HOW FEAR DETERMINES THE BEHAVIOUR OF STOCKS DURING A CRISIS

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ΒΕΒΑΙΩΣΗ ΕΚΠΟΝΗΣΗΣ ΔΙΠΛΩΜΑΤΙΚΗΣ ΕΡΓΑΣΙΑΣ

«Δηλώνω υπεύθυνα ότι η συγκεκριμένη πτυχιακή εργασία για τη λήψη του Μεταπτυχιακού Διπλώματος Ειδίκευσης στη Λογιστική και Χρηματοοικονομική έχει συγγραφεί από εμένα προσωπικά και δεν έχει υποβληθεί ούτε έχει εγκριθεί στο πλαίσιο κάποιου άλλου μεταπτυχιακού ή προπτυχιακού τίτλου σπουδών, στην Ελλάδα ή στο εξωτερικό. Η εργασία αυτή έχοντας εκπονηθεί από εμένα, αντιπροσωπεύει τις προσωπικές μου απόψεις επί του θέματος. Οι πηγές στις οποίες ανέτρεξα για την εκπόνηση της συγκεκριμένης διπλωματικής αναφέρονται στο σύνολό τους, δίνοντας πλήρεις αναφορές στους συγγραφείς, συμπεριλαμβανομένων και των πηγών που ενδεχομένως χρησιμοποιήθηκαν από το διαδίκτυο».

[ΟΝΟΜΑΤΕΠΩΝΥΜΟ ΦΟΙΤΗΤΡΙΑΣ] **[ΥΠΟΓΡΑΦΗ]**

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Context

INTRODUCTION

Economists have been intrigued by crises and financial bubbles[1] for a long time. However, even though the consequences of the above-mentioned events are severe, financial analysts and economists alike have trouble both predicting these crises, as well as dealing with the chaos they give birth to. The evolution of the financial systems, commerce, national economies and their interdependence, has made one thing clear: nearly everything in economics is a chain. Everybody affects everybody, and is affected by everybody.

The study of the international turbulence caused by the 2007 – 2010 subprime mortgage crisis in the US, rests, until today, a complex task.

A decline in the real estate market is a source of trouble for the economy, no doubt, nonetheless, the crisis we are facing now differs from its past "siblings" in the sense that in the past such events caused the so-called "credit crunches" in the banking sector. The present crisis, unfortunately, could not be contained in the banking sector (Susan Wachter, 2007), it is far wider.

However, according to Caballero, Farhi and Gourinchas (2008a), the above crisis was not an event that occurred out of the blue. Indicators did exist. Let us not forget that before the 2008 global crisis, we had the dotcom bubble in the 1990's, the subprime crisis in 2007 and the asset and commodity bubbles in 2005 and 2008, respectively.

Going back to the 2007 crisis in the US, let us take a closer look…

Home foreclosures, dwindling consumption, a huge strike for the stock exchange, hedge funds, banks and CDOs' bankruptcies, are just a few examples of the situation that dominated North America in 2006 and 2007. Needless to say, the above crisis swept across the world, within the following year. Due to the enormous exposure of the international markets to the MBS and the fragility of the US financial system (DeGregorio, 2009), the risk that originated in the US, migrated into the commodity market, as well as the bond market in other countries. Losses on securities linked to U.S. real estate sector could reach US$1 trillion!

A major event of our time, the *subprime mortgage crisis*, as it is often called, has influenced countless individuals, families, corporations and countries, each and every

[1] For a more detailed description of the term "bubble", please see Appendix A.

one of which have tried to find the solution and the path that will lead them back to normality; some have succeeded, some have not.

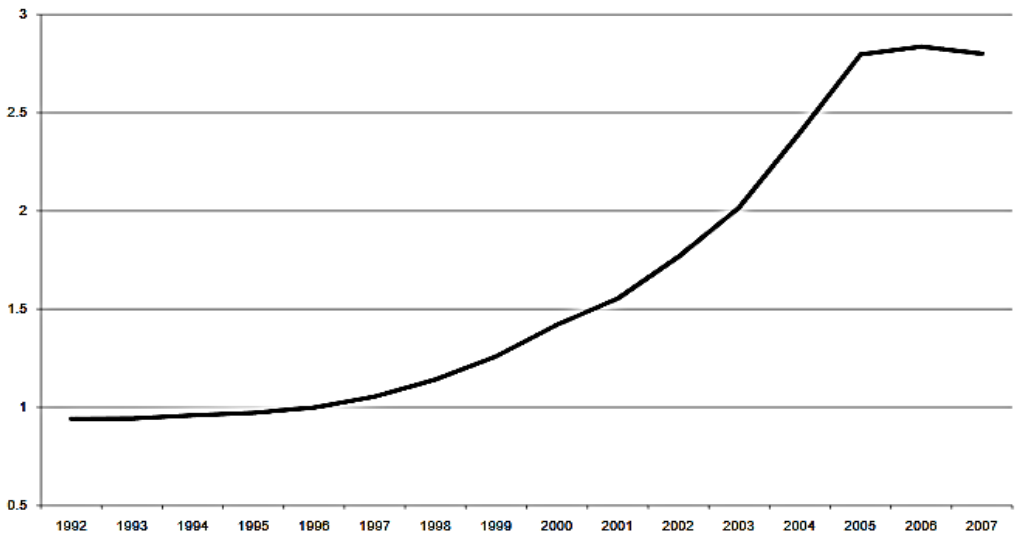
The purpose of this paper is to enrich the knowledge of the reader, concerning the 2007 crisis in the US – and not only, which was of paramount importance not just for the international financial markets, but also for millions of individuals personally. May this assignment be helpful to those who wish to dig further into the causes of the crisis, as well as its repercussions.

CAUSES OF THE CRISIS[2]

Even though the first explanation that comes to mind as a cause for the subprime mortgage crisis is the problems brought about by the home loans granted at that time – a huge part of which was never paid back to the banks – many events served as contributing factors that led to the outbreak of the global mess that was to come.

Dark clouds started appearing in the American sky, a few years earlier, when home prices were gradually increasing, in 2001, until they reached a peak in 2005. Reinhart and Rogoff (2008) note that this steep rise in real estate prices was the highest ever observed until then, compared to other post-war crises. After that, dramatic decreases in real estate prices, due to the "market correction", led home owners to despair, since they found themselves owing more, but, owning less, in terms of values.

Figure 1: Home prices, 1992-2007



Source: Fiserv Case Shiller Weiss

Even though warning voices were not absent, history showed that they were not heard, at least, to the extent that would prevent the mayhem that was about to burst and turn many people's lives upside down.

Back in 2008, house prices kept falling uncontrollably and due house bills kept increasing. In the eyes of the IMF, this combination was a bad omen. For the first

[2] For a more detailed description of the factors that led to the crisis, please see Appendix B.

time, the Fund publishes a report; a report that states clearly one thing: huge imminent losses! Real estate prices, delinquencies on mortgages and mortgage loans failures, could lead to $945 billion losses! It was estimated by Standard & Poor's that banks across the globe would proceed to write-offs of loans associated to US real estate.

However, the true danger lied in the view of the IMF that the real amplitude of the damage, cannot be predicted precisely! The interbank leverage and the "domino" risk, kept being two vague notions that could not be actually measured.

Going back to the crisis, let us not forget the dot-com bubble that took place a few years earlier. Due to the dot-com bubble, federal funds rates were cut from 3,25% to 2%. This, in turn, affected the 10-year Treasury bond returns, which, in turn affected the mortgage rates, by increasing them, i.e larger amounts to be paid my mortgage payers as interest. The policy followed by the Fed, however, was "misguided by erroneously low inflation data", said Richard W. Fisher, CEO of the Federal Reserve Bank of Dallas.

Table A: Bank Losses, 2007-2008

BIGGEST LOSSES FROM JANUARY, 2007 TO APRIL 2008 (US$ BILLIONS)			
Société Générale	$3,9	Canadian Imperial Bank of Commerce	$4,1
Mizuho Financial Group	$5,5	RBS	$5,6
Credit Suisse	$6,3	Crédit Agricole	$6,6
Wachovia	$7,3	Deutsche Bank	$7,5
Washington Mutual	$8,3	IKB Deutsche	$9,1
JP Morgan Chase	$9,7	HSBC	$12,4
Morgan Stanley	$12,6	Bank of America	$14,9
Merrill Lynch	$31,7	UBS	$38,0
Citigroup	$40,9		

Source: Bloomberg

Of course, the federal funds rates fluctuations were not the only explanation for the mess concerning the mortgage rates. Alan Greenspan argued that home prices skyrocketed on a global scale, due to the increase in international savings accounts, which led to a decrease in interest rates. So, on the one hand, we have those who put emphasis on the Fed's interest rate policy and on the other hand, we have those who

support that interest rates were low, due to the international increasing trend, as far as savings accounts were concerned.

