Information criteria for VAR(p) model for the government shutdown index and real returns on GSPC, MID, and SML indexes

		Lag 1	Lag 2	Lag 3	Lag 4	Lag 5	Lag 6	Lag 7	Lag 8	Lag 9	Lag 10
GSPC	AIC	**8.3963**	8.4044	8.4186	8.4360	8.4521	8.4677	8.4803	8.4992	8.5132	8.5270
	HQIX	**8.4202**	8.4441	8.4742	8.6166	8.6729	8.7286	8.5996	8.6324	8.6643	8.6940
	SBIC	**8.4566**	8.5047	8.5591	8.6166	8.6729	8.7286	8.7814	8.8404	0.8945	8.9485
MID	AIC	**8.6387**	8.6403	8.6567	8.6748	8.6867	8.7934	8.7177	8.7370	8.7454	8.7617
	HQIX	**8.6625**	8.6800	8.7124	8.7463	8.7741	8.8068	8.8369	8.8721	8.8965	8.9287
	SBIC	**8.6989**	8.7406	8.7972	8.8554	8.9074	8.9644	9.0187	9.0781	9.1268	9.1832
SML	AIC	**8.9179**	8.9287	8.9469	8.9667	8.9688	8.9843	9.0010	9.0167	9.0283	9.0476
	HQIX	**8.9443**	8.9727	9.0084	9.0459	9.0658	9.0986	9.1329	9.1662	9.1954	9.2323
	SBIC	**8.9842**	9.0392	9.1015	9.1655	9.3119	9.2715	9.3324	9.3923	9.4481	9.5116

$$Gov_{shut_t} = \varphi_{x,10} + \varphi_{x,11} Gov_{shut_{t-1}} + \varepsilon_{x,1t}$$

$$Index_{x,t} = \varphi_{x,20} + \varphi_{x,21} Gov\_shut_{t-1} + \varphi_{x,22} Index_{x,t-1} + \varepsilon_{x,2t}$$

The above partially restricted VAR(1) model is then tested against a fully restricted VAR(1) model for each of the indexes. The full restriction of the VAR(1) model is implemented by setting $\varphi_{x,21} = 0$. Wald and LR tests are carried out against the null hypothesis of no Granger causality between government shutdowns and real returns on the indexes. Singular and bootstrapped tests with 599 bootstraps for each of the index are run and their results are reflected in Table 8.

The results of Wald and LR tests for all indexes in Table 8 strongly indicate no Granger causality in the data. The p-values are very high in both the singular and bootstrapped tests (especially in the case of S&P 500 Index, where the p-values are close to 1), which suggests that we cannot reject the null hypothesis of no Granger causality between government shutdowns and real returns on indexes in any of the analyzed cases. Nonetheless, all of these results are for the tests carried out on the full sample of available data. As already discussed in the methodology part, the past research has already hinted at the data on government shutdowns being unstable and experiencing structural shocks in its parameters. That can also be suspected from the visualization of the time series of government shutdown index, reflected in Figures 8, 9 and 10, as it can be clearly seen that the time series values experience very sharp temporary increases and decreases. However, we need to test the data for stability before we can make any conclusions in that regard.

Table 8 Granger noncausality tests on the full sample of the government shutdown index and real returns on GSPC, MID, and SML indexes

		Test statistics	p-value	Bootstrap p-value
GSPC	Wald test	0.0001	0.9909	0.988
	LR test	0.0001	0.9909	0.982
MID	Wald test	0.0450	0.8322	0.848
	LR test	0.0453	0.8315	0.780
SML	Wald test	0.1675	0.6826	0.646
	LR test	0.1688	0.6811	0.706

Sup-F, Ave-F and Exp-F tests developed by Andrews (1993) and Andrews and Ploberger (1994) are applied on the data for government shutdowns by trimming off 15% of values in the beginning and end of the sample, leaving us with the interval of [0.15, 0.85]. The results of the tests are represented in Table 9. All three tests report minuscule p-values that reject the null hypothesis of stable parameters. That means that our data is not consistent over time and, thus, the relationship between government shutdowns and real returns on indexes may vary over time. That allows us to investigate these relationships further, as discussed in the methodology part of the paper.

