The effect of financial crises on investment and the influence of uncertainty avoidance and financial systems

Master Thesis

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Master Thesis Economics (International Business)

Author: Jelle Gardien

Student number: s4442644

Supervisor: Tyagi, M. (Mukul)

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Abstract

The aim of this master thesis is to find out what effect financial crises have on investment as well as to explore cross-country differences arising from uncertainty avoidance and a country's financial system. The country sample consists of all 28 countries that are member of the European Union, including the United Kingdom. The time period in which data for this research is collected is between 1970-2016. Using a fixed effects estimation method, this research finds that financial crises have a significantly negative effect on investment. This effect is more negative for countries that score high on the uncertainty avoidance index and less negative for countries that score low on the uncertainty avoidance index. These findings remain robust when analysing the results with economic- and institutional control variables. No significant effect of a country's financial system has been found.

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1. Introduction

The global financial crisis that started in 2007 has shown the great interconnectedness between markets all over the world. Extreme market reactions amplified the transmission of shocks from one market to another (Kräussl et al., 2016). Within the European Union (EU), the effects of the global financial shock were asymmetric across countries, disproportionally affecting countries that relied most heavily on external funding. In late 2009, the financial shock led to the sovereign debt crisis in the European Union (Lane, 2012). Financial crises can cause large temporary uncertainty shocks that can have enormous consequences for the economy. One of these consequences is the dramatical reduction of investments during times of crises, because it increases the real-option value for firms to postpone investments (Bloom et al., 2007; Bloom, 2009). The increase of real-option value for firms can be explained with the theory of irreversible investment under uncertainty. According to this theory, the investment decision of a firm is generally irreversible because the expenditures cannot be recovered. If a firm decides to incur a sunk cost with the decision to investment, it thereby kills its future option to invest. High uncertainty resulting from a financial crisis therefore increases the option value for firms to delay their investment (Dixit & Pindyck, 1994). Figure 1 shows how investment was reduced by the sovereign debt crisis in four countries within the EU that were hit hardest by the crisis. The red bars represents periods of financial crises.

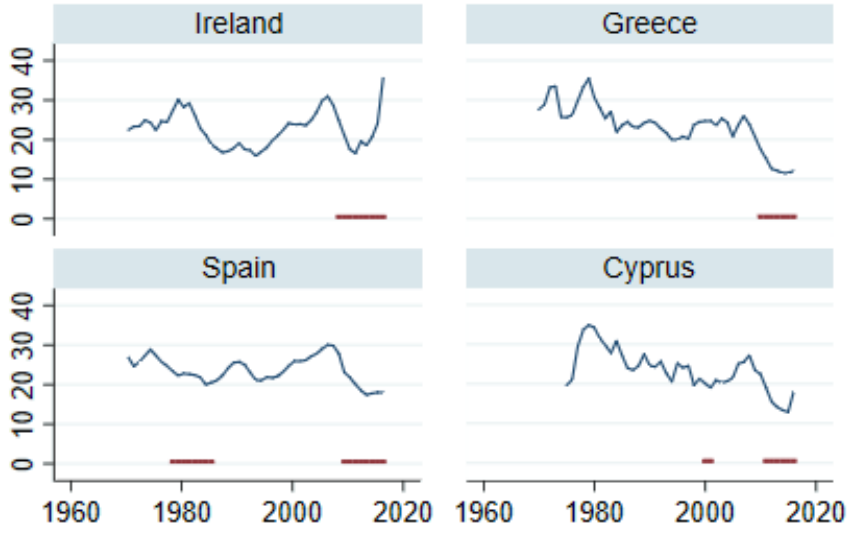

Figure 1: Reduction of investment in four countries that were hit hardest by the sovereign debt crisis. The y-axis represents investment. The red bars represent financial crises periods.

Countries act different when it comes to coping with uncertainty arising from financial crises. By analysing cross-country differences of the effect of financial crises on investment, Inklaar and Yang (2012) found that investment relative to GDP had only decreased in countries scoring high on the uncertainty avoidance index (UAI). This finding does not suggest that investment in countries scoring low on the UAI is insensitive to financial crises, because investment is measured relative to GDP.

However, it does suggest that for these countries "*the long-term consequences of a financial crisis will be less severe, since the accumulation of capital is less affected than in countries with a high degree of uncertainty avoidance*" (Inklaar & Yang, 2012, p.467). Their conducted research has covered 74 countries in the time period between 1970-2005.

Uncertainty avoidance (UA) is one of the six cultural dimensions defined by Hofstede (2011). These dimensions are aspects of national culture that can be measured relative to other cultures and therefore are an important concept for international business scholars (Hofstede, 1994; Hofstede, 2011). The dimension of UA deals with a society's tolerance for uncertain situations. Inhabitants of countries scoring low on the UAI generally prefer to take initiative and are more likely to enter into situations with an uncertain outcome, in contrast to inhabitants of countries scoring high on the UAI who generally prefer to be guided by others and have a more extensive fear for failure (De Jong & Schilpzand, 2020).

In terms of exploring macroeconomic phenomena arising from cultural differences, cross-country differences within Europe are highly interesting to research. Europe has a rich cultural history and quite recently 28 different countries have joined forces to create the EU, forming an internal single market that allows for free movement of people, goods, services and capital. Although these countries form a single union, they are still culturally different from each other. "*Cultural differences between the nations of Europe persist because of the lack of a strong central authority able to unify and homogenize the peoples of Europe, while the lack of such a centralized and unifying authority can be largely attributed to the depth of these cultural and historical differences*" (Smith, 1993, p.133). The '*depth of these cultural and historical differences*' refers to historical traditions between the nations and their conflicting perceptions of self-interest resulting from, among others, two great World Wars.

Reviewing existing literature on the determinants of investment has shown the importance of financial systems. Financial systems are important in channelling individual- or household savings into the corporate sector and also aid in allocating investment funds among companies. They can be distinguished on either being predominantly dependent on banks, or on financial markets (Kwok & Tadesse, 2006). Using a database constructed by Demirgüç-Kunt and Levine (1999), an index has been created for this research that divides countries into being bank-based or market-based: the structure index. According to this index, five countries have been classified as being market-based, and the other 23 countries as being bank-based.