Although, after 2004, the Fed increased the interest rates many times, until it finally stopped, due to the fear of inertia of the real estate sector, the history had already taken its course. A downturn in housing prices was simply obvious and inevitable. Voices claiming that the Fed should have acted sooner "to avoid a festering of the housing bubble early on", from economists like Nouriel Roubini were simply not heard…

To recapitulate, low interest rates, led to increased subprime loans, increased home ownership rates and, of course, increased home prices. Home ownership in the US went from 64% in 1994 to 69.2% in 2004 (Callis and Cavanaugh (2007) and nominal house prices increased by more than 180% between the years 1997-2006. Household debt, as a percentage of disposable income, increased from 77% to 127% from 1990 to 2007 (Economist, November 22, 2008). It is also important to mention that, during the bubble years, the risk premium required to grant a mortgage loan was significantly low, making it easier for the banks to offer loans, which would later turn out to be, well… non-performing. Before the crisis, subprime mortgage loans were one tenth of all mortgages. By 2006, subprime mortgages increased to a 13% and that was just the beginning. Bernanke (2009a) argues that the housing boom was largely reinforced by an increase in lending.

Another contributing factor of paramount importance to the subprime mortgage crisis is the fact that, during the bubble days, banks offered certain "incentives" to their clients, such as suspiciously low initial interest rates for mortgage loans (which would, of course, later increase significantly). They even distributed loans without demanding written proof of the client's property or sources of income, the so-called "stated income" loans. Banks wanted lending to go up and they did not care about their clients' "quality". Mayer, et al, (2009) point out that mortgage defaults were mostly on "subprime" or "near-prime" mortgages, which means that those delinquent were not the prime borrowers, i.e. the "good" clients, but the bad!

Taking a stroll down memory lane, those well-versed with the crisis, might support that regardless of the economic details and manipulations, the core of this bizarre situation was moral hazard. Every institution and individual who participated in the

"mortgage" process, sought to transfer all the danger to the next party and generate as much profit as possible for themselves. Brokers' wages were not affected by the performance of the loans they granted, so they had little interest to search the client's trustworthiness, let alone the fact that the more complicated product they sold, they bigger their commission, a fact that according to Bernanke (2009), should not have taken place, since according to the latter, bonuses had better be granted only when the incentives of employees agreed with those of their institutions. Additionally, in 2007, the underwriting had become, for most cases, automated, that is, minimum documentation was required and loans were given out more quickly and easily.

The next link of the chain was securitization. Plainly, what happens during securitization is that banks grant mortgage loans to people, who – in our case – were very likely to be unable to repay these loans (and the banks knew that, besides, as Mishkin (1997) points out very correctly, information asymmetry played a key role in the evolution of the crisis) and then banks assemble these loans, together with "healthy" ones, and create "pools", bundles of both "healthy" and possibly non-performing loans and sell them on as collateral for mortgage-backed securities, also known as MBS. Each MBS needs a rating, based on its collateral. A big part of these products had AAA rating.

What is really interesting here, is that no one who bought an MBS, knew what was in them! Imagine buying a bond with a collateral, which is consisted of a hundred loans. Nobody searched if these loans were indeed healthy. The story is as follows: the pools of loans, included both AAA loans, as well as junk ones. Each MBS needed a rating. How was this rating going to be produced? Well, history showed that MBS had misleading ratings, higher that they should. Buiter (2007) highlights the fact that securitization, as well as a blind trust in the credit rating agencies' ratings were important drawbacks of the financial system, back then.

So, in a nutshell, investors bought junk loans as collateral for their investment, without really knowing it, because no one really got in the procedure of searching it through! Banks did not care, because they managed to transfer all the risk from the non-performance of these loans to other investors, like SPVs (Demirguc-Kunt and Serven (2009), Trichet (2009a) and investors did not care, because they gained enormous returns from these products; forget not that home prices increased

exponentially back then. It is very important to understand that by securitizing financial products, the link between loan originators, i.e. banks, and risk-bearers was shattered, making it, thus trivial for banks to "care" about their clients' integrity (DeMichelis, 2009).

It is crucial, though, to bear in mind that even countries like the United Kingdom, where there was not an exaggeration in securitization activity, did suffer a very severe crisis, sometimes tougher than that of the US, according to Hall and Woodward (2009).

To make matters worse, borrowers, too, had their own share of responsibility for the crisis. People thought that high home prices and easy credit would continue for eternity; thus, private owners kept on getting more and more loans, since it was easy and cheap money, they provided fraudulent proof of their financial situation, because they considered getting more money a bargain, and banks, on the other hand, never checked them, because their interests lied in giving more loans! In his own words, Tyler Cowen (2008), claimed that "[T]here has been plenty of talk about predatory lending, but predatory borrowing may have been the bigger problem".

"Where is the law?", someone might wonder. The crisis spread out so quickly, partly because the law was negligent, too. Where were the federal regulators, when banks started slackening their loan-granting standards? According to them, they did not have enough power to exert their authority. Many borrowers were under state jurisdiction and not federal. However, the central bank was able – under federal law – to play its role and safeguard the stability of the economic environment. That did not happen. Buiter (2009) argues that, back then, corruption in regulation was a rather common phenomenon.

The Fed's role in all this situation was crucial. There were warning voices from within; Fed governors, like Edward M. Gramlich, who died in September 2007, did speak of an imminent crisis and sounded the alarm bell, but Alan Greenspan – Fed Chairman at that time – was too busy to listen and so, nothing happened (Edmund L. Andrews, 2007).

CONSEQUENCES

In order to understand the importance of the situation, someone should bear in mind that the housing market was considered to be the backbone of the American economy, according to specialists. So, this whole turbulence and prolonged crisis was sure to drag the American economy down with it and so it happened.

After the bursting of the bubble, the subprime mortgage industry collapsed. The defaults on subprime mortgage loans, which accounted for one fifth of the US home loan market, were countless! Foreclosure rates were higher than expected, homeowners continued being delinquent, interest rates reached their highest level in years, banks and underwriters could not grant any more loans, both because no one had the money to buy, but also because in order to maintain their capital ratios stable, they would have to lower the amount of credit they offered. So, financial institutions started shutting down, one by one. In America, JPMorgan Chase bought Bear Stearns, the fifth largest investment bank in Wall Street, to save it from annihilation.

The predictions were more than unpleasant. Wall Street's giants, like Lehman Brothers, started losing immense amounts of money and this would only be the beginning. The stock market was shocked. Many countries' general indices nosedived.

After a while came the "reset", investors who had bought MBS forfeited the game or were found high and dry, because the MBS lost their value, confidence was lost, lending declined, foreclosures carried on, decreasing home prices resulted in a GDP free fall (Boone, Johnson and Kwak, 2009) and tax revenues shrunk, as well. Liquidity belonged to the past and commodity prices increased worryingly. Banks and financial institutions around the world went bust and many countries went to battle with recessions. Later on, consumption expenditures declined and commodity prices fell again below the equilibrium.

Figure 2: Course of the crisis

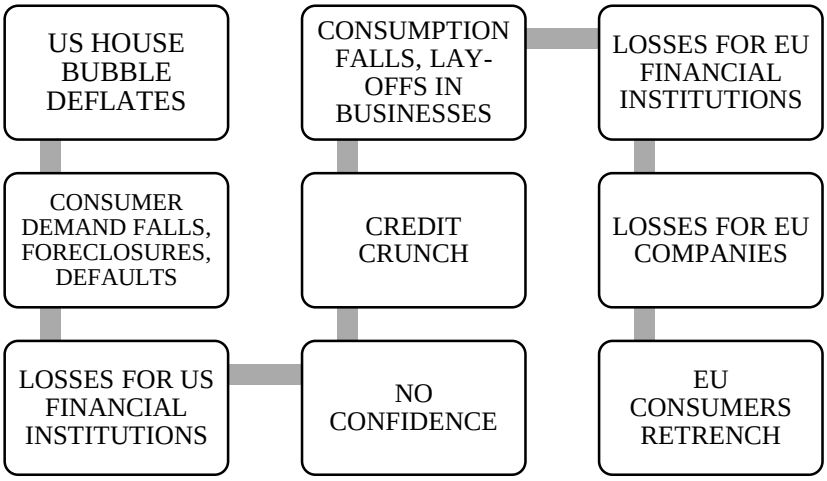
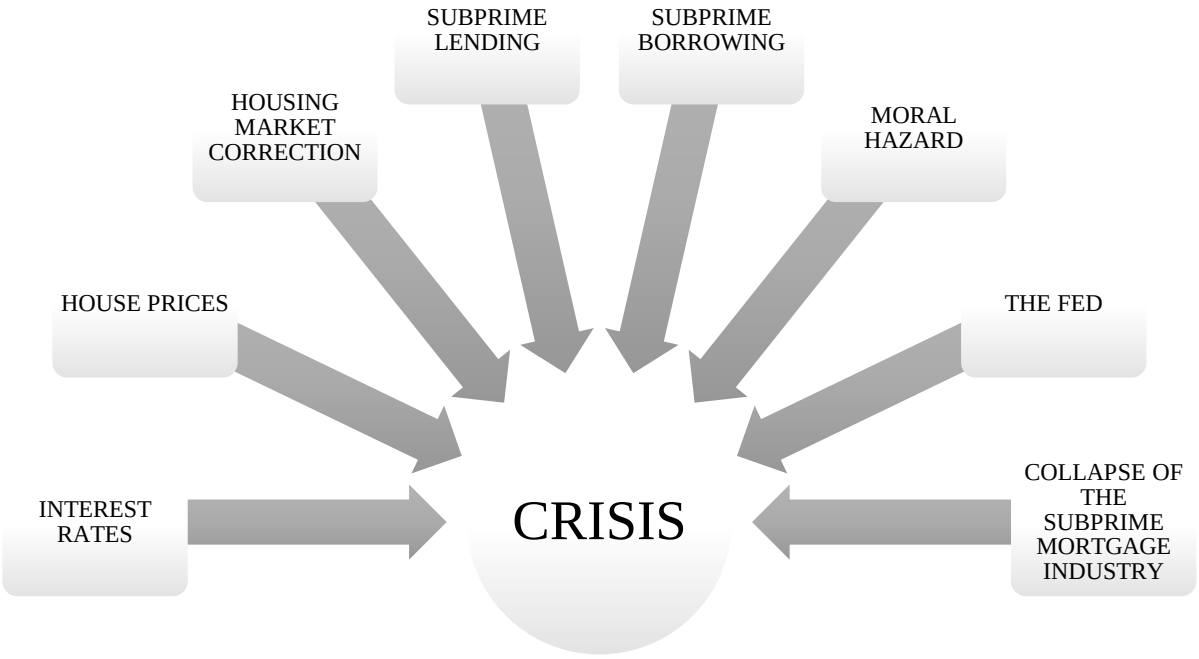