We will now analyze how the causal relationships between government shutdown and the observed change over time, if they exist at all. For that purpose, 24-month rolling windows for each set of data have to be created. Considering that the length of the available time series data varies for the chosen indexes, $T - l + 1 = 407 - 24 + 1 = 384$ of rolling windows can be created from the data on GSPC and MID, while only $T - l + 1 = 359 - 24 + 1 = 336$ rolling windows can be created for the real returns on SML. Each of the rolling windows include 24-month long samples of government shutdown index and real returns on its respective index. The rolling windows are denoted by the last month in the 24-month long sample, e.g. the rolling window for the period 1985:M2-1987:M1 is denoted as 1987:M1.

Bootstrap LR tests are carried out on each of the rolling windows in order to see how the relationship have been developing over time. Here, the LR tests compare whether a partially restricted VAR(1) model is better at predicting real returns on an index than a fully restricted VAR(1) model, where $\varphi_{\mathrm{x},21} = 0$. In order to obtain more significant results in relatively short samples of 24 months, the residuals of the fully restricted VAR(1) model are then resampled with replacement for $N_b = 599$ times for each of the rolling windows, and LR

Table 9 Parameter stability test statistics for the government shutdowns index in VAR(1) model over sample 1985:M2-2018:M12

	VAR(1)	
	Statistics	p-value
Sup-F	27.012	<0.01
Exp-F	8.5814	<0.01
Ave-F	9.8541	<0.01

tests are then run on the samples of bootstrapped p-values for all of them. The results of these bootstrap LR tests on GSPC, MID and SML are shown in Figures 11, 12 and 13, respectively.

At the first glance, the bootstrap p-values seem to be relatively similar when testing with each of the stock index separately. They all tend to have very high p-values throughout the majority of the rolling windows, while still dropping below 0.10 for some periods of time. Like in past research, here we consider that if p-value<0.1 it is significant and thus government shutdowns do Granger cause real stock returns during those 24-month-long periods of time. We will look into each of the indexes separately and then we will compare these findings in order to answer our research question of whether size of a company has any impact on the way real stock returns react to government shutdowns.

Figure 11 illustrates the bootstrap p-values in relation to real returns on S&P 500 Index. The p-values indicate that in 50 out of 384 (13.0%) rolling windows government shutdowns do Granger cause real returns on S&P 500 Index at 10% significance level. These rolling windows are denoted as the following: 1998:M3-2000:M10, 2013:M8, 2015:M3-2015:M8, 2015:M12, and 2018:M2-2018:M11. Please note that here and henceforth the significant effect is prominent in 24-month-long periods ending with the listed months. Furthermore, 40 out of 384 (10.4%) of the p-values are significant at 5% significance level and 16 out of 384 (4.2%) of them are significant at 1% level.

Moving on to Figure 12, it shows the bootstrap values for real returns on S&P MidCap 400 Index. Here, 70 out of 384 (18.2%) rolling windows indicate a significant Granger causality relationship between government shutdowns and real returns on S&P MidCap 400 Index at 10% significance level. Those rolling windows are the following: 1990:M11-1992:M9, 1998:M1-2000:M8, 2013:M8, 2015:M12, 2017:M10-2017:M12, and 2018:M2-2018:M11. If

Figure 11 Rolling window bootstrap p-values of LR statistics testing the null hypothesis of $\varphi_{21} = 0$ in relation to S&P 500 Index in restricted VAR(1) model