For this research, three main hypotheses have been developed that aim to answer the following questions: (1) What is the effect of a financial crisis on investment? (2) How does a country's uncertainty avoidance influence this crisis effect on investment? And finally, (3) does the financial

system of a country play a role on the crisis effect on investment? Therefore, the aim of this master thesis is to find out what effect financial crises have on investment as well as to explore cross-country differences arising from UA and a country's financial system. This research aims to explore a macroeconomic phenomenon such as investment within a single union and it does so by limiting the country sample to countries within the EU. The country sample consists of all 28 countries that are member of the EU, including the United Kingdom because they were still member of the union during the time period of 1970-2016 in which data for this research is collected. This is also the time period of the relatively new financial crises database constructed for European countries by Lo Duca et al. (2017). By extending the time period compared to Inklaar and Yang (2012), one of the contributions of this research is that is includes the effects of the 2007-2008 global financial crisis. Furthermore, this research adheres to a different approach to financial crises. Inklaar and Yang (2012) have used an event-based approach in which the financial crisis dummy variable has a value of 1 for the year a financial crisis started, and zero otherwise. However, this research uses a period-based approach in which the dummy variable has a value of one for every consecutive year in which a financial crisis is present. Lastly, the effect of a country's financial system on investment in times of a financial crisis is explored, which has not been done by Inklaar and Yang (2012).

This research starts with identifying the difference in outcomes resulting from using a fixed effects and a random effects model. After having concluded that fixed effects is the preferred estimation method, the results show that financial crises have a highly significant negative impact of -0.782 on investment. Even more interesting is the interaction term between the financial crisis dummy and UAI. This coefficient shows a highly significant and negative sign of -0.013, indicating that countries that score high on the UAI have witnessed a greater decline in investment compared to countries that score low on the UAI. All of these results have been tested and were not affected by the robustness analysis of economic- and institutional control variables. When performing the same analysis using the event-based approach proposed by Inklaar and Yang (2012), the negative effect of financial crises on investment is more severe (-0.972) than in the period-based approach. Furthermore, the negative effect of the lagged financial crisis dummy is even more negative (-1.038). However, with the event-based approach, the highly interesting interaction term between the financial crisis dummy and UAI suddenly becomes positive and insignificant. Finally, the effect of a country's financial system has no significant impact on investment in times of financial crises.

2. Literature review

2.1. National culture

In order to understand how uncertainty avoidance can have an influence on the economy, it is first important to understand the broader definition of national culture. In particular, the definition of the concept itself, how national culture can arise, and finally what its implications might be for international business scholars.

Cultural difference

Culture has long been a vague and difficult to grasp concept that is thought to explain differences between groups of people. The topic has nowadays received an increased focus by international business scholars. Hofstede (2011) defines culture as "*the collective programming of the mind that distinguishes the members of one group or category of people from others*" (p.3). In this definition, "one group" or "category" of people can be a nation, an ethnic group, a type of business or many other things. This master thesis is interested in cultural differences between countries. Therefore, culture or national culture is hereby defined as "*the collective programming of the mind that distinguishes the members of one country from other countries*". In his earlier work, Hofstede (1994) formulated four dimensions of culture, being power distance, uncertainty avoidance, individualism versus collectivism and masculinity versus femininity. Later, the two dimensions of long term versus short term orientation, and indulgence versus restraint were added to the paradigm. These dimensions represent aspects of national culture that can be measured relative to other cultures, and therefore allow for cross-cultural research (Hofstede, 2011).

The data out of which the first four dimensions are created, originates from a large survey research among IBM employees working in marketing and customer service positions from subsidiaries in different countries. Because local IBM employees with a similar type of job and education but located in different countries are compared with each other, idiosyncratic differences are eliminated. This way, the observed differences in cultural dimensions are likely to reflect cultural differences between countries instead of a variation in individuals' personality (Inklaar & Yang, 2012). All scores on these survey questions have been transformed to obtain a number on a scale from approximately 0 to 100, with some exceptions. One of these exceptions is the score of 112 on uncertainty avoidance for Greece, which is a relatively high score. National cultures are very stable over time. Replications of Hofstede's (1994) study on culture dimensions decades after his original work show that the results are still relevant and that the relative positions of national cultures have not changed (Rinne et al., 2012).

When having a proper look at the country scores, historical roots of cultural differences can be seen. For example, all Latin countries score relatively high on the dimensions of power distance and uncertainty avoidance. This observation could possibly be traced back to the common history of the Roman empire, of which these countries have inherited at least a part of their inhabitants from. An important characterization of the Roman empire was the existence of a central authority and a system of law that applied to all its citizens. "*This established in its citizens' minds the value complex which we still recognize today: centralization fostered large power distance and a stress on laws fostered strong uncertainty avoidance"* (Hofstede, 1994, p.6). Another great historical empire with a central authority was the Chinese empire. One important difference was their system of law. Where the Roman empire had a developed a unique system of codified laws for all of their citizens, the Chinese empire did not have such emphasis on law. It was governed by men instead of by law. In the countries that were under Chinese rule in the past, value complexes can still be recognized today. Centralization fostered large power distance and their missing system of law resulted in medium to weak uncertainty avoidance in these countries. These examples show the assumptions of historical roots of cultural differences, however, it will always remain speculative (Hofstede, 1994). Figure 2 explains the emergence and stabilization of cultural differences, introduced by Hofstede (2001). Changes in cultural patterns originate mainly from outside through forces of nature or forces of man. The arrow of outside influences is linked to the origins on purpose, because Hofstede (2001) believes that societal norms rarely change directly through outside influences. He believes that societal norms change because of ecological factors such as hygiene, economy and technology. Shifts in societal norms will normally occur gradually, except for extreme outside influences such as a military conquest (Kwok & Tadesse, 2006).

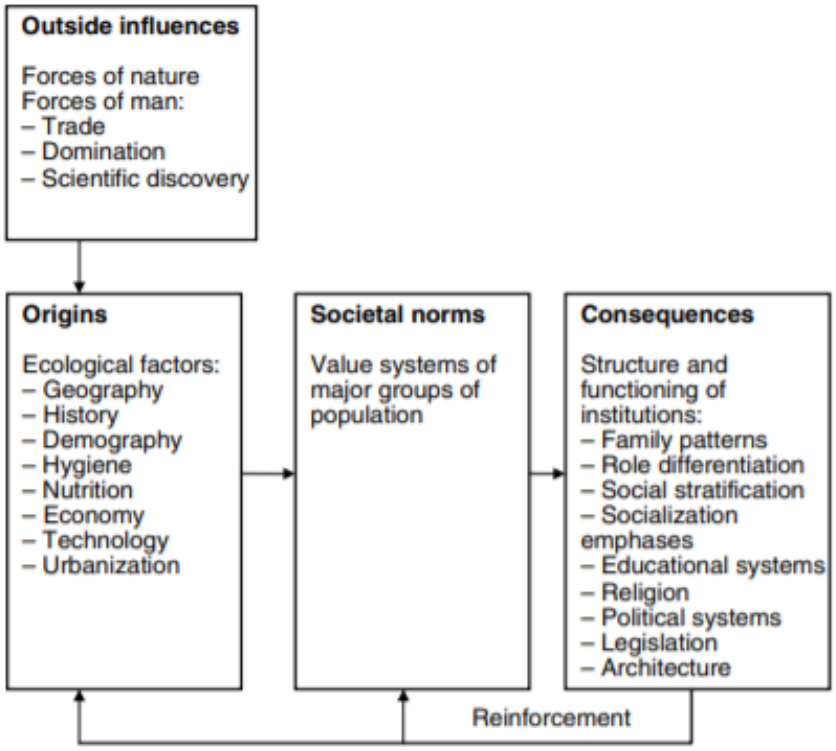

Figure 2: The emergence and stabilization of culture patterns. It is adapted from Hofstede's (2001) book (Kwok and Tadesse, 2006).