Figure 3: Contributing factors of the subprime mortgage crisis in the USA, 2007



THE EPIDEMIC OF THE CRISIS

When the US subprime crisis, started becoming global, that is, "contaminating" other "healthy" – up until then – economies, the top priority for policymakers around the world became to find a quick and drastic way to intercept this problem. Nobody wanted to admit that the banking system was so fragile and high-ups in every country did everything in their power to restore confidence in the financial markets.

The crisis can be divided into two sub-periods: the subprime crisis in the US (before the collapse of Lehman Brothers) and the global crisis (after the collapse of Lehman Brothers on September 14, 2008). In this section, we will deal with the situation in Europe, after the crisis became global.

Europe was deeply wounded by the crisis, there is no denying in that. Nevertheless, back in 2006 – 2007, all seemed less menacing, since the economy in Europe was healthy and growing. A domino effect, luring the continent into chaos, was believed by many to be out of the question. The worst was yet to come.

2008 started well, the economy during the first quarter performed strongly. Then came timid and gradual signs of trouble, but the situation was still a long way from crisis. From the second quarter of 2008 and onwards, economists started predicting the shrinking of the European economy. It started with small and gentle quarterly contractions that grew larger and larger. To make matters worse, the IMF published a report in the end of November, in 2008, that verified the severity of the situation: the prediction for the European GDP was a 0,7% decrease. Unemployment rates started increasing and people started losing their jobs. People in the euro area started losing their confidence in the economic system. Then came the credit crunch. Firms across Europe found it hard to get new capital, since lenders questioned their solvency. Stock exchanges in Europe reflected a rather disappointing image, if not tragic. Banks cut lending to a minimum or increased the financing costs, making it difficult for firms to get "easy money", like in the – not so distant – past.

Figure 4: Confidence sentiment, 1999-2008

Source: European Commission

Commodity prices spiraled out of control. Between 2007 and 2008, oil skyrocketed from nearly 40euros to 90euros per barrel, increasing thus, the cost for enterprises. The wages of laborers were significantly cut and as a consequence, demand fell. After that, the appreciation of the euro against the dollar by nearly 30% (from USD 1,20 to USD 1,60), rendered the euro a non-competitive currency, hence the decrease in European exports. Furthermore, the ECB, too, increased interest rates at the beginning of 2006, directing them towards a 4% peak, in the middle of 2007. Imports were more expensive and, of course, demand fell.

However, apart from the above-mentioned reasons that made Europe more "vulnerable" as a whole, some member-states were in a tough position prior to the arrival of the crisis. Spain, Ireland and the UK had housing bubbles, too, current account deficits and problems concerning their international competitiveness. On the other hand, at the same time, Germany saw growth coming sooner than expected.

How come the crisis in the US was transmitted in the Euro area so quickly?

Many factors played a role in the worsening of this financial and social whirlpool. On the one hand, the US, Spain and Britain had large current account deficits, that is, more imports than exports, and on the other hand, Asian countries and Germany, had current account surpluses. Those countries with deficits, tend to borrow from those with surpluses, in order to continue their activities normally. So, basically, what happened is that the US (deficit country) "borrowed" from Germany (surplus country). In what way? By selling to Germany, MBS or other products, which later proved to be a bomb… in Germany's hands! Some banks in Germany even went bankrupt or were bought out. According to Gros and Micossi (2008), several banks in Europe were exposed to foreign countries, because of their bilateral transactions.

In 2008, the Financial Market Stabilization Fund (SoFFin) was introduced. The Fund aimed mostly at guaranteeing loans and recapitalizing banks – up to €10bn per institution.

Another very serious event took place in England. Northern Rock, a retail bank situated in the middle of the mortgage chain, saw its first bank-run, in the wake of the announcement that the Bank of England had helped it financially (Buiter, 2007). After a while, the government itself guaranteed the bank's deposits, but trust was already lost. The nationalization of the institution was a one-way street, since no other buyer was willing to place their funds in a "ruined" bank.

Additionally, globalization has facilitated transactions among countries, without, however, accompanying these transactions by the appropriate consulting and supervisory services, or regulation, creating thus, a "creative unclearness" with regard to the slew of complex financial products available worldwide. Bernanke (2009) supports the need for improvement in supervision, communication and risk-management, regardless of the phase of the economy.

Thirdly, deregulation and the choice of governments to interfere less and less with the economy, helped the situation get out of hand more quickly, or – to be more precise, did not prevent it from happening. Had fiscal policies been stricter, the vulnerability of the economic system might have been contained. Buiter (2009) is of the opinion that countries like the US and the UK, created non-manageable deficits, due to their

“lax” fiscal policy, making it difficult for the governments to create new balances, due to the ruination of their credibility.

Another, rather interesting phenomenon taking place in our days, is the change observed in the distribution of wealth, especially in countries with more advanced economies. To be more precise, the chasm separating the rich from the poor deepens day by day, meaning the rich become fewer and richer and the poor become more and poorer. The economic reverberation of this, is that income is directed mainly to those who prefer to place it in investments and – why not – speculative financial products than to those who would boost consumption of goods in a direct manner.

Generally, the strong presence of “economics” everywhere should not be taken lightly. It is partly because of this that the crisis has spread so quickly. Nowadays, a considerable part of transactions is done via financial products, sometimes, too complex to understand. Payments to senior executives in companies are done via stock options, derivatives are on the rise, investors prefer to invest in financial products than spend their money on real, tangible assets and so the financial sector develops dramatically. Transactions are now easier, quicker and more profitable than ever, due to the technological advancements observed in the financial sector. However, Mishkin (2008) underlines the fact that even though IT has contributed to a “democratization of credit”, in the long run, it also did contribute to the financial crisis.

Lastly, one must always keep in mind that countries and banks across the world are linked, they interact with each other, so, all these “facilitations” of modern finance will always be under the shadow of a global breakdown.

THE EUROPEAN ANSWER TO THE CRISIS

European leaders would not stay idle in the face of the turmoil spreading all across Europe. It was only natural for the governments and European high-ups to take action.

In the summer of 2007, European policymakers began implementing strategies to boost liquidity and help financial institutions recover. The situation was tough, since banks would not lend to each other, out of fear. Every bank and financial house was potentially insolvent. Governments and economic gurus had a tremendously difficult task: to restore confidence in the financial system, because the problem was not merely damaged financial institutions, but destroyed trust. Once confidence was restored and banks were properly "stocked", they would, in their turn, provide liquidity to the rest of the system, and how? Collateral requirements started to relax with time, making it easier for private investors or plain people to access funds. A rather paradoxical phenomenon concerning interest rates, though, was that, they were raised by the ECB, during the fall of 2007. The moment called for decreases (the US were lowering the interest rates at the same time), yet, the opposite strategy was followed by Europe. The increases in interest rates were justified by given information about high inflation, at that time. Nevertheless, later the ECB understood its mistake and decreased interest rates.

Of course, the above planning was done primarily by the European Central Bank, but the governments of each country, too, contributed in their own way. At first, each member-state concentrated on implementing measures to "contain" the crisis, to prevent it from spreading further. It was only after a while, that a coordination among governments took place.

The priority was to protect national economies, keep them from unraveling. People's savings needed to be guaranteed, using public funds. However, the situation got out of control quickly, since, everywhere, people were frantic and tried to save their money wherever they thought was safer. The first major blow for Europe – and for UK, more particularly – was the bank-run, which occurred in Northern Rock, a British retail bank, followed by its nationalization.

On top of that, it is no secret that some EU countries had encouraged deregulation and imposed low taxes on civilians and investments, facilitating thus, "easy money" policies, which later turned out to be a "bubble".

Even though the European Commission published a recovery plan, in October, it was rather "sloppy" and did not live up to the expectations of its creators. Later, in November, a second recovery plan for Europe was created, which was efficient and put the emphasis on stimulating demand.

