UNIVERSITY OF LJUBLJANA
FACULTY OF ECONOMICS

MASTER'S THESIS

MATEJ FELICJAN

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SWINE FLU PANDEMIC 2009: A GOLDEN ERA FOR PHARMACEUTICAL COMPANIES

Ljubljana, December 2018 MATEJ FELICJAN

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The undersigned Matej Felicjan, a student at the University of Ljubljana, Faculty of Economics, (hereafter: FELU), author of this written final work of studies with the title Swine Flu Pandemic 2009: A Golden Era for Pharmaceutical Companies, prepared under supervision of Aleš Berk Skok, PhD

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LIST OF ABBREVIATIONS

WHO: World Health Organization
GPHIN: Global Public Health Intelligence Network
CDC: Center for Disease Control and Prevention
FFJR: Fama, Fisher, Jensen and Roll
CAPM: Capital Asset Pricing Model
APT: Arbitrage Pricing Theory
CAR: Cumulative Abnormal Returns
ROE: Return on Equity
CAAR: Cumulative Average Abnormal Returns
AAR: Average Abnormal Return
NA: No data available

INTRODUCTION

Kitler, Gavinio and Lavanchy said in 2002 that before World War I influenza was not threatening as a problem which might cause a lot of problems but it was said that the problem would be solved satisfactorily. There were bigger problems, like cholera, but everything changed in 1918 when the first huge influenza occurred. From then on there were more catastrophic influenzas. Taubenberger and Morens said in 2006 that the influenza from 1918 was the mother of all pandemics and this was correct because the pandemic of 2009, for example, was a kind of a new version of the 1918 flu pandemic. The previous triple reassortment of flu viruses combined in a new way with the swine flu virus causing huge problems in 2009. In her article from 2009, Kara Rogers described very nicely all the problems that particular influenza caused, the biggest of which is the very rapid spread of the virus around the world and among people. In 2005, World Health Organization (hereinafter: WHO) published guidance titled the WHO global influenza preparedness plan in which it laid down the measures to respond to the threat of pandemic influenza but that guidance did not help in 2009. They decided for the highest pandemic alert on 11th June. This decision was made on the grounds of the number of victims and the number of countries already infected but even now there are questions about their decision. Two student researchers Nolan Higdon and Michael Smith, together with their Faculty Evaluator Mickey Huff from Diablo Valley College made some important points on 2nd October 2010, when they said that the flu from 2009 was based on incomplete data which created a better financial picture for drug companies. Furthermore, it was said by Cohen and Carter that there were scientists who were between the pharmaceutical companies and WHO and who significantly influenced the WHO decision.

In the thesis my main purpose is to look at the pharmaceutical market and what happened during the pandemic of 2009. I wanted to research the positive influences of the pandemic for swine flu vaccine producers and compare them with producers of other medicines. Certainly, we can claim that the pandemic had a greater influence on the flu vaccine producers but with the master's thesis I wanted to see whether that really happened, that is whether there was such a positive effect on the pandemic vaccine producers.

The tools used in the thesis were event study, ratio analysis, stock returns and CAPM Beta[1] calculation. With event study I represented abnormal returns of selected companies. This tool is useful for calculating the consequences of unpredictable events which occurred in the past. Ratio analysis is another useful tool which is well used by investors and which, in combination with CAPM Beta and stock returns, might provide a valuable overview of some companies.

In the master's thesis I first recount the whole story of the pandemic of 2009. I describe what happened and show the connections between that pandemic and other important pandemics

[1] is a measure of the volatility of a securtiy or portfolio in comparison with the whole market

in history. After that, I explain some ideas about information dissemination, because information had a huge influence on the WHO decision. I then use event study to analyze the abnormal returns of some of the biggest pharmaceutical companies. Because there is a presence of clustering, a cross-sectional test is also provided. Finally, I provide a ratio analysis together with stock returns and CAPM Beta for additional explanation of balance sheets showing the good shape of pharmaceutical companies due to the pandemic.

1 REPRESENTATION OF THE 2009 SWINE FLU PANDEMIC

The swine flu outbreak of 2009 is one of the most well-known illnesses to have occurred in the 21st century. It can be said that it was an outbreak of influenza which was especially notable due to the speed with which it spread among countries and their citizens. This flu is also known as the influenza pandemic (H1N1) of 2009 or even H1N1 flu and was classified as influenza A 2009. The problems started in the border area of Mexico and the United States in March when this new version first appeared. The greatest concerns were in Mexico, and due to the high spread around the world through human-to-human transmission, the number of affected countries and infected people started to grow (Hajjar & McIntosh, 2010). Countries which had problems with flu needed to report cases to WHO and that was the main factor behind their decision to raise the pandemic alert to the highest level, which was done on 11th June. This was the first pandemic in 40 years and infection control proved very difficult because of the high transmissibility of that strain (Rogers, 2009; Al-Muharrmi, 2010).

The first appearance of the global H1N1 influenza virus pandemic was in 1918 and that episode of influenza was one of the biggest in modern history with a number of deaths all over the world (Trilla, Trilla & Daer, 2008). From then on there were even more influenza viruses, which also caused significant problems among people but none of them was as harmful as the one in 2009. In that year the virus found every possible way to reach countries around the world. The 1918 influenza virus was somehow linked with the 2009 influenza virus with a kind of different subtype of gene assortment. Nevertheless, after 1918 there was an H2N2 virus in 1957, and H3N2 in 1968. In 1977, the A/H1N1 virus caused some problems because it circulated among humans and the seasonal epidemics of influenza A virus from 1968 to 2009 were dominated by the A/H3N2 virus generated by some antigenic drift (Kilbourne, 2006). The virus in 2009 was a different kind compared to all the others because it was a completely new strain of influenza and was also unpredictable for scientists. That virus can be classed as a swine-origin influenza virus A/H1N1 and is genetically related to viruses which are circulating in pigs (Girard, Tam, Assossou & Kieny, 2010).

The H1N1 virus was the result of several viruses which were circulating in pigs and that is probably the origin of the virus. The first virus in pigs was the North American H3N1 triple-reassortment, the second is classical swine H1N1 lineage and the third is the Eurasian avian-like swine H1N1. We can see that there are a number of different versions of influenza A viruses and it is likely that just about a month before the outbreak of the illness, the

transmission of the virus to humans happened. Scientists also said that the reassortment of different viruses occurred some years before those viruses found their way to humans and that it was of note that pigs did not influence the worldwide spread of the virus among people (Klemm, Das & Hartman, 2014; Rogers, 2009).

The spread of the virus was fast and a consequence of that was the growing number of casualties from the beginning of illness. Even the number of countries affected by the virus problem was high and the problems were hard to solve, but still, that was the most important thing for WHO. It did not know how to react, but nevertheless it raised the pandemic alert to the highest level, 6. That decision was made because it wanted to provide some additional movement among countries and health institutions as a way of solving the problems connected with the flu and also to reduce the number of infected people (WHO, 2009). Interestingly, the virus did not infect older people aged over 60 years, which was very unusual. The virus primarily affected children and those with lung or cardiac disease conditions. In 2009, people were afraid and that fear grew almost every day along with the number of casualties. Therefore, there was a massive need for specific vaccines to somehow help infected people and achieve a lower mortality rate due to the flu. Together with health ministers, national health agencies and the pharmaceutical industry, WHO organized a collaboration in which developing an H1N1 flu vaccine was the main purpose (Girard, Tam, Assossou & Kieny, 2010).

1.1 Origin and characteristics of the influenza

Everything started in the small village La Gloria in Veracruz in the north of Mexico, near the border with the USA. Initially the virus was not specifically noticed because hospitalization was not required and the illness was completely unknown. The first young boy infected with the virus was called “patient zero” and we can say that that was the beginning of the outbreak (Hsieh, Ma, Hernandez, Lee & Lim, 2011). What happened in the beginning was a total surprise because it had not been suspected that such a virus could emerge in humans and that everything would happen so quickly. By the end of April there were around 2,000 cases in Mexico City alone. At first, it was said that this influenza virus was just a new strain of two different swine viruses and scientists did not know before that it might even happen. From Mexico the virus crossed the border to California and another two children were hospitalized. From that day on the spread of the virus became really fast. The virus spread worldwide through human-to-human transmission and within a few months there were many countries with confirmed cases. Some of the most affected countries were the USA, Spain, United Kingdom, Japan, Austria and Germany, even tropical countries like Thailand and those of Central and South America were among them (Dandagi & Byahatti, 2011). WHO general director Margaret Chan decided to declare the outbreak an international concern and action was taken due to the huge panic among people and the number of cases. The actual number of H1N1 influenza cases is still unknown because countries were not able to test in laboratories every individual with signs. The number was just a prediction and it was said that several tens of millions of people were infected; in December 2009, there were

around 50 million cases in America and around 200 million in other countries. We can definitely say that number was high but still, most of the infected people recovered in a few days. The illness was not so deadly but every infected person needed to get specific treatment (Stein, Vliet & Timen, 2011).

In the 2009 pandemic the younger population was especially problematic. Children and young people under 24 years had the biggest problems and had the greatest possibility of becoming infected. According to statistical data in Canada, the USA, Chile, Japan and the UK, the median of affected people was between 12 and 17 years (Karageorgopoulos, Vouloumanou, Korbila, Kapaskelis & Falagas, 2011). It is also worth mentioning some important points about partial immunity to the virus among older people, which is definitely a characteristic of the H1N1 flu virus. A lot of studies were made in this area and all of them showed that 33% of humans over 60 years old carried some special antibodies to H1N1 2009, which resulted in some kind of immunity to the virus. Nevertheless, if an older person did become infected, there was more chance of death in comparison with younger infected people. H1N1 influenza is mostly a mild illness which has symptoms like fever, cough, runny nose, myalgia, malaise, shortness of breath, rhinorrhea and conjunctivitis, and many patients also mentioned diarrhea and vomiting. All those signs can be treated with other medicines so in a few days all of them can be removed. The problem happened when the consequences of the illness caused bigger problems such as respiratory failure, acute respiratory distress, multi-organ failure and also, at the end, risk of death. We need to mention that death might occur only in some very special cases, usually when patients have some other problems like asthma, auto-immune disorders, obesity, cancer or diabetes, and the most problematic illness for the younger population and for possible death is definitely asthma (Carlson, Thung & Norwitz, 2009). We can compare all those signs of swine flu with seasonal flu and we can see that the signs were basically the same. The difference was merely in the fact that younger people and pregnant women were the most problematic for getting the flu which might lead to death (Kerkhoveand and others, 2011).

1.2 How can a pandemic actually emerge?

It is impossible to state exactly how a pandemic can emerge because there are numerous ways and everything happens without warning. Nevertheless, scientists frequently mention two different mechanisms which were the most likely in the recent pandemic. The first mechanism is an emergence of a completely new virus, which is essentially what happened in 1918, and is also the most logical cause. Another way is the modification of a circulating human virus by importation. This method was well known from pandemics in 1957 and 1968. There are certainly a few more reasons that might explain some of the results in the recent pandemic and there might still be things which cannot be explained by scientists. Viruses are complex things; their emergence cannot be fully known and it is hard to predict which direction they will take. If we look at 2009, we can speculate as to what was happening and why the spread was so rapid but still, there are a few indications that lead us to suspect that everything happened in a completely unknown way (Morens & Fauci, 2007).

1.3 Transmission of the virus and incubation period

If we compare the pandemic of 2009 with other seasonal influenzas, we can see that the transmission of the H1N1 virus was basically the same. At first there were some unprotected contacts with respiratory droplets which can happen by inhalation. Some people claim to have become infected by eating pork but that is not true. If pork meat is cooked properly, there is no possibility of infection, the only cause is contact with infected people. We can also see that the transmission in the 2009 pandemic was much higher than in the seasonal flu and it was also higher than in pandemics from 1918 on. The incubation period for infection is in the range from one to seven days, but scientists usually reported that the period was from one to four days. After the pandemic, some data were provided on the internet about how many people had become infected. Therefore, between 22 and 33 percent of people who were in contact with an infected person became infected themselves, and we can say with certainty that this number is much higher than it is for seasonal influenza, which is definitely another indication of the fast spread (Sinha, 2009).

1.4 Vaccines

Vaccines are used for almost every illness and are the most effective tools to prevent the spread of a virus and the same was true in 2009 during the pandemic. Vaccines are a useful tool to mitigate most of the effects of viruses but still they need to be well produced without side effects. In 2009, the virus started spreading rapidly around the world and a very effective vaccine was needed. At the beginning of the illness, there were no available vaccines to quickly intervene and slow down the spread of the virus. Development of an influenza vaccine was a challenge on which WHO worked from the start of the virus. WHO wanted to help people who were affected and achieve some kind of immunogenicity and safeness among the population. Development of the vaccine started in the middle of April 2009, but the problem here is that virus was already among people and it took at least six months just to identify it. WHO started its special campaign against the virus with some basic sanitary practices. In almost every part of the media there were campaigns about how to properly wash hands or about wearing face masks, etc. That was basically the first step of WHO "vaccines production", where they wanted to achieve a reduced spread of the virus and lower mortality (Larson & Teytelman, 2012).

When production of vaccine started, everything was happening so fast that they did not know how many doses of vaccine were required to achieve full protection. That question was also connected to the challenge of manufacturing the drugs. That is, if two doses were needed, there would be a need for more vaccines and the problem would then be how to produce enough doses of the vaccine. There were also some concerns that after the first wave of the pandemic another wave would take hold which might cause even bigger problems for producers. In June 2009, it was said that annual capacity of the vaccine stood at 876 million doses, of which just a few producers were responsible for 560 million. If we look at that number, we can say that while the number is high, it is definitely not enough to satisfy all

the demand. The first vaccines produced went to some pediatric care providers, hospitals, health centers, etc. Next, vaccines were available for clinics and in nursing homes. They wanted somehow to achieve immunization of the entire world population, which was an optimistic idea. H1N1 infection was treated with oseltamivir (Tamiflu) or zanamivir (Relenza). There was some evidence for oseltamivir and some resistance to it, especially as a first-line treatment after the initial signs of the illness. A few months later, in October 2009, peramivir came on the market but there was a problem in that the vaccine was not supported and approved in the United States. Nevertheless, the vaccine was still used in some emergency cases for hospitalized patients who had life-threatening illness. This action was taken because hospitals did not know exactly what to do, so these were just last resorts to help their patients. In the fall, the company Sinovac Biotech together with Novartis AG provided a vaccine about which they said that one shot was enough for full protection. Those words were not proven but there was very little time and consequently the vaccine got immediate approval. Even the Chinese government gave approval, so they started with massive production by which they were able to vaccinate around five percent of the whole Chinese population in 2010. WHO also worked in the low- and middle-income countries and provided around 200 million doses for them. Pharmacy companies saw business opportunity in producing flu vaccines and therefore many of them entered into their production (Marcello and others, 2010).

2 WHO PREPAREDNESS PLAN AND THE PHASES TO THE HIGHEST PANDEMIC ALERT

The exceedingly high mortality rate and the number of cases was an important factor in the management of national risk and for national authorities. As already mentioned, it is a well-known fact that pandemics are unpredictable and can break out at any time. They can cause a high number of deaths, and social and economic disruption throughout the world, and therefore people and health organizations are always concerned that something serious could happen. In 1999, WHO published an important influenza plan with the purpose of helping and providing some guidelines for regional and national planning. The document was also completely revised and the latest version was published in 2005 (Lee & Park, 2005).

The purpose of the document published by WHO is to provide additional help to all countries so that they are able to react well in different situations. The name of the document is the WHO global influenza preparedness plan and it includes the role of WHO and the organization's recommendations for the time before and during a pandemic. The document provides countries with the information needed to react better in the situations when a pandemic strikes and so that they know how to work in problematic situations which might occur unexpectedly. In the document there is provision for possible events and how to react at different levels of threat. The purpose of the plan is to provide public health advice and avoid risks which might occur due to the new influenza viruses. It also provides some recommendations for national authorities, by which they are able to help their citizens. They

additionally wanted to provide greater transparency and coordination within countries so that they are able to help each other. WHO knew that countries are different so it gave them guidance to develop their own pandemic plans or even update their own national influenza preparedness plan in which recommendations needed to be included. With the plan WHO achieved better coordination and transparency and the main result was the reduction of the risk of pandemic spread (WHO, Department of Communicable Diseases, 2005, p. 1).

The guidance redefines the phases in the situation of emergence of a new influenza virus as follows:

- **Interpandemic period:**
  - **Phase 1:** There are no specific new types of viruses. The influenza virus is still present but only in animals so the probability of human infection is very low, and the main purpose is strengthening influenza preparedness. (WHO, Department of Communicable Diseases, 2005, page 2)
  - **Phase 2:** In this phase there are a few possible ways in which the virus could be transmitted from animals to people and cause some problems. The virus might be a risk for humans and in this phase, there is a need to minimize the risk of transmission from animals to humans. Also, countries need to detect and report every specific action rapidly. (WHO, Department of Communicable Diseases, 2005, page 2)
- **Pandemic alert period:**
  - **Phase 3:** The most important fact in Phase 3 is that there is a human infection but there is no presence of human-to-human spread or it might happen, but just in a few instances. In this phase they want to detect and respond to all possible cases. (WHO, Department of Communicable Diseases, 2005, page 2)
  - **Phase 4:** The spread is localized which means that it is present in only a few places. It is important to delay the spread and win some additional time for the preparation and production of vaccines. (WHO, Department of Communicable Diseases, 2005, page 2)
  - **Phase 5:** In this phase the human-to-human spread is still localized but the virus is much more adapted to humans; however, the virus is still not fully transmissible. In this phase there is one important goal and that is to maximize all possible efforts to delay or stop the spread which might cause serious problems and a pandemic. (WHO, Department of Communicable Diseases, 2005, page 2)
  - **Phase 6:** Pandemic is present! There is also an increase in transmission in the whole population and the goal is to minimize the consequences of the pandemic. (WHO, Department of Communicable Diseases, 2005, page 2)

We can see from the phases described above that each one of them provides only assumptions about how to react and respond in the steps which might lead to a pandemic. Between the first two phases there is just a difference in the risk between infection among humans and the virus which carried by animals. All other phases have higher distinctions based on an assessment of the risk of a pandemic, so more factors should be implemented

into such phases and those factors should provide much stricter steps to the final pandemic phase (California Department of Health Services, 2006).

Furthermore, something is missing from this preparedness plan and that is some important goals which should be included. Certainly, one important thing is health promotion, whereby people would get important information and might be prepared for some of the consequences that could occur because of the virus. If people knew at the beginning how to react, it is possible that the spread would be much lower. Another step which might be a part of that preparedness plan is prevention, whereby some signs of the virus should be treated carefully with vaccines in hospitals to prevent spreading and additional cases. Another step which is missing from the plan is the situation where there are no possible ways for people to help. People should always know what to do and how to help themselves. Among countries around the world there are some that already have additional plans for problems like pandemics and these can provide help to a great number of people, therefore they should be used by WHO (Haneline & Meeker, 2011).

2.1 Other ways to prevent morbidity and mortality in pandemics

Preventing pandemics and the problems connected with them is very difficult but, nevertheless, there are some steps to slow down the whole process of the spread of the virus. The most important thing of all is to reduce the spread and to find a vaccine so that people will trust the public health authorities more. The final result of the virus on the whole healthcare system would be much lower. Definitely, methods of preventing spread without the pharmaceutical industry are a good way to have a positive impact on the influenza pandemic. Governments all over the world should apply some measures by which they might help their populations who might become infected; all decisions should be appropriate and should be taken in a way that reduces the consequences of such problems with viruses. Some of those measures are:

- people should stay at home if they are ill because by going to work they might spread the infection to their colleagues,
- countries should cancel large public events because there is a higher chance of contracting the virus at such events
- the government should have control over people who are ill and they should be able to prohibit them to go outside their homes,
- even in schools or in other places like theaters, adults should have limited contact because the spread could be faster,
- because the virus might affect the younger population more than adults, students at universities should not congregate in places where spreading could be higher.

All those actions are steps towards the reduced spread all over the world. Certainly, these steps do not solve other problems, but still contribute to public health in general. Governments can do a lot when the first pandemic signs occur but a lot of work is needed in

all their actions. For example, let's say that governments should inform people in all public places to wash their hands and use masks, this can be done by teachers in schools or via the media. Nevertheless, there are other contributing factors; for example, people who are self-employed cannot stay at home because otherwise they would have no income. Thus, solving one problem connected with influenza might open up more problems and it is true that every idea might cause huge financial losses (Santibañez, Fiore, Merlin & Ress, 2009).

2.2 How WHO collects information for possible influenza pandemics

The pandemic of 1918 had a number of consequences and before that pandemic influenza was not regarded as a serious problem but after that everything changed. In 1948, WHO set up the global influenza surveillance network which was a kind of alert system which was able to recognize some new viruses. This network collected information from 110 laboratories in 82 countries around the world, there were four collaborating centers for influenza reference and research from the USA, UK, Australia and Japan. By collecting all the information in those centers, they had the possibility of monitoring what was going on among countries and citizens and, using reports from ministries and other institutions, they were able to influence them in a timely manner. It is important that all the collected information was gathered systematically and from different sources, because in doing so they were able to influence public health. Also, they were able to commence immediate production of the vaccines, which was important for a specific illness. That network is still a good idea but nowadays information needs to be collected using modern communication technologies and not just from informal sources. The old ways do not give as good a picture about what is going on as sources such as social media do. News of some of the outbreaks might be found in electronic media but it is still important which news sources should be held up as the best. Nevertheless, WHO receives a lot of useful information which it uses to post regular updates on the web (Kitler, Gavinio & Lavanchy, 2002, page 1).

One important piece of work was done by Health Canada, which does a lot of work with WHO, which is named the Global Public Health Intelligence Network (hereinafter: GPHIN). The tool works continuously and searches all global media news sources on the web. It seeks to identify important information about viruses and diseases which might create problems among people over the world. It is an important network because it might detect possible outbreaks and we already know that electronic media is the fastest method for spreading news nowadays; according to some analyses, around 60% of possible viruses might be found from informal sources. Global epidemic intelligence is now focused on communicable diseases (WHO, emergencies preparedness, response, Epidemic Intelligence – systematic event detection, available on the web).

2.3 Timeline of swine flu

In 1889, there was a main flu virus which circulated among humans and came from the H1 family so the roots of the 2009 pandemic were set a long time ago. In 1918, H1 was replaced

by a new H2 strain, which started in Russia. This came to light because everyone who was born before 1889 was immune to the new strain which occurred in 1918, and subsequently, those born before 1918 were immune to the 2009 strain. Everyone else who was born after the specified year did not have any immunity. The 1918 flu was a huge disaster because it caused the deaths of around 50 million people all over the world, all of whom died due to the H1N1 virus. That virus evolved directly from a bird flu to a human flu. Around one third of the whole global population was sick, some of them less severely but we can still say that the consequences of this flu were vast. Forty years later (in 1957), another pandemic occurred all over the world. That pandemic was caused by H2N2 and it completely displaced the H1N1 virus which was still present in humans. That pandemic caused about one million deaths so the consequences were certainly not as high as those in 1918. The virus was a kind of a new version of H and N surface proteins so consequently people were not immune to it which is why this virus caused a pandemic. However, people who were born before 1957 and were ill in that pandemic were immune in the 2009 pandemic because their body carried some antibodies which helped them. In 1976, the H1N1 virus jumped from pigs to humans, killing a US army recruit. The virus stayed inside the army base but it caused a lot of concern. Global health organizations thought that this situation would cause another pandemic as bad as the one in 1918 and therefore started vaccinating people (around 48 million people were vaccinated). However, the virus still appeared in China the following year and caused just a mild pandemic, affecting people who were born after the flu of 1957. That was the year when the virus was reborn. In this pandemic infected people did not produce any antibodies against the flu of 2009. Nevertheless, infections caused a reaction called cell-mediated immunity where some specific blood cells target and also destroy infected cells, which helped in the pandemic of 2009. Another important year was 1998 when the predecessor of H1N1 took hold in the United States. This virus was a mix of human, bird and swine viruses and the authorities tried to control it with vaccines. After that the virus changed, all of which led to the new virus which took hold in 2009. The 2009 virus was a new variant of the virus of 1998 and the viruses behaved in the same way. Before the 2009 pandemic, there was another flu called bird flu. That flu was deadly for humans and it killed more than half of its victims but a positive thing in that virus was that it was unable to spread from human to human. An interesting fact about H5N1 flu is that the virus was found in Indonesia before the pandemic, immediately causing a lot of concerns about combining with other viruses (MacKenzie & Marshall, 2009; Stein, Vliet & Timen, 2011).