National culture is an important concept for international businesses, because this type of business operates in different countries in which people have different values, norms and patterns of behaviour. The existing culture in a country affects all of its citizens: parents and their children, teachers and their students, managers and their subordinates et cetera. Furthermore, people who write theories and create management concepts are also humans, and therefore inherently prone to the constraints of the cultural environment in which they grew up. Management practices that work in one country do not necessarily work in another country as well and therefore, management practices are culturally dependent (Hofstede, 1994). Apart from the importance of national culture in management literature, organizational culture is also highly important. This type of culture is of another order than national cultures, because being part of an organizational culture is usually partial and voluntary, in contrast to the permanent and involuntary characteristic of the country someone is born in. Organizational cultures differ predominantly at the level of shallow practices such as symbols, heroes, and rituals. National cultures differ predominantly at the level of basic values, which are more deeply rooted in the human mind than shallow practices (Hofstede, 1994).

Uncertainty avoidance

Uncertainty avoidance (UA) deals with a society's tolerance for ambiguity, indicating the degree to which members of the culture feel either comfortable or uncomfortable to unstructured situations: situations that are different from usual and therefore unknown. Countries that score high on UA try to minimize the possibility of unstructured situations by rigorous behavioural codes, laws, and rules among others (Hofstede, 2011). UA is generally higher in continental European countries and their former colonies in Latin America, and lower in Anglo-Saxon and Nordic countries, former British colonies and Chinese culture countries (Huang 2008). As explained earlier, differences in UA have probably arisen centuries ago, and could relate to the system of law that has dominated over the history of time. Because Europe has had a very rich cultural history, it could be expected that European countries differ quite a lot in their scores on UA. When analysing the UA scores of all countries of the European Union, rather big differences are indeed visible. The countries scoring lowest on UA are Denmark and Sweden with a score of respectively 23 and 29. The countries scoring highest on UA are Greece and Portugal with a score of respectively 112 and 104. Figure 3 shows a map of Europe with the UA score for all members of the European Union, including the United Kingdom.

Uncertainty is different from risk, in the sense that risk can be calculated and uncertainty cannot be calculated. Put differently, risk on investment is calculatable but uncertainty resulting from a sudden crisis is not (Hofstede, 2011). "*In sum, in countries scoring low on Uncertainty Avoidance a majority prefers taking initiative and entering activities with an uncertain outcome. In countries, scoring high on this dimension a majority prefers to be guided by others and fears failure*" (De Jong & Schilpzand, 2020, p.5). Appendix 1 shows a table with ten differences between weak- and strong UA societies. The cultural dimension of UA is created by averaging the answers to the psychological survey questions for IBM employees on three concepts that relate to people's attitude towards uncertainty, on a scale from 1 (strongly agree) to 5 (strongly disagree) (Huang, 2008, p.351):

- Rule orientation: Agreement with the statement "company rules should not be broken – even when the employee thinks it is in the company's best interest".
- Employment stability: Employees' statement that they intend to continue with the company for more than X years.
- Stress: Stress is expressed in the mean answer to the question: "How often do you feel nervous or tense at work".

Although Hofstede's (1994) measure of UA is most prominent in economic literature, other measures for UA have also been constructed. Inklaar and Yang (2012) have included two other measures for UA: one from Hoppe's Survey on Salzburg Seminar Elite Alumni, and one from the European Media and

Marketing Survey (EMMS), together with a measure for risk loving: WSV. However, these other measures have considerable drawbacks. For instance, there appears to be a lack of data for many countries, and the measures are less homogenous than Hofstede's (1994) measure of UA. Apart from these measures, Inklaar and Yang (2012) have also included two religious components, which are the share of Protestants and the share of Catholics in the population in 1980. The idea behind the latter is that a relatively high share of Catholic people in a country is hypothesized to contribute to a higher degree of UA, and a relatively high share of Protestants in a country is hypothesized to contribute to a lower degree of UA. In other words: UA is embedded in a society through history of the dominant religion. Inklaar and Yang (2012) included the two religious components to "*account for the possible endogeneity of the tolerance for uncertainty by using religious composition of the population as instruments*" (p.467). It could be argued that countries that have witnessed a lot of crises have become less tolerant for uncertainty and UA could therefore not be exogenous. However, their results show that the religious component is highly correlated with UA in the same way as hypothesized earlier. Religious composition could explain more than one third of the cross-country differences in UA (Huang, 2008). Uncertainty can have major implications for a country's macroeconomy. For example, Bloom (2009) investigated the impact of uncertainty shocks and found different effects on the economy. In the short run, higher uncertainty dramatically decreases hiring and investment rates because it increases the real-option value for firms to postpone hiring new people or make investments. This also leads to a reduction in the rate of reallocation from low to high productivity firms, therefore causing a drop in aggregate productivity growth. These effects are all restored once the uncertainty has subsided, but have caused increased volatility. However, in the medium-run this increased volatility generates a volatility overshoot. Output, employment and productivity are being restored. In short, an uncertainty shock is followed by a short, but sharp recession, where after it slowly recovers.

Figure 3: Map of Europe with the Uncertainty Avoidance Index for all countries of the European Union, including the United Kingdom.
Notes: There is no data on the UAI for Cyprus; Countries that are listed on the map but without a score for the UAI are not a member of the European Union, and therefore do not take part of this research.

2.2 Investment

This chapter will elaborate on scientific literature regarding investment. First, different theories of investment will be elaborated. Hereafter, the importance of financial systems will be explained.

Theories of investment

Investment is the act of incurring costs in the present with the expectation that it generates rewards in the future. Some examples of investment are a firm that constructs a new production plant, a firm that buys in a stock of certain goods to sell in the future, or the government that spends money on a new highway. It is a rather broad definition. For this research, investment is determined as 'gross fixed capital formation' (World Bank, 2019) of which the full definition is explained in chapter 3.1. There are three characteristics that most investment decisions have in common. The first is irreversibility, which means that at least part of the initial cost of investment are sunk costs. The second is uncertainty over future rewards. The third is about the choice of timing the investment, which can be postponed in order to, for instance, gain the ability to obtain more information about expected future rewards (Dixit & Pindyck, 1994). These characteristics are not part of the neoclassical investment theories, but are included in the new view of investment. This chapter will elaborate on the neoclassical theories of investment, including Jorgenson's (1963) neoclassical theory, the accelerator principle, and Tobin's q-theory. Hereafter, Dixit and Pindyck's (1994) new view of investment will be explained.