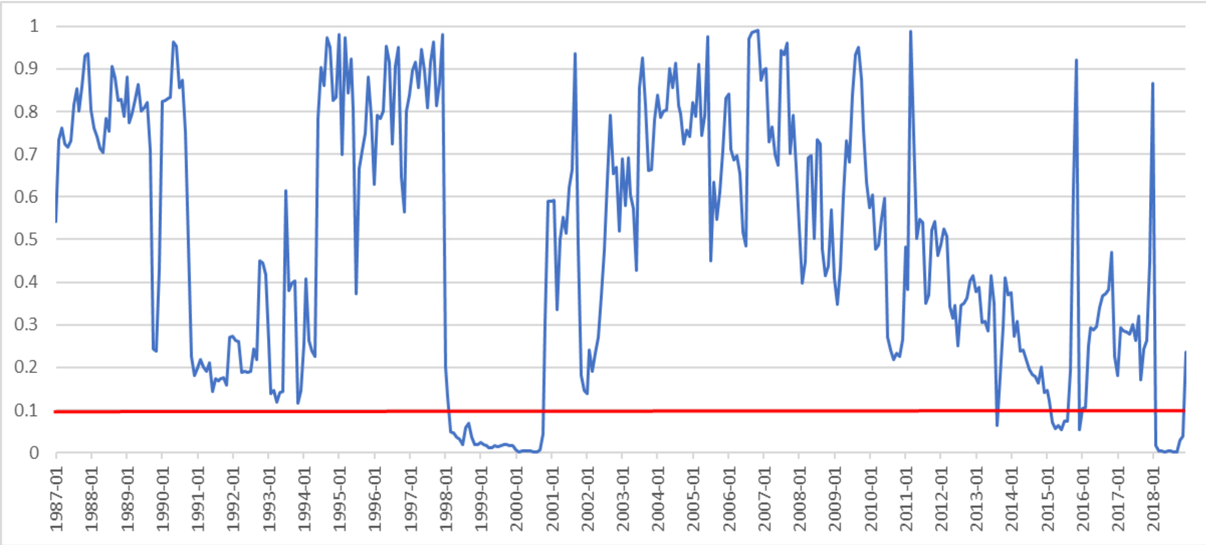
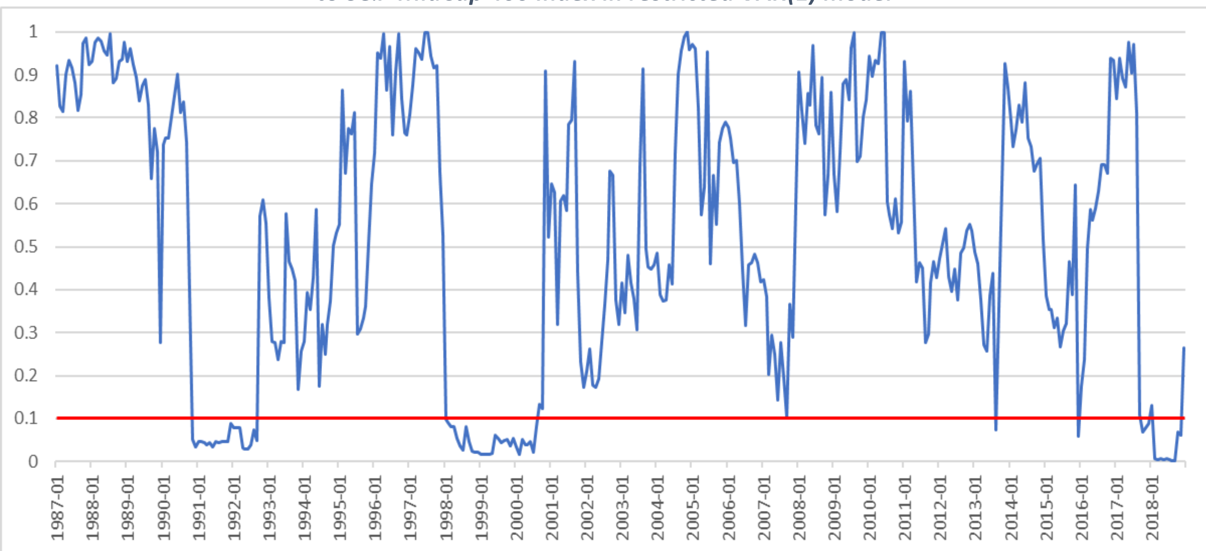