The 2009 pandemic started in April 2009 when the first cases of a new virus were reported in Mexico. Everything happened really fast and in the same month that this new type of swine flu was announced with three cases in United Kingdom, the virus spread from the United States to Europe. On 25th April 2009, WHO general director Margaret Chan stated that the flu was an international concern and that there was a need for a public health intervention. Two days after that, 900 cases were reported in Mexico and also seven deaths were laboratory confirmed. The real number of deaths was suspected to be around 80 but the problem was that laboratories were not able to confirm all cases. Other countries such as

Spain and the United States also had some confirmed deaths which was a serious problem for WHO, which raised the alert level to Phase 4. A day after that, it raised the alert once again to the fifth level which was a strong signal that a pandemic was coming. Media reports about the flu grew as it became one of the biggest concerns for public health all over the world and a lot of work was done in individual countries to help their citizens be better prepared if they became sick due to the virus. Up to the end of the April the following countries confirmed cases: United States, Mexico, Canada, New Zealand, the United Kingdom, Israel, Spain, Austria, Switzerland, Germany and the Netherlands, so the list of the countries with confirmed cases started growing rapidly (Adams, 2009). By May, the concerns over public health were rising. On 1st May there was confirmation of human-to-human transmission and it was said that the danger due to the flu was high. Consequently, some schools were closed and limits to the size of public gatherings were set. Some big soccer games around Mexico City were played behind closed doors, just one example of the actions of the authorities against the flu. Nevertheless, the spread of the flu was high and all those actions mentioned before did not help in any way to slow down the whole process of spreading. In Europe there were quite different ideas about how to react to the flu at first. People with the flu were not even tested, unless they had travelled to affected areas or had been in close contact with an infected person. If the reaction of Europe had been different, WHO probably would have raised the pandemic alert to the highest level much faster. However, WHO thought that the situation was not so critical and that the flu was concentrated in the United Stated and Mexico (Hine Deirdre Dame, 2010).

In the following points I intend to expose the most problematic dates in the recent pandemic which greatly influenced WHO and its decision on the highest pandemic alert and through those dates we can see how fast the spread was and how big the number of infected people became (MacKenzie & Marshall, 2009; Stein, Vliet & Timen, 2011):

- On 1st May there were 331 cases reported in eleven countries all over the world, which was not such a high number. The biggest concern was in Mexico and the United States because there had already been ten deaths as well as 256 confirmed cases.
- The following day more countries reported cases and among those countries were some of the biggest in the world (China, France, Costa Rica). There were 16 countries with infected citizens and 658 confirmed cases of flu.
- On 3rd and 4th May a few more countries reported flu cases and those were Ireland, Italy and Colombia; by now there were 898 cases and in Mexico alone there were 25 deaths reported. Nevertheless, WHO officials said that the problems with the flu were declining.
- On 6th May even Sweden and Guatemala had confirmed flu cases and in the United States, the Texas Health Department stated that another person had died due to the virus.
- The following day the number of confirmed cases was high and stood at 2,371. In Brazil four cases were reported and the total number of countries with confirmed cases of the flu was 25. The total number of deaths was 44 and the number of cases was around 2500.

- On 11th May, there were even more confirmed cases due to the virus in Canada and Costa Rica, while other countries also had some reports about problems and the total number of infected countries was 30 with 4694 confirmed cases. The next day it was also confirmed that the virus was a big threat for pregnant women.
- From that date on nothing special happened. The number of deaths was growing and by 20th May the total number was already 10,243.

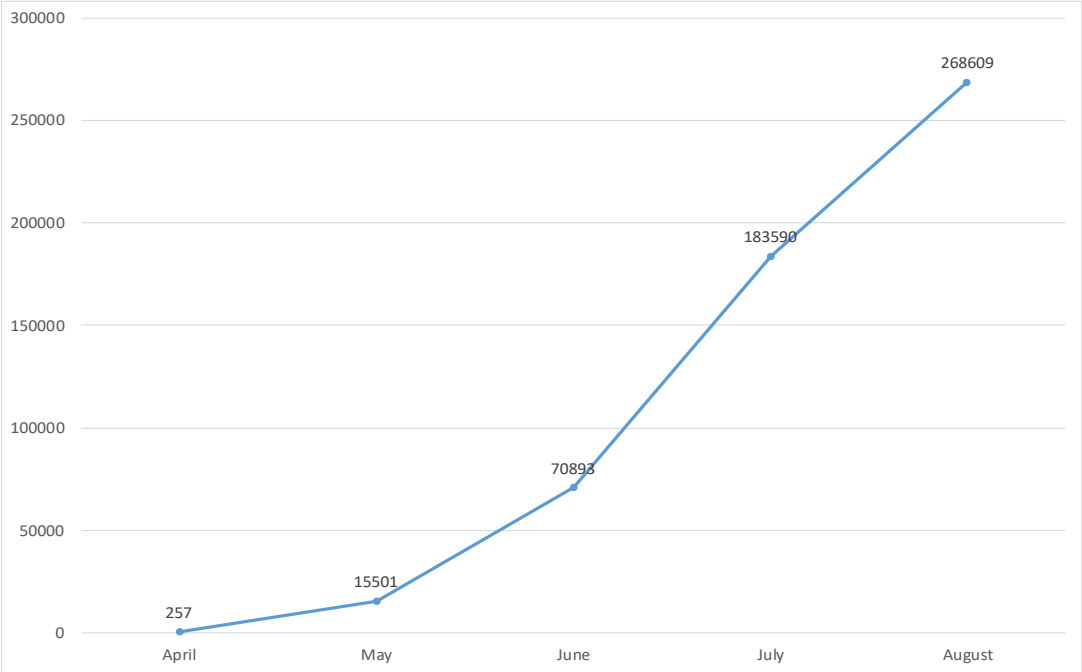
Concerns were still growing in June, together with fear among people about the number of cases and deaths. A big question was linked to the vaccines. Among countries where the virus had started to take hold, citizens were very afraid and had a lot of questions about what would happen and how the spread could be prevented. In June, the number of countries with reported cases was 70. Some countries started doing tests by which they were able to ascertain the true number of cases. We should also look at some specific dates and see what was going on in June (Jones, 2013):

- On 1st June there were already 17,410 cases reported in 62 countries all over the world, which was another sign of the fast spread. In Mexico there was also a much higher number of deaths and in all the states of the United States of America there were confirmed cases. Pharmaceutical companies started concluding contracts with federal governments. For example, the biotechnology firm MedImmune's FluMist signed a contract with the US government which was worth around 90 million dollars after which they started producing a vaccine which was then approved for use in the United States for people between 2 and 49 years old. Older people were not vaccinated because, as stated earlier, they were immune to the pandemic virus.
- On 3rd June, the virus was also reported in Africa which was an indication that the virus had even spread to a specific area where living standards were not at a high level. Also, there was a confirmed death in the Dominican Republic and the total number of confirmations there of death due to the virus was now six.
- 11th June is the date which is the most important for the whole pandemic and also for this master's thesis because that is the date when WHO declared the highest pandemic alert (phase 6). Some people said that WHO took quite a long time to reach their decision but some of them also said that that the organization should have collected more data for such a decision. It was the first pandemic in 41 years and the whole world was in shock.
- The number of cases reported and the number of deaths were still growing. The first case in Europe was in Scotland, there was also a confirmation of death in South Africa, and even in Argentina, etc.
- Due to the considerable problems all over the world, the Chinese authorities started developing their own vaccine on 22nd June.
- At the end of June, there was the first reported case which was vaccinated with Tamiflu in Denmark.

In July, vaccines for the pandemic were the most pressing concern for countries around the world. Every media report concerned vaccine production and the pharmaceutical companies

connected with the production. The number of cases was still rising and laboratories had problems because they did not have enough capacities for the confirmation of all cases. It was also found out that pregnant women had a higher chance for problems with the virus. It was also discovered that the virus presented serious problems for people who had complications with their lungs. Laboratories also found out that Tamiflu vaccine was not helping infected people so the United States started using a standard formula for flu vaccine because they thought this was a far better way of helping their citizens. In September, the authorities were more optimistic and were happy with the production of the swine flu vaccine made by Novartis. This big Swiss pharmaceutical company produced a good vaccine against flu which was protective for 80% of subjects who got one dose of the vaccine and over 90% for people who got two doses. They tried the vaccine on about hundred subjects and their vaccine got the approval of the authorities. Another three different vaccines from CSL Limited, MedImmune LLC and Sanofi Pasteur were approved that month. Still, there were some problems due to the short supply of the vaccines in some countries. Pharmaceutical companies worked to their full capacities but the demand was high due to the fast spread and number of cases (MacKenzie & Marshall, 2009; Stein, Vliet, & Timen, 2011; Adams, 2009).

Figure 1: Confirmed cases of flu in 2009 by months



Source: European Centre for Disease Prevention and Control (2009), own work.

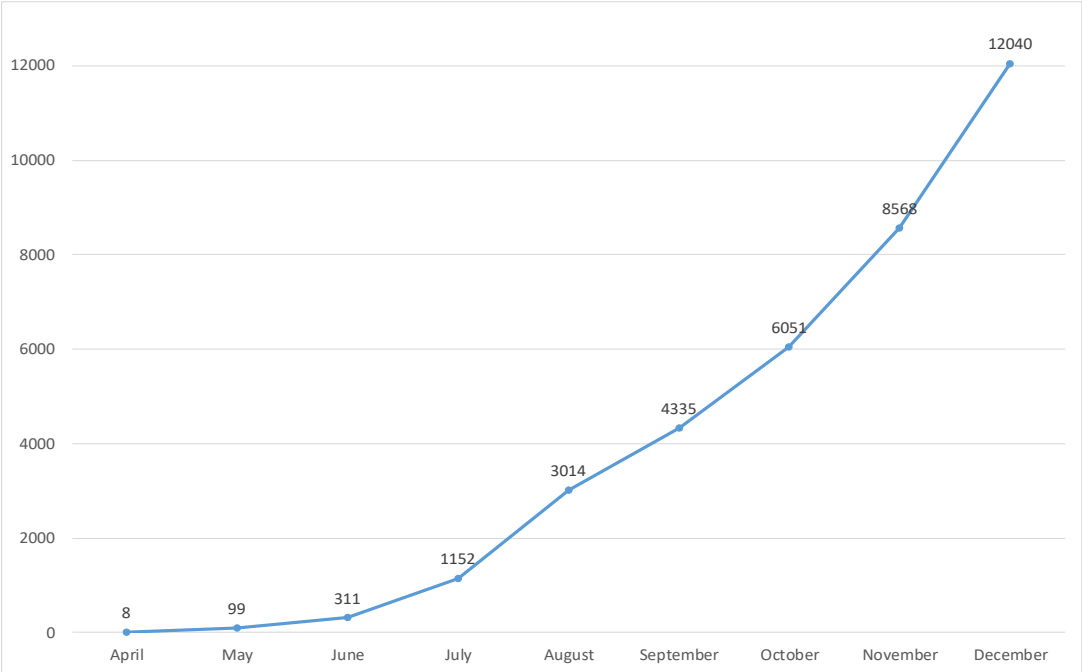
The previously mentioned months were the most problematic. Nevertheless, the numbers of cases and deaths were growing and the authorities did not have a specific plan for how to deal with the situation.

On the figure 1 and figure 2 we are able to see the extent of the problem. On the figure 1 we can see the number of confirmed cases for the most critical months of the pandemic. We can

connect that number of confirmed cases with the high spread of the virus. Data was collected on the last day of each selected month and the data was provided by European Centre for Disease Prevention and Control. I need to mention that after August the specific number of cases all over the world could no longer be obtained. The reason for that was the fast spread in underdeveloped countries such as those in Africa. Laboratories were not able to confirm every case which had flu signs. The specific number of cases was provided for more months because when a person died the laboratory tested for the H1N1 virus.

We can see from the figure 2 how problematic the virus was. It jumped from 8 confirmed deaths to more than ten thousand cases in just a few months. The authorities had major concerns about this and they were happy with every step the pharmaceutical companies took and their intention to produce flu vaccines.

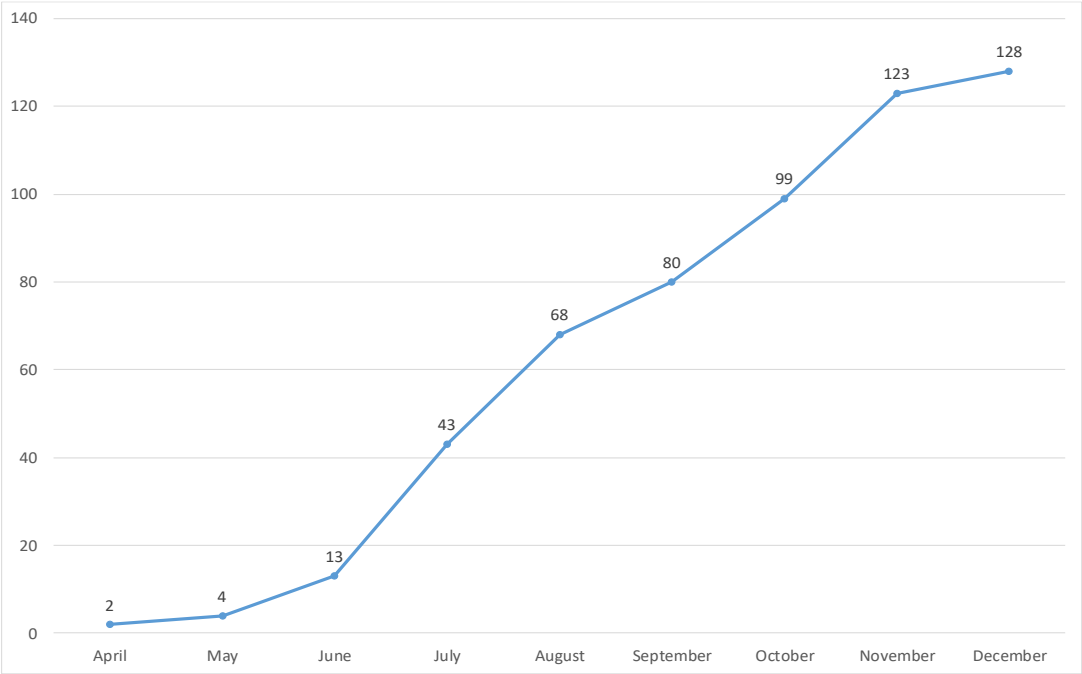
Figure 2: Confirmed deaths due to flu in 2009 by months



Source: European Centre for Disease Prevention and Control (2009), own work.

In the figure 3, we can see that number of countries that confirmed deaths was growing fast, causing a lot of concerns for the public and for WHO which wanted to do something but did not know in what way should it work. We can see that number of countries that confirmed cases of deaths in 2009 jumped from 2 in April to 128 in December which caused a lot of concern among the authorities. Countries were panicking because they were unprepared and they did not get instructions to avoid flu problems. Everything was going on really slow. In one hand we had fast spread of the virus, but in the other hand there were unprepared people who did not know what to do and how to deal with a problem. They picked some medicines to somehow avoid all possible problems of virus but that was not a way to which solve all the problems among citizens.

Figure 3: Number of countries that confirmed cases of deaths in 2009



Source: European Centre for Disease Prevention and Control (2009), own work.

We can clearly see from figure 1, figure 2 and figure 3 that the virus was problematic. The number of cases and affected countries provided enough information to create huge problems among countries with the virus. The spread was fast what can be seen in the comparison between April and August, when the numbers of cases and deaths were more than one hundred times bigger. That the problem was high can be seen at the end of 2009 when laboratories stopped working on collecting data due to lack of their capacity.

2.4 Was the WHO decision to declare the highest pandemic alert the right decision?

The media talked a lot about the pandemic and about all the details between WHO and the pharmaceutical companies. A lot was also said about new countries which were infected. Nevertheless, there were some theories about WHO's decision to issue the highest pandemic alert. Some scientists said that that steps should have decided on sooner due to the high spread and consequently, there would have been an opportunity to do even more and to slow down the virus, at least for a little while. On the other hand, there are some scientists who said that the highest pandemic alert was not needed. Some critics said that behind the WHO action there was a secret which is connected to pharmaceutical companies and their profits. Bryan Walsh prepared an interesting article which can be accessed on the web in which he talks about whether H1N1 flu was a pandemic or not. At the beginning of June, concerns were high even in countries like Australia, which was a consequence of problems with growing reported cases. The disease spread among citizens outside institutions like schools and hospitals. At the beginning those problems were known only in Mexico and the United States but within a few months most of the affected countries had started talking about such problems. Another problem was that deaths were confirmed among some people who did

not have any health problems before infection with the H1N1 virus. In June 2009, WHO's director for health, safety and the environment Fakuda said that the virus appeared to be evolving into a pandemic, and we should ask whether that was said in the right way for public health and for citizens all over the world.

In May, WHO said that the problems were big and that something should be done to start dealing with the consequences of the virus. In the same month, they announced pandemic Phase 5, an action that was prompted by the 114 confirmed deaths. There were just a few more countries involved and the specific number of infected people was completely unknown. The true number was not high but there were still concerns about the high speed of the spread among people. All those ideas led to the change of the phase. This novel influenza virus which was transmitted from human to human was a completely unknown virus so the reaction to all those problematic aspects caused by the virus needed to be good and quick. The criteria for Phase 6 include the requirement of sustained community-level outbreaks in at least one other country in a different region of the world and in the flu of 2009 that specific country was Australia. If we take a look at that criteria, we can see that highest pandemic alert could have been announced sooner but Fakuda said that they were too afraid and cautious because they knew that the highest level of alarm would cause panic. WHO did not want to cause panic but nevertheless, even if the consequences of the H1N1 virus were not so severe, that should not have an influence on the phases of the pandemic alert. Panic among the public was definitely one of the most important factors for WHO and its decision for the phases of pandemic alert but that should not be one of the factors for WHO. Although predictions about the threat are not possible, they should still always work in such a way as to help all citizens as much as they can. The authorities in WHO should have declared the highest pandemic alert sooner, if we look at the situation out there among countries, but they demonstrated that there were things much more important than public health. The WHO reactions were definitely not as good as they should have been but some governments did not help either because they simply put a lot of pressure on WHO and they did not do anything to help their citizens, they were just waiting for information about what they needed to do. WHO should always work independently without worrying about the economic impacts on countries all over the world because its main purpose is public health, but in the 2009 pandemic the organization completely forgot its purpose. The phases to the highest pandemic alert are what should be respected in serious situations and those steps to the highest pandemic alert should not be changed when the virus appears and starts to spread but that was exactly what happened in 2009 (Walsh, 2009).

3 USING BAD DATA BASIS AND SALES OF VACCINES

Drug companies were very happy in 2009 because viruses which harm people around the world are a welcome opportunity to manufacture new drugs and sell them with high profits. The Council of Europe closely investigated the pandemic in 2009 because they were of the opinion that every specific step taken by WHO was made just to boost the profits of pharmaceutical companies and that they might even harm people with their actions. In 2009,

WHO stated some things which never happened and which were claimed without any specific evidence. That year, WHO stated that the H1N1 virus might cause problems and infect about two billion people and hundreds of thousands of lives might be lost in America alone, but what happened was completely different. The President of the United States stated that only around 120 million Americans would be infected and about 90,000 deaths might be caused due to the virus. Obama's data was collected by his own scientists so the numbers were probably not far from the mark. If we take a quick look back at 2009, we can see that just 14,000 deaths were reported, which is a much smaller number than that predicted by WHO. The 2009 pandemic was a really important thematic for scientists and a group of scientists at the Harvard T.H. Chan School of Public Health carried out tests among people with symptoms of H1N1. They found out that approximately 1.44% of patients with H1N1 symptoms were hospitalized between April and July, and just 0.239% of them required intensive care, while just 0.048% of them actually died. That number is not high and is actually 7 to 9 times lower simply due to the data that was used for calculating (Harvard School of Public Health, 2009). The flu was not a big problem, yet countries invested big amounts of money into vaccines with the result that millions of unused vaccines are still somewhere in warehouses. Scientists stated that every specific step by countries was made due to the misleading information of WHO and that the organization should be more careful about the ideas it provided to the media and countries. One example of the misleading information and consequently its steps to the highest pandemic alert is that provided by Russian lawmaker Igor Barinov. He claimed that WHO was connected with some pharmaceutical companies. Furthermore, the French health minister Roselyn Bachelot put forward some theories about unnecessary vaccine doses. By looking at the months before the highest pandemic alert we can see that WHO took an important step in April 2009 when it changed the meaning of the term pandemic and stated that clarifying the pandemic without a specific number of deaths or illness is enough. Strangely, about a month later, it declared the highest pandemic level even though the numbers of deaths and illness cases did not warrant it. It is still not known specifically why such steps were taken but there were certainly some secret interests among some players. Jefferson, who was a general practitioner in the British Army and who worked for Cochrane Collaboration[2], said that a whole industry was waiting for a pandemic and behind it all, there were scientists who needed just such a virus to work on (Grolle & Hackenbroch, 2009). Other critics also claimed that bad data allowed drug makers achieve such financial results because all that bad data was used for WHO's decisions and for the important actions it carried out. Companies have a network of people through whom they are able to strongly influence the whole market (Kyriakou, 2010).

[2] a non-profit and non-governmental organization formed for organized medical research findings about health interventions which are made by health professionals, policy makers, etc. It comprises around thirty thousand volunteer experts all over the world who form 53 groups with the intention to review healthcare interventions.

Higdon and Smith from Diablo Valley College carried out some very good research which focused on concerns about the highest phase of pandemic alert. WHO claimed that there was a great need for vaccines for H1N1 flu because public health was in real danger; for this reason, countries all over the world ordered around 4.9 billion doses of vaccines just to avoid the virus. In some countries, vaccination was even mandatory. Most people around the world did not know exactly the best way to fight the virus, nor did they know how big the threat was, so their only instructions were provided by WHO, namely that the virus was a real threat for public health all over the world. The biggest issue behind all the actions taken by individual countries and by WHO was data and how to collect it with enough accuracy. The real number of flu cases is still completely unknown because not all people with some signs of the flu were tested due to the low number of laboratories. WHO consequently took all the steps without any specific data and without any evidence. In April, for example, WHO declared a Phase 4 but just two days after that they raised the phase to a higher level, which was done without specific proof which might have been obtained in those two days. In June, WHO announced the highest level of pandemic alert, but once again there was no evidence. Basically, we can see that WHO reacted suspiciously. Furthermore, the organization did not work in such a way as to collect data to prove all their steps. The Center for Disease Control and Prevention (hereinafter: CDC) also decided that data collection was not needed to determine the spread of the flu, but how could the highest pandemic alert be taken, consequently creating a considerable degree of fear among the public, without specific proof? That the data was not considered important can be found in the previously shown figure 1 where number of cases was no longer provided from August on, so there is no real way of knowing how the situation developed. The number was probably higher every month but such information is very important and needs to be proved. WHO stated that around two billion people could become infected (which did not happen) in two years and in doing so it only stirred up fear among the public because in the two years from 2009 nothing special happened, the flu was simply not present any more (Higdon, Smith & Huff, 2010).