Orthodox theory of investment

To investigate a firm's investment decision, economic students are often taught the simple rule of 'net present value' (NPV). The NPV is calculated as the difference between the present value of the expected profits after investment and the present costs of the investment. If the NPV is greater than zero, the firm should invest according to this simple rule. This is also the basis for Jorgenson's (1963) neoclassical theory of investment (Dixit & Pindyck, 1994). This neoclassical investment theory starts with the optimization problem of a firm by maximizing profits in each period, and depends on output, the price of output, and the user cost of capital. The user cost of capital depends on the purchase price, interest- and depreciation rates, and taxes. The theory is based on the assumption that there exists an optimal capital stock. The optimal capital stock can be reached by equating the marginal product of capital and the user cost of capital. If the current capital stock of a firm is lower than the optimal capital stock, the firm will invest until it has reached its optimal capital stock, and vice versa (Jorgenson, 1963, 1967). Because this theory assumes that the capital adjusts fully and directly to the desired capital stock, there is actually no investment function and therefore, this theory is more like a capital theory as opposed to an investment theory (Eklund, 2013).

Now, continuing with the accelerator approach. This theory is often associated with a Keynesian approach due to the fact that prices are assumed to be fixed. The accelerator theory follows Jorgenson's (1963) neoclassical theory, but now the price variables are constant. With the price of output being constant and the price variables in Jorgenson's (1963) user cost of capital being fixed, the optimal capital stock is now a function of output. This means that investment depends on the growth of output (Eklund, 2013). In investment theory, the acceleration principle, or accelerator effect, states that if demand for consumer goods increases, the demand for investment to produce these goods increases even more. The idea behind this is that for a firm to increase its production capacity, often large fixed-cost investment is necessary in order to respond to increased customer demand. In a broader sense, if a country's total output in GDP increases, the acceleration principles implies that there will be a magnified increase in investment. However, this also works the other way round. If national output decreases, for instance after a financial crisis, it is expected that investment spending decreases even more. In this research, the accelerator effect will be tested with the hypothesis that lagged GDP growth has a positive effect on investment.

Both Jorgenson's (1963) neoclassical- and accelerator theories assume instantaneous and complete adjustment of the capital stock in each period, and do not incorporate a role for expectations in their formulation. These two problems are ought to be solved by Tobin's q, respectively by adding an adjustment cost function to the optimization problem and by assuming that investments are being made up until the point where the market value of assets is equal to the replacement cost of capital (Eklund, 2013). This means that a firm increases its capital by investment if the market value of the capital assets is higher than their replacement cost. Tobin's q "*compares the capitalized value of the marginal investment to its purchase cost*" (Dixit & Pindyck, 1994, p.2). It is measured as the capitalized value of the marginal investment divided by its purchase cost. If q is higher than 1, the firm should invest. If the value is lower than 1, the firm should not invest and existing capital should be reduced. The paper by Eklund (2013) shows mathematical derivations for all three theories of investment described above.

Theory of irreversible investment under uncertainty

In their book called 'Investment Under Uncertainty', Dixit and Pindyck (1994) develop the theory of irreversible investment under uncertainty. The focus of this theory is put on the interaction between irreversibility, uncertainty over future rewards, and timing of the investment to determine the optimal decisions of investors. In this new view of investment, the decision to invest relies on incurring a sunk cost because of the assumption of irreversibility. This choice results in uncertain future returns. Moreover, the firm has the option to delay the investment and should "*increase its capital stock only if q exceeds unity by a margin sufficient to compensate the firm for the loss of the option to delay*"

(Hubbard, 1994, p.1817). Compared to the different neoclassical approaches described above, the new view does not adhere to two basic assumptions. The first assumption is that a firm's existing capital can easily be sold to other users (reversibility). The second assumption is that an opportunity to invest is a one-off opportunity, and thus the investment opportunity disappears if the firm declines the project (Hubbard, 1994).

When a firm decides to incur an irreversible investment expenditure, it thereby kills its option to invest. This decision foregoes the possibility for the firm to wait and gather more information on the desirability or timing of the investment. This option value being lost should be accounted for as an opportunity cost being part of the investment. The value of an additional unit of capital should hereby "*exceed the purchase and installation cost, by an amount equal to the value of keeping the investment option alive*" (Dixit & Pindyck, 1994, p.3). First, the authors show that the opportunity cost of the option value is an important part of the investment decision of a firm. If the sunk cost of the investment is high, or the uncertainty over the future price is high, the result is an increased option value. Second, the option value is not affected by hedging the risk in forward or future markets, because this type of risk is accounted for by decreased returns in efficient markets. Third, the particular form of uncertainty affects the investment decision when future costs are uncertain. If the uncertainty is about the price of a unit of capital input, the effect is ought to be the same as that of output price risk. If the input price has gone op, the firm has a valuable freedom to delay the investment. However, if the investment project consists of several sequential steps with uncertainty about the total cost of investment, and information about the uncertainty will only be revealed after the first steps have been taken, it may be desirable to invest in a project even if 'the orthodox' NPV is negative. This is because these sequential steps have information value that is worth more than their value to the "orthodox" NPV. Fourth, the authors show that smaller scale investment that increase future flexibility might hold more value than large investments that induce economies of scale advantages (Dixit & Pindyck, 1994).

2.3. Financial systems: bank based versus market based

Financial systems are of great importance in allocating scarce resources. They do so by channelling individual- or household savings into the corporate sector and by allocating investment funds among companies. Furthermore, financial systems play a role in allocating part of the corporate returns back to the individual savers (Kwok & Tadesse, 2006). Over the past decades, in which the modern economy evolved, financial systems have evolved differently across countries and cultures. Financial systems can be distinguished between being predominantly dependent on banks, or on financial markets: bank-based versus market-based systems. Kwok and Tadesse (2006) have classified two possible explanations as to why countries differ in their type of financial system. The legal-system-based

explanation highlights that the strength and quality of the legal system determines the type of financial system that dominates in a country. It appears that in countries with weaker legal systems, the bank-based financial system dominates because banks can enforce contracts and are good monitors. In countries with stronger legal systems, market-based systems dominates because of the lesser importance of banks.