What needs to be highlighted at this point, is the following: the difference between the crisis in America and the one in Europe is firstly, that the crisis in Europe was "lighter" and secondly, that European leaders knew how to act in the face of it, they did not go searching. The strategy to be followed by European leaders has five axes: expansionary monetary policy, expansionary fiscal policy, anti-deflationary wage policy, stabilization of the financial sector and local measures to keep the damage made to each country, there.

First things first. The ECB needs to require logical minimum reserves from each bank and keep interest rates at a normal level. Capital ratios in banks need to be restored to their original state (4%) and to do that, recapitalizations would have to be around $550bn for Europe. At this point, it is highly important that Germany change its behavior, because so far, the monetary policy followed was on the wrong direction and far from expansionary. Interest rates must be cut by 1%, in order for the economy to "ignite" again. However, when one tampers with interest rates, they must bear in mind that this should be done carefully, within the inflation – deflation range and never go beyond it. During inflation, money is flowing infinitely, goods cost more – that is, interest rates, wages and prices are higher – and purchasing power drops. During deflation, money is scarce, goods cost less and the value of money increases. So, heading for the fiscal policy to be followed, it must be clarified that governments must now tamper with public spending, taxes and interest rates. Interest rates must go to lower levels, yes, but too low interest rates cause inflation. Taxes ought to be lower, but too low taxes lead to increased consumption, economic growth and – if done improperly – to inflation, as well, since prices will start increasing. Government expenditure needs to be more and more jobs need to be created, that way unemployment would be tackled, nonetheless, in order to increase government

expenditure, taxes must be increased a bit, too, since the government's money come from them.

In medio virtus.

An equilibrium is vital. Neither inflationary phenomena are desirable nor deflationary. Wages and prices should be kept stable and never be left to nosedive. Perhaps by "centrally" deciding on the lowest wage and on a stable wage growth, along with the inclusion of a productivity growth plan, the situation might be ameliorated. Also, apart from that, countries should consider investing in alternative sources of energy, as well, maybe not for direct results, but for the long-term sustainability and recovery of the economy. Additionally, a re-regulation of the financial sector is necessary, to put some things in order, and investors should be encouraged to place their funds mostly in the regulated market. OTC markets can hardly be controlled, and yet, the volume of OTC transactions is significantly larger than those occurring within the Exchange room. It is high time this changed.

Needless to say, the EU leaders must monitor the economy on a frequent basis to ensure that all goes according to plan and keep SIFIs (Systematically Important Financial Institutions) safe, at all times.

CBOE'S VOLATILITY INDEX (VIX) – THE *FEAR* INDEX

The Volatility Index (VIX), is an index that measures the implied volatility[3] of S&P 500 index, calculated and published by the Chicago Board Options Exchange (CBOE). It is considered as the "fear gauge" or "fear index". It is considered by many to be the world's most important barometer of investor sentiment and market volatility. The VIX index shows the expectations concerning the stock market volatility in the near future, by quoting the expected annualized change in the S&P 500 over the next 30 days. Practically, it is a weighted combination of prices for several options belonging to the S&P 500.

The idea of the formulation of a volatility index was conceived by Menachem Brenner and Dan Galai, around 1993. It started as a weighted measure of the implied volatility of eight S&P 100 at-the-money put and call options to develop, in 2004, in an index that would use options based on the S&P 500. If the price of VIX is over 30, that means that there is indeed fear and uncertainty among investors. If the price is below 20, that means things are generally "good".

Apart from the "original" VIX index, there are also two other volatility indexes that come from it: the VXN, which tracks the NASDAQ 100 and the VXD, which tracks the Dow Jones Industrial Average (DJIA).

For the calculation of the VIX index, a kernel-smoothed estimator that takes as inputs the current market prices for all out-of-the-money calls and puts for the first and second month expirations, is used.

It is important to bear in mind that the VIX is the volatility of a variance swap (created using simple puts and calls) and not that of a volatility swap, which would demand dynamic hedging (volatility = standard deviation). The VIX is the square root of the risk-neutral expectation of the S&P 500 variance over the next 30 calendar days, it is quoted as an annualized standard deviation and is expressed in percentages.

To be more specific, if the VIX equals 15, it means that, with a 68% probability, an annualized change of less than 15% up or down is expected.

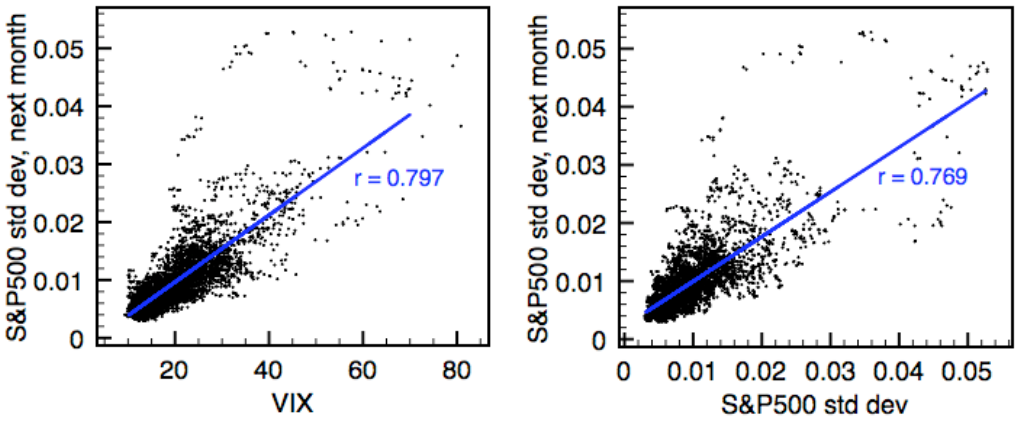
[3] For a more detailed description of the term "implied volatility", please see Appendix C.

Even though the VIX is supposed to measure "fear", a high figure is not always bad news, since the above index is a measure of market volatility in either direction, upwards or downwards.

In practical terms, when prices are expected to increase, investors would rather not be short in call options, since the predictions are not favorable for them. When this happens, the VIX increases. When prices are expected to move either upwards or downwards, writing any option that will cost the writer in the event of a sudden large move in either direction may look equally risky.

Consequently, when the VIX is high, investors anticipate sharp market moves, either up or down. The opposite occurs, when investors do not expect significant downside or upside trend.

Figure 5: Performance of VIX (left) compared to past volatility (right), from January/1990 – September/2009. The blue lines indicate linear regressions. VIX has virtually the same predictive power as past volatility.



VIX measures the current price of index options, rather than predicting the future volatility. Generally, there is a large portion of economists who claim that, in spite of their sophistication, forecasting models are not really trustworthy. Nassim Taleb and Emanuel Derman, among others, claim that investors cannot really "predict" future prices and that "models are metaphors - analogies that describe one thing relative to another".

VIX would be expected to have predictive power only under the condition that the prices computed by the Black-Scholes model are indeed true. However, Robert J.

Shiller argues that calculating VIX retrospectively in 1929 did not catch the volatility during the Great Depression, since the conditions of the Great Depression itself were unpredictable. So, VIX should not be trusted to predict such severe events.

EURO STOXX 50 VOLATILITY – VSTOXX

The EURO STOXX 50 Index includes stocks from the most important leading companies of countries belonging to the Eurozone. VSTOXX shows us the implied volatility of the prices of the options with corresponding maturity, on EURO STOXX 50 Index. It is based on the square root of implied variance. VSTOXX does not measure implied volatilities of at-the-money EURO STOXX 50 options, but the implied variance for all options expiring at a certain time in the future.

This model has been developed by Goldman Sachs, along with Deutsche Börse and via linear interpolation using the two closest sub-indices, a 30-day rolling index is calculated every 5 seconds using real EURO STOXX 50 option bid/ask prices. The VSTOXX is calculated on the basis of eight expiry months with a maximum time to expiry of two years. If there are no sub-indices expiring within a month, the VSTOXX is calculated using extrapolation, using the two nearest available indices which are as close to the time to expiry of 30 calendar days as possible.

There are 12 VSTOXX indices, for 30, 60, 90, 120, 150, 180, 210, 240, 270, 300, 330 and 360 days to expiry. Thus, those indices do not expire, because they are independent of a specific expiration time in the future. This helps minimize volatility fluctuations close to expiry. Except for the above-mentioned indices, there are 8 additional sub-indices, calculated for the EURO STOXX 50 option expiries ranging from one to twenty-four months.

EMPIRICAL PART – SECTION 1: INTRODUCTION

We will use time-series data from a range of countries, both European and for the US. We are interested in observing how "fear" affects each country's financial data and stock prices, in particular. That said, we will proceed in an economic examination of the crisis, based on both economic and behavioral data.

To begin with, we will work simultaneously with two regions: the US and Europe. Thus, we need two "fear" indicators, one index for the US and one for Europe, as well as ten other indices, which indicate the economic situation of each selected country in Europe and in the US, as a whole. The indices used for the purpose of our study are tabulated in the table below (Table 1).