However, it was not just the scientists from Diablo Valley College who had theories about the WHO decisions; there were other academics who claimed the same thing. Professor Michel Chossudovsky claimed that WHO significantly manipulated the data just to provoke widespread fear of illness and to somehow influence the health emergency. He pointed out the interesting decision of the CDC about collecting the data. The organization suddenly decided not to collect data anymore and stopped doing that on 24th July so WHO did not have any empirical data about virus spread. It claimed that the reason for that was in the new model by which it was able to determine the true number of flu cases. The CDC authorities stated: "The model took the number of cases reported by states and adjusted the figure to account for known sources of underestimation". Massive vaccination was consequently done on the basis of unreal and unproved data and the reason behind it all can be found in the better financial overview of pharmaceutical companies. Furthermore, CDC even claimed that the data which was provided to companies for developing vaccines was underestimated. All the figures used in their presentation were also inflated with unconfirmed cases and there

were also cases of seasonal influenza. In this model CDC claimed that the number of infected people with H1N1 between April and June 2009 was around one million, which was probably wrong, but nevertheless, that was the only number collected. Using those numbers, they also calculated predictions of the spread of H1N1 swine flu among countries which were then used for specific national vaccination programs and those numbers were high. For example, in the United States basically half of the population needed to be vaccinated according to the CDC model, and those results of the model were a base for contracts between pharmaceutical companies and countries (Chossudovsky, 2009).

Behind the foregoing, we can predict that there is a possible connection to enrich pharmaceutical companies which needs to be looked at and which is also our intention in the master's thesis. It is likely that some other institutions also enjoyed increased profits because even though the pandemic was critical for public health, the potential danger due to the flu was not sufficiently great as to justify the concerns and reactions. We can also think about the connection between the people who work in WHO, and the question of whether people will continue to believe the information coming from organizations such as WHO. We have seen that the people who work at such institutions have rules which they can frequently manipulate for their own ends.

3.1 Scientists who were connected with WHO and some pharmaceutical companies

It has frequently been said that among scientists and WHO there were people inside the organization and those people who did paid work for the announcement and helped to declare the highest alert of the 2009 pandemic. It is clear that WHO never revealed the whole truth about what was behind it all and it is unlikely that the full truth will ever be known but we can identify some logical connections. The British Medical Journal has written extensively about possible connections between scientists and WHO but nothing can be said with certainty. The publication claimed that behind all the decisions in 2009, there were a few scientists who provided advice about the stockpiling of pandemic vaccines and all of them received some benefit. Those scientists received money from vaccine manufacturers, which was revealed after the swine flu and is not logical that they were within WHO at the same time. On the basis of its recommendations, many countries bought vaccines from a few pharmaceutical companies, basically from those where scientists had some connections inside WHO. Nevertheless, pharmaceutical companies get a lot of money from selling those vaccines and scientists likely received a percentage from that. The Bureau of Investigative Journalism talked about three scientists who were most connected with the whole business between the pharmaceutical companies and individual countries and were actually paid by Roche and GlaxoSmithKline. A strange coincidence behind all this is that those three scientists were involved in the research activities of those companies so they were part of the vaccine production from the start of the problems with the illness. WHO never revealed who those three scientists were but some reporters in the media had ideas. Another very ironic element was the emergency committee, the membership of which was kept secret. This would not ordinarily be a problem but the fact is that this committee is a special organ

that has the task of advising WHO's general director Margaret Chan, who set the pandemic alert to Phase 6. The names of the committee members were known only among WHO employees and there were connections between them and the biggest companies in the pharmaceutical industry. WHO claimed that keeping the identities of the emergency committee secret was necessary to protect scientists from outside influences. Some media researchers claimed that members of that special organ put a lot of pressure on WHO and its director for the highest pandemic alert. Still, we need to mention that WHO is an institution which is responsible for public health so it probably tries to do its best for public health but still, in such a critical situation as the 2009 pandemic, there is no sense in keeping the names of members of some organs secret. To provide the best for people, all information important to the public should be revealed because people want to know who is responsible for important decisions (BBC News, 2010).

Swine flu was treated as a big problem but there was just ten percent of the predicted number of cases and in the end the mortality rate was just 0.0005 percent, which is a very low number. We can see that all the actions were ill-considered if we look at the final results of the virus. The pandemic was one of the mildest flu outbreaks in the whole century, even though the media issued so many bad reports about it. Paul Flynn for the Council of Europe stated that the 2009 pandemic was a huge waste of public money and that behind it all there were actions executed simply to scare people, which is rather ironic (LeFanu, 2013).

Much has already been said about some scientists who were somehow involved in WHO pandemic planning and who were also influenced by some pharmaceutical companies which were the main vaccine producers. But we should look at the years before the pandemic when everything started. In 1999, an influenza pandemic plan was revealed by WHO and in this plan some rules and instructions were explained for the problems of probable pandemics in the future. This plan was prepared together with the European Scientific Working Group on Influenza but the issue here is that the group was financed by Roche and other pharmaceutical companies which in 2009 were the main producers of swine flu vaccine, so we can suspect that some of the groundwork was laid many years before the influenza outbreak in 2009. There is no sense that the plan was made by scientists who are part of some of the biggest pharmaceutical companies and it is plain that they made good long-term plans for the companies where they worked. We can also prove this by mentioning some key scientists who were involved in the group, of which René Snacken and Daniel Lavanchy were two. Snacken, for example, who wrote some important studies for Roche while Lavanchy was also an employee of WHO, where he worked in one specific department but also appeared at Roche events. Furthermore, there are some other members of the European Scientific Working Group who were connected with pharmaceutical companies; one of them is Karl Nicholson (a professor at Leicester University in the United Kingdom) and the other is Abe Osterhaus (a professor at Erasmus University in the Netherlands). Both of them were also connected with Roche, like the previous two mentioned, and were part of a marketing team between 1998 and 2000, that is, when the influenza pandemic plan was released.

Nevertheless, all of them always claimed that they were never connected with pharmaceutical companies but it was nevertheless discovered that they were even included in the control of the trial version of a vaccine which was produced by Roche during the flu outbreak. This study is the most important one for Roche because in it we can find a good level of support for the vaccine. Another important thing mentioned by the European Scientific Working Group was their intentions for countries that had to plan their vaccine production capacity to encourage the pharmaceutical industry by mentioning that using vaccines was a good thing for people. Nevertheless, there were some people who were not fully convinced about the work of the previously mentioned group. Barbara Mintzes is the first one I should mention, and she is an assistant professor at the University of British Columbia. She said that the group could not work effectively because it is funded by pharmaceutical companies and there is a concern over a conflict of interests. She also mentioned that we cannot have a group where the scientists inside it are involved in the marketing of drugs at promotional events and who, on the other hand, have opportunities to give advice about what should be done. Another thing that should be mentioned about the scientists and the special group was pointed out by Dr. Elashoff. That scientist said that another vaccine called Zanamivir did not reduce symptoms of the illness so consequently it was rejected by American and European drug regulators. It was explained that the drug does not work due to the all other vaccines which are used every day by people all over the world but, nevertheless, Zanamivir was then approved in 1999, which is not logical because it was approved even though it was explained with good evidence that it did not help people with flu signs. Almost the same story was true in Europe with Tamiflu. There were more scientists there who were probably involved in the good financial results of companies. A few of them also confirmed that they were part of Roche and that they had subsequently received payment from Roche and from GlaxoSmithKline and those were Nicholson, Osterhaus and Hayden. The previously mentioned Nicholson was also an author who, together with Monto (another scientist who had connections with the pharmaceutical industry and WHO), released a publication about dealing with vaccine usage in pandemics and for that both of them received financial support from Roche and GlaxoSmithKline, but both of them also work for big pharmaceutical companies. Due to the foregoing, scientists talked about the securing of their names. They claimed that exposing all scientists and other experts on such problems in the public domain is not possible because those experts have a lot of important data and knowledge to help WHO and the population but we should still say that there are too many connections between people who work for WHO and who were also connected with drug companies. Only a few scientists were mentioned in the media for the things that happened from 1999 on, that is from the release of the pandemic plan, but there are many more of them who received money from pharmaceutical companies for they role they played (Cohen & Carter, 2010).

I have explained only the basic facts which were mentioned frequently in the media and which can briefly explain that there was a special connection between pharmaceutical companies (that is, flu vaccines producers) and people in WHO. The connection was

probably intended to gain money and consequently achieve good financial results for pharmaceutical companies and the pharmaceutical industry in general. In further chapters we intend to research whether that was right. It is very difficult to find all the connections among scientists in WHO and pharmaceutical companies because the plans made for a pandemic were made years before the 2009 pandemic, so they had a lot of time for good work which could not be easily revealed by the media and other investigators. People around the world should be concerned because some scientists are obviously playing with public health for private gains. All this information about scientists, WHO and its committee raises questions about the credibility of the whole institution and about the trust of public in the global health system. It was mentioned earlier that the number of victims was not so high for the pandemic and that the number also even fell below some conservative predictions made by WHO. The problem might arise that the issues in public health could one day become really problematic and that people would not believe institutions such as WHO. Mortality might be much higher just because people would not work in line with WHO recommendations.

3.2 How big were the sales?

We can now take a look at the sales achieved by pharmaceutical companies during the 2009 pandemic. When the virus broke out in Mexico and the USA, predictions were made about mortality but those predictions were much higher than the real mortality rate revealed at the end of the flu. The media reported much about WHO decisions and their consequences and it was also clarified that all pharmaceutical companies involved in the production of flu vaccines earned at least $5 billion just from the sales of vaccines during the swine flu. That boost in sales can be seen especially in companies such as Roche, GlaxoSmithKline and Sanofi-Aventis, two of whom were mentioned in the previous chapter because there were scientists who were involved in WHO and their decisions who were also paid by those companies which were among the main flu vaccine producers. To give a few examples, GlaxoSmithKline gained around $1.7 billion from swine flu vaccine sales and that was gained just in the fourth quarter of 2009; Novartis gained around $700 million in the fourth quarter from swine flu vaccine sales, while Sanofi-Aventis gained around $500 million. Those companies also entered into huge contracts with governments because countries had instructions that they should buy vaccines for their citizens and those instructions were once again ordered by the organs of WHO where some scientists were playing an important role. There are also other companies such as Novartis and Baxter that also achieved huge sales of vaccines. We can now provide the good example of GlaxoSmithKline which sold 150 million doses of vaccines which were used just for swine flu, and there were other vaccines which were used as a seasonal flu vaccine. The previously mentioned number of vaccines was provided by the companies in July, that is until the end of the year when the pandemic broke out and when the panic started to grow, the number was much higher. Therefore, we can suspect that WHO's decisions were definitely influenced by pharmaceutical companies, but there is no real evidence of that and it is unlikely that anything new will be revealed in

the future due to the good preparation for the pandemic among scientists who were involved in the decisions and consequently in the profits. The disappointing thing behind all this is that many vaccines are left in warehouses and governments do not know what to do with them (Jack, 2009; BBC News, 2010).

Novartis was one of the most frequently mentioned companies during the flu outbreak which is why I included it in the calculation in the thesis, and also, it is one of the biggest pharmaceutical companies in Europe. The company opened the first large-scale cell-culture manufacturing plant in the United States of America and the plant was funded to the tune of $487 million from federal funds. This plant replaced a very old manufacturing process and by using new equipment they wanted to increase the reliability of the vaccines. With the new plant they were able to produce around 50 million doses of seasonal flu vaccines and 150 million doses of pandemic flu vaccines in just six months but nevertheless, the United States wanted to have even higher production capabilities. There was a special organ in the United States (Food & Drug Administration) which did not approve all vaccines due to some adjuvants[3] but on the other hand, they were approved in other parts of world, such as Japan and Europe. Novartis turned that problem into a positive for their production and increase in sales because they produced a vaccine with their own licensed adjuvant and that vaccine was able to be sold in the USA. GlaxoSmithKline from Britain, Sanofi-Aventis from France, Merck from New Jersey, USA and Wyeth, which is a unit of Pfizer, also entered into huge contracts with countries, which provided them with excellent financial results. We can also mention Pfizer and their contract worth $68 billion of Wyeth acquisition, or also Abbot Laboratories which bought a Belgian company called Solvay for $6.6 billion, or even Johnson & Johnson who bought another company from the Netherlands. Those are good examples of how much companies invested into vaccines production to improve the financial picture of their respective company. Other parts of the world were also seen as good business opportunities for those companies and GlaxoSmithKline, for example, signed a new contract with Shenzhen Neptunus Interlong Bio-Technique while Sanofi took a stake in an Indian company for around $824 million. Novartis was once again influenced to make a financial investment in China where the company's investment was valued around $125 million and it was worth 85% of the whole company. The numbers provided were just a few investments of the biggest pharmaceutical companies and were simply executed in order to be able to produce even more vaccines to lead to an increase in sales (Capell, 2009).

We saw that pandemics are a big opportunity for pharmaceutical companies and also for their profits, which we will examine and explain in the following chapters. The problem behind the pandemic is what to do when the pandemic is over. After the pandemic (which turned out to be not as problematic as anticipated when the virus started spreading), companies might have considerable problems due to the huge production facilities and lower demand for vaccines. It is better for companies to deal with illnesses such as cancer, because those illnesses are an everyday problem and people would like to have medicines for them

[3] Additives which increase reaction to the vaccines in human body and also lower the required dose of vaccine.

but so far nothing has been developed. In the long term, pharmaceutical companies have still many ways to achieve high sales, but they might also have financial problems due to lower demand for their medicines.

4 COMPARING THE 2009 SWINE FLU PANDEMIC WITH OTHER INFLUENZAS IN THE LAST CENTURY

By looking at the last century we can see that there were more pandemics which occurred around the world and resulted in significant numbers of victims. Some of them were very dangerous, while others just caused a lot of fear and their consequences were not so big in the end. Pandemics might have even some connections and the recent pandemic in 2009 can be connected with viruses that caused problems many years before that one. For a better explanation of the whole story behind the swine flu pandemic, I tried to identify some connections and differences among the flu outbreaks in 1918, 1976, and the recent flu in 2009. We can point to an interesting fact in that people who were infected with the flu in 1918 were immune to the virus in 2009, which is something I want to represent in this chapter. Moreover, those people who were infected during the flu in 1976 were partially immune to the flu in 2009. Therefore, it is true that viruses are still somewhere out there and the question arises of when is the right time for them to re-occur. The virus which took hold in 2009 had been stable in pigs since 1918 and animals were just a source for the future pandemic. For now, people around the world do not have any problems, they are somehow immune to such viruses like H1N1 but in the future, it is certain that something will happen but it is very difficult to predict exactly what will that be. It is hard to predict anything due to the unknown behavior of the viruses (Manicassamy and others, 2010).

4.1 Swine flu in 1918 in comparison with the 2009 swine flu pandemic

Predicting pandemics and the behavior of viruses is impossible and consequently pandemics always occur without warning, with some of them taking a hold around the world. If we look at history, we can see that pandemics have occurred with some intervals. The first pandemic in the last century occurred in 1918, and this was essentially the toughest pandemic of all that occurred in that century. The next pandemic was in 1957, and the third one was in 1968. As mentioned before, the pandemic in 1918 occurred all over the world and there were more than 40 million victims in less than one year. Most people infected were between 20 to 45 years old and we cannot even imagine how great the problems among the population and public health systems were that year. The next two pandemics were not so tragic. The number of victims was much smaller, totaling between one and four million. The real question among all the data is what will happen if a pandemic with such consequences as the one in 1918 were to appear again. We also need to mention that medicine has advanced a great deal. There are modern devices for doctors and scientists, and a lot of different medicines for many illnesses but still we saw in 2009 that new viruses can occur and can cause a lot of damage. One of the biggest problems is air travel, which is responsible for the fast spread of new viruses and for this reason some new interventions with well-known

vaccines cannot be performed due to the much shorter timescale. Furthermore, there might be a problem concerning the low capacity for producing new vaccines. Countries all over the world should be (due to the all occasions) prepared for possible new viruses and other infections every day, by which they would eliminate huge consequences (WHO, Communicable Diseases Department, 2005, p. 2–3).

I mentioned earlier that the influenza in 1918 was a very tough challenge for public health and people all over the world, and we cannot compare that influenza with the recent pandemic in 2009 in terms of the number of deaths. There were some questions about the influenza in 1918 and how it started. A good article by Taubenberger and Morens appeared in 2006 in which the authors questioned whether a pandemic like that of 1918 could happen again and what our reaction would be to all the consequences which would come together with such problems at that time. Just three years after the article was released, a pandemic appeared which is another reminder that predicting pandemics is impossible. In 1918 there was a number of victims due to this virus and all other pandemics were nothing in comparison with the pandemic in 1918. The death rate in the influenza of 1918 was about 5–20 times higher than was expected at the beginning of the outbreak, which was simply due to the all other problems which accompany such viruses. By looking at deaths between 1918 and 2009, we can see that in the recent pandemic the highest mortality was among younger people who were otherwise healthy and it was discovered that this was because older people had already been exposed to other related viruses and were now immune to the virus which caused such problems in the recent pandemic (Taubenberger & Morens, 2009).

The pandemic of 1918 was known as the three waves pandemic. These three waves were then thought as an implication for predicting future pandemics but this proved not to be the case. Scientists should try to understand patterns among pandemics because by understanding and planning ahead for pandemic prevention, we could improve public health and provide help much faster to infected people all over the world. In 1918 there were three waves and the second one was the deadliest. It appeared in summer/fall. It is difficult to find a logical connection between all three patterns but there are probably some small details which might still be of help to scientists in such situations (Morens & Fauci, 2007).

Due to the unpredictability of the viruses, the pandemic of 2009 happened, bringing with it many problems. A lot of the problems were similar to those in 1918 and now, a new strain of virus appeared. I have mentioned some pandemics in the last century and it is true to say that we have learned a lot from them but still, the 2009 pandemic caused consequences all over the world. For the future we need better plans for the most problematic situations because it is very concerning that two strains in less than one hundred years were able to cause such effects even though we have modern medical devices and a lot of knowledge of viruses. Scientists working in medicine should also connect with those who work with animals, because it is a problem when viruses from animals are transmitted to people. With reactions and collaboration among people working in different sectors, better decisions

might be taken when some major problems develop around the world (Khanna, Saxena, Gupta & Kumar, 2013).

4.2 The swine flu outbreak of 1976 versus the swine flu of 2009

A lot was said around dealing with the 2009 influenza because there had been so many influenzas in the past from where we could gain some useful knowledge, but still, the 2009 pandemic was a huge shock for countries and for public health. But why were countries unprepared? Why were there no rapid interventions? We also need to look at the swine flu outbreak of 1976 when swine flu caused a lot of concern, and we should compare what was done in the past and what was done in 2009.

If we compare the pandemic in 1976 with the pandemic of 2009, we should look at the place where everything started. In 1976 it was initially thought that everything had started in Asia or in the Southern Hemisphere but it actually started in the United States. Basically, the same thing happened in 2009. In that year it was thought that the pandemic had started in Asia but it was discovered that the United States together with Mexico were the origin of the virus. It was thought for both pandemics that all people, both young and old, would be infected with the same amount of probability but the 2009 pandemic actually caused greater problems among young people while old people were immune to the virus due to prior infection or vaccination (McCullers and others, 2010).

Furthermore, the pandemic in 1976 was considerably influenced by politics while for the 2009 pandemic the Center for Disease Control and Prevention was designated as the lead agency for pandemic response and all its decisions were implemented into individual countries, which is a sign that there was no influence from politicians. The CDC also had control over all media and public information. In contrast with the flu in 1976, there was the presence of computers and cellphones in 2009, while the data in 1976 was obtained mostly from State Health Departments. In 2009, information travelled much faster because within just a few minutes information from Slovenia, let's say, might be obtained in America, which was not possible in 1976. The CDC had a problem because that positive was not used in the pandemic. They concentrated mostly on data from State Health Departments because it was said that this data was the best. A major problem in 2009 was that the virus was spread all over the world so analysis was consequently much harder. If we look at 2009, it is true to say that we need a specific program for collecting and reporting real-time information because that is the key thing for solving such health problems that occur among people. In 1976 a specific document about vaccination was released and in 2009 that was the key thing for immunity of all those people who had been vaccinated in 1976. That plan was based on existing public health programs and distribution of vaccines and it was a basis for every country to implement immunization programs. While the 1976 pandemic had this document, countries in 2009 did not have a lot of information and everything was merely based on a worst-case scenario. Every specific reaction in 2009 was taken very quickly, but we saw in the end that the consequences of the virus were not as serious as originally anticipated. From

one pandemic to another, the CDC lost its credibility and power because in 1976 every decision made by them was taken based on evidence while in 2009 every specific action was taken based on inaccurate data (Sencer, 2011).

5 INFORMATION DISSEMINATION BETWEEN THE LAST TWO PANDEMICS

One thing which is really important to discuss is information dissemination. People all over the world are posting some interesting events, information, links, notes, ideas and other content, which are available to access online every second (Zheng, 2005). We need a reliable and efficient system for information which is posted online and the outcome would be an improvement when immediate responses are needed to problematic events. People would have a much better understanding of what needs to be done and they would be able to react much faster. In the end, we would have higher survival rates and we would likely be able to stop some viruses earlier. Information media can be separated into two parts, where one is the so-called social part and the second is the traditional part. Social media are short messages, news portals which are really popular nowadays due to the social media platforms which are used around the world. Even traditional media are still popular, especially among the older group of people and here we have cellphones, television, communication among people, etc. Simply by looking at all these different media, we cannot really say which is the best one. One useful means for disseminating information are messages via telephone but the problem is that we cannot disseminate some specific detailed information only short ones. Television is one which is popular but the problem is that news is provided at times when people are at work and consequently do not have time to take a look at television news bulletins. We can say that television news is the best for retired people and definitely has the highest degree of trust among people. By looking at all those specific ways of disseminating information, we can say that oral communication is one of the most efficient and reliable but the problems is its slow speed (Zhang, Huang, Su, Zhao & Zhang, 2014).

By looking at 2009, we can see that that it was a particularly successful year for the pharmaceutical market but it was also a good year for media employees too. They had a good opportunity to produce a lot of articles because the pandemic was an interesting theme to report about. We can compare that year with the pandemic of 1976. Information dissemination is a useful tool to help people with some ideas about how to deal with flu signs, how to react if something happens, what the key facts are if a virus attacks etc. It is interesting that there is a connection between the rise in the number of media reports and number of flu cases, so a higher number of media reports also reflects the higher number of flu cases. We can say that in 2009 the media caused hysteria and panic among the population and companies that work in the pharmaceutical field, which was another reason for WHO and their rapid steps to the highest pandemic alert. Scientists all over the world are still talking about it and all of them claim that the media played a significant role in WHO decisions (Klemm, Das & Harmann, 2014). Due to the bad reports provided by various

media, people were very afraid and together they placed a great deal of pressure on WHO, which consequently did not know how to react. Public trust in the biggest pharmaceutical companies and those institutions which are concerned with public health is really important. Media reporting has an important role in that and people nowadays tend to believe more in the media than in important institutions connected with public health (Wagner-Egger, Bangerter, Gilles & Green, 2011).

It is the case that information dissemination control is very important and to achieve that it is necessary to collect reliable data which can help at problematic times and might not be connected only with public health but also with situations that can occur every day (Chen, Cheng & Chen, 2014). In 2009 information about mortality in other pandemics was a cause of great alarm. The media revealed this extensively and people were consequently very afraid and overestimated the risk of infection. Most importantly, in some critical situations, people's reactions are positive when it comes to helping themselves and others but that is not possible when there is a high degree of panic. Widespread fear can also have serious social and economic consequences. Therefore, the media need to assist people by reporting some helpful information about symptoms, about how they can protect themselves, and they can even compare some illnesses for better understanding. All of those actions have the potential to be very helpful. Even the number of media reports is important because a high frequency of articles about health problems can result in a negative effect on human behavior. For example, there were numerous media reports in the first week after the outbreak of the flu that said that about 80% of respondents had increased hand washing, which is a positive result achieved by media information. It is true that the media report information that people like to know about and if they had not compared the 2009 flu with the epidemic in 1918 in relation to the number of deaths, that would not have been interesting to the public. News media might cause different reactions but the aim behind every media report is to get a higher number of viewers or readers, although the most important fact should be to reflect reality (Nelissen, Beullens, Sabbe & den Bulck, 2014).