The risk-reduction-based explanation highlights the variation of financial systems in their risk reduction capabilities. According to traditional finance theory, investors should diversify their risk resulting in a risk-sharing strategy in which investors' risk is exchanged among individuals, each carrying a small amount of risk (Lockett & Wright, 1999). However, this risk-sharing strategy does not eliminate macroeconomic shocks such as a financial crisis. These so-called "systematic risks" can have a similar negative effect on all assets over time, resulting in major losses for individual investors. Bank-based systems appear to be better in smoothing financial risk over time than market-based systems. For example, a comparison has been made between Germany and the United States (US) for the oil shock of the 1970s. "*The effect is quite different in countries such as Germany, where individuals' savings are placed mostly with financial intermediaries such as banks and insurance companies. Because their claims on the intermediaries were fixed in nominal terms, individual investors did not suffer such a decrease in wealth as their US counterparts during this time period. Somehow, the German financial system was able to smooth the oil price shock rather than pass it on to investors*" (Kwok and Tadesse, 2006, p.229).

The risk-reduction-based explanation has led the authors to conduct research regarding a national cultural explanation of financial systems. Quite easily, the link can be made between financial systems and national culture. As described in chapter 2.1, one dimension of national culture is about how individuals deal with risk and uncertainty: uncertainty avoidance. The capability of a bank-based system in reducing risks from uncertain events is suitable for countries scoring high on UA. On the contrary, higher risk also comes with increased opportunities for higher returns, which suits countries that score low on UA. After showing evidence of the legal-system-based explanation, Kwok and Tadesse (2006) found that uncertainty avoidance is also statistically significant for the type of financial system in a country.

Heterogeneity in the dependence on bank financing is not simply a matter of legal- or cultural differences across countries. Heterogeneity in the dependence on banks is also common between industries or even between firms within the same industry. Bucă and Vermeulen (2017) conducted a research on the effect of bank credit supply reduction as a result of the 2008-2009 financial crisis on the investment behaviour of firms with different dependencies on bank financing. Using a panel

dataset of aggregated balance sheet data for different manufacturing industries from different European countries, the authors show that the tightening of credit standards by banks after the financial crisis resulted in a much larger reduction of investment for segments of the economy that are dependent on bank debt. According to the authors it is not the level of indebtedness that matters for the reduction of investment, but the level of bank debt. This supports the view that possibly one of the reasons for the severe 2008-2009 crisis in the euro area comes from banks' behaviour to the crisis instead of weak firm's balance sheets.

In this research, the effect of a country's financial system on investment in times of a financial crisis will be explored. Based on prior research, the effect can be twofold. On the one side, bank-based systems can be better in smoothing financial risk over time. On the other side, high dependence on banks in times of financial crises can result in a larger reduction of investment due to the tightening of credit standards.

3. Data

The sample for this research contains all countries from the European Union (EU), including the United Kingdom who left the EU on January 2020, equalling a total of 28 countries. Yearly data has been gathered for the time period between 1970 and 2016, which is the exact period of time for the financial crisis database by Lo Duca et al. (2017). This time period is an extension to the work of Inklaar and Yang (2012), who have included data for the time period between 1970-2005. Now, the extension is especially relevant since it creates opportunities for this research to show the effect of the major 2007-2008 financial crisis. Summery statistics for all variables can be found under Appendix 2.

3.1. Dependent variable

The dependent variable is investment divided by GDP. Investment is another word for Gross Fixed Capital Formation (GFCF), which is defined as: "*Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the 1993 SNA, net acquisitions of valuables are also considered capital formation*" (World Bank, 2019).

Inklaar and Yang (2012) have distinguished investment on three types: by type of investor, type of asset and type of industry. However, this research does not consider these distinctions because the necessary data for such an analysis is not readily available. Furthermore, this research is interested in examining the effect of financial crises on investment. Therefore, it does not matter what type of investor, what type of asset, or what type of industry is affected differently by uncertainty. Inklaar and

Yang (2012) have used the logarithm of investment divided by GDP as their dependent variable. Appendix 3 shows histograms for both GFCF divided by GDP and the logarithm of GFCF divided by GDP. From these histograms, the decision has been made to not use a log transformation for the dependent variable, as it does not improve the normality distribution of the variable. Furthermore, log transforming the dependent variable will complicate the analysis of the results. Figure 4 shows heterogeneity of investment across countries. Figure 5 shows heterogeneity of investment across years, where the effect of the major 2007-2008 financial crisis is clearly visible.

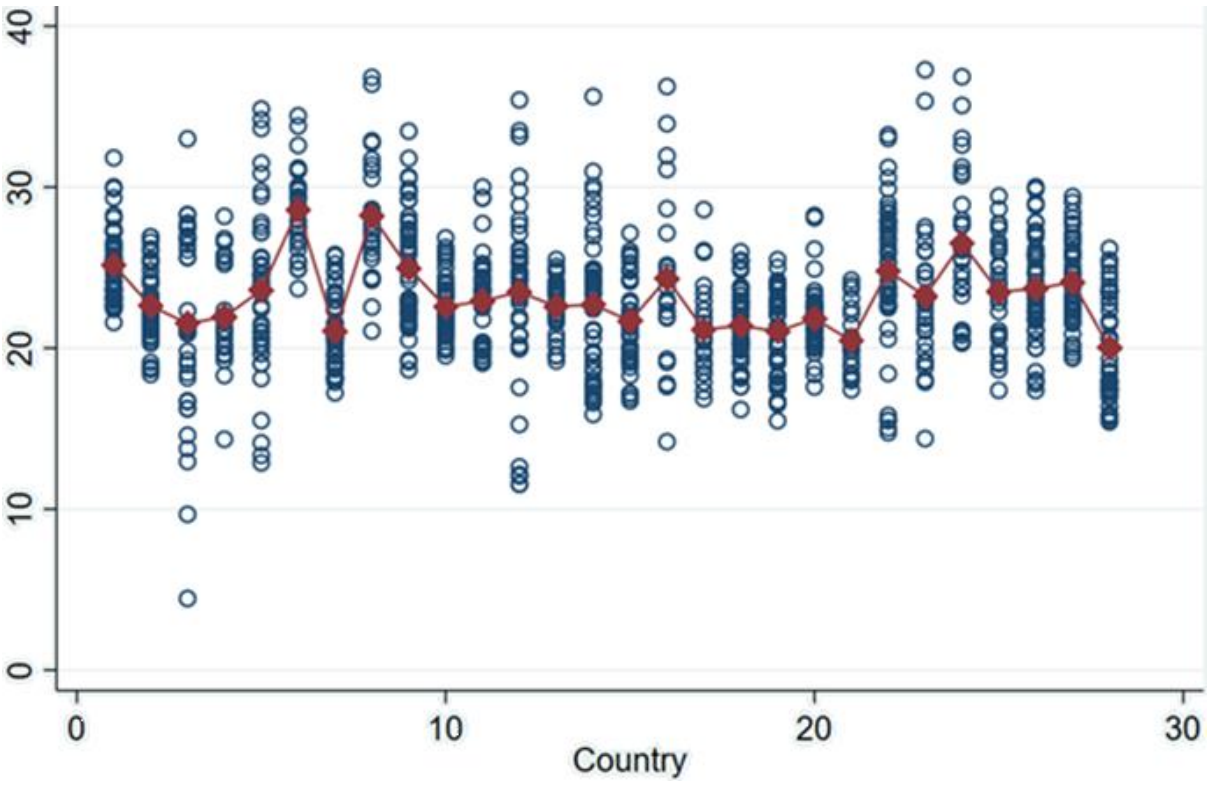

Figure 4: Heterogeneity across countries. The y-axis represents investment. The red dotted line shows the average investment per country.