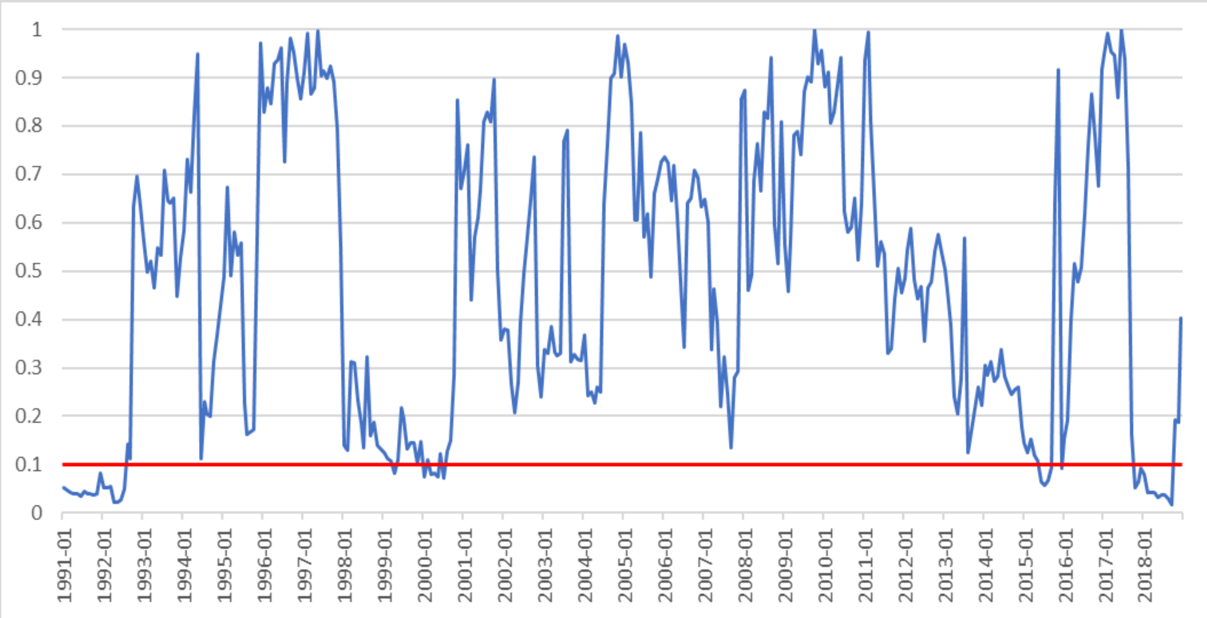
Figure 12 Rolling window bootstrap p-values of LR statistics testing the null hypothesis of $\varphi_{21} = 0$ in relation to S&P MidCap 400 Index in restricted VAR(1) model



we look at 5% and 1% significance levels, we have 44 (11.5%) and 8 (2.1%) rolling windows with significant results, respectively.

Finally, Figure 13 shows us the bootstrap p-values in relation to real returns on S&P SmallCap 600 Index. Here, 42 out of 336 (12.5%) of the rolling windows indicate a significant Granger causality relationship between government shutdowns and real returns on S&P SmallCap 600 Index. The following are the rolling windows with significant results: 1991:M1-1992:M7, 1999:M4, 2000:M1, 2000:M3-2000:M5, 2000:M7, 2015:M6-2015:M9, 2015:M12, and 2017:M10-2018:M9. 21 (6.3%) of them have relationships significant at 5% level and none of them are significant at 1% level.