Dramatization of the 2009 flu outbreak was high and was built on excessive media attention with a plethora of media reports. By comparing the pandemic in 1976 with the swine flu pandemic of 2009, we can see that in 1976 media reports were framed with some medical or scientific and political issues. On the other hand, the 2009 pandemic was connected with the health risk and that featured prominently on television news. For both pandemics, the media reported extensively about the number of deaths but the problem was that in 1976 a lot was said about the flu virus thread and side effects of vaccines, while in 2009 there were reports about the low number of vaccines. Furthermore, in 1976 there was not such a high number of news stories connected with prevention and education emphasized in the television news so people needed to obtain sufficient health protection information, causing more panic. In 2009, television news used some new ways of informing people, who, it can be said, were certainly constantly informed about the health crisis. Television news was describing the risk of the flu in detail, they talked a lot about deaths, about the fact that children and

pregnant women had a higher risk of getting infected and dying, a lot was even said about vaccination problems and so on. This meant that panic grew with every specific media report because there were no positive reports. Governments should explain to the public all safety instructions and approaches for disease prevention but they were mostly quiet and the media were able to provide whatever they wanted (Pan & Meng, 2015).

We can say that television news uses a lot of signals describing how to effectively prevent disease. Those signals are, for example, past cases, doctors' opinions, medication costs and vaccines, government responses and so on. Therefore, it is very important that governments' emergency management systems take the utmost care with all safety precautions in all flu pandemics, no matter when they occur. Information is the key factor for helping governments all over the world provide some guidelines for the public. Also, the actions of governments are very much dependent on the information provided by the media etc.

5.1 Real-time data sources for early warning of infectious disease

The main idea is that in modern times we are all dealing with some free sources of unstructured information. We read news on the internet, visit online discussion sites such as forums, and upload detailed local and real-time data about diseases on the web. In addition, much can be found on those sources about countries where there is a lack of traditional public health surveillance. We know a lot of systems by which we can achieve improvement of public health surveillance and better interventions in the spread of diseases, so a considerable benefit for public health organizations as well as for people would be achieved.

In recent years, global travel and the emergence of new diseases have seen a significant increase, so there is a clear need to have a digital information platform by means of which we could get the best information as quickly as possible. We should also have warning systems by which we can react faster. It was discovered that the timing of the maximum prevalence of the pandemic wave together with amplitude and duration might be predicted by standard regression analysis. In the regression analysis there is a need to fit a mass-action epidemic model to the surveillance data. In 2009, something strange happened because a lot was said about the big number of deaths but ultimately the real number was much lower. It is a key fact that the prediction of important events using good information should be at a higher level. The previously mentioned regression analysis should have been used in 2009 and the actions taken by the authorities should provide more details which might result in different steps to achieving better health among the population (Hall, Gani, Hughes & Leach, 2007).

In the past there have been some well-known surveillance systems which have established reporting processes at local, regional and national level which then lead to the international level. The process is slow, which causes problems for analyzing huge amounts of data and means that disease can spread much faster. The solution for the problem described is Epidemic Intelligence (EI) which comes in a digital form of geographical and

communication tags. Scientists have provided many different Epidemic Intelligence systems which might be used for processing outbreaks of possible pandemics and those are the Global Public Health Intelligence Network (hereinafter: GPHIN), HealthMap, MediSYS, Argus, BioCaster, EpiSPIDER etc. The difference between those various systems are the different data types they use. They also work on different levels of automation and human analysis but ultimately, all of them provide some distinct information. If we take a look at GPHIN, the system provided by Health Canada and used also by WHO, it can be compared with HealthMap and EpiSPIDER because all of them provide unstructured event-based reports and analyze global infection disease surveillance but the problem is speed. For reports from such systems we need a couple of days but the virus might spread faster, and some media reports are not reliable. Those programs work on different ranges of sources and GPHIN, for example, works only on data provided by companies who sell their service of collecting event information and with a few steps of extracting information, results are provided to clients via a search engine. Another system called HealthMap provides a geographic panorama of possible epidemics and the results are provided completely automatically. The systems described provide different results with different steps to final results but the real problem is whether or not the results are reliable. The results contain a lot of noise and information and are not verified by professionals. It is a fact that wrong data can lead to bad social and economic consequences. (Pan & Meng, 2015; Klemm, Das & Hartman, 2014). Another problem for such systems is the number of media reports because during a pandemic there is a much higher number of news articles but there also is also the risk of a higher number of mistakes (Nelissen, Beullens, Sabbe & Van den Bulck, 2014).

In conclusion, we need to say that all of those systems are good, but future development should still focus on the idea of how to link all the systems together and connect them to public health experts in the field. The media has a significant influence on people and data shared over social media, internet, television, etc., should be used for predicting the worst cases that might happen. They should establish some good networks for alert verification and dissemination to enhance traditional medical surveillance systems, which was proved not to be good enough in 2009. However, it is very easy to say what would be good, but much harder to implement all those ideas into one specific tool.

5.2 Integrated digital public health dashboard – medi+board

The systems described above have many shortcomings which should be addressed for implementing a new system which would help people around the world and be a source of additional help for the biggest health institutions which deal with public health. A group of students from the Department of Computer Science, University College London created a good solution in which all the deficiencies of the previously mentioned systems would be eliminated. This solution is called medi+board and it is able to monitor epidemic intelligence sources and also traditional case-based surveillance. The system automatically provides warnings for possible epidemics, it has the possibility of interaction, and it also provides results in graphic way. An advantage of the system is that it scans all possible multiple data

sources and then patterns with the possibility of new possible pandemics can be found. With this system a very good level of reliability might be achieved because some threats might be correlated with other sources (Kostkova, Garbin, Moser & Pan, 2014). Health organizations all over the world are still not using this program even though the results provided by it are very encouraging and might be especially helpful.

5.3 Twitter as a real-time large-scale population monitor and YouTube as a source of information

Having all important data in physical form is a bad habit because errors might happen while transferring important information by computer for additional tests and analysis. We live in a time when modern technology is all around us and laptops or cellphones are useful tools for data analysis. These modern devices also have the function of synchronizing data so at the same moment we can have the same data on all devices which are connected to each other. This is an advantageous feature for data analysis and making important decisions. Furthermore, people are becoming obsessed with such devices, they read a lot of content on the web, and they also share a lot of content on social media platforms like Twitter, Facebook and others. These platforms provide the possibility of two-way retrieval of data where interesting facts might find a way to the central database to be used for additional research. Another key feature is provided by cellphones and that is GPS location. Every post contains a GPS location, so it shows the place where the content was posted. If we post that something bad has happened, every person viewing that content can see where it happened, and scientists might use that for additional research. In the past none of these things were possible because people did not have such devices, and organizations and governments had complete control over all news published news in newspapers or on television. Now, the story is completely different because anyone can post ideas which might be good, bad, true etc. But that is not enough because other people can comment on every post and can say something more about the posted content. As mentioned already, there can be questions about the reliability of such information, some of it is good and might be very helpful, but some of it is untrue and could be unhelpful. Nevertheless, if information is posted regularly, people tend to believe it (Aanensen, Huntley, Feil, Al-Own & Spratt, 2009).

In pandemic situations some of the biggest health institutions and those that work in the pharmaceutical industry might use social media and news posted online as the best source for solving problems. Those social platforms offer many possibilities for informing people in real-time; they also provide location, and the key factor of speed. One of the best social platforms is Twitter which is made for short messages. This website is an information source, where news and key facts might be published, which should be used for media coverage dissemination whereby people might be informed about risks. The drawbacks of using Twitter might be found in the misleading background of posted tweets which means that some tweets might talk about problems but those problems might not be connected (Paul, Dredze & Broniatowski, 2014).

Nevertheless, the fast process and possibility of posting tweets yield good results and that positive characteristic of Twitter should be used by bigger institutions. It is important to mention that Twitter is very popular so it provides real-time projection whereby people can be informed about what the problem is, what the possible consequences are, why something happened, etc., at the same time that the event is going on. There is just one deficiency and that is the problem of propagating news over Twitter. Some ideas or tweets might be pleasant and interesting and the consequence would be the fast spread of such ideas, but on the other hand while some tweets might be really useful, they would not be spread as they should be. Nevertheless, due to the speed and possibility to post tweets at any time, the authorities should use it as a key source for predicting what might happen. People post content that is popular and it has been ascertained, for example, that people used the term "pandemic" a lot in their tweets the day before the pandemic was announced. Certainly, some of those tweets may have been posted without knowledge or without truth with the aim of being popular and generating a lot of likes or retweets. This material posted without specific knowledge is not useful for scientists and for their need to know about the spread of illness (Kostkova, Szomszor & Louis, 2014).

Twitter can also be used for other cases and one of them is a tool for streaming the disease. Using Twitter posts, the course of disease activity might be discovered much faster than current practice used by the authorities can. This can be done through the activity of Twitter users because they want to provide updates as fast as possible by tweeting about what is going on. All those updates by users are free so the authorities have the opportunity to collect the data quickly and without specific costs. With such information the authorities would have insight into the situation of the disease, how people are dealing with the problem etc. Still, there are some problems. One problem is lack of users in some countries. For example, people from underdeveloped countries do not have computers, and even in countries like the USA, there is a lack of active users among the older population, etc. Therefore, there are a few steps which might bring Twitter's usefulness to a higher level but a huge role is played here by people who need to be active. Twitter as a real-time prevention and detection tool can probably be used for every single disease where there is a need to allocate diseases (Signorini, Segre & Polgreen, 2011; Young, Rivers, Lewis, 2014).

It is a fact that use of social media websites is growing rapidly and such websites are becoming very powerful because more and more people are using them. Together with the popularity of such sites, the extent to which people are influenced by posts is also growing. Nowadays, people regularly read, and also believe, a lot of information posted online, even if such information is not reliable. Although much is said about Twitter, other social websites are also a good tool for talking about diseases. YouTube is one such social website where various videos are posted by the platform's users who also have the opportunity to comment on videos and so on. This website is useful because by talking topics can be explained in a friendly way and might also exert greater influence (Wattenhofer, Wattenhofer & Zhu, 2012). YouTube is also used all over the world and the number of views of some videos are

enormous, which is a consequence of the growing popularity of the website. YouTube should certainly be used for sharing relevant healthcare information which might be provided by the biggest healthcare institutions or even by pharmaceutical companies. With such actions, people might be able to be better informed and would know better how to react and how to deal with such problems. With videos there might be also the problem of misleading information and its dissemination, which are the same problems that might occur while using Twitter. YouTube users want to be informed and they want to understand the issues, and understanding can be facilitated with videos. During the swine flu pandemic, a lot of videos were posted by the Center for Disease Control and Prevention which was held up as a reliable source of information. Some other providers of video content about swine flu were not so reliable. There were 344 videos about swine flu of which 142 were useful with reliable information. In the future, all of the biggest healthcare institutions should use YouTube as a warning tool much more frequently because informing people with videos is easy. We also know that television news is still a useful tool for informing people, but mostly for the older population. For the younger population, YouTube is definitely the best way to provide information about diseases and their consequences (Pandey, Patni, Singh, Sood & Singh, 2010).

6 EVENT STUDY METHODOLOGY INTRODUCTION

Event study is one of the most important tools in finance. Stock prices and also other market instruments can be influenced by many different things. Some of them can be predicted and investors can take some good decisions, while on the other hand, unpredictable events might hurt their finances. When unpredictable events occur investors sometimes do not know what to do. With event study methodology we are able to investigate the effects of some events on a specific dependent variable. Usually, we use stock prices of companies as the dependent variable, because stock prices can be easily found on the web, so we can say that with event study we are looking at changes in stock prices beyond expectations over a period of time, that is over a selected event window. In brief, event study shows whether an abnormal stock price effect has happened due to the selected event. The most important factor is efficiency of the market which causes the consequences of the event to be seen immediately in the prices of the stocks, so we are therefore able to calculate the economic effect of the event over a short period. A particular advantage of event study is that it allows us to present findings to a large group of people who might not have a lot of knowledge and experience of complicated financial theories.

When we decide to use the event study tool, we basically need to implement the following steps:

1. We need to take a decision about which event we want to investigate. After that, we need to collect all the stock data of companies which were in some way influenced by the event. For the purpose of the calculation, the stocks data included should be at least 120 days before and 30 days after the event.

2. We then need to take a decision about which period will be examined around our event date. The date we will examine is called the event window, prior to it we have the estimation window and after it we have the post-event window.
3. For calculation of expected returns during our event window, we also have to calculate some important parameters. We will use the market model, so we have to calculate our alpha, which is a y-intercept, and our beta, which is our slope for our estimation window.
4. When we have gathered all the data and when we have calculated all the important parameters, we can then plot a figure of abnormal returns and cumulative abnormal returns during the event window. Consequently, we can observe the economic effects of the specific event, but we need to be sure that all the possible effects which might post the same consequences on abnormal returns are removed. Also, if we want to obtain good and useful results, we need to work with a reasonably large sample size and we need to choose an appropriate event period.

6.1 Background of the event study model

The first ideas about the event study model were represented in 1970. In this year, some steps were reproduced to examine how a specific event influences the market. This process was represented by Fama, Fisher, Jensen and Roll (hereinafter: FFJR) who captured the effects of a specific event on the selected stock. By choosing the event they also selected the period of time in which the selected firms were dealing with the consequences of the selected event. After that, they looked at the changes in stock price which might be beyond or above normal. In this way they wanted to get information about the relation between the returns of selected stock during the specific month and between returns on a broad stock market index during the same month. The aforementioned scientists used data of monthly returns from 1926 to 1960 and they also included the period with the selected event. Every calculation was made using equation (1), by which they were able to estimate the parameters of the ancestor of the nowadays well-used market model for each stock (Konchitchki & O'Leary, 2011):

$$R_{jt} = \alpha_j + \beta_j R_{mt} + u_{jt} \quad (1)$$

Scientists also redefined the time relative to the event month because in this process they wanted to investigate the average stock price movement for the sample stocks around the month when the event happened. This process is still commonly used and is very useful. Furthermore, a wide factor from the return on stock was even removed by the specific method and also the implemented so-called error term (which can be seen in the equation 1), by which they still have the effect of split announcement.

Average abnormal return was calculated with the equation (2) and this equation (2) is still used frequently nowadays:

$$AAR_k = \sum_{j=1}^{N_k} \frac{AR_{jk}}{N_k} \quad (2)$$

In the equation (2) we can see AR_{jk} which is basically an estimator of the abnormal return for selected stock, while N_k is just the number of firms which were included in the study during the selected month. All of the calculated average abnormal returns are then summed together as in formula (3) by which the cumulative effect can be obtained.

$$CAAR_{K1,K2} = \sum_{k=K_1}^{k_2} AAR_k \quad (3)$$

All the above-described processes of FFJR about how to calculate the final result of Cumulative Average Abnormal Return are commonly used nowadays and are held up as a standard for event study process. There were subsequently other ideas about estimating the market model parameters because the model is quite old. Some other techniques have been implemented but there is no good solution for an event study tool and consequently it is essentially unchanged from 1970. The work of the previously mentioned scientists was good and it can be said that they implemented an important tool which can be of great value (Fama, Fisher, Jensen & Roll, 1969).

The event study model I described has some deficiencies, and some problems which might cause some bad results, but, nevertheless, with some specific actions, many of them might be solved and better results might be obtained. A lot of studies have tried to address such problems of the model but ultimately most of the problems can be ignored because in practice such events do not cause such significant problems in results that need to be used. One problem which arises quite frequently and which is a typical one for our case of swine flu pandemic is cross-sectional dependence. It should be mentioned that this problem does not arise in situations when the event dates are not clustered, which means that event dates are randomly dispersed throughout the whole calendar time. The problems happen when the event time is on a specific date, that is just at one specific time and at the same time this event influences the whole industry and then the securities needed for calculation of the event study (where we are using abnormal return estimates of the market model) are randomly chosen from all possible industries. It is important to note that if the event period is very short relative to the estimation period, then AAR_s time series dependence is not important (Henderson, 1990).

By making a quick overview of event study calculation through the last century, we can say that the event study process has developed a lot in recent decades and consequently, it is used a lot by scientists for various types of research. Event study is not used only in accounting and in finance but also in other areas where scientists want to know what is going on due to a particular event. As mentioned already, the biggest influence on the event study model was provided by Fama, Fisher, Jensen and Roll in 1969 and from that year on some

additional factors arose which made this model even better and made it possible to obtain better results with the calculation. Many methods are used in event study calculation and it is hard to say which one is the best, so the event should be looked at as a whole on a case by case basis, and then the best model for the specific case can be used (Corrado, 2010a).

6.2 Analysis and development of cross-sectional regression

When event time is not completely equal to calendar time, for each problem we can use the estimated standardized average abnormal return for each calendar month k as the dependent variable in a weighted least squares regression. This might be done using the special portfolio method which was developed in 1974. Basically, this is explained by disturbances which might occur in a regression where we have firm specific variables and when we use estimated abnormal returns for the sample firms for the dependent variable. Such disturbances might be correlated and heteroscedastic. There are additional ideas about how to deal with such problems. Another is in the situation where the average value of each explanatory variable for the firms in the calendar month's portfolio is weighted in such a way that we divide the observations by the estimated standard deviation of the average abnormal return. Elimination of cross-sectional dependence in the dependent variable might be done by combining a portfolio of securities which are somehow connected with the event in the same calendar month and then the estimation of the regression is made with the data for the portfolios. Elimination of heteroscedasticity is made by weighting estimates of portfolio abnormal return and the average values of the portfolio of the independent variables. The minimum variance coefficient estimates are achieved by weighting all the observations in this way. Some other ways of solving this problem were developed in the past because this approach is possible and it can be used only when the event time is the same as calendar time, which is not always possible (Binder, 1998).

Such problems are still present and a lot of approaches exist to deal with cross-sectional dependence. All the approaches deal with the problem but we cannot really say which approach is the best and for now there is no specific method commonly used by those who deal with such problems. From among all the ways mentioned to eliminate such a problem (there are even more of them), which provide good results, every person who is dealing with these problems should use the best possible way to achieve the best end results.

6.3 Which are the models of normal return?

MacKinlay from The Wharton School of the University of Pennsylvania provided a useful article for the Journal of Economic Literature (1997), where he described nicely the all-important elements connected to event study methodology. To measure the normal rate of return to generate estimates of abnormal return at the end, we know a variety of models which were developed and used extensively by scientists. Those approaches can be grouped into two categories, where first group is statistical and the second group is economic. In the statistical category models simply follow some statistical assumptions concerning the

behavior of asset returns and it should be mentioned that they do not depend on any economic arguments. The second category is completely different because the models rely on assumptions concerning investors' behavior. However, there is a kind of a rule that while using economic models in practice, it is necessary to add some statistical assumptions even if the behavior is present. There is a potential advantage of economic models over statistical models because there are chances of calculating more precise measures of the normal returns by using some economic restrictions. While using statistical models an important assumption is imposed which is that asset returns are jointly multivariate normal distributed through time. This assumption is useful because it does not lead to problems, is empirically reasonable, and inferences using the normal return models are somehow robust to all deviations from the assumption.

1. The Constant Mean Return Model is probably the simplest model and was developed by Brown and Warner. It often provides the same results as other models. Nevertheless, results based on this model do not systematically deviate from results based on more sophisticated models, so the problem is when we perform long-term event studies. It is important that the variance of the abnormal return is not much reduced by choosing a better model even if there is a lack of sensitivity (Campbell, Andrew & MacKinlay, 2012).
2. The Market model is a statistical model and its main idea is to relate the return of any given security to the return of the market portfolio. Actually, this model is a set of numerous statistical assumptions which are merely asserted and there are still some unresolved methodological problems with them. Nevertheless, this model is a significant improvement on the constant mean return model. We can say that because the point of the model is to remove that portion of the return which is related to the variation in the abnormal return and, at the end, the final result is lower variance of the abnormal return. Therefore, basically, the model is built on the actual returns of a reference market and the stock correlation of a specific selected company which has the reference market. Furthermore, an important aspect that needs to be mentioned is the benefit from using the market model. The benefit depends mostly on R^2 of the market model regression because the higher the R^2 is, the larger the variance reduction of the abnormal return, and even the gain. By using the model, there is a greater possibility of finding some effects of the specific event (Coutts, Mills & Roberts, 1994). The market model can also be represented on the graph and it should look like a line which fits to a plot of asset returns against returns on the market portfolio. A problem might occur in the model in a situation when events are not clustered in calendar time, and a consequence of that might be higher variance of estimators of abnormal returns than disturbances of our market model. Another fact which needs to be mentioned is the unbiasedness of the model which might happen when a larger sample of unrelated securities is used than the model estimator of the average abnormal return or when event dates are not clustered in calendar time. In these conditions the market model estimator is efficient.

3. Other statistical models have been proposed, one of which is the factor model or so-called multi-factor model the main idea of which is to reduce the variance of the abnormal return by the variation in the normal return and the main factors are usually portfolios of traded securities. By using the multi-factor model, we want to measure normal returns. This model might contain a different number of factors, so it could be based on three or even four factors. We know a lot of different one-factor models and the first one-factor model is the previously mentioned market model. The two-factor model can be found in banks, where we have bank returns as one factor and the percentage change of interest rates on long-term government bonds as the second. Then, probably the most known three-factor model was developed by Fama and French in 1993. In their CAPM model they use two additional factors with which they claimed that much of power of the model is achieved. They claimed that such things are anomalies which should be included into the calculation because they are important and the fact that CAPM model does not pay attention to them is enough to put them into the observation. In the three-factor model all anomalies disappear and possible explanations for that are said to be irrational pricing and data problems (Fama & French, 1996).
4. As mentioned already, there are other well-known models which contain some restrictions in the calculation and those are, for example, Capital Asset Pricing Model (hereinafter: CAPM) and Arbitrage Pricing Theory (hereinafter: APT). There are a lot of questions about how good the CAPM model is and whether it is good enough for use but nevertheless, this model is used a lot to calculate expected returns of specific assets and to price securities. The reasoning behind CAPM was connected with the idea that not all kinds of risks should have an effect on asset prices but basically some risk can be diversified away when holding it in portfolio and consequently we do not have risk anymore (Perold, 2004). On the other hand, APT is a theory where the expected return of a given asset is a linear combination of different factors which create risk. In APT we can include as many factors as we want and every additional factor adds some explanatory power of multiple risk factors.

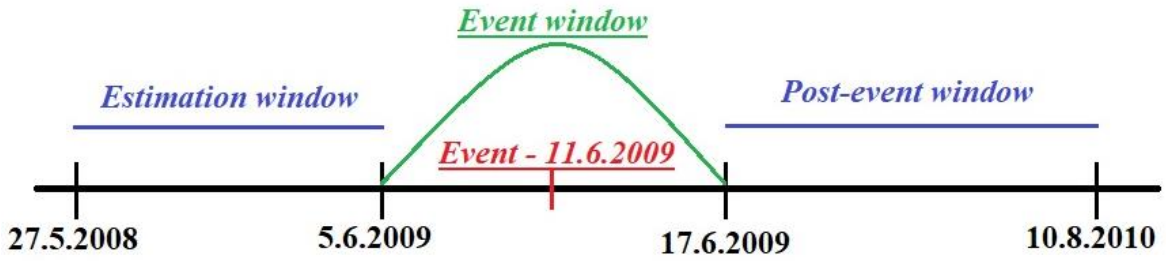
Among all the models mentioned above, statistical models are probably the best due to the elimination of most of the biases, and consequently they are the leader among the models in event study calculation.