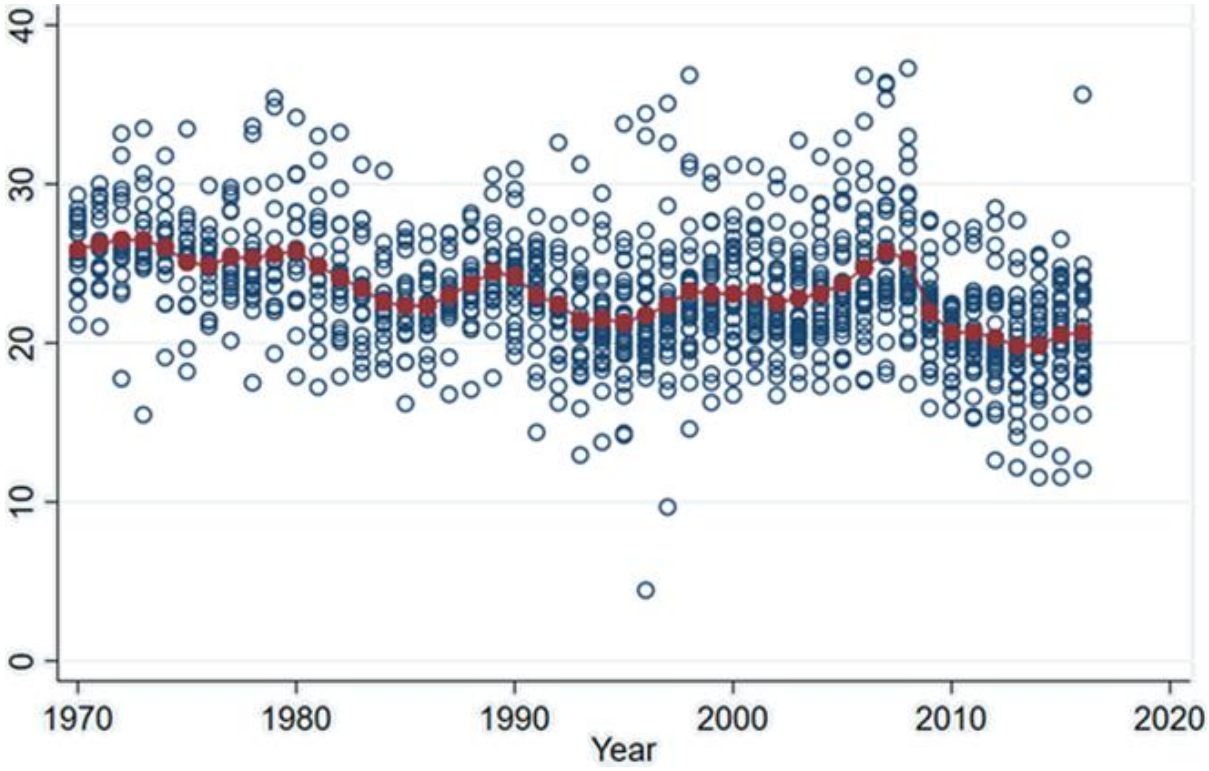

Figure 5: Heterogeneity across years. The y-axis represents investment. The red dotted line shows the average investment per year.

3.2. Independent variables

Financial crises

Financial crises are often multidimensional events that can be difficult to grasp using a single indicator. There have been many different forms of financial crises in the past with different impacts and differing amounts of countries involved. However, financial crises share common elements. Claessens and Kose (2013) define a financial crisis as being associated with one or more of these phenomena: "*substantial changes in credit volume and asset prices; severe disruptions in financial intermediation and the supply of external financing to various actors in the economy; large scale balance sheet problems (of firms, households, financial intermediaries and sovereigns); and large scale government support (in the form of liquidity support and recapitalization)*" (p.4). Financial crises can be classified into four different types: currency crises, sudden stops, debt crises, and banking crises. These different types of crises often overlap, making it difficult to identify the type of crisis. For example, banking crises often appear to be associated with sudden stops and currency crises (Claessens & Kose, 2013).

Inklaar and Yang (2012) have identified financial crises using a database created by Laeven and Valencia (2008), in which three different types of financial crises are classified: currency crises (depreciation of the nominal exchange rate of at least 30% that is at least a 10% faster depreciation than the year before), debt crises (sovereign default to private lending) and banking crises

(systematically important financial institutions are in distress). Sudden stops are not included in their research because prior research by Joyce and Nabar (2009) has shown that sudden stops only affect investment in case of a banking crisis. Inklaar and Yang (2012) have included these three types of financial crises as dummy variables in their estimation model in order to investigate whether these different types of crises have different effects on investment. Their results show that each type of crisis has a significant negative effect on investment with a comparable effect, either current, lagged, or both. This can be hypothesized by the idea that for each type of crisis, uncertainty is increased which leads to lower investment. Interacting the crisis dummies with UA shows that the marginal effect of a crisis on investment is significant and negative for countries with high UA (Inklaar & Yang, 2012).

More recently, a new database on financial crises has been developed for European countries (Lo Duca et al., 2017). This data runs from 1970-2016 and contains 50 systematic crises. Compared to existing databases such as the database by Laeven and Valencia (2008), it has improved on four points of which the first two are relevant for this research. "*First, this dataset provides a unique and detailed overview of crises episodes specific to European countries, which are validated by financial stability experts from a wide range of policy institutions. Second, from a technical point of view, it identifies crises by combining a quantitative approach based on a financial stress index with expert judgement from national and European authorities. This approach ensures a more precise definition of crisis periods and also enables the separation between crisis and post-crisis adjustment periods, which facilitates the estimation and calibration of models"* (Lo Duca et al., 2017, p.3).

This new database does not distinguish financial crises based on the three types of crises as Laeven and Valencia (2008) did. Instead, a distinction is made between different risks, including instability in the banking sector, sudden adjustments of external positions, sovereign risk and significant asset price corrections. Most of the financial crises included are caused by a combination of multiple risks. Because of this, and because of the comparable effect of different types of financial crises found by Inklaar and yang (2012), this research does not differentiate between types of financial crises. Here, the dummy variable for financial crises will have a value of one for all years in which a financial crisis is current. Figure 6 shows all financial crises (red bars) and the investment per country. Most financial crises have a duration of multiple years, which can be seen from the length of the red bars (Figure 6).