Table 1: List of Areas and Indices

REGION	ECONOMIC INDEX	FEAR INDEX
US	S&P 500 COMPOSITE	
	NASDAQ COMPOSITE	
	DOW JONES INDUSTRIAL AVERAGE	
		VIX
EUROPE	EURO STOXX 50	
		VSTOXX
GERMANY	DAX 30	
FRANCE	CAC 40	
SPAIN	IBEX 35	
ITALY	FTSE MIB	
OTHER INDICES	EH HICP	
	INDUSTRIAL PRODUCTION EXCLUDING CONSTRUCTION (EU28)	

The data used for our research are monthly and downloaded from DataStream, as well as Bloomberg data bases. The time period covered is between the years 2006 – 2017. The reason for choosing this time span is because of our purpose to capture the economic situation of the counties examined, as well as their interaction, before,

during and after the outburst of the crisis. What we will try to do in this paper is prove the correlation that exists among the above-mentioned variables and the effect of fear on each country.

To be more specific, as far as the US are concerned, we use S&P 500, which is an "American stock market index based on the market capitalizations of 500 large companies" (Wikipedia), Dow Jones, which shows "how 30 large publicly owned companies based in the United States have traded during a standard trading session in the stock market" (Wikipedia), NASDAQ Composite, which is a "stock market index of the common stocks and similar securities listed on the NASDAQ stock market and is heavily weighted towards information technology companies" (Wikipedia) and the CBOE's Volatility Index (VIX), which is a "popular measure of the volatility of S&P 500 index options, calculated and published by the Chicago Board Options Exchange (CBOE) and is colloquially referred to as the fear index or the fear gauge" (Wikipedia).

As far as Europe is concerned, we use four general indices for Germany, France, Italy and Spain, DAX 30, CAC 40, FTSE MIB and IBEX 35, respectively, to track the country's general economic profile, since these are each country's benchmark indices. Additionally, we use four other indices for inflation (EH HICP), production (Industrial Production excl. Construction), EURO STOXX 50, which represents 50 "supersector leaders in the Eurozone" (Wikipedia) and VSTOXX, which is the European equivalent of VIX.

Our aim, as stated above, is to detect how "fear" influences the prices of the stocks, in each country.

Since it is impossible to know a priori which index affects which, in order to examine closely the relations among the indices, we must experiment with many combinations among our data.

EMPIRICAL PART – SECTION 2: WORKING WITH EVIEWS

The software we will use for our research is EViews.

The first step to follow is to import our data, from the Excel file, into EViews. This is the data we will work on. After that, we take all the data's logarithms, via the EViews function *ldow=log(dowjones)*, e.g. for Dow Jones Industrial Average. Next step is to get the data's returns, using the equation that follows: *rdow=ldow-ldow(-1)*. We have completed the two basic steps to bring our data in the desirable form to run our regressions, since we want to find which variable affects which.

Starting with the regressions, we work with several combinations. For example, starting with the US, we want to find out how VIX affected S&P500. We shall divide the time period into three sub-periods: 2006 – 2009, 2010 – 2013 and 2013 – 2017, to capture in detail the behavior of our data when the crisis burst in America, when it came to Europe and the aftermath, respectively.

Using the equation $R_{SP_t} = a_t + b_{SP,t-1}R_{SP,t-1} + b_{VIX,t}R_{VIX,t} + b_{VIX,t-1}R_{VIX,t-1}$, what we basically try to find is how the S&P500 is affected by its own lag (that is, the S&P500 value of the previous month), by VIX and by VIX's lag (the value of VIX during the previous month). After having ran several regressions for all of the three time sub-periods, we come to the conclusion that S&P500 was affected a lot not by VIX itself, but by the lag of VIX, as well as the lag of itself, especially during the years 2006 – 2009. The outcome seems logical, since it was during these years that the crisis burst in the US. The results are shown in the table, at the beginning of the next page (Table 2).

Table 2: Regression Analysis for S&P 500 (2006-2009)

Dependent Variable: RSP
Method: Least Squares
Date: 10/19/17 Time: 23:44
Sample (adjusted): 2006M03 2009M01
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000898	0.006722	0.133645	0.8945
RSP(-1)	0.440778	0.125807	3.503596	0.0014
RVIX(-1)	-0.172647	0.030537	-5.653709	0.0000

R-squared	0.554897	Mean dependent var	-0.010015
Adjusted R-squared	0.527078	S.D. dependent var	0.055421
S.E. of regression	0.038113	Akaike info criterion	-3.614714
Sum squared resid	0.046483	Schwarz criterion	-3.481398
Log likelihood	66.25749	Hannan-Quinn criter.	-3.568693
F-statistic	19.94670	Durbin-Watson stat	1.931271
Prob(F-statistic)	0.000002		

As we observe, during 2006 – 2009, both RSP(-1) and RVIX(-1) are statistically significant and RVIX(-1) affects RSP, which is our dependent variable, negatively. The explanatory power of this model is high enough, with an R^2 equaling 55%.

In simple words, what this table shows us is that the return of S&P500 index was highly explained both by its own previous values, as well as the previous values of the fear index.

Table 3: Regression Analysis for S&P 500 (2010-2013)

Dependent Variable: RSP
Method: Least Squares
Date: 10/19/17 Time: 23:40
Sample: 2010M01 2013M01
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004814	0.004702	1.023826	0.3134
RSP(-1)	0.076161	0.097242	0.783210	0.4391
RVIX	0.022976	0.022896	1.003484	0.3229
RVIX(-1)	-0.195721	0.023251	-8.417740	0.0000

R-squared	0.694031	Mean dependent var	0.006802
Adjusted R-squared	0.666216	S.D. dependent var	0.048532
S.E. of regression	0.028039	Akaike info criterion	-4.208657
Sum squared resid	0.025944	Schwarz criterion	-4.034503
Log likelihood	81.86015	Hannan-Quinn criter.	-4.147259
F-statistic	24.95141	Durbin-Watson stat	2.567324
Prob(F-statistic)	0.000000		

The table above (Table 3), gives us the results of another regression, again among RSP, RSP(-1), RVIX and RVIX(-1). The situation here is a bit different. Although our R^2 is high (0,694031), we observe that only the coefficient of RVIX(-1) is statistically significant, since t-Statistic= 8,41>2 (in absolute values), which means that only the value of the VIX's lag affects "significantly" the return of S&P500, which agrees with our argument, from our analysis on Table 2. On top of that, the RVIX(-1) coefficient now is a bit higher (-0,19) than the one of our first regression (-0,17).

Staying in the US, what happens if we want to check how VIX affected the Dow Jones Industrial Average Index? The same process, only now we will alter our equation a bit, to incorporate, instead of S&P500, Dow Jones. Our equation becomes $R_{DOW_t} = a_t + b_{DOW,t-1}R_{DOW,t-1} + b_{VIX,t}R_{VIX,t} + b_{VIX,t-1}R_{VIX,t-1}$. The results are demonstrated below (Table 4).

Table 4: Regression Analysis for Dow Jones Industrial Average (2010-2013)

Dependent Variable: RDOW
Method: Least Squares
Date: 10/20/17 Time: 13:12
Sample: 2010M01 2013M01
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.006339	0.003845	1.648732	0.1087
RDOW(-1)	-0.125248	0.172152	-0.727543	0.4720
RVIX	-0.157675	0.018747	-8.410768	0.0000
RVIX(-1)	-0.044862	0.032203	-1.393112	0.1729

R-squared	0.704377	Mean dependent var	0.007691
Adjusted R-squared	0.677502	S.D. dependent var	0.039856
S.E. of regression	0.022634	Akaike info criterion	-4.636946
Sum squared resid	0.016905	Schwarz criterion	-4.462792
Log likelihood	89.78350	Hannan-Quinn criter.	-4.575548
F-statistic	26.20959	Durbin-Watson stat	2.101774
Prob(F-statistic)	0.000000		

In this case, we see that our model explains rather well the behavior of Dow Jones (R^2= 70%). However, the key factor that influences Dow Jones's behavior is VIX, or rather, the return of VIX (since t-Statistic= 8,41>2 (in absolute values), as well as the lag of the return of VIX, but to a smaller extent (t-Statistic= 1,39~2 (in absolute values). Both variables affect Dow Jones's returns negatively.

NASDAQ is, too, affected by VIX, but not in a considerable manner. The explanatory power of our model is low, with an R^2 of only 23% and only RVIX and RVIX(-1) (to a smaller extent) affect NASDAQ. But, generally, we would not claim that NASDAQ was highly affected by the variables in the model. Results can be seen in the table at the beginning of the next page (Table 5).

Focusing on Europe, now, let us find out how fear influenced the prices of stocks in this area.

It is important at this point to highlight that Europe is not the region of origin for the crisis – America is – and thus, the effects of the crisis may have reached Europe a bit later. For Europe, we will deal with four major counties that have the largest

economies – Germany, France, Spain and Italy – as well as with indices that express the situation of the European economy as a whole.

Table 5: Regression Analysis for NASDAQ Composite (2006-2009)

Dependent Variable: RNAS
Method: Least Squares
Date: 10/20/17 Time: 13:16
Sample (adjusted): 2006M03 2009M01
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.016032	0.024027	-0.667263	0.5095
RNAS(-1)	-0.032222	0.174806	-0.184330	0.8550
RVIX	0.241583	0.108309	2.230500	0.0331
RVIX(-1)	-0.221173	0.114737	-1.927654	0.0631

R-squared	0.236478	Mean dependent var	-0.013676
Adjusted R-squared	0.162589	S.D. dependent var	0.148387
S.E. of regression	0.135789	Akaike info criterion	-1.048212
Sum squared resid	0.571602	Schwarz criterion	-0.870458
Log likelihood	22.34370	Hannan-Quinn criter.	-0.986851
F-statistic	3.200442	Durbin-Watson stat	1.980009
Prob(F-statistic)	0.036828		

So, what happens if we want to check how VSTOXX affected Dax30? Or, to put it differently, how did fear affect Germany? The process remains the same as above, only now the equation, in EViews, becomes: *rdax c rdax(-1) rvstoxx rvstoxx(-1)*. The results are demonstrated below (Table 6).