7 EVENT STUDY CALCULATION

The most important date, which is the main date for my event study, is June 11th when World Health Organization raised the swine flu pandemic alert from Phase 5 to Phase 6. First of all, I will make a calculation for biggest European pharmaceutical companies, then I will continue with the biggest American pharmaceutical companies and at the end, I will compare both markets to see how big the influence was on the pharmaceutical market due only to the WHO decision.

We can see my event window in the figure 4. I decided that my event window would start on June 5th 2009 and end on June 17th 2009, and my event is in the middle of the selected event window. The estimation window starts on May 27th 2008 and the post-event window ends on August 10th 2010. It is important to highlight the presence of total clustering because my event influenced every selected company in my research on the same day, so the event is clustered on June 11th 2009. Essentially the event affected the whole financial system.

Figure 4: Testing period of event study for selected event



Source: own work.

With my event study I concentrated on the abnormal returns and cumulative abnormal returns of the selected companies. With that we are able to compare both markets and see which markets the flu had a bigger influence on. As a benchmark I took the S&P 500 index. It should be mentioned that the mean adjusted return model, which was used for calculation, has a lot of critics but still it is the model most frequently used for the calculation of abnormal returns.

The best results to show that the immense effects of the swine flu can be provided by using randomly selected companies, because some of them were connected with the production of the vaccines while some were not, but ultimately, we should get positive upward movement of companies' returns.

My calculation started by collecting returns for all firms, then I calculated expected returns (average of returns) for each firm in the period. After that, I took the return on event day for each firm and then I calculated our cumulative abnormal return for each firm as the difference between the realized return on event day and between expected return. After that I also made a test statistic. It was calculated as the average cumulative abnormal return divided by standard deviation of that cumulative abnormal return. An important element in that procedure is that I divided standard deviation by the square root of one divided by the number of firms, because I had to correct it for the number of firms. Next, I used the procedure which was described by MacKinlay in 1997. First, I collected data and then I calculated returns for each firm and for the S&P 500 index in the estimation window and then I ran a regression. In that way I was able to get alpha and beta for the market model. I was then able to calculate expected return in the event window and I was also able to get abnormal returns as the difference between expected return and realized return in the event

window. I summed the abnormal returns which gave me cumulative returns. I also needed to do standard test statistics for abnormal returns, which are statistically significant for the 5% level if the absolute value of test statistics is higher than 1.96 (MacKinlay, 1997).

7.1 Hypothesis of calculation

Event study is a tool which is used to examine the effect of a selected event on a number of firms which can be chosen without any specific criteria. Our hypothesis (4) looks like this:

$$H_0: AR_t = 0;\ \forall t = 0.1, \dots, n \tag{4}$$

$$H_0: means\ that\ abnormal\ return\ at\ time\ t\ is\ zero$$

$$H_o: event\ has\ no\ impact\ on\ companies'returns$$

An alternative hypothesis (5) can be also chosen:

$$H_1: AR_t = 0;\ \forall t = 0.1, \dots, n \tag{5}$$

$$H_1 = event\ had\ an\ impact\ on\ companies'returns$$

In the calculation procedure I was able to accept or reject the null hypothesis with $\propto = 5\%$. As mentioned already, with event study I wanted to reject the null hypothesis and to show that the selected event had a huge impact on companies.

7.2 Calculation for the biggest European pharmaceutical companies

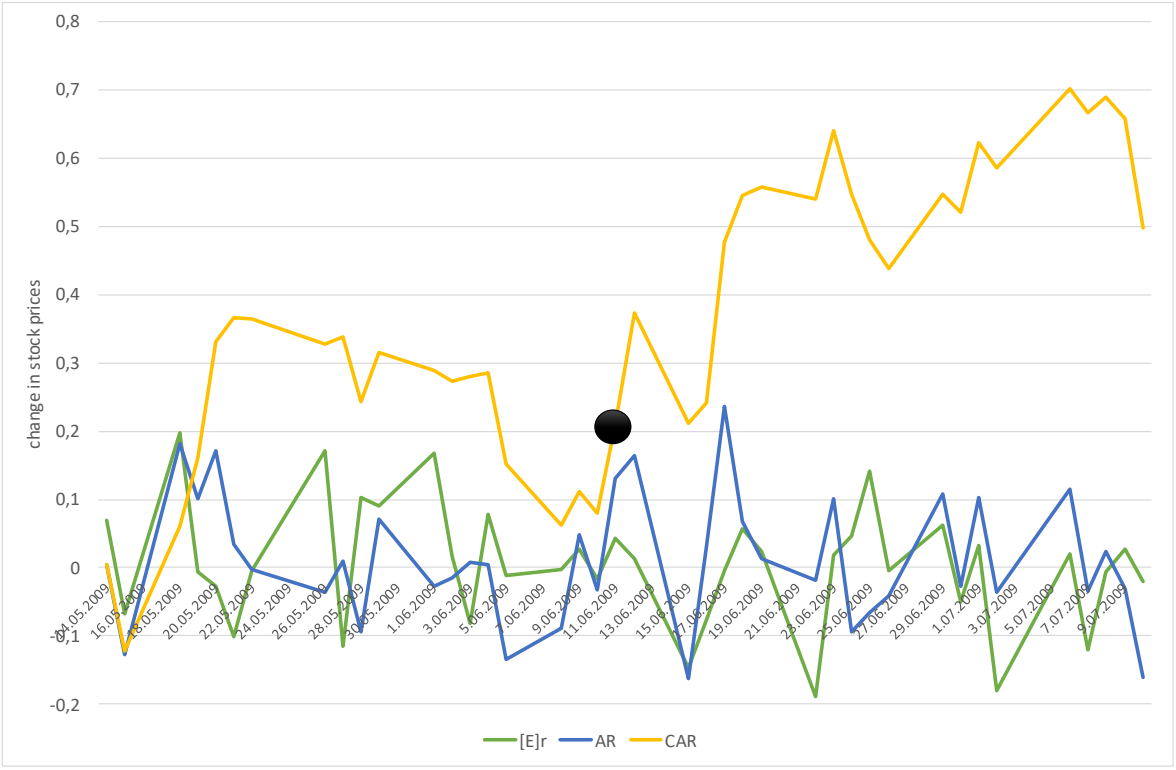
In the calculation procedure I took the following European pharmaceutical companies:

- Novartis International AG (It is a global healthcare company based in Basel, Switzerland and its purpose is to provide solutions to address the evolving needs of patients around the world.),
- Hoffmann-La Roche AG (Often referred to simply as Roche. It creates innovative medicines and diagnostic tests by which it tries to help millions of patients around the world. It is located in Switzerland and it operates worldwide.),
- Sanofi S.A. (It is a multinational pharmaceutical company and its seat is in Gentilly, France. In 2013 it had the fifth-largest world prescription sales. It is also a global healthcare leader which is focused on patients' needs. It offers different medicines, consumer healthcare products, generics, animal health etc.),
- GlaxoSmithKline (or GSK for short, is a British pharmaceutical company with headquarters in Brentford, London. It is not an old company. It was established in 2000 but in 2015 it was the sixth largest pharmaceutical company in the world.),
- AstraZeneca plc (It is a global biopharmaceutical business whose products and innovativeness are used by patients all around the world. It was established in 1953 but

its most important year was 1999 when the Astra company from Sweden joined with the British firm Zeneca.),

- Bayer AG (It is a German chemical and pharmaceutical company and its most important product, well known around the world is Aspirin.),
- Fresenius SE & Co. KGaA (It is a European healthcare company which is based in Germany. Its products are focused on dialysis and outpatient medical care, on hospital management etc.),
- Merck Group (This is a multinational chemical, pharmaceutical and life sciences company with headquarters in Darmstadt, Germany. It has a long tradition, established in 1668 which means that it is the world's oldest operating company.),
- Novo Nordisk (This is a global healthcare company from Denmark. It has a more than 90-year tradition of innovation and is a leader in diabetes care. Its production facilities can be found in eight countries around the world.),
- Allergan plc (Although it is a multi-national pharmaceutical company, it is headquartered in Ireland. It produces branded and generic drugs and it works extensively on pharmaceutical research and development.),
- Endo International (This is a company from Ireland. It was created as a result of a management buyout from DuPont Merck in 1997.),
- Union Chimique Belge (UCB for short, this is a global biopharmaceutical company. Its focus is creating value for people who live with immunology and neurology conditions. Its headquarters are in Brussels, Belgium.).

Figure 5: Calculation for the European pharmaceutical market



Source: Yahoo Finance (2017), own work.

I tried to put into the calculation all the biggest European pharmaceutical companies, which together have a huge number of employees and generate massive profits every year. I tried to select companies from different European countries but Germany is still the country with the most-developed pharmaceutical niche.

On the figure 5, we can see abnormal returns of European pharmaceutical markets of randomly selected firms in Europe. We initially suspected that WHO decisions have a strong influence on the whole pharmaceutical market, which we wanted to calculate and provide a graphical result for better explanation. Our event date is labelled with the black dot on the yellow line which represents cumulative abnormal returns (hereinafter: CAR) of selected companies. We can see that from the event date onwards CAR started growing rapidly. We can also see some upward movement a few days before the event date which might be the consequence of rumors about the highest pandemic alert, due to the growing number of deaths or even due to the World Health Organization pandemic alerts which were one of the most important news stories months earlier. We can see positive upward movements on the European market so we can conclude that the highest pandemic alert of WHO had a positive impact on the pharmaceutical market, which is precisely what I aimed to show. We can also suspect that even after the end of the event window the CAR would still go up, so the WHO decision was not just positive for sudden abnormal returns but can cause significant results even over a longer period. Due to WHO issuing the highest pandemic alert, CAR started growing, proving that the decisions of such big and important institutions as WHO have a great deal of influence on the whole healthcare industry.

7.3 Calculation for the biggest American pharmaceutical companies

In the calculation procedure I took the next biggest pharmaceutical companies according to their revenue, tradition and influence on the pharmaceutical market in USA:

- Gilead Sciences Inc. (It is a company which is focused on the discovery, development and commercialization of some innovative medicines. It is based in California and for many years its main business has been antiviral drugs used in the treatment of HIV, influenza, hepatitis B and hepatis C. It was founded just 30 years ago.),
- Johnson & Johnson (Its headquarters are in New Jersey, was established in 1886 and is well known all around the world. It produces multinational medical devices and also some pharmaceutical goods. It has around 250 subsidiaries in more than 60 countries around the world.),
- Pfizer Inc. (It is a well-known pharmaceutical corporation with headquarters in New York City. It is one of the world's largest pharmaceutical companies and it produces vaccines and other medicines for a variety of medical areas like immunology, oncology and so on. It was founded in 1849 so it has a long tradition.),
- Amgen Inc. (It was previously known as Applied Molecular Genetics but from 1980 has simply been called Amgen Inc. It is an American biopharmaceutical company which is headquartered in Thousand Oaks, California. This multinational company is the world's

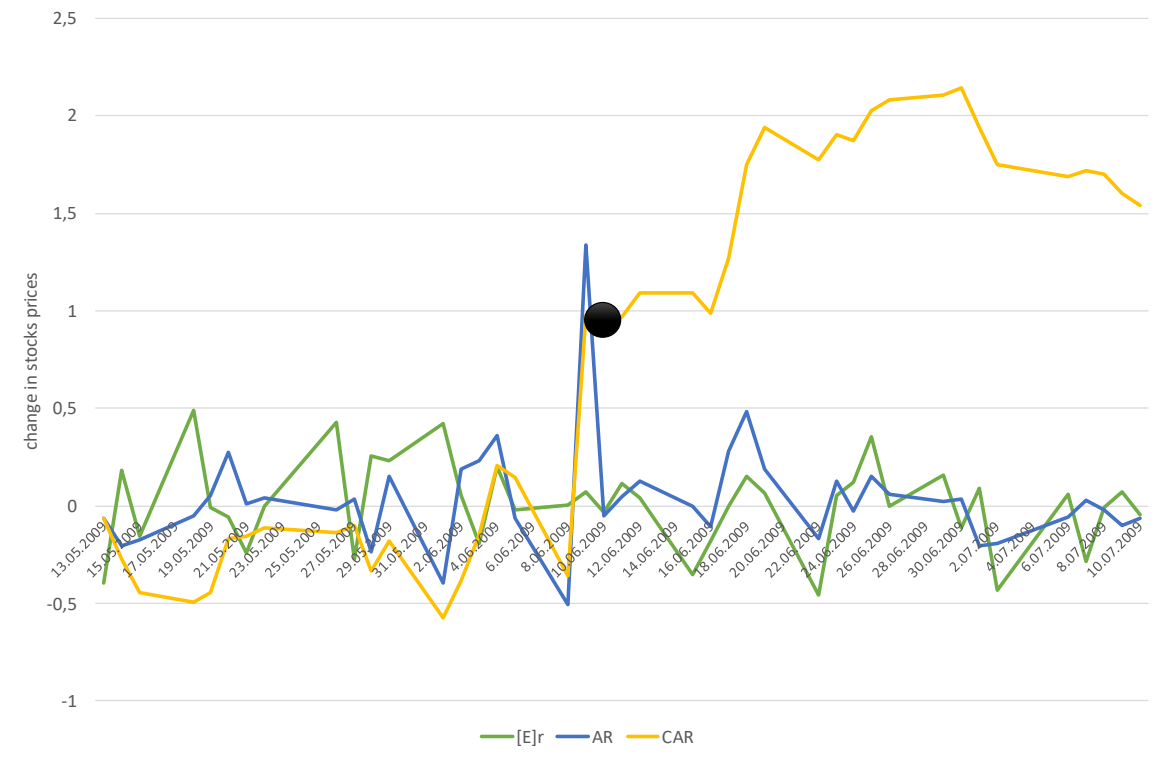
largest independent biotechnology firm and is well known because of two vaccines which are used to prevent infections in patients undergoing cancer chemotherapy.),

- Merck & Co. Inc. (Its headquarters are in New Jersey and it was founded in 1891 as a subsidiary of Merck; it became an independent company in 1917. Merck currently employs over 2500 people and it pioneered the commercial manufacture of morphine for an expanding global market.),
- Eli Lilly and Company (It is a global company with headquarters in Indiana. It has also lot of other branches in 17 countries around the world. It was founded in 1876 and first became well known due to the mass-production of penicillin, insulin and Salk polio vaccine. The company is also very famous for drugs used in psychiatric medicine, the most well known of which are Prozac, Dolophine, Zyprexa, etc.),
- Bristol-Myers Squibb (Often referred to simply as BMS, this is a pharmaceutical company with headquarters in New York City. They manufacture drugs for cancer, HIV, cardiovascular diseases, diabetes, psychiatric disorders, rheumatoid arthritis, hepatitis etc. It was founded in 1887 as Bristol-Myers and in 1989 it was merged with Squibb. The company wants to develop and deliver innovative medicines which can help treat serious diseases.),
- Abbott Laboratories (It is a famous healthcare company with a tradition going back 129 years. It works worldwide but its headquarters are in Illinois. At first, the company just formulated some already-known drugs but then it also started to produce medical devices and sell some research-based drugs. Nowadays, its medical tests and diagnostic instrument systems are mostly used in hospitals and laboratories around the world, providing the possibility to diagnose HIV, hepatitis, cancer heart failure, etc.),
- Biogen Inc. (It was formerly named Biogen Idec and is a multinational biotechnology firm based in Massachusetts. It is specialized in discovering, developing and delivering therapies which can help against some neurodegenerative, hematologic and autoimmune diseases. It was established in 1978 and in 2003 it merged with California's IDEC Pharmaceuticals.),
- Mylan N.V. (It is a 56-year-old company with headquarters in West Virginia. It has many subsidiaries around the world for different pharmaceutical areas. Initially it manufactured only penicillin G and some vitamins, but as time has passed, its range has become much bigger.),
- Valeant Pharmaceuticals International Inc. (It is a pharmaceutical company which was established in 1960. Its headquarters are in Quebec and although it is not an American company, I decided to put it in the USA area, because it exerts a huge influence there. It develops a broad range of pharmaceutical products and its primary areas are dermatology, neurology, gastrointestinal disorders, etc. It tried to acquire Actavis and Cephalon, so we can see that it has a strong presence on the American market.),
- Acadia Pharmaceuticals Inc. (It was established in 1993 in San Diego. It is a biopharmaceutical company and it carries out a lot of work on treatment for Parkinson's disease psychosis. In 2012, they extended a drug discovery and development research agreement with the European pharmaceutical company Allergan. With the agreement

they want to work together in the discovery of new therapeutics for glaucoma and ophthalmic conditions.),

- Acorda Therapeutics (It was founded in 1995 in New York. The company's main purpose is developing drugs to improve therapies which improve neurological function in disorders of the central nervous system.),
- Alexion Pharmaceuticals Inc. (A company from Connecticut, founded in 1992 and is well known due to the development of drugs used to treat rare disorders like hemolytic uremic syndrome. The company works worldwide and is concerned with immune system research related to autoimmune diseases.),
- Avax Technologies Inc. (It is a company based in Philadelphia and known due to the cancer vaccine MVax.),
- Baxter International Inc. (It was established 86 years ago and its headquarters are in Illinois. The company produces vaccines with which hemophilia, kidney disease and other immune disorders may be treated.),
- BioMarin Pharmaceutical Inc. (This California-based company was established in 1997. It does a lot of work in Asia and Europe and it was the first company to provide therapeutics for mucopolysaccharidosis. It now has six products on the market.) and
- Celgene Corporation (It is a biotechnology company with its headquarters in New Jersey and it works worldwide. It was established in 1986 and its main purpose is discovering, developing and commercializing medicines for inflammatory disorders and for cancer.).

Figure 6: Calculation for the USA pharmaceutical market



Source: Yahoo Finance (2017), own work.

All of the companies listed in the chapter were randomly chosen because I wanted to present the effect on the whole market in the USA. I chose the biggest companies in the American market, but I also picked some companies which are smaller but still have a considerable influence on the pharmaceutical market. I also included one Canadian company, because its strategic area is closely connected with American companies. As well as working a lot with companies in America, it has also tried to merge with some companies there in the past.

On the figure 6, we can see that our idea about extent of the influence of WHO on the pharmaceutical market is true. From the figure 6 we can see that from 11th June 2009 onwards (black dot on the figure 6), abnormal returns started growing very fast. It is quite interesting that the highest jump was one day before the highest pandemic alert, so on 10th June, which is probably a consequence of rumors and the media where there was a lot of discussion about the WHO decision.

In the previous figure 5 showing the European market, we saw that the consequence on the randomly selected pharmaceutical companies was big. We wanted to see what happened in the USA because that is where the pandemic started. We can see from the figure 6 that the effect of the WHO decision on the market was once again considerable and the consequence was even greater than in the European market. Such a big jump was probably due to the number of infected people as well as panic among them, and also due to the fact that everything started in the USA. There were also more valuable contracts with pharmaceutical companies and bigger problems.

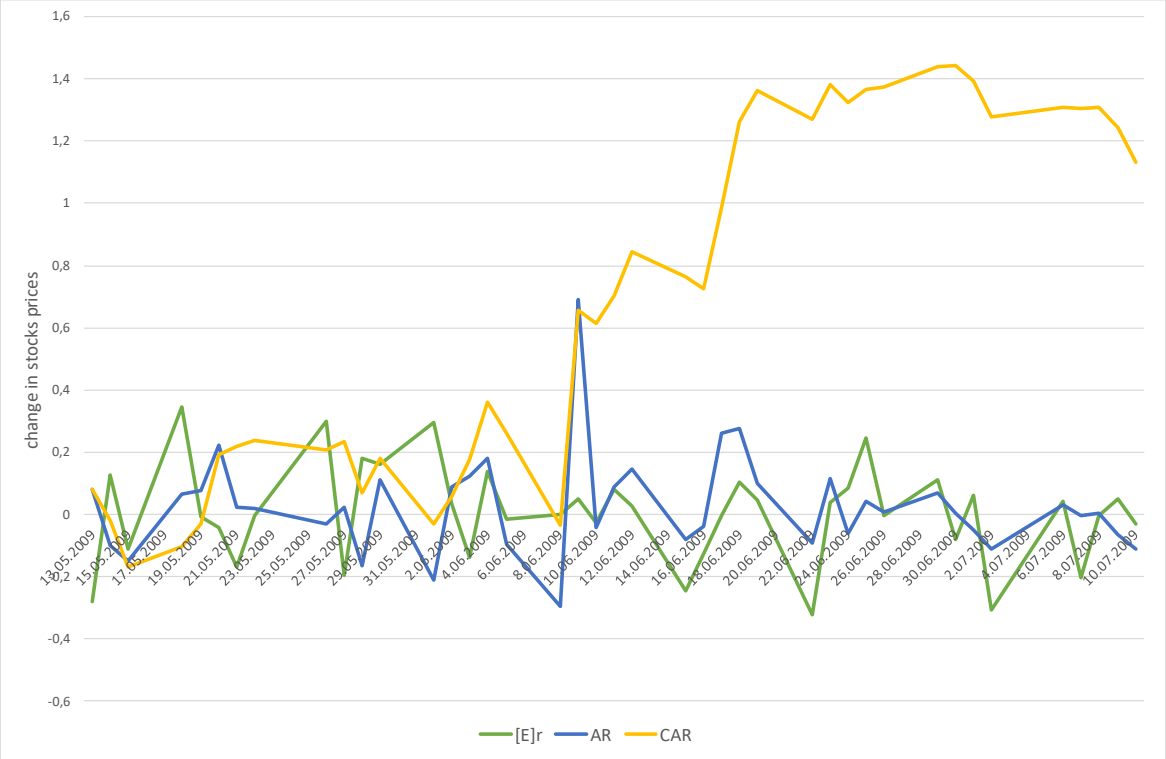
7.4 Calculation for both markets together

After the separate calculation for each individual market, I also made a calculation for both markets together, where I put all companies from the EU and USA markets together. With that I wanted to see how much the WHO decision affected both markets, because we said earlier that everything started in the USA, but the pandemic problem spread all over the world. Therefore, no matter where the pandemic starts, it will have consequences across the world.

We can see from the figure 7 that WHO's decision to declare the highest pandemic alert had a huge impact on the pharmaceutical markets of the EU and USA. If we look at the previous two figures (figure 5 and figure 6) and the figure 7, we can see that there was definitely a much higher impact on the USA market, because the figures for both markets together and the USA market alone are almost the same.