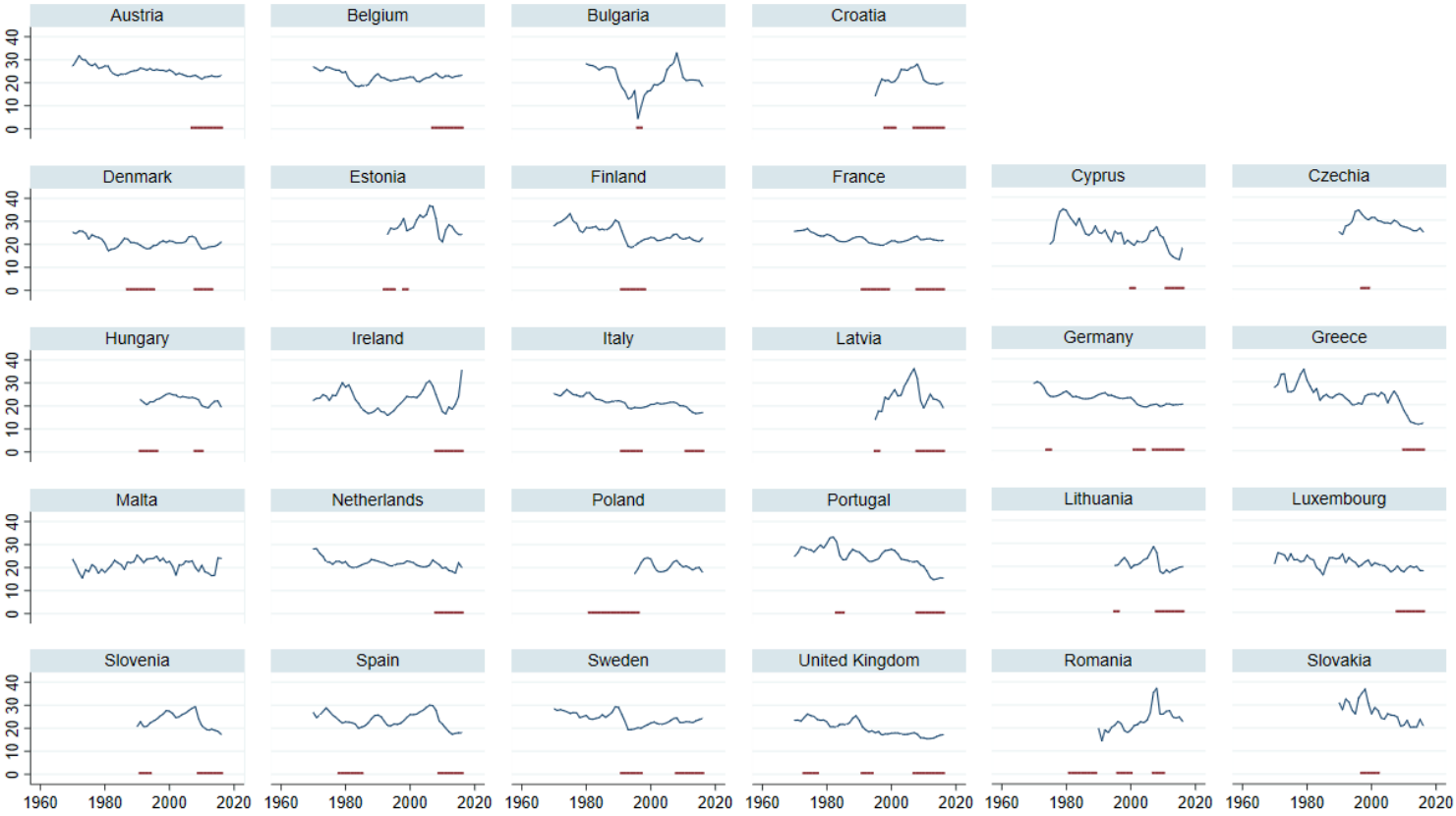

Figure 6: Investment per country over time. The red bars represent the presence of a financial crisis.

Uncertainty avoidance

To measure UA, Hofstede's (1994) Uncertainty Avoidance Index will be used. Because this measure is not volatile over time, the same value of UA for a country will be used throughout all years. For instance, the Netherlands scores 53 on UA, so the value is 53 for every year between 1970-2016. Inklaar and Yang (2012) have also used a religious component in their research to account for the possible endogeneity of UA in their research. Their research has already shown that this is not the case and therefore, the religious component will not be used in this research. Data for UA can be found on Hofstede's own website (geerthofstede.com).

Financial systems

To test whether the financial system of a country could has a significant effect on investment in times of financial crises, all countries will be classified as being either bank-based or market-based. Demirgüç-Kunt and Levine (1999) created a database that captures various aspects of financial institutions and markets. This database permits the construction of a variable for financial system. The authors created four categories of financial systems. They did not only make a distinction between bank-based and market-based, but also between underdeveloped- and developed systems. For this research, only the distinction between bank-based and market-based will be made because of simplicity, and because most countries in the European Union have a developed financial system. In

1999, only three (Greece, Ireland, and Denmark) out of 15 European Union countries included in their data sample were classified as underdeveloped (Demirgüç-Kunt & Levine, 1999).

To determine whether a country should be classified as bank-based or market-based, Demirgüç-Kunt and Levine (1999) introduced the structure index. When a country scores below the mean value of structure it is classified as bank-based, and when a country scores above the mean value of structure it is classified as market-based. The structure index is not readily available and should be calculated according to three indicators: size, activity, and efficiency. Size equals *"the domestic assets of deposit money banks relative to domestic stock market capitalization*". Activity equals "*the ratio of private credit by deposit money banks relative to the total value of stock transactions on domestic exchanges*" (Demirgüç-Kunt & Levine, 1999, pp.14-15). This research has consulted other literature (Demirgüç-Kunt & Huizinga, 2000; Girardone et al., 2009; Demirgüç-Kunt & Maksimovic, 2002) in determining the calculation of the efficiency indicator, due to the ambiguous nature of the calculation for the concept. It shows that the calculation for efficiency is the product of total value traded on the stock market and average overhead costs of banks in the country.