Table 6: Regression Analysis for DAX30 (Germany) (2006-2009)

Dependent Variable: RDAX
Method: Least Squares
Date: 10/30/17 Time: 21:41
Sample (adjusted): 2006M03 2009M01
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.004813	0.006014	0.800380	0.4296
RDAX(-1)	0.261967	0.146297	1.790653	0.0831
RVSTOXX	-0.222665	0.027117	-8.211278	0.0000
RVSTOXX(-1)	-0.038647	0.040128	-0.963094	0.3430

R-squared	0.704575	Mean dependent var	-0.004982
Adjusted R-squared	0.675985	S.D. dependent var	0.060663
S.E. of regression	0.034531	Akaike info criterion	-3.786714
Sum squared resid	0.036964	Schwarz criterion	-3.608960
Log likelihood	70.26749	Hannan-Quinn criter.	-3.725353

After a series of regressions, we choose to demonstrate the one with the highest explanatory power (R^2= 70%) for Germany's DAX30 Index. By checking the t-statistic values, we observe that for the period between 2006 and 2009, DAX's previous value (to a certain extent), as well as VSTOXX's current value, did affect the index (e.g. t-statistic= 8,2>2), in a negative way (RVSTOXX coefficient= -0,22).

As for France, following the same procedure, we come to the conclusions emerging from the table below (Table 7).

Table 7: Regression Analysis for CAC40 (France) (2010-2013)

Dependent Variable: RCAC
Method: Least Squares
Date: 10/30/17 Time: 22:05
Sample: 2010M01 2013M01
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004331	0.004648	-0.931726	0.3582
RCAC(-1)	-0.190650	0.180817	-1.054379	0.2994
RVSTOXX	-0.249464	0.024668	-10.11293	0.0000
RVSTOXX(-1)	-0.106432	0.054706	-1.945507	0.0603

R-squared	0.774919	Mean dependent var	-0.000982
Adjusted R-squared	0.754457	S.D. dependent var	0.055860
S.E. of regression	0.027680	Akaike info criterion	-4.234403
Sum squared resid	0.025284	Schwarz criterion	-4.060250
Log likelihood	82.33646	Hannan-Quinn criter.	-4.173006
F-statistic	37.87132	Durbin-Watson stat	1.966081
Prob(F-statistic)	0.000000		

Having experimented with a number of regressions, the one of the above table is the one with the highest explanatory power (R^2= 77%) for France's CAC40 Index. By checking the t-statistic values, we observe that for the period between 2010 and 2013, VSTOXX's current value, as well as its lag, did affect the index (e.g. t-statistic= 10,1>>2), in a negative way (RVSTOXX coefficient= -0,24).

Spain, following the example of France – in terms of the explanatory power of the model – was affected a lot by "fear", during the years 2010 until 2013 (Table 8).

Table 8: Regression Analysis for IBEX35 (Spain) (2010-2013)

Dependent Variable: RIBEX
Method: Least Squares
Date: 10/30/17 Time: 22:23
Sample: 2010M01 2013M01
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.011575	0.008638	-1.340057	0.1894
RIBEX(-1)	0.008803	0.189724	0.046398	0.9633
RVSTOXX	-0.290548	0.044130	-6.583914	0.0000
RVSTOXX(-1)	0.015951	0.073875	0.215922	0.8304

R-squared	0.570008	Mean dependent var	-0.010086
Adjusted R-squared	0.530918	S.D. dependent var	0.072225
S.E. of regression	0.049467	Akaike info criterion	-3.073235
Sum squared resid	0.080749	Schwarz criterion	-2.899082

The model has a mediocre, yet adequate, explanatory power, around 57% and basically, only the return of VSTOXX – the fear index for Europe – affects negatively the returns of IBEX35, the basic index of Spain.

Italy was affected a lot by “fear”, during the years 2006 until 2009, as did Germany (Table 9).

Table 9: Regression Analysis for FTSE MIB (Italy) (2006-2009)

Dependent Variable: RMIB
Method: Least Squares
Date: 10/30/17 Time: 22:25
Sample (adjusted): 2006M03 2009M01
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004867	0.006229	-0.781377	0.4405
RMIB(-1)	0.353954	0.140208	2.524491	0.0169
RVSTOXX	-0.184644	0.026909	-6.861791	0.0000
RVSTOXX(-1)	-0.034220	0.036211	-0.945002	0.3520

R-squared	0.653437	Mean dependent var	-0.018334
Adjusted R-squared	0.619898	S.D. dependent var	0.055745
S.E. of regression	0.034368	Akaike info criterion	-3.796180
Sum squared resid	0.036616	Schwarz criterion	-3.618426
Log likelihood	70.43315	Hannan-Quinn criter.	-3.734819
F-statistic	19.48326	Durbin-Watson stat	1.928293
Prob(F-statistic)	0.000000		

For Italy, we have the following situation. During 2006 – 2009, both the lag of MIB index's value and the return of VSTOXX affected the MIB index, negatively. The coefficient of RVSTOXX's lag is not statistically significant (0,94<2, hence not statistically significant).

If we were to examine Europe as a whole, however, we ought to separate the effects of the crisis into two periods: 2006-2009 and 2010-2013, both of which have notable differences, in terms of influences. To examine Europe as a whole, we will use another index, called Euro Stoxx 50, which is a stock index "made up of fifty of the largest and most liquid stocks in the Eurozone" (Wikipedia). Results demonstrated in the tables below (Tables 10 and 11).

Table 10: Regression Analysis for Europe (Euro Stoxx 50) (2006-2009)

Dependent Variable: RSTOXX
Method: Least Squares
Date: 10/31/17 Time: 00:33
Sample (adjusted): 2006M03 2009M01
Included observations: 35 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.000812	0.005670	-0.143297	0.8870
RSTOXX(-1)	0.286579	0.143132	2.002202	0.0541
RVSTOXX	-0.203379	0.025203	-8.069522	0.0000
RVSTOXX(-1)	-0.035712	0.036971	-0.965937	0.3416

R-squared	0.704633	Mean dependent var	-0.012024
Adjusted R-squared	0.676049	S.D. dependent var	0.056575
S.E. of regression	0.032201	Akaike info criterion	-3.926442
Sum squared resid	0.032144	Schwarz criterion	-3.748688
Log likelihood	72.71274	Hannan-Quinn criter.	-3.865081
F-statistic	24.65143	Durbin-Watson stat	1.942774
Prob(F-statistic)	0.000000		

What we observe in these two tables is that, although the 2010-2013 model is "better" than the 2006-2009 one, in terms of R^2 numbers (0,74> 0,70), RVSTOXX, whose coefficient is statistically significant in both models (-0,20, -0,25) is "stronger" in the second model, that is, it affects more negatively the return of the Euro Stoxx 50 index, during 2010-2013. Additionally, in the first model we see that Euro Stoxx 50 is also positively affected by its lag.

Table 11: Regression Analysis for Europe (Euro Stoxx 50) (2010-2013)

Dependent Variable: RSTOXX
Method: Least Squares
Date: 10/30/17 Time: 22:30
Sample: 2010M01 2013M01
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.005559	0.005087	-1.092885	0.2824
RSTOXX(-1)	-0.149147	0.185105	-0.805743	0.4262
RVSTOXX	-0.254220	0.026741	-9.506783	0.0000
RVSTOXX(-1)	-0.087115	0.057380	-1.518210	0.1385

R-squared	0.746928	Mean dependent var	-0.002316
Adjusted R-squared	0.723922	S.D. dependent var	0.057199
S.E. of regression	0.030054	Akaike info criterion	-4.069818
Sum squared resid	0.029808	Schwarz criterion	-3.895665
Log likelihood	79.29164	Hannan-Quinn criter.	-4.008421
F-statistic	32.46595	Durbin-Watson stat	1.813905
Prob(F-statistic)	0.000000		

Let us experiment, now, by adding some more factors to our equation for Europe, so that our regression analysis becomes more complete.

Below, are two separate tables of regression results, one for Germany (Table 12) and one for the Eurozone (Table 13), as a whole. The difference of these tables, compared to the ones already examined above, is that now we have added two more factors in our analysis: inflation and industrial production indices, which serve as complementary factors that will help make our model more complete and efficient.