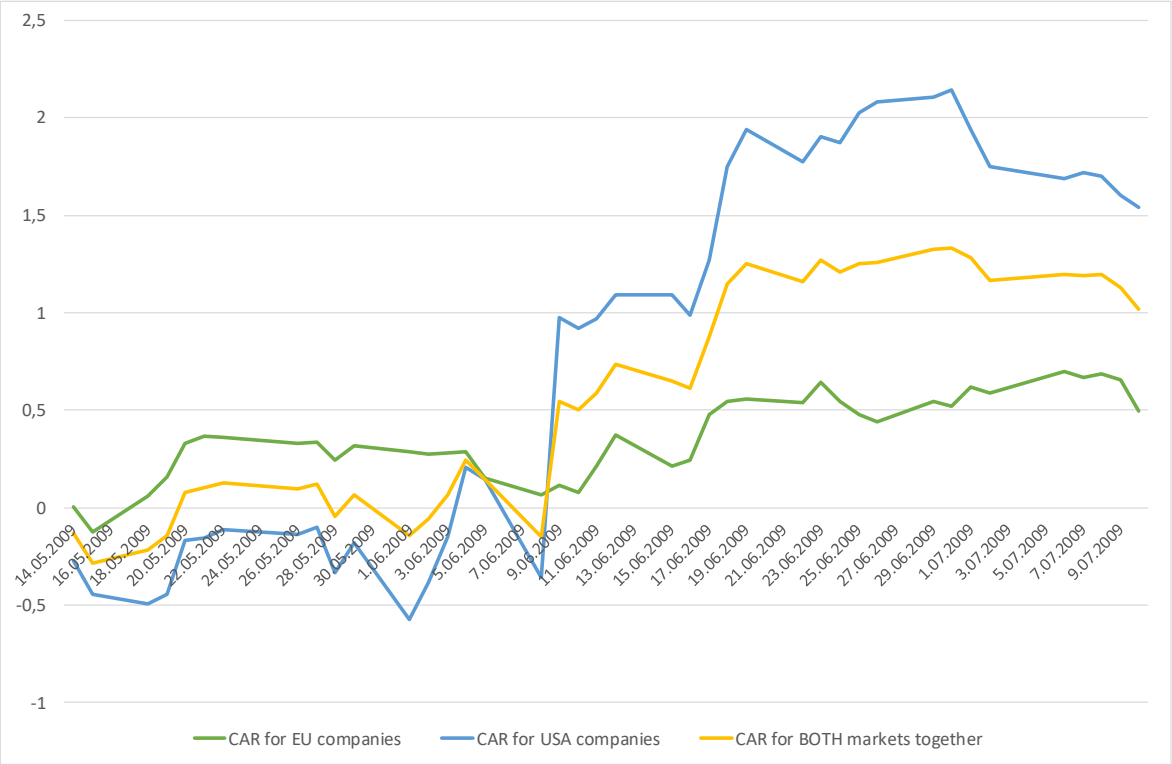
The most important reasons for that were the investments into pharmaceutical companies, and contracts which were signed with American pharmaceutical companies. The pandemic started in the USA so companies there have a greater influence on the whole healthcare market. The American authorities provide vast sums of money for some of biggest companies which were developing vaccines for flu and all of those factors contributed to such high abnormal returns for companies.

Figure 7: Calculation for USA and EU markets together



Source: Yahoo Finance (2017), own work.

Figure 8: CAR for both markets



Source: Yahoo Finance (2017), own work.

In the figure 8, we can see CAR for both markets separately and yellow CAR which represents both markets together. We can see that the biggest difference from the WHO highest pandemic alert was on the USA market but even on the EU market CAR started to grow, although more slowly. The result for both markets together provides a significant result in CAR which means that the WHO decision caused vast abnormal returns for pharmaceutical companies. We can say now that WHO decisions have a huge influence on pharmaceutical companies all over the world. If we were to calculate abnormal returns for some other pandemics, the results would probably be similar.

We ought to also mention that the USA market is bigger than the European market. If we take a look at some of the basics about the size of the pharmaceutical industry, we can see that in 2009 the world pharmaceutical market was estimated at $837 billion according to IMS Health. The European market was approximately $263.9 billion, which represented 31.5% of the whole market while the USA market together with Canada and Latin America stood at approximately $371.6 billion, which represented 44.4% of the global pharmaceutical market. All ten of the biggest pharmaceutical companies worldwide were included in the calculation and those were Pfizer, Merck & Co., Novartis, Sanofi-Aventis, GlaxoSmithKline, AstraZeneca, Johnson & Johnson, Eli Lilly and Bristol-Myers Squibb. Due to the bigger market of the USA in comparison with the EU market, even the abnormal returns are different. Companies in the USA have better possibilities for implementing new drugs and might produce more medicines in a shorter time than companies in the EU. The whole pharmaceutical market in the USA needs to provide medicines for a bigger population, which is another important factor in the results of American companies and there was also a bigger number of infected people in the USA than in the EU, because the swine flu started in the USA, which meant that more people needed to be vaccinated. Other countries like Mexico also needed medicines and most of them were provided by American companies because Mexico does not have the same kind of possibilities for developing new medicines as the USA does with its numerous scientists and laboratories, etc.

7.5 Cross-sectional test

Table 1: Results for both markets together and test statistic

Date	[E]r	AR	CAR	AR t-test	AR significant?	CAR t-test	CAR significant?
5.06.2009	-0.030694	-0.196206	-0.196206	-0.591696	NO	-0.591696	NO
8.06.2009	0.002183	-0.594137	-0.790343	-1.791727	NO	-2.383423	YES
9.06.2009	0.100843	1.383905	0.593562	4.173417	YES	1.789994	NO
10.06.2009	-0.051800	-0.083131	0.510431	-0.250696	NO	1.539297	NO
11.06.2009	**0.157863**	**0.174830**	**0.685261**	**0.527233**	**NO**	**2.066530**	**YES**
12.06.2009	0.054807	0.288208	0.973469	0.869142	NO	2.935673	YES
15.06.2009	-0.495253	-0.163424	0.810045	-0.492834	NO	2.442839	YES
16.06.2009	-0.253764	-0.074105	0.735940	-0.223477	NO	2.219363	YES
17.06.2009	-0.005926	0.519516	1.255456	1.566694	NO	3.786057	YES

Source: Yahoo Finance (2018), own work.

As mentioned above, we can see in the table 1 positive abnormal returns, which are mostly growing over the selected days. We can see that according to the results, the result on the event date is non-significant for abnormal returns. It is significant just two days before the event date. According to the results, we can claim that results are not statistically significant on our event date.

I also made a calculation for cumulative abnormal returns. We can see from the table 1 that the results are significant three days before the announcement of the highest pandemic alert and also from the announcement till the end of the calculation.

Due to the results from the AR test, I wanted to correct the test statistics. In our event study we used daily stock returns, one of the methods most frequently used in event studies. When the event day is the same for all companies in the sample, we have cross-sectional correlation among abnormal returns and Kolari and Pynnonen claimed that even a small cross-correlation might have an effect on test results, especially if it is not properly accounted for. We mentioned before that with our selected event we have a big problem because there is a total clustering so the event affects every company at the same time. We need to deal with that somehow and there are different ways to do so. I have already mentioned Kolari and Pynnonen and I also used their correction to tests for abnormal returns which is set on average correlation coefficient; the biggest problem with this is that they claimed that the correlations must depend on the size of the sample and then this size of the sample needs to tend to zero. That condition almost never holds but nevertheless, we need to mention that cross-sectional correlation of an abnormal result is a difficult problem to deal with and all the options to deal with it are very complicated or not well explained.

I made a correction by setting equal weights for every company included in the calculation procedure. After doing that, I summed them up and I got a return of my portfolio with weighted returns by number of firms over the whole of the studied period. The number of companies for both markets is 30, so I weighted returns by 1/30.

Table 2: Results for both markets together with corrected test statistic

Date	[E]r	AR	CAR	AR t-test	AR significant?	CAR t-test	CAR significant?
5.06.2009	-0.036707	-0.159856	-0.159856	-0.507319	NO	-0.507319	NO
8.06.2009	-0.006012	-0.560343	-0.720199	-1.778307	NO	-2.285627	YES
9.06.2009	0.086097	1.392946	0.672747	4.420661	YES	2.135035	YES
10.06.2009	-0.056412	-0.038168	0.634579	-0.121131	NO	2.013903	YES
11.06.2009	**0.139332**	**0.226711**	**0.861290**	**0.719491**	**NO**	**2.733394**	**YES**
12.06.2009	0.043117	0.300049	1.161339	0.952237	NO	3.685631	YES
15.06.2009	-0.470423	-0.142877	1.018461	-0.453437	NO	3.232194	YES
16.06.2009	-0.244967	-0.112314	0.906147	-0.356440	NO	2.875754	YES
17.06.2009	-0.013584	0.428353	1.334500	1.359423	NO	4.235177	YES

Source: Yahoo Finance (2018), own work.

In the table 2 we can see some significant differences between the corrected and uncorrected test statistics. Still, we can see a positive answer for AR significant two days before event date. We need to mention that no perfect technique exists for dealing with cross-sectional abnormal returns. Many researchers are trying to find new approaches to deal with this and to get more accurate results without any bias. I made also a test for CAR and it can be seen that results are significant from three days before the pandemic onwards.

Corrado and Truong in 2005 and also Luoma in 2001 said that if the data is available, we should use a long estimation window length and that is the best way to obtain reliable results. In my event study I used an estimation window of 250 days and therefore it can probably be claimed that my results in the event study are reliable.

Although we made a correction, we would expect different results from our test statistics. Certainly, there should be more results like that on 9.6.2009 because these adjusted t-test statistics are used to test whether the CAR is significantly different from zero and, according to the table 2, we cannot clearly claim that.

Nevertheless, due to all the tests, we can make some conclusions. We can reject a null hypothesis for both tests and our answer is that World Health Organization had some effect on abnormal returns and on cumulative abnormal returns of the selected companies.

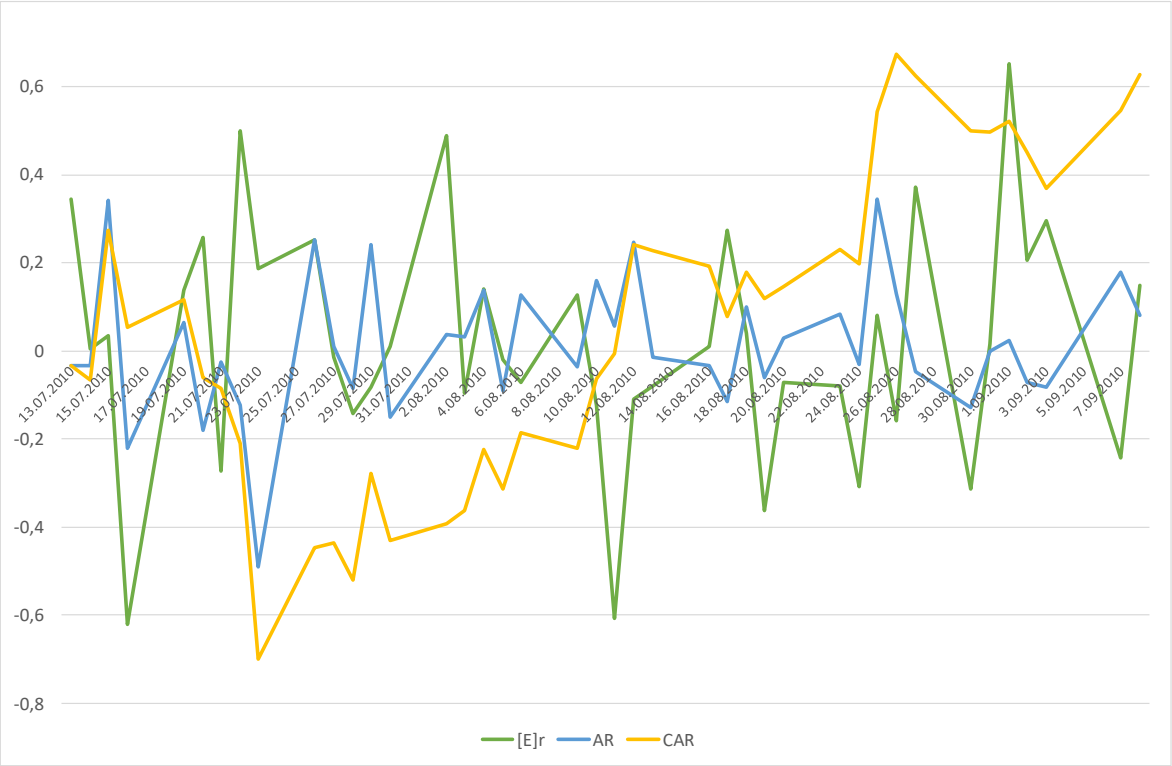
7.6 Post-pandemic period of the 2009 swine flu pandemic

The general director of WHO Margaret Chan announced the post-pandemic period of the 2009 swine flu pandemic on 10th August 2010. This announcement was made on the recommendation of the WHO Pandemic Emergency Committee which claimed that the level of influenza and the situation among people was back to the level before the pandemic (European Centre for Disease Prevention and Control, 2010). This post-pandemic period was not a sign that H1N1 virus was completely eradicated and while it would not cause any major problems it would continue to circulate among people for many more years. Even when the period was announced, it was said that problems might be still present among the younger population but there were some reports from countries about good vaccination coverage. Nevertheless, viruses are very unpredictable and it is likely that they might cause some additional problems in future but in 2010 said it was said that the real concern which was present in 2009 about the potential consequences of the virus was over. The virus was not highly influential and vaccines basically provided a good level of protection against the virus. Countries were able to detect cases and report them faster because the virus was now known and they were better prepared to deal with the possible problems connected with the virus.

In this chapter I wanted to look at what happened with cumulative abnormal returns after the highest pandemic alert. I performed an event study for the announcement of the post-pandemic period of the swine flu pandemic and with this I was able to look at what happened with abnormal returns after the pandemic and due to the post-pandemic period. I included in

the calculation all pharmaceutical companies from the USA and EU markets together because I wanted to compare both markets in the two different periods. From the figure 9, we are able to see that after the highest pandemic alert the cumulative abnormal returns went back to the same level as before the pandemic. It must be mentioned that the significant drop in the figure 9 and its consequence was definitely a sign of the post pandemic-period. There were some rumors before the announcement of the post-pandemic period on 10th August 2010, the consequences of which can be found in the financial results of the pharmaceutical companies and in the figure 9.

Figure 9: Study for both markets during the announcement of the post-pandemic period



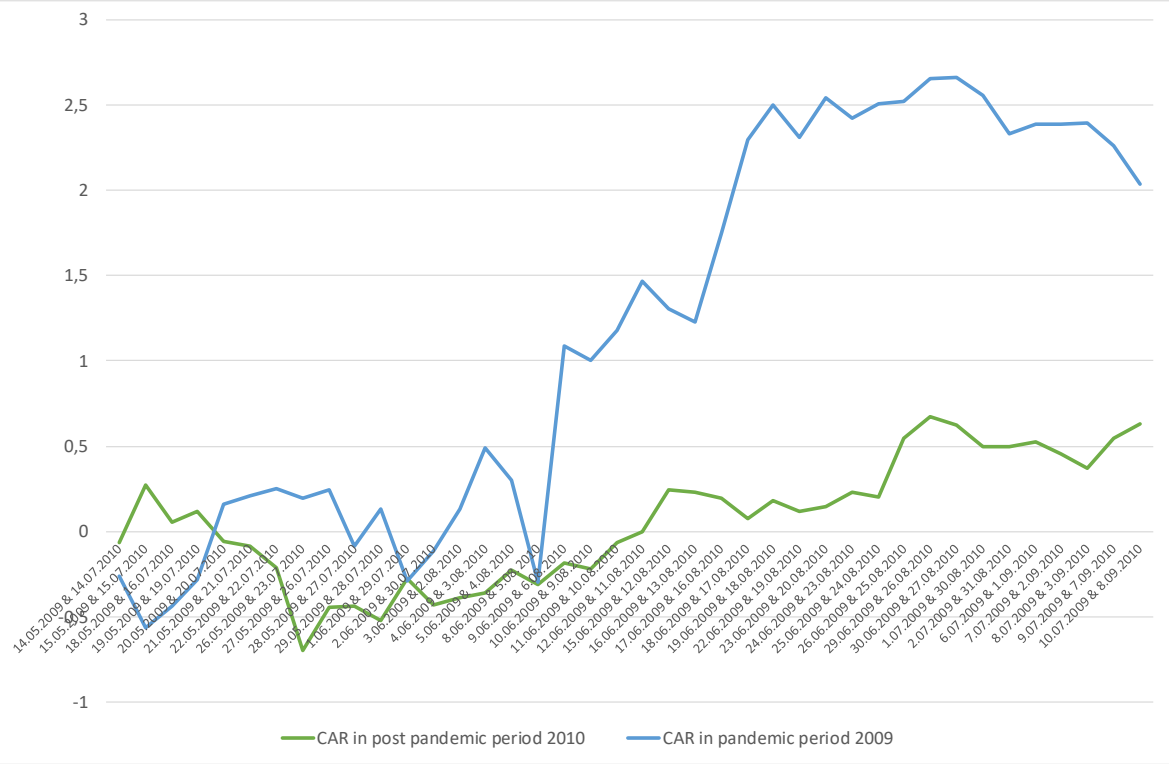
Source: Yahoo Finance (2017), own work.

In the figure 10 I wanted to compare both periods, so that we would be able to see what happened with CAR after the pandemic. I decided to join two event windows in the same figure 10. The first event window was during the highest pandemic alert, so the event date is 11th June 2009, and I also took another event window which contains the same number of days before and after the event date which was the announcement of the post-pandemic period.

In the figure 10, we can see how big cumulative abnormal return in 2009 was in comparison with following year when the post-pandemic period was announced. We can definitely say that the pandemic had a positive financial result, especially in the time after the announcement of the highest pandemic alert. Just a few months later, it was found that the virus was not so problematic and that it was more comparable with seasonal flu, but the

problem was actually the panic among people and WHO's reaction. At the beginning it was also thought that there would be a huge number of deaths but the real number was much lower.

Figure 10: CAR for two selected time periods



Source: Yahoo Finance (2018), own work.

After the pandemic was over and when the post-pandemic period was announced on 10th August, we can see in the figure 10 that nothing special happened on the pharmaceutical market and that CAR returned to the same level it had been at before the announcement of the highest pandemic alert in 2009. There was a downturn for selected pharmaceutical companies of CAR at the time of the announcement of the post-pandemic period, but it went up just a few days later.

Such major decisions from WHO about the highest pandemic alert do exert a great deal of influence on the whole pharmaceutical market. CAR jumped after the announcement because people and consequently even governments were afraid that something serious would happen. However, after the threat was over, everything returned to the same level and we can see that CAR in 2010 was not as positive as it had been a year before. We can conclude that after the pandemic CAR returned to the same level as before the pandemic, which can be seen in the previous figure 10. During the pandemic there was a high upward movement of CAR as a consequence of the pandemic but after that it went back down to the levels before the pandemic.

8 PERFORMANCE SUSTAINABILITY OF PHARMACEUTICAL COMPANIES

We saw in the previous chapter a positive impact of the pandemic on the selected pharmaceutical companies. Now we want to look at the sustainability of the selected companies. We want to know whether a positive impact of the pandemic could be found even among selected ratios of some pharmaceutical companies and among their stock returns. I selected seven companies that were flu vaccines producers during the pandemic and another seven companies which were producers of medicines for other illnesses but were not involved into pandemic vaccines production. With that I wanted to see whether there were some differences between companies which were swine flu producers and those which were not.

First of all, we will concentrate on ratio analysis, which is the sum of numerous indicators by which we can measure a firm's performance. This analysis is frequently used among investors for making important decisions (Chen & Shimerca, 1981). For calculating ratios, we need more financial data about specific firms, which can usually be found in their financial statements, and on some big global financial providers. We cannot expose the most important ratio and almost every economist cited a different one as being the most effective to show problems. It is important to look every specific item in a formula, and how it is obtained (Altman & Hotchkiss, 2006). Financial ratios are used a lot by accountants and analysts to forecast future financial situations, and also by researchers in statistical models for possibilities of corporate failures and tests about economic hypotheses (Barnes, 1987).

On the other hand, daily stock returns are a simple and quick calculation. We know that stock prices change every day and calculating daily stock returns is a useful way to look at changes in the past. A positive percentage change means that the stock has grown in value. By looking at stock we can get a quick overview about what was going on among companies on specific dates. Thus, if something unpredictable happened, (the announcement of the highest pandemic alert in our case) the results should be found in upward jumps in stock prices. After that, we will also look at CAPM Beta analysis because this calculation is really important for understanding the results obtained from the calculation to connect ratio analysis with stock returns and CAPM Beta, and understand why we have such results.

8.1 Ratio analysis

For ratio analysis I selected Gross Profit Margin, Net Profit Margin and ROE. Those ratios are used a lot in economics and comparing them can provide us with some information about what was going on. One year is the most important for our thesis and that is the year when the swine flu pandemic occurred. For a better comparison of the strength of the financial results, I will also select one year before and after the pandemic, and also the years 2005 and 2013. I also implemented the Dow Jones Industrial Average for comparing selected companies by pharmaceutical average. All results of the selected ratio were obtained on the

Bloomberg Terminal and I decided to take quarters for every year to see whether the flu only had a major effect in the second quarter when the highest pandemic alert was announced, or there was a greater influence in the following years.

In the tables, we can see that for Roche only semi-annual data is available. The reason for that can be found in the decision of the European Parliament and Council with their Transparency Directive from 2013. They said that companies do not need to provide quarterly reports, only semi-annual reports are needed. Roche is based in Switzerland and they use International Financial Reporting Standards and provide them in the middle of the year as a semi-annual report and at the end of the year as the financial report for whole year. The European Council claimed that their decision for semi-annual reports was to encourage companies to take a longer-term perspective and that quarterly financial information was not needed for investors. It is now the case that US companies need to provide quarterly reports while EU companies need to provide semi-annual reports, and investors now need to take some facts about EU companies from information obtained on US companies.

8.1.1 Gross profit margin analysis and comments on the results obtained

This ratio (6) is a measure of the gross profit earned on sales and is expressed as a percentage. It is important to note that this gross profit margin considers the firm's cost of goods sold but it is important that it does not include other costs, just the variable one, so basically, gross profit is what we get after deducting the costs which directly influence production of the products or the provision of services. The term gross profit is sometimes misleading because it leaves out some important costs which are connected with running a business (an example is the wages for the bookkeeper who runs your payroll, etc.) (Wood, 2016).

$$Gross\ Profit\ Margin = \frac{Revenue - Costs\ of\ Goods\ Sold}{Revenue} = \frac{Gross\ Profit}{Revenue} \quad (6)$$

With this ratio (6) we assess a company's financial health and we are also able to reveal the proportion of money which was left over from revenues after calculating the cost of goods sold. Every company wants to have its gross profit margin as stable as possible. (Gazely & Lambert, 2006; Baskerville, 2016) A higher percentage of gross profit is a good sign that your business profitability is also higher, so more profit is available to cover all the costs, which is a positive fact for every company (Donnelly, 2013).

From the table 3, we are able to see Gross Profit Margin for selected periods. The most important year for our thesis is 2009, especially the third and fourth quarters when the biggest results of the pandemic on the selected ratios should be seen. I calculated the averages for those companies which were producing swine flu vaccines and for those which were producing medicines for other illnesses. I wanted to compare the selected companies with the pharmaceutical industry and how great the consequences of the pandemic were on the selected companies.