Figure 13 Rolling window bootstrap p-values of LR statistics testing the null hypothesis of $\varphi_{21} = 0$ in relation to S&P SmallCap 600 Index in restricted VAR(1) model



This summary of the results indicates that, to our surprise, S&P MidCap 400 Index, representing medium size companies, is the one affected by government shutdowns the most, while S&P SmallCap 600 Index, representing small size companies, is affected by government shutdowns the least. Even if we look only at the sample of 336 rolling windows covering all three indexes (1991:M1-2018:M12), the results seem to be even more enhanced, where government shutdowns have significant results on S&P 500 Index 14.9% of the time, on S&P MidCap 400 - 20.2% of the time, and on S&P SmallCap 600 – 12.5% of the time. It is interesting to note that 15 rolling windows indicate significant results in all terms of all three indexes: 1994:M4, 2000:M1, 2000:M3-2000:M5, 2000:M7, 2015:M12, and 2018:M2-2018:M9. At the same time, 42 rolling windows show significant results in relation to both S&P 500 and S&P 400 MidCap indexes: 1998:M3-2000:M8, 2013:M8, 2015:M12, and 2018:M2-2018:M11. This indicates that a lot of the times, when there is a prominent significant Granger causality relationship between government shutdowns and real stock returns, it affects the whole or at least the majority of the financial markets.

At the first glance, these results seem to contradict our initial assumption that small companies are affected by government shutdowns more than medium and big companies, as the results show that S&P SmallCap 600 Index is affected by government shutdowns in the least amount of rolling windows within our sample, while S&P MidCap 400 Index is the one that is affected in the most amount of rolling windows within our sample. This may indicate that small companies are actually the least sensitive to government shutdowns while the most sensitive ones are the medium size companies. However, there may be another explanation for these results.

Something that has not been discussed while choosing the indexes is the fact that each of them consists of different numbers of companies, which is represented in the names of the index. S&P MidCap 400 Index, representing medium size companies, includes the smallest variety of companies, while S&P SmallCap 600 Index, representing small size companies, includes the highest variety of companies. This means that S&P SmallCap 600 Index has the most diversified portfolio of companies, while S&P MidCap 400 has the least diversified portfolio of companies. Considering that this coincides with the test results, it seems probable that the risk of government shutdowns is diversifiable and that the reason why S&P SmallCap 600 Index is the least affected by government shutdowns is because it does the best at diversifying this risk.

The above reason gets in our way of making any significant conclusions in relation to whether the size of a company has any effect on the relationship between its real returns and government shutdowns. In order to get a better insight into this matter, it may be useful to carry out the same type of test on real returns on stocks of differently sized companies as opposed to stock indexes. However, that would raise other potential issues, like how to control for other variables (company characteristics) that may impact the relationships. On the other hand, this paper did expand the understanding of government shutdown risk, as it indicates that the risk is diversifiable. Nonetheless, further research focused on this particular issue should be carried out in order to make any strong conclusions in relation to the statement that the risk of government shutdowns is diversifiable.

II.5. Conclusions

The main focus of this paper was to analyze how the effect government shutdowns have on real stock returns varies in relation to the size of the company in question. The focus of this work was based on the assumption that smaller companies would be more sensitive to government shutdowns, as they do not have as many resources for tackling economic policy uncertainties as bigger companies would.

Residual bootstrap likelihood ratio statistics tests were carries out in relation to three indexes: S&P 500, S&P MidCap 400 and S&P SmallCap 600. The tests have shown that government shutdowns do not have a permanent effect on the real returns on these indexes, but there is a Granger causality relationship between government shutdowns and the real returns in some 24-month-long periods of time. Furthermore, the results show that government shutdowns have the most consistent effect on real returns on S&P MidCap 400 Index and the least consistent effect on S&P SmallCap 600 Index. That may be an indication that small companies are not more sensitive to government shutdowns than medium or big companies. However, another possible interpretation of these results is that the risk of government shutdowns is diversifiable, and that S&P SmallCap 600 Index does the best job at diversifying it, as it includes the most companies out of the three analyzed indexes.

The above reasons make it tough to make any strong conclusions on whether size of the company has any effect on the relationship between its real returns and government shutdowns. We recommend that more in-depth research with more control over different company or index characteristics should be carried out in order to expand our understanding in relation to this issue.

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