Table 12: Regression Analysis for Germany (with inflation) (2006-2009)

Dependent Variable: RDAX
Method: Least Squares
Date: 10/30/17 Time: 23:34
Sample (adjusted): 2006M02 2009M01
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012916	0.006437	2.006604	0.0533
RVSTOXX	-0.192270	0.027140	-7.084264	0.0000
RINF	-0.501079	0.185711	-2.698157	0.0110
RPROD	1.405725	0.427715	3.286594	0.0025

R-squared	0.700081	Mean dependent var	-0.003469
Adjusted R-squared	0.671963	S.D. dependent var	0.060476
S.E. of regression	0.034637	Akaike info criterion	-3.783335
Sum squared resid	0.038392	Schwarz criterion	-3.607389
Log likelihood	72.10004	Hannan-Quinn criter.	-3.721925
Prob(F-statistic)	0.000000		

What the model above tells us is how fear (RVSTOXX), inflation and industrial production affected the DAX30. It is a very strong model (judging from the R^2, which is very high (70%), all our coefficients are statistically significant (since all t-statistic values are above 2), and we see that, during 2006 – 2009, the returns of VSTOXX and inflation affected negatively the return of DAX30, while the industrial production affected DAX30 positively.

The same model for the years 2010 – 2013 did not have the same explanatory power, so – having a much smaller R^2 – we consider it weak and inadequate to explain the effect of fear in Germany, during the above-mentioned time span.

Spain and France behaved similarly to Germany.

In the next table (Table 13), we see the behavior of the Eurozone towards fear, during the years 2006 – 2009 (when the effect was most visible), taking into account inflation and industrial production.

Table 13: Regression Analysis for Europe (with inflation) (2006-2009)

Dependent Variable: RSTOXX
Method: Least Squares
Date: 10/31/17 Time: 21:30
Sample (adjusted): 2006M02 2009M01
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003879	0.006095	0.636446	0.5290
RVSTOXX	-0.177083	0.025698	-6.890792	0.0000
RINF	-0.394110	0.175844	-2.241244	0.0321
RPROD	1.439789	0.404990	3.555126	0.0012

R-squared	0.689543	Mean dependent var	-0.010751
Adjusted R-squared	0.660438	S.D. dependent var	0.056282
S.E. of regression	0.032797	Akaike info criterion	-3.892526
Sum squared resid	0.034420	Schwarz criterion	-3.716580
Log likelihood	74.06547	Hannan-Quinn criter.	-3.831116
F-statistic	23.69128	Durbin-Watson stat	2.099323
Prob(F-statistic)	0.000000		

Again a very good, strong model (R^2= 68%), tells us how fear (RVSTOXX), inflation and industrial production affected the Eurozone. Our coefficients are statistically significant (since all t-statistic values are above 2), and we see that, during 2006 – 2009, the returns of VSTOXX and inflation affected negatively the return of Euro Stoxx 50, while the industrial production affected Euro Stoxx 50 positively.

Putting aside the "fear" factor, let us also examine how, and if, countries within Europe affected each other. For instance, how did Spain and Italy affect Germany and France? Are the relations bidirectional?

Table 14: Regression Analysis for "Contagion" effect among European countries (2010-2013)

Dependent Variable: RDAX
Method: Least Squares
Date: 11/13/17 Time: 22:54
Sample: 2010M01 2013M01
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.012310	0.005429	2.267525	0.0298
RMIB	1.196669	0.209928	5.700385	0.0000
RIBEX	-0.565883	0.200709	-2.819417	0.0080

R-squared	0.689275	Mean dependent var	0.007458
Adjusted R-squared	0.670997	S.D. dependent var	0.057001
S.E. of regression	0.032695	Akaike info criterion	-3.925570
Sum squared resid	0.036345	Schwarz criterion	-3.794955
Log likelihood	75.62305	Hannan-Quinn criter.	-3.879522
F-statistic	37.71080	Durbin-Watson stat	2.207900
Prob(F-statistic)	0.000000		

Table 15: Regression Analysis for "Contagion" effect among European countries (2006-2009)

Dependent Variable: RCAC
Method: Least Squares
Date: 11/13/17 Time: 23:14
Sample (adjusted): 2006M02 2009M01
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.003496	0.002922	1.196463	0.2400
RMIB	0.795310	0.082284	9.665384	0.0000
RIBEX	0.174642	0.076166	2.292895	0.0284

R-squared	0.919500	Mean dependent var	-0.010845
Adjusted R-squared	0.914621	S.D. dependent var	0.055152
S.E. of regression	0.016115	Akaike info criterion	-5.338435
Sum squared resid	0.008570	Schwarz criterion	-5.206475
Log likelihood	99.09183	Hannan-Quinn criter.	-5.292377
Prob(F-statistic)	0.000000		

The previous tables (Table 14 and Table 15) confirm the fact that the European sentiment was not alone to affect the counties' returns, but there were influences among countries, as well. Germany and France were indeed affected by Spain and Italy, according to the tables above. Between 2010 and 2013, we see that RMIB and RIBEX affect RDAX, as our 68%-explanatory-strength model shows. Both the countries' coefficients are statistically significant and Spain affects Germany negatively (coefficient = -0,56). Between 2006 and 2009, RMIB and RIBEX affected RCAC, as well. A very strong model (R^2= 91%) demonstrates that both Spain and Italy affected France.

So far, we have examined the effect of fear in Europe and America, separately. It is high time we connected them, to see how fear in the US "spread" across Europe. Did the "American fear" affect the Europeans? How did Germany and the Eurozone react when the crisis started spreading? These are questions we hope to answer with the analysis below.

In the table below (Table 16), we check only how – and if – the American fear, affected the European sentiment. As anticipated, the returns of VIX did not affect the returns of VSTOXX, during the years 2006 – 2009 (the crisis had not come to Europe back then) nor it did during 2010 – 2013 (regression model R^2= 0,0005!). However, we see a significant influence during the last three years of the crisis, 2013 – 2017, as demonstrated in the table below (Table 16).

Table 16: Regression Analysis for "Contagion" effect (2006-2009) (VIX-VSTOXX)

Dependent Variable: RVSTOXX
Method: Least Squares
Date: 11/07/17 Time: 12:22
Sample (adjusted): 2006M02 2009M01
Included observations: 36 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.028385	0.037221	0.762616	0.4510
RVIX	0.076427	0.174810	0.437201	0.6647

R-squared	0.005590	Mean dependent var	0.031022
Adjusted R-squared	-0.023657	S.D. dependent var	0.217811
S.E. of regression	0.220373	Akaike info criterion	-0.133040
Sum squared resid	1.651181	Schwarz criterion	-0.045067
Log likelihood	4.394723	Hannan-Quinn criter.	-0.102335
F-statistic	0.191144	Durbin-Watson stat	2.238099
Prob(F-statistic)	0.664730		

Table 17: Regression Analysis for "Contagion" effect (2013-2017) (VIX-VSTOXX)

Dependent Variable: RVSTOXX
Method: Least Squares
Date: 11/07/17 Time: 12:26
Sample: 2013M01 2017M01
Included observations: 49

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.002391	0.026439	-0.090423	0.9283
RVIX	-0.378013	0.108459	-3.485325	0.0011

R-squared	0.205376	Mean dependent var	0.000752
Adjusted R-squared	0.188469	S.D. dependent var	0.205323
S.E. of regression	0.184965	Akaike info criterion	-0.497336
Sum squared resid	1.607974	Schwarz criterion	-0.420118
Log likelihood	14.18472	Hannan-Quinn criter.	-0.468039
F-statistic	12.14749	Durbin-Watson stat	2.287362
Prob(F-statistic)	0.001076		

In the table above, we see a significant change in influences, compared to the previous years of the crisis. R^2 moves from 0,005 to 0,20 and the coefficient of RVIX (t-

statistic= -3,4, implies that VIX is a statistically significant variable to be considered), is negative (-0,37), meaning that the two variables move towards opposite directions. To put it in simple words, only during 2013-2017 we observe a significant influence of the VIX towards VSTOXX.

As far as DAX is concerned, the index was not affected at all by VIX, since after a series of regressions we tested for each separate time period mentioned above, our R^2 numbers equaled to 0,014, 0,0002 and 0,05, respectively. That tells us that there was no "VIX" impact on DAX.

Euro Stoxx 50, too, was not affected by VIX either, since after a series of regressions we tested for each separate time period mentioned above, our R^2 numbers equaled to 0,008, 0,0006 and 0,07, respectively. That tells us that there was no "VIX" impact on Euro Stoxx 50, either, at least, not directly.

At this point, the author considers it interesting to look for "inverse" relationships and influences, between Europe and America. So far, we have examined how America affected Europe. What if we were to examine the situation the other way round? Did Europe affect America? This will be the last question we will try to answer via our analysis below, until we reach our final conclusion.

Table 18: Regression Analysis for "Inverse" contagion effect (2010-2013)

Dependent Variable: RVIX
Method: Least Squares
Date: 11/14/17 Time: 00:04
Sample: 2010M01 2013M01
Included observations: 37

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.033891	0.037829	-0.895888	0.3772
RDAX	1.733500	2.027504	0.854992	0.3991
RCAC	4.937041	3.688710	1.338420	0.1905
RIBEX	3.105882	1.783689	1.741269	0.0916
RMIB	-3.865425	2.350057	-1.644822	0.1101
RSTOXX	-5.070580	6.720629	-0.754480	0.4563

R-squared	0.139693	Mean dependent var	-0.011285
Log likelihood	8.978436	Hannan-Quinn criter.	-0.068901
Prob(F-statistic)	0.430292		

Admittedly, this is the closest Europe came to influencing America. The table above (Table 18) is the strongest in terms of explanatory power, among other tables for different time periods and what we see is that, basically, Europe did not affect the US at all. Maybe Spain and Italy could be considered as potentially influential factors, but only in a weak sense, since their coefficients are close to being statistically significant (1,6<2 and 1,7<2), but are not quite there yet.