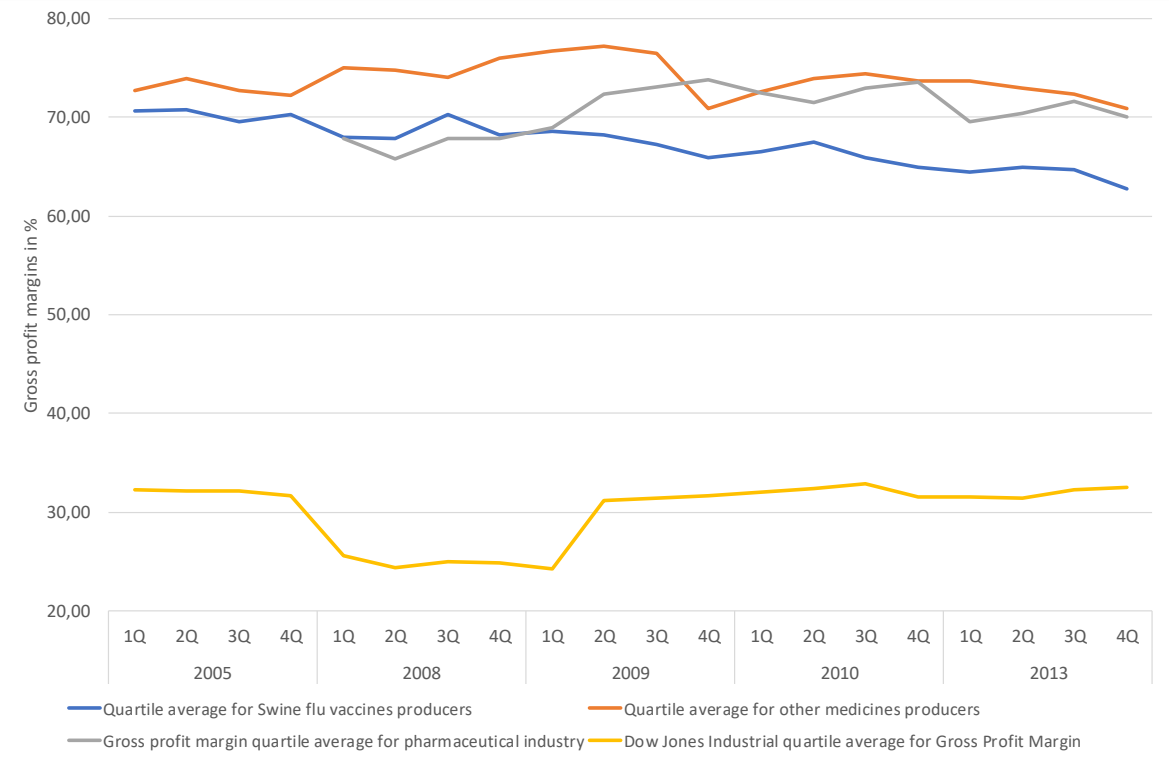
Table 3: Gross Profit Margin for selected companies

GROSS PROFIT MARGIN (in %)																				
	Company	Vaccine	2005				2008				2009				2010				2013			
			1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.1. - 31.3.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.
Pharmaceutical companies that produced Swine flu vaccines	GSK	Pandemrix	77.62	77.98	78.36	78.03	77.15	76.59	75.18	76.24	73.60	74.92	73.63	73.82	73.47	76.41	72.02	71.14	69.46	70.20	67.57	63.42
	Novartis	Optaflu	73.76	74.68	70.89	74.39	73.28	72.63	71.89	71.88	73.96	73.71	72.52	72.10	74.94	73.11	71.44	68.72	67.58	69.22	68.03	67.51
	Abbott Laboratories	Influvac	53.60	52.35	53.36	54.38	56.75	58.40	57.48	60.89	56.30	58.25	56.71	56.95	56.65	59.85	56.87	59.42	54.78	53.27	53.26	53.19
	Endo International	Amantadine	78.52	78.48	74.96	77.94	80.52	79.42	77.58	77.92	75.24	74.52	73.05	74.53	74.18	72.96	69.84	66.83	61.37	61.61	61.01	56.60
	Roche	Tamiflu	73.94		73.85		70.31		69.81		70.42		69.99		72.11		71.87		73.70		75.21	
	Pfizer	Celvapan	83.69	86.92	88.71	84.90	84.81	82.86	85.30	88.30	87.04	84.01	84.61	76.20	74.65	78.50	76.31	76.02	81.76	82.72	81.91	79.39
	Mylan	Influvac	53.02	50.58	46.52	48.41	32.60	34.43	54.99	32.80	43.45	41.66	39.95	38.17	39.95	39.59	42.81	40.38	42.51	43.63	45.75	44.01
	Quartile average for selected companies		**70.59**	**70.70**	**69.52**	**70.27**	**67.92**	**67.81**	**70.32**	**68.26**	**68.57**	**68.21**	**67.21**	**65.97**	**66.56**	**67.50**	**65.88**	**64.91**	**64.45**	**64.91**	**64.68**	**62.76**
Companies that produces medicines for other illnesses	Bristol-Myers Squibb	Cancer, AIDS etc.	70.12	69.67	69.62	68.88	67.90	67.90	68.90	72.39	73.04	73.74	72.49	71.53	72.83	73.22	73.32	72.33	72.25	72.63	71.09	71.34
	Biogen	Autoimmune diseases etc.	84.64	89.75	84.98	79.20	89.29	90.70	90.17	90.54	90.53	91.70	91.66	91.15	91.25	91.18	91.84	91.77	90.55	86.61	87.16	86.85
	Bayer	Aspirin, other drugs	47.17	45.53	43.65	46.49	51.93	49.99	48.72	49.25	52.05	52.63	51.58	49.49	51.86	51.43	51.45	49.46	53.02	52.14	51.77	48.58
	Amgen	Cancer chemotherapy drugs	82.74	83.29	83.99	84.38	84.89	86.32	82.53	85.12	85.58	85.70	85.70	85.88	85.86	85.46	84.62	85.11	82.44	83.22	83.40	79.47
	Merck & Co	Mumps, rubella vaccines	76.29	78.77	77.13	77.42	78.99	77.19	76.13	76.18	75.23	77.05	76.36	51.45	54.33	59.91	62.33	63.29	64.56	62.90	61.09	62.80
	Eli Lilly and Company	Psychiatric medications	75.44	76.24	76.52	76.85	76.88	76.68	77.83	82.53	83.82	82.10	81.09	75.88	79.54	82.19	82.54	80.08	79.32	80.35	79.25	76.13
	Novo Nordisk	Diabetes care drugs	/	73.32	73.18	73.22	77.27	77.01	76.83	79.85	79.93	79.92	78.55	79.83	80.33	80.71	81.16	80.87	81.94	83.13	82.81	84.33
	Quartile average for selected companies		**62.34**	**73.44**	**72.72**	**72.31**	**75.31**	**75.37**	**74.44**	**76.54**	**77.17**	**77.29**	**76.78**	**75.73**	**73.71**	**74.07**	**75.32**	**74.56**	**74.87**	**74.66**	**73.80**	**72.54**
Gross profit margin average for pharmaceutical industry			**NA**				**67.88**	**65.82**	**67.90**	**67.90**	**68.90**	**72.39**	**73.04**	**73.74**	**72.49**	**71.53**	**72.99**	**73.60**	**69.56**	**70.38**	**71.64**	**70.08**
Groos profit margin average for all industries			**32.23**	**32.12**	**32.11**	**31.61**	**25.64**	**24.43**	**25.02**	**24.83**	**24.25**	**31.15**	**31.36**	**31.61**	**32.08**	**32.41**	**32.83**	**31.57**	**31.57**	**31.40**	**32.26**	**32.51**

Source: Bloomberg Terminal (2018), own work.

For a quick overview of Gross Profit Margin in the selected years, we can look at the next figure 11:

Figure 11: Gross Profit Margin



Source: Bloomberg Terminal (2018), own work.

According to the results, we can see that the pandemic did not influence Gross Profit Margin at all. Those results are very surprising because I thought that some positive improvement could be found in the ratio, especially in the third and fourth quarters of the pandemic year. It is also surprising that the ratio of the whole pharmaceutical average was higher than average ratio result of the selected companies that produced swine flu vaccine. It is interesting that it was not just that in 2009 the influence of the pandemic cannot be found in the ratio, but nothing special happened even when the post-pandemic period was announced in August 2010. We could have expected that due to that announcement there would have been some consequences in a lower ratio, due to the lower number of new contracts between governments and companies.

We can see that Gross Profit Margin, according to the Dow Jones Industrial Average, was far better for pharmaceutical companies. That included all pharmaceutical companies; both those that were flu vaccines producers and those which were not had very good results during that selected years. On average, results for the selected companies still went up a little during 2008, but the result should be much better due to the pandemic and its considerable impact on the pharmaceutical market. According to the results, we cannot say that a positive upward movement happened among the selected companies in the pandemic year as was expected.

8.1.2 Net Profit Margin analysis and comments on the results obtained

The simplest way to describe Net Profit Margin (7) is to say that it is a percentage of profit from business operations which is obtained after excluding interest, taxes, all operating expenses and preferred stock dividends from the company's total revenue. That is, profitability ratio and companies with a higher ratio are more efficient and higher efficiency is definitely the chief aim for companies from all industries. It is expressed as a percentage but might be presented also in decimal form. Companies usually express Net Profit Margin in a percentage form which is a nice opportunity for investors to compare profitability of more companies regardless of size. Net Profit Margin is used a lot also as an indicator of how good financial health is (Sutton, 2000).

The basic formula for calculating Net Profit Margin is (7):

$$Net\ Profit\ Margin = \frac{Net\ Profit}{Total\ Revenue} = \frac{(Total\ Revenue - Total\ Expenses)}{Total\ Revenue} \quad (7)$$

By looking at this margin, we can also get some information also about the business of a specific company. If the business is positive that is well connected with profitability, because higher profits lead to higher profitability and that consequence might be seen even in a higher margin. So, high Net Profit Margin means that goods or services are provided at a significantly higher price than its costs and can result from good work of the management department, low expenses and pricing strategies (Wood, 2016).

From the following table 4, we can see Net Profit Margin for every quarter of the selected year for the companies included in the observation. By looking at our most important 2009 averages of selected companies in the second, third and also the last quarter, there should be the best results due to the pandemic. It is interesting to note that the positive upward movement can be found only among companies which were not producing swine flu vaccine.

On the other hand, nothing special happened in the pandemic year for swine flu vaccine producers. We would expect that in 2009 there would be some upward movements due to the highest pandemic alert but that did not happen. There are upward movements for companies which produced drugs for other illnesses which could be explained by the fact that people all over the world often reach for medicines when they experience symptoms and feel unwell.

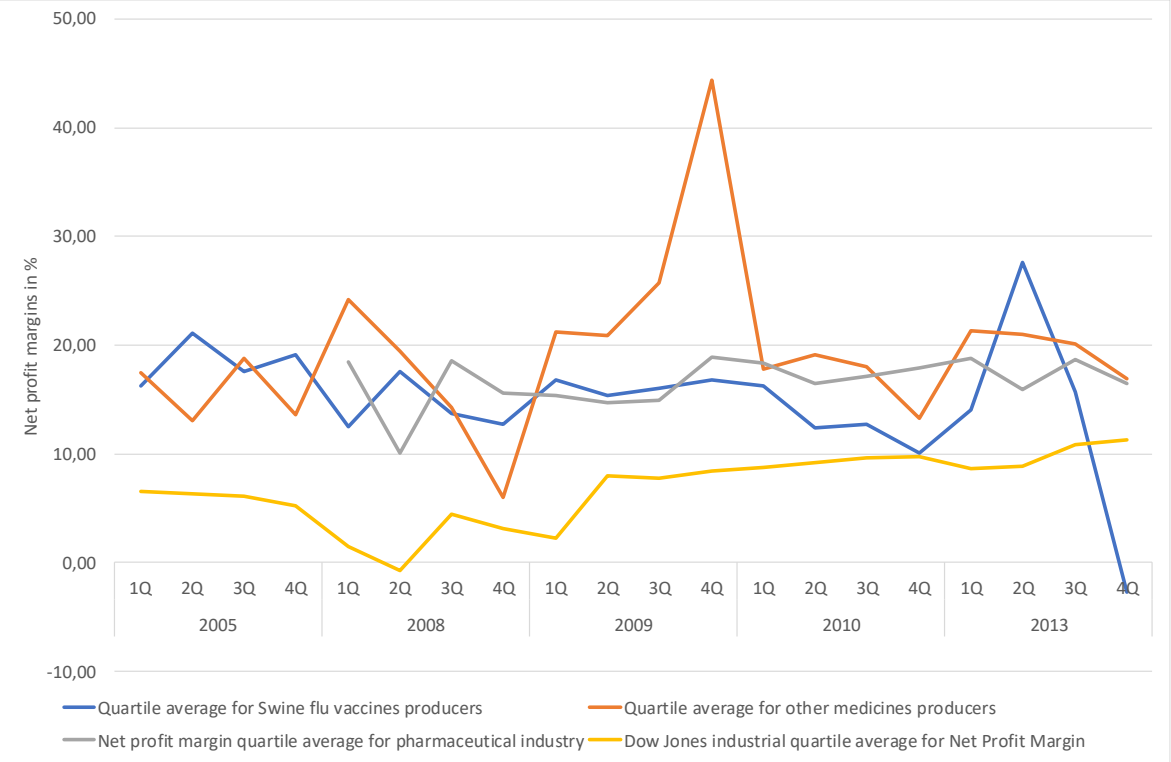
Furthermore, we claimed at the beginning of the thesis that some of the first signs of flu might be helped by some other drugs. Therefore, it is definitely usual that if someone feels sick, they do not go immediately to the doctor and receive a vaccine for flu but take some other drugs by which some health problems might be solved. According to the results, we can say that people did that and tried to help themselves.

Table 4: Net profit margin for selected companies

NET PROFIT MARGIN (in %)																				
			2005				2008				2009				2010				2013			
	Company	Vaccine	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.1. - 31.3.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.
Pharmaceutical companies that produced Swine flu vaccines	GSK	Pandemrix	23.87	22.07	22.06	18.99	22.99	21.89	17.46	14.21	16.71	21.27	19.75	20.14	18.21	-4.33	18.91	-9.59	14.85	15.79	14.88	36.23
	Novartis	Optaflu	20.17	21.03	19.17	18.12	23.38	20.97	19.45	15.27	19.77	18.94	18.48	17.54	23.74	20.28	17.75	15.00	16.88	18.95	17.29	14.89
	Abbott Laboratories	Influvac	15.57	15.88	12.64	16.15	13.86	18.08	14.47	19.32	21.41	17.19	19.07	17.51	13.03	14.63	10.27	14.46	10.13	8.74	20.02	11.61
	Endo International	Amantadine	10.03	24.98	27.14	30.27	20.51	18.66	20.83	20.93	11.64	8.05	13.69	37.77	16.56	12.98	12.21	18.91	2.33	4.91	6.08	-132.65
	Roche	Tamiflu	17.35		16.09		21.91		17.57		14.47		17.21		22.20		14.00		25.50		22.24	
	Pfizer	Celvapan	2.30	30.24	14.11	21.77	23.50	22.89	19.03	2.15	25.11	20.58	24.77	4.64	12.22	14.45	5.41	16.65	22.16	108.68	20.49	18.94
	Mylan	Influvac	24.20	15.85	11.95	12.05	-38.33	-1.53	-13.10	-0.43	8.77	7.33	-0.42	2.88	7.42	6.30	10.57	1.38	6.55	10.44	8.99	9.96
	Quartile average for selected companies		**16.21**	**21.06**	**17.59**	**19.06**	**12.55**	**17.55**	**13.67**	**12.72**	**16.84**	**15.40**	**16.08**	**16.81**	**16.20**	**12.36**	**12.73**	**10.12**	**14.06**	**27.57**	**15.71**	**-2.68**
Companies that produces medicines for other illnesses	Bristol-Myers Squibb	Cancer, AIDS etc.	11.76	20.54	20.22	9.94	13.51	14.68	14.56	20.31	14.76	21.07	20.18	159.45	15.46	19.44	19.78	9.45	15.90	13.24	17.02	16.35
	Biogen	Autoimmune diseases etc.	7.39	5.70	4.56	8.78	17.31	20.80	18.92	19.33	23.54	13.07	24.78	27.12	19.61	24.20	21.61	19.71	30.16	28.47	26.68	23.26
	Bayer	Aspirin, other drugs	9.73	6.07	7.98	0.90	8.93	6.74	3.49	1.34	5.38	6.64	3.37	1.94	7.59	5.77	3.32	-2.19	3.71	11.30	8.12	7.60
	Amgen	Cancer chemotherapy drugs	30.14	32.44	30.66	25.19	30.45	24.07	29.88	24.66	30.80	34.18	36.36	24.44	32.49	31.60	32.39	26.61	33.84	26.89	28.81	20.38
	Merck & Co	Mumps, rubella vaccines	25.55	13.18	26.23	19.42	56.73	29.22	18.38	27.27	26.46	26.38	56.60	64.36	2.62	6.63	3.07	-4.39	7.74	14.93	8.23	10.19
	Eli Lilly and Company	Psychiatric medications	21.06	-6.87	22.06	18.06	22.14	18.62	-8.94	-69.74	26.02	21.89	16.93	15.43	22.75	23.46	23.04	18.90	27.63	20.34	20.84	12.52
	Novo Nordisk	Diabetes care drugs	16.97	20.33	19.92	12.69	20.54	22.24	23.69	18.52	21.60	23.01	22.01	17.78	24.31	23.05	23.00	24.47	29.94	31.50	31.28	27.90
	Quartile average for selected companies		**17.51**	**14.82**	**18.80**	**14.54**	**24.23**	**23.41**	**14.28**	**4.69**	**21.22**	**20.90**	**25.75**	**43.25**	**17.83**	**18.59**	**18.03**	**14.29**	**21.27**	**19.93**	**20.14**	**16.61**
Net profit margin average for pharmaceutical industry			**NA**				**18.41**	**10.02**	**18.59**	**15.58**	**15.35**	**14.72**	**14.89**	**18.90**	**18.34**	**16.50**	**17.17**	**17.89**	**18.76**	**15.87**	**18.71**	**16.49**
Net profit margin average for all industries			**6.54**	**6.34**	**6.14**	**5.19**	**1.52**	**-0.69**	**4.43**	**3.13**	**2.27**	**8.02**	**7.75**	**8.41**	**8.75**	**9.21**	**9.63**	**9.75**	**8.69**	**8.88**	**10.85**	**11.26**

Source: Bloomberg Terminal (2018), own work.

Figure 12: Net Profit Margin



Source: Bloomberg Terminal (2018), own work.

By looking at the figure 12, we can see a good upward jump for producers of other medicines. That result would be quite logical for swine flu vaccines producers due to the higher demand for swine flu vaccines due to the highest pandemic alert, but on the other hand, that positive upward movement also happened for other companies which were producing other medicines.

So, a good positive impact of pandemic cannot be found in Net Profit Margin results for the swine flu producers. An interesting fact is that even our second margin did not provide us with some positive impacts for swine flu vaccine producers which would be quite logical at the beginning due to the huge demand and lucrative contracts for those companies.

8.1.3 Return on Equity (ROE) analysis and comments of obtained results

All investors want to see a high return on equity ratio by which they get the information that the company is using the money they have invested into the company in a good way, effectively in a way that generates even more money for them. That margin is a ratio of efficiency which means that it shows how good the company is at using shareholders' money for generating even more profits and consequently by that the company might develop and grow. When we calculate Return on Equity ratio (hereinafter: ROE), we need to use book value and not the market value because market value is much higher due to the name of the company, brand etc.

The formula (8) for calculation is:

$$Return\ on\ Equity\ Ratio = \frac{Annual\ Net\ Income}{Average\ Shareholder's\ Equity} \quad (8)$$

Return on Equity is expressed as a percentage. By looking at different Return on Equity margins, we can say that those results between 15% and 20% are considered to be good and are a sign that the company is doing well. Those results should be compared between companies from the same industry because, as already mentioned, by doing that we are able to see which company in the industry is good and we also get information about how big the margin is in the chosen industry. ROE may vary significantly from one industry to another or even from one company that pays a large dividend compared with another that does not. We need to be really careful when we look at the Return on Equity Ratio because high ratio does not always mean a better value. High Return on Equity Ratio is good thing if there is a high net income compared to equity but high Return on Equity Ratio might mean also a small equity account compared to net income and that is a sign of risk (Jones, 2014; Gomez, 2016).

Ultimately, the goal is to look at the equity of shareholders and ask what the story is behind that number, that is, how it is obtained. This number has a significant effect on the ROE and it can undoubtedly be manipulated a lot by companies. Therefore, we need to check every specific number that is included in the calculation and how this exact number is obtained (Jun, 2012; Kijewska, 2016).

Calculations of ROE for selected companies are provided in the following table 5 where we can see all the data collected from the Bloomberg Terminal for the selected companies in the selected years.

From the table 5, we cannot definitively say that positive effects of the pandemic can be identified. During the pandemic year 2009 we can see that nothing special happened among most of the companies included in the observation. There are no any companies for which we can clearly say that they had a much better margin due to the pandemic. There is no logical explanation why that is so but, nevertheless, there might several reasons behind it. We would expect a jump in the ROE value through 2009, especially for swine flu producers which did not happen.

We said that the pandemic was in force in the middle of 2009 but we can see some positive results about half a year later, that is in the first half of 2010. This probably happened because governments did not sign huge contracts immediately but negotiated a little with flu producers, so that the positive impacts of the pandemic might happen some months later when contracts were signed and companies announced their profits in their statements in 2010, when they received some accounts payable. Even other pharmaceutical companies had positive results in that year. One positive to mention is the fact that from 2010 to 2013 the selected companies stayed in good shape, which investors and companies like to hear.

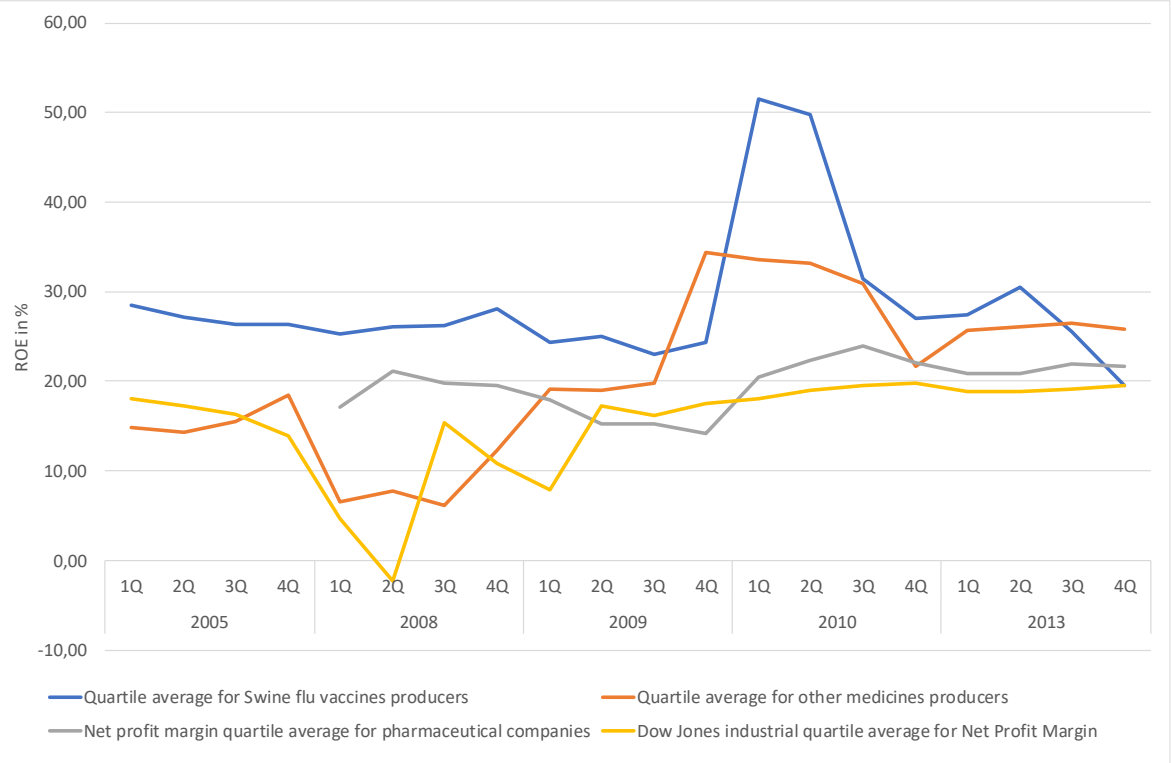
Table 5: Return on Common Equity for selected companies