To conclude, the table above ended our analysis concerning the behavior of countries within Europe and of the US, towards the fear that dominated the markets, during the crisis years and next, we will proceed with the conclusion of our research.

CONCLUSION

This paper examines the causes and consequences of the 2006 – 2010 subprime mortgage crisis in the US, as well as how this crisis – originating from the US – became global. The analysis of this essay revolves around two central axes: America and Europe. First we looked at the causes that led to the subprime crisis, and, then, enumerating its consequences, we found out that one among them, was its contagion to Europe. It was only natural to check what happened in Europe, after the contagion, and how did the European leaders react in the light of the "tornado" that was coming.

So far for the theoretical part.

Proceeding to the empirical part, our purpose is to find out what sort of relation exists between fear and the markets. To be more specific, we try to prove that fear affects the behavior of exchange traded stocks, in Europe and the US separately, and in combination. The core question of the practical part is "Did the American sentiment affect the Europeans"? "Did the American fear spread to Europe"?

We used monthly data, for the time-period 2006 – 2017, to capture the situation of the crisis at full length. Firstly, we worked with the US. We acquired stock returns for three of America's most basic indices – Dow Jones, S&P500 and NASDAQ – along with VIX, an index, which is considered by many to be the world's most important barometer of investor sentiment and market volatility, and via the process of regression, we tried to find how and if VIX, affected the returns of the above mentioned stocks. Our findings showed that fear did affect the returns mostly of the Dow Jones and the S&P500, and less of the NASDAQ, negatively, of course. This happened particularly during 2006 – 2013.

Moving to Europe, we acquired stock index returns for four major European countries – Germany, France, Spain and Italy – considered as benchmarks, as well as the returns of EURO STOXX 50, which is an index that includes stocks from the most important leading companies of countries belonging to the Eurozone, and data concerning the inflation and the industrial production of Europe, during 2006 – 2017. Additionally, we use VSTOXX, which is the European equivalent of VIX, that is, an indicator of sentiment, of fear in the European markets. Again, we try to find if fear affected the returns of the above mentioned stocks. Our findings showed that fear affected negatively Germany and Italy first, during 2006 – 2009 and Spain and France

later, during 2010-2013. All across 2006 – 2013, EURO STOXX 50 received the negative influences of VSTOXX. Looking at it from the opposite direction, France was the only country to affect VSTOXX, negatively, during 2010 – 2017. Also, as anticipated, inflation had a negative impact on the returns of the stocks, whereas industrial production had a positive impact. There were also inter and intra-European influences, such as the influences of Spain and Italy, towards Germany and France. During 2006 – 2009, France was affected positively by the above mentioned countries, while, during 2010-2013, Germany was affected negatively by Spain and positively by Italy.

Trying to combine two continents, to find any contagion or "spillover" effects, we came to the conclusion that there was no contagion at all, between Europe and America, at least not via the fear sentiment. The American fear did not transmit to Europe, except for after 2013, when it was already too late, and so, it cannot be considered as responsible for bringing the crisis to our continent.

After several experimentations on the effect of the American fear (VIX) to European stocks' returns and vice versa, it was surprising to reach the conclusion that no solid evidence of influence existed between them, in terms of sentiment, at least.

In economics, we always claim that everything is linked and everything comes down to "ambience", therefore, one would expect, if anything, that when something strange happens on the other side of the globe, especially in the US, that it would be "visible" financially and (macro-)economically in the stock markets, for example. In our case, that did not happen. Fear did not "cross" the Atlantic and it did not affect the European stocks, up until 2013.

The reasons why the American fear did not affect Europe or why the American fear did not spread to Europe may vary. So may the reasons that drove Europe into the crisis, regardless of the situation in the US.

Europe was influenced by the US, there is no denying in that. However, what we achieved with this essay is to prove that the nature of the influence should not be searched in the sentiment, but in other factors, such as the transactions between Europe and America. Earlier on, we did mention that German banks had bought MBS from America that, with the outburst of the crisis in the US, practically, exploded within German premises. Isn't that a reason strong enough to open the bag of Aeolus

for Europe? Besides, common activities that made Europe and America collaborate were and are countless, the banks are linked, the enterprises across the world interact with each other and when one faces trouble, all are potentially in trouble and so on. We are a part of this vicious circle and it will not end soon, luckily or unfortunately.

If the reader were to keep in mind only one thing from this assignment, I would urge them to consider the following: in this modern world of globalization, all, and economies above all, intertwine. If this is for our benefit or not, is beyond the interest of this essay. Nonetheless, may the contemporary homo economicus, and each individual person in every society try to achieve what is best for them – without hurting others – not egotistically, but in a sense of mental fulfillment, for only if people possess and are able to manipulate themselves and their own self-awarement, can we hope for less unhappiness in the future. What the 2006 crisis had to teach to the humanity, among other things, was that

… materialism does not bring happiness.

APPENDIX A – WHAT IS A BUBBLE

Generally, it is considered that the "right" price for any economic product is derived by the sum of the discounted free cash flows it will generate for its owner, in the future. What really happens during a financial bubble, is that the price of a financial asset skyrockets, without actually reflecting the asset's real "fundamental" value. A stock's price gets from zero to a hundred in no time, practically. This happens due to speculation. Speculation in economics is the process in which brokers, or investors in general, "bet" on the rise or fall of an asset's price, each one for their own personal reasons. If a stock's price is expected to go downhill, everybody sells. The opposite happens in the case of a positive scenario. In both cases, we are trading occurs in bulk! Speculation is all about fear (when people sell) and greed (when investors buy). The problem with bubbles, however, is that they are understood by people, after they have actually occurred. Someone claims that a stock is "good" and everybody buys, without examining the case carefully. Of course, as the price of an asset rises, it can fall as easily, leaving people with millions of lost invested capital. And why? Because no one had the patience to examine if the "rumors" were true…

APPENDIX B – WHAT REALLY HAPPENED

After the collapse of the dotcom bubble, in 2001 – 2002, the Fed lowered significantly the federal funds' interest rates. The decrease in interest rates, affected both home prices by increasing them and mortgage rates by decreasing them. Consumers started getting more and more loans, since the interest rates were low and their homes were worth a lot. Signing contracts with false information concerning their financial situation, people managed to get mortgages and other consumer loans, based on their home's high value. Brokers, banks and other institutions were glad to hand out loans since, the more complicated the product, the higher their commission; they even offered incentives to their clients, either super low interest rates for a certain period or reduced risk premiums. Of course, financial institutions knew well the consequences of their actions that could even lead to their going bankrupt, so they figured out a way to "secure" themselves against that possibility. What they invented was… securitization, a process which helped the lending institutions "get rid" of the loans they granted (Frank and Krahnen, 2008)! Of course, as Rajan (2005) clearly states, by

transferring the risk, banks, who would otherwise be interested in the monitoring of their clients, now were not, since hedge funds and other institutions were indeed not interested. So, the total systemic risk increased.

Imagine being an investor and buying a bond. That bond has a collateral, whose content is unknown or too complicated to examine. This collateral is an AAA "bundle" of loans. "Everything's good", someone might think. Where did this AAA come from? "The credit rating agencies", somebody might add. And, based on what criteria do these companies provide the ratings? Who pays them? Well, here is the whole story. Credit rating agencies were paid to produce a rating by the same people who sold the MBS (mortgage-backed securities), the "bond" we mentioned earlier. Practically, this is like saying that the companies who sold the MBS to unsuspecting clients, "paid" for a good rating. Of course, "the client is always right", so the credit rating agencies gave AAA ratings to pools of mortgages, which included say 25 non-performing loans and 5 healthy ones. This is why questions arose concerning the credit rating agencies' role in the subprime crisis (Portes, 2008; Bolton et al, 2009; Richardson and White, 2009).

All this is happening, of course, under the umbrella of a single thought "Who's going to catch me?", also known as the problem of moral hazard. Everybody acts according to their interests, knowing that this will burst sometime in the future, but since the risk is transferred to the next link of the chain, nobody cares. On top of that, the federal law is absent, legislators fail to keep up with the developments, so this whole situation is unregulated, too!

Then came the housing market correction, during which, home prices plummeted, in some cases, prices even dropped by 50% or below (Robert Shiller, 2007). This was the beginning of the end. Home prices touched bottom and, at the same time, the Fed increased the interest rates – since everyone blamed the Fed's rates for being too low. People found themselves unable to repay their high mortgages, so the banks started confiscating homes, which they would later sell at half price. Prosperity gave its place to despair, and quite so began the crisis which was later meant to shock the world, as a whole…

APPENDIX C – WHAT IS IMPLIED VOLATILITY

"In financial mathematics, the implied volatility of an option contract is the value of the volatility of the underlying instrument which, when input in an option pricing model (such as Black–Scholes) will return a theoretical value equal to the current market price of the option." (Wikipedia)

Implied volatility differs from historical volatility because the latter is calculated from known past returns of a security.

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