RETURN ON COMMON EQUITY																				
	Company	Vaccine	2005				2008				2009				2010				2013			
			1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.1. - 31.3.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.	1.1. - 31.3.	1.4. - 30.6.	1.7. - 30.9.	1.10. - 31.12.
Pharmaceutical companies that produced Swine flu vaccines	GSK	Pandemrix	81.02	69.46	71.80	71.94	53.12	54.40	53.87	52.49	52.14	60.38	58.25	61.67	61.29	48.54	41.43	17.30	65.43	72.31	77.60	85.60
	Novartis	Optaflu	19.60	19.85	19.93	19.11	26.95	25.90	15.09	16.47	16.42	14.93	14.67	15.60	18.47	18.34	17.50	16.24	14.48	13.90	13.13	12.79
	Abbott Laboratories	Influvac	23.48	25.68	24.76	23.47	23.82	24.38	26.02	27.69	29.96	27.54	28.24	28.49	27.37	26.71	22.11	20.32	21.92	17.16	11.99	9.93
	Endo International	Amantadine	18.11	19.55	22.02	26.98	18.83	20.87	20.52	20.43	18.11	18.17	16.07	19.70	20.65	21.62	21.12	15.99	-42.46	-39.67	-39.79	-85.73
	Roche	Tamiflu	22.93		19.31		22.99		19.97		33.88		30.03		219.46		102.95		94.78		66.04	
	Pfizer	Celvapan	13.69	15.08	12.12	12.09	11.00	13.68	16.01	13.24	12.62	11.63	12.19	11.71	10.59	10.90	7.98	9.92	18.77	33.37	32.27	27.94
	Mylan	Influvac	20.78	17.49	14.11	11.61	20.52	20.37	32.49	46.02	6.84	9.02	1.64	3.18	2.88	2.62	6.84	6.64	18.64	21.52	17.74	19.86
	Quartile average for selected companies		**28.52**	**27.15**	**26.29**	**26.36**	**25.32**	**26.08**	**26.28**	**28.04**	**24.28**	**25.08**	**23.01**	**24.34**	**51.52**	**49.74**	**27.05**	**27.05**	**27.37**	**30.48**	**25.57**	**19.49**
Companies that produces medicines for other illnesses	Bristol-Myers Squibb	Cancer, AIDS etc.	18.71	22.93	24.08	28.02	-79.53	-69.92	-68.42	-10.42	43.72	43.76	27.91	78.36	74.98	71.64	69.82	20.30	9.79	8.92	19.30	17.81
	Biogen	Autoimmune diseases etc.	1.57	2.10	1.98	2.34	10.40	13.59	14.45	13.81	15.00	13.64	14.13	16.13	15.86	19.22	18.47	17.31	22.05	22.70	22.96	23.90
	Bayer	Aspirin, other drugs	8.39	10.69	14.57	14.58	15.97	15.39	9.56	10.42	8.00	7.49	7.20	7.73	8.59	8.39	8.78	6.62	12.76	12.72	15.23	16.03
	Amgen	Cancer chemotherapy drugs	13.09	14.40	17.55	18.30	16.26	17.38	21.77	21.10	20.53	21.91	21.55	21.15	22.47	21.05	19.33	19.85	23.95	23.03	23.29	24.69
	Merck & Co	Mumps, rubella vaccines	32.81	26.30	26.29	26.31	26.65	25.00	22.50	42.27	30.35	28.16	37.88	33.14	30.39	29.04	20.09	1.52	11.17	10.00	8.78	8.57
	Eli Lilly and Company	Psychiatric medications	19.37	11.92	11.25	18.24	26.54	28.93	18.07	-20.47	-16.11	-13.93	-1.83	53.25	46.90	47.37	43.15	46.20	31.06	33.23	29.04	28.92
	Novo Nordisk	Diabetes care drugs	10.24	11.71	13.13	21.66	29.52	23.49	25.38	29.60	32.47	31.82	32.14	31.34	35.46	35.29	36.97	39.62	68.77	72.39	66.55	60.54
	Quartile average for selected companies		**14.88**	**15.22**	**15.55**	**18.49**	**6.54**	**7.93**	**6.19**	**9.51**	**19.14**	**19.29**	**19.85**	**35.12**	**33.52**	**33.34**	**30.94**	**24.28**	**25.65**	**26.31**	**26.45**	**25.81**
ROE average for pharmaceutical industry			**NA**				**17.16**	**21.07**	**19.81**	**19.49**	**17.92**	**15.19**	**15.24**	**14.13**	**20.50**	**22.28**	**23.89**	**22.11**	**20.86**	**20.90**	**21.91**	**21.67**
ROE Average for all industries			**18.03**	**17.28**	**16.36**	**13.86**	**4.67**	**-2.31**	**15.34**	**10.84**	**7.86**	**17.21**	**16.16**	**17.49**	**18.08**	**18.99**	**19.59**	**19.74**	**18.92**	**18.81**	**19.06**	**19.54**

Source: Bloomberg Terminal (2018), own work.

For a better explanation of the results in the table 5, I also made a figure 13 by which it is possible to take a better look at what was going on through selected years. It can be seen in the figure 13 that the pharmaceutical industry is a successful area to invest in because through the selected years the results for that industry were much better than the results of the Dow Jones Index Industrial Average.

Figure 13: Return on Common Equity



Source: Bloomberg Terminal (2018), own work.

8.1.4 Overview of all selected ratios among companies

According to all the selected ratios, we can say that the pandemic did not provide such obvious positive improvements for the selected companies. Certainly, before the calculation we expected that some upward movement would happen, especially for pharmaceutical companies which produced swine flu vaccines but this did not happen. We saw with event study that there was a pandemic influence on the companies but according to the ratio analysis we cannot say that with any proof. Also, according to the results, we saw that Net Profit Margins and Gross Profit Margins were even better during the pandemic year for those companies which did not produce a swine flu vaccine compared to those which produced swine flu vaccines, which is a surprising result.

Due to the margins obtained, I also calculated net profits for selected companies which can be found in the Table 6:

Table 6: Profits of selected companies

Profits of pharmaceutical companies that produced Swine flu vaccines (in millions)				**Profits of pharmaceutical companies that produced medicines for other illnesses (in millions)**			
Year	**2008**	**2009**	**2010**	**Year**	**2008**	**2009**	**2010**
GSK	8.740	8.880	2.870	Bristol-Myers Squibb	5.250	10.610	3.100
Novartis	8.200	8.400	9.790	Biogen	0.783	0.970	1.010
Abbott Laboratories	4.880	5.750	4.630	Bayer	1.161	2.226	1.245
Endo International	0.262	0.266	0.259	Amgen	4.052	4.605	4.627
Roche	10.040	7.860	8.540	Merck & Co	7.808	12.899	0.861
Pfizer	8.100	8.640	8.260	Eli Lilly and company	-2.071	4.328	5.069
Mylan	-0.181	0.233	0.345	Novo Nordisk	9.645	10.768	14.403
Sum of profits of above companies by year	**40.041**	**40.029**	**34.694**	**Sum of profits of above companies by year**	**26.628**	**46.406**	**30.315**

Source: annual reports of selected companies (2018), own work.

If we look at the results of swine flu vaccines producers shown in table 6, we can clearly see that profits in the pandemic year 2009 were even lower than a year before, which was not initially expected. On the other hand, some companies produced drugs for other illnesses and had much higher profits in 2009 in comparison with a year before, which might still be a consequence of the pandemic. It is well known that people usually reach for medicine at first signs of illness and this probably happened in 2009. Such action might be seen in the highest profits among producers of other medicines. According to the results, we cannot clearly say that the pandemic had a major effect because we can see that flu vaccine producers did not show profit improvement through 2009. Still, we can say that some effects of the pandemic might be seen in to the lower profits in 2010 in comparison with year before.

An unexpected result for our thesis is the low profits in the pandemic year 2009. We anticipated that from 2008 to 2009 there would be an improvement for flu vaccine producers but from the table 6 we can see something completely different. The story behind all this lay in the prices of swine flu vaccines. Producers of other medicines have the same margin of their products and, due to the flu and the higher demand for drugs at the first signs of some illnesses (including flu), they sold a lot of medicines. Swine flu vaccines producers, on the other hand, needed to invest a lot into vaccine production at the beginning. After that, they produced a lot of vaccines, because governments provided many orders and consequently companies were able to provide lower prices with a lower margin of their products. Ultimately, the sum of profits for swine flu producers in 2009 was lower than we would have expected. According to many news stories in 2009 and the reports of pharmaceutical companies, companies really did that. Goldman (2009) and Sohini (2015) (and others as well) claimed in 2009 that governments got vaccines for a lower price so companies provided vaccines to them at a lower margin. The companies did that due to huge orders and

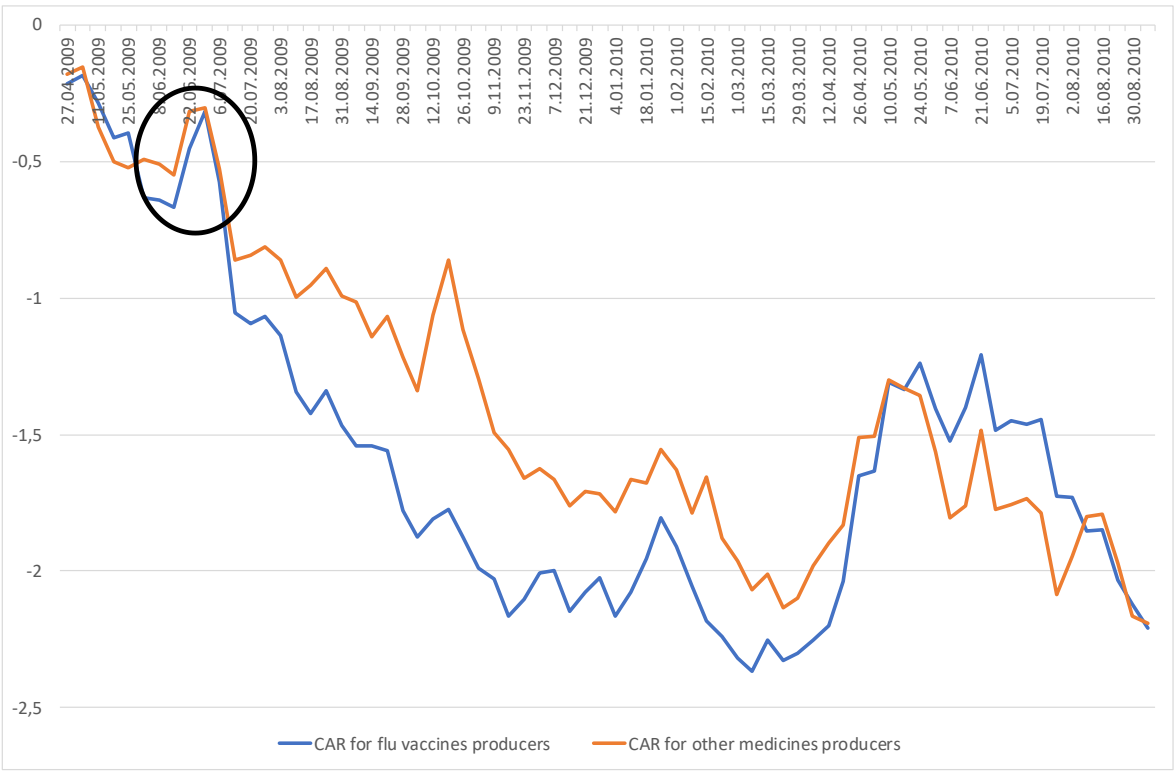
also because many of the orders were set by governments. Consequently, we had lower profits in 2009 for swine flu vaccines producers, while for producers of other medicines we had much better results because their margins stayed at the same level but due to the flu people still used some of their products against the first signs of the illness.

Nevertheless, we need to claim that the pharmaceutical market is a really good place to invest in. We know that in 2008 there was a huge financial crisis which created huge problems for all of industry in general but there was no such problematic influence to the pharmaceutical industry. We said earlier that according to the Dow Jones Index there were even some negative results among selected ratios, while ratios for pharmaceutical industry were always above zero.

8.2 Stock Returns and CAPM Beta calculation for selected companies

Previously, we saw that according to the selected ratios among selected companies we could not make any conclusions about the effects of the pandemic. Nevertheless, we should look now at the stock returns for the same companies which were also included in the ratio analysis. Finally, we want to explain why we get such results of ratio analysis if we know that large contracts were signed with swine flu vaccines producers and that there were some really profitable contracts signed with swine flu vaccines producers.

Figure 14: CAR of stocks for selected companies



Source: Yahoo Finance data (2018), own work.

Firstly, I made a calculation of cumulative stock returns for companies which were flu vaccines producers and those who made medicines for other illnesses. With this calculation I wanted to see what happened between two announcements, so between the pandemic (11th June 2009) and post-pandemic period (10th August 2010). I started my stock returns observation around a month before the pandemic announcement and finished a month after the post-pandemic announcement because I wanted to see clearly whether there were some significant influences around those two dates. Also, I wanted to see what was going on throughout those two periods, that is whether there were just some quick upward movements which went back to the normal level after those two dates. We can see the results in the figure 14.

According to the results, we can see that cumulative abnormal returns of selected stocks were lower in comparison with stocks of other companies on the market. We can clearly see in the figure 14 that CAR of selected stocks was below zero through the whole period.

The most interesting thing for our thesis is the few days after the announcement of the pandemic when we expected a jump in stock value and that actually happened according to the data. Those days can be found in the figure 14 and they are marked with a circle. Once again, we can say that the pandemic had a positive influence on the pharmaceutical market and such influence happened no matter whether the companies were swine flu vaccines producers or not. We can also see that the pandemic had only a short-term effect because just a few days after the pandemic announcement cumulative stock returns went back down. We cannot find any significant drops in the stock returns among pharmaceutical companies when the post-pandemic period was announced.

The reason for the results obtained in stock returns calculation can be found in the stability of the pharmaceutical market. We know that we have markets which are very risky while others are not and risky markets have a much greater influence on specific unpredictable events. A useful option to get some information about stability of the market is CAPM Beta. When we want to invest some money in some specific companies, we always want to know how risky those companies are. Of course, there are differences among people, some of whom want to take more risk because they might get higher profits in the end, while others want to invest into stable profitable companies with lower but stable profits. There are a lot of different things which influence the risk, like market capitalization, revenue size, management of the company and so on. But, after all, the most important thing for investors should be the previously mentioned CAPM Beta, or Capital Asset Pricing Model Beta, which is a measure that tells us how risky the specific stock is and it includes volatility or systematic risk of a specific security or a portfolio in comparison to the whole market. This simple measure helps every investor to make good decisions about stocks and portfolios.

When we want to invest into stock, we always want as high returns as possible but every stock is also exposed to two types of risks which are sometimes missed by investors. Having higher returns but also a higher risk is not good. The first risk is non-systematic risk which

is typical for some companies or industries. This type of risk can be solved by diversifying the money we want to invest into various stocks of different industries and companies. Our pandemic is a typical non-systematic risk because the pandemic most influenced the pharmaceutical market due to the higher demand for vaccines. When the pandemic was announced, we had a positive risk which might provide higher profits to investors but on the other hand, the announcement of the post-pandemic period might provide some losses. On the other hand, we know the systematic risks which investors cannot avoid but they can be understood as much as possible with Beta measuring, which measures stock risks in relation to the whole market. A nice advantage of CAPM Beta is that investors can completely remove all the unsystematic risk by diversifying their portfolios.

Usually, large companies tend to have low Betas because that is a sign of stability and consequently, they are more interesting for investors. Companies with lower Betas are those which still have some stable revenues and stock prices no matter what the situation on the market is. It might happen that market is in recession but consequently if the Beta of a specific company is low, that would not cause such big problems to that company, while on the other hand, that company might have big problems if its Beta were high.

When we looked at the three selected margins in the previous chapter, we saw that nothing special happened among the selected companies. When the pandemic took hold and the highest pandemic alert was announced, we claimed that ratios would go up a lot, especially in the second half of 2009 but nothing actually happened. The reason behind such results of the ratios can be found in the Betas of those selected companies. In the table 7 I put all companies which were included into the ratio analysis. All the stock data for the selected companies were obtained from Yahoo Finance and I used index data S&P500.

Table 7: CAPM Beta values for selected companies

Beta of pharmaceutical companies that produced Swine flu vaccines		**Beta of pharmaceutical companies that produced medicines for other illnesses**	
GSK	0.43567	Bristol-Myers Squibb	0.57534
Novartis	0.42500	Biogen	0.60657
Abbott Laboratories	0.43291	Bayer	0.71325
Endo International	0.64242	Amgen	0.34450
Roche	0.50777	Merck & Co	0.58533
Pfizer	0.58661	Eli Lilly and company	0.50386
Mylan	0.79706	Novo Nordisk	0.48658
Beta for all selected companies above together	**0.52518**	**Beta for all selected companies together above**	**0.54176**

Source: Yahoo finance stock data (2018), own work.

From the previous table 7 we can see that Betas of those companies were low which means that those companies are less risky and volatile than the whole market is. I calculated those Betas through the same period as for the returns of the stocks which were calculated in the previous table 7 and we can claim that events such as this pandemic do not influence those so much. If their Betas were higher, the stock returns would be higher and the ratios would probably show better results of selected companies.

If we take a look, for example, at Novartis which is one of the most important European swine flu vaccine providers, we can see that its Beta is just 0.4250 which means that if the stock market moved up by 5% then Novartis stock would only move by 2.125%. Therefore, the upward movement of that company is lower than the movement of the whole market but nevertheless when recession comes, the downward movement is also lower, what is also important.

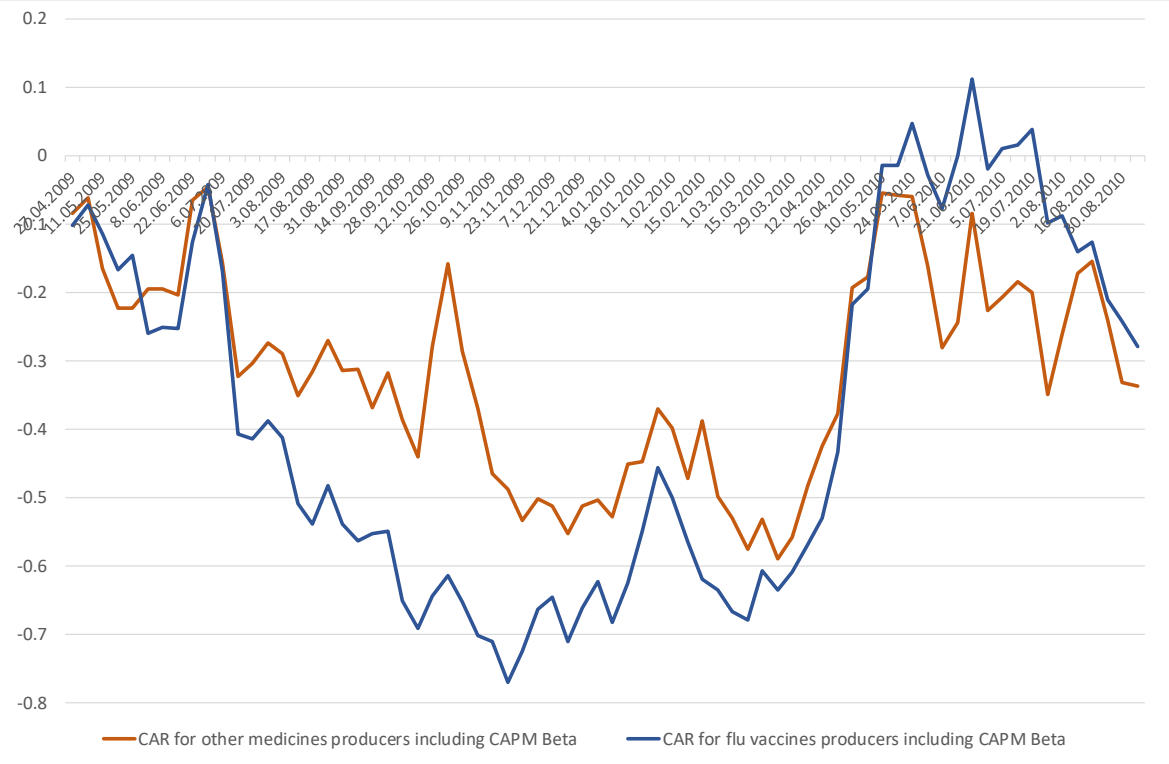
We know a lot about stock market cycles with some long-term patterns and in them we have some upward and downward movements. During the pandemic, selected companies had lower upward movement at the time of the announcement of the pandemic but even when the post-pandemic period started the downward movement was not problematic at all. We can claim that companies in the observation definitely have one thing in common, which is stability and that is an important fact for stock market cycles and especially for investors.

According to the explanation above, we can say that the reason for such average margin results of selected companies can be found in the Beta values. It is interesting that there are a few companies with a slightly higher Beta (more than 0.6) such as Mylan (0.7971), Endo International (0.6424), Bayer (0.7133) and Biogen (0.6066) and those companies also provide slightly worse results in margin calculation during the pandemic year 2009. Mylan, for example, had much lower ROE than other companies in observation, it also even had a negative Net Profit Margin in that year; Endo International also had some problems that year with much lower Return on Common Equity in comparison with other companies; Bayer had the lowest selected margins in 2009, and so on. All those calculations influenced the average and are just one of the reasons for the end results obtained, so we could not make any conclusions about positive pandemic impacts.

We calculated CAPM Betas and we should now implement them into the calculation of cumulative abnormal returns of stocks. We wanted to see whether selected pharmaceutical companies were more profitable according to stocks than other companies including CAPM Betas.

In the figure 15, we can see cumulative abnormal returns of selected stocks in comparison with other companies on the market. According to the results we can see that in the selected periods stocks of pharmaceutical companies were even less profitable than other stocks on the market and flu producers were less profitable than other producers of other medicines.

Figure 15: CAR of selected stocks in comparison with whole market



Source: Yahoo finance stock data (2018), own work.

Results obtained in the figure 15 were expected due to the previously obtained profits. We now have an explanation of why we get such results of selected margins and why there are no any significant improvements among margins during the pandemic year. Margins and profits were much lower than we would expect. Companies needed to produce higher amounts of the vaccines with lowest margins and consequently even their stocks were less profitable in comparison to the whole market. We can see in the figure 15 some upward movement some weeks before the post-pandemic announcement, probably as a consequence of the much lower threat of swine flu, needs for flu vaccines and, consequently, lower production of swine flu vaccines.

9 CONCLUSION

With that our main purpose of taking a look at the pharmaceutical market during the 2009 pandemic is achieved. We saw some positive influences of the pandemic on the whole pharmaceutical market. The pandemic in 2009 caused a lot of problems for people all over the world, and also a nice business opportunity for pharmaceutical companies. Using event study, ratios analysis, stock return and CAPM Beta calculation, we were able to see that events such as pandemics cause a positive effect on the whole industry. Event study calculation provides us with some positive upward movements among selected companies as a consequence of the pandemic. In the following chapter, where we wanted to provide more positive pandemic influences with ratio and stock analysis, we basically saw that

influences of the pandemic on the swine flu producers were lower and the reason for that was the small margins. Behind it all there was good business among companies and countries which reflects in the financial results of companies and unexpected profits and ratio results. On the other hand, producers of other medicines had better financial results because their margins stayed at the same level. When we made calculations of selected stocks returns, we saw that there were no significant positive influences of the pandemic. We definitely know that the pharmaceutical market is a good opportunity to invest in but events such as the pandemic do not influence companies much in the longer term.

The pandemic was a great threat to public health, and it was important to deal with it where popular social media were still not sufficiently used. There are many possible ways to improve information dissemination in pandemics because the internet and social media are popular and information from them can be used for some important predictions of possible health problems. Also, cellphones are devices which are used every day and most of them have navigation and internet which can be used in a positive way by citizens.

From the consequences of the 2009 pandemic, we can say that World Health Organization should work more intensively to predict such big health problems. In the past there have been many pandemics but we still do not have a good plan and procedure for countries all over the world, by which they could help their citizens. Also, laboratories should be upgraded with much more modern devices, because laboratories were not able to test each individual affected person but confirmation of flu cases is one of the most important factors in making the decision to declare the highest pandemic alert. In the future, WHO should definitely not take any important decision simply on unconfirmed data.

In the future, more pandemics will occur and the first steps to deal with them should be made among the biggest health institutions. Until then some good programs for dealing with health problems should be created because people would consequently be safer, there would be fewer deaths and the confidence among people in such institutions would be much bigger. The point is that WHO is the most important authority responsible for public health around the world and its decisions are held up as guidelines which then influence the whole economy, population and countries.

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