For this research, the structure index is calculated by first taking the mean scores of the three indicators for 213 countries in the time period between 1970-2016. If the mean scores would have only been calculated for the European Union countries, the structure index would give a score relative to the other countries in the sample but would not give the correct identification of a country being bank-based or market-based. Checking for outliers resulted in the removal of three countries (Zimbabwe, Russia, and Hong Kong). Hereafter, mean scores for size, activity and efficiency have been calculated. These mean scores are subtracted from the individual country scores, resulting in relative country scores. The structure index is then calculated by adding a country's three relative scores and divide by three. If its value is negative, the country is classified as bank-based. If its value is positive, the country is classified as market-based. For this research, a dummy variable has been created with a value of 1 if the country is market-based, and a value of zero if a country is bank-based. Only five countries are market-based: Finland, Luxembourg, The Netherlands, Sweden and the United Kingdom. The calculations for size, activity, efficiency and the structure index are shown below. Table 1 shows a table of all countries and their relative size, activity, efficiency, and the structure index.

$$Size = \frac{stmktcap}{dbagdp}$$

$$Activity = \frac{stvaltraded}{pcrdbofgdp}$$

$$Efficiency = \frac{stvaltraded}{100} * \frac{overhead}{100}$$

$$Structure\ index\ = \frac{(s-\bar{s})+(a-\bar{a})+(e-\bar{e})}{3}$$

Country	Relative size	Relative activity	Relative efficiency	Structure index
Austria	-0,480	-0,147	-0,002	-0,210
Belgium	-0,126	-0,024	-0,002	-0,051
Bulgaria	-0,453	-0,182	-0,003	-0,213
Croatia	-0,200	-0,191	-0,004	-0,132
Cyprus	-0,195	-0,143	0,000	-0,113
Czech Republic	-0,309	0,014	-0,001	-0,099
Denmark	-0,146	0,020	0,001	-0,042
Estonia	-0,166	-0,093	-0,002	-0,087
Finland	0,352	0,588	0,004	0,315
France	-0,198	0,119	0,002	-0,026
Germany	-0,377	0,116	0,003	-0,086
Greece	-0,188	0,083	0,002	-0,035
Hungary	-0,274	0,126	0,003	-0,048
Ireland	-0,103	-0,079	-0,003	-0,062
Italy	-0,283	0,112	0,006	-0,055
Latvia	-0,431	-0,182	-0,004	-0,206
Lithuania	-0,098	-0,136	-0,003	-0,079
Luxembourg	0,506	-0,208	-0,004	0,098
Malta	-0,344	-0,211	-0,004	-0,186
Netherlands	-0,082	0,216	0,005	0,046
Poland	-0,218	0,003	-0,001	-0,072
Portugal	-0,443	-0,064	0,000	-0,169
Romania	-0,316	-0,186	-0,004	-0,169
Slovak Republic	-0,539	-0,180	-0,003	-0,240
Slovenia	-0,338	-0,167	-0,003	-0,169
Spain	-0,284	0,221	0,010	-0,018
Sweden	0,247	0,278	0,009	0,178
United Kingdom	0,359	0,234	0,009	0,201

Table 1: Relative size, activity, efficiency and the structure index per country. The five countries that are underlined are classified as 'market-based'.

3.3. Control variables

In their baseline model, Inklaar and Yang (2012) have only included the lagged dependent variable (lagged investment) and lagged GDP growth, because they argued that while aiming to maximize the number of countries in their research, they cannot include many control variables in the baseline model. The lagged dependent variable is included in the baseline model because of the consensus that investment shows persistence, meaning that it reflects partial adjustment in investment behaviour. Lagged GDP growth is included because of the hypothesized existence of a flexible accelerator effect, where investment depends on previous year real output growth (Joyce & Nabar, 2009). Furthermore, "*The list of control variables includes the (nominal) interest rate, inflation rate, degree of trade openness, debt service to GDP ratio, FDI to GDP ratio, changes in the terms of trade, financial openness and financial development"* (Inklaar & Yang, 2012, p.474). In addition to these economic control variables, institutional control variables have also been added to the model. These variables are included because they could affect investment in a country after a financial crisis. Appendix 4 shows the correlation matrix of GFCF and the economic control variables and Appendix 5 shows the correlation matrix of GFCF and the institutional control variables.

Economic control variables

Interest rates can have an effect on investment because they make it cheaper (low interest rate) or more expensive (high interest rate) to borrow, which influences the cost of borrowing for investment. Joyce and Nabar (2009) further explain the hypothesized effects of the determinants of other control variables on investment. Inflation can increase uncertainty, and therefore negatively affect investment. Higher openness to trade can increase efficiency and generate higher returns on investment. Besides that, countries that are more open to trade generally have a more advanced financial intermediation with a better network of supplier credit and risk-sharing intermediaries. These arguments result in the idea that trade openness can positively affect investment. FDI can positively affect investment through the provision of external sources of funding, which enhances domestic investment. Debt service has an impact on the supply of loanable funds. In countries with higher debt service ratios, potential borrowers could be relatively more credit-rationed at the current world interest rate than potential borrowers from countries with lower debt service ratios, resulting in a possible negative effect on investment.

Changes in the terms of trade may have an influence on the relationship between investment and the financial crises variables, because it affects the relative prices of imported capital goods. Joyce and Nabar (2009) have tested various variables for financial openness. They found that "*openness to capital flows worsens the adverse impact of banking crises on investment*" (Joyce & Nabar, 2009,

p.314). One of the variables used for financial openness is the Lane-Milessi Ferretti (2007) measure of financial openness. This variable for financial openness is also used in the paper by Inklaar and Yang (2012), measuring the sum of foreign portfolio assets and liabilities as a percentage of GDP. It acts as an indication of how closely a country's financial system is to the world capital markets. Furthermore, a control variable for financial development is included. Inklaar and Yang (2012) have used a database on financial development and structure for this measure. This measure is created by Beck et al. (1999), and these authors argue that prior financial crises in South East Asia and Latin America have shown the importance of a well-functioning financial sector for the economy as a whole. Therefore, higher financial development is associated with higher investment.

World bank data on debt service is not available for the countries used in this research. Data on Financial openness (Lane & Milesi-Ferretti, 2007) and financial development (Beck et al., 1999) are not easily available and thus, these three control variables are excluded from this research. Joyce and Nabar (2009) did not use financial openness and financial development either. In short, the following economic control variables are added: short-term interest rates (OECD), inflation (World Bank), trade openness (World Bank), FDI (World Bank), and terms of trade (World Bank).

Institutional and government quality

A solid institutional framework is of great importance for investment, because institutions form the basis for the operation of the capital market and because investors will be reluctant to invest money when a lot of risk arises from, for example, weak property rights or high levels of corruption (Gwartney et al., 2006). The paper by Gwartney et al. (2006) emphasizes that countries with higher quality institutions do not only attract higher levels of private investment but also witness higher growth per unit of investment. In addition to economic control variables, institutional control variables are also added to this research because institutional determinants could be more proximate causes for the findings resulting from the baseline model.

Inklaar and Yang (2012) have used six indicators for institutional quality based on the Worldwide Governance Indicators (WGI). These indicators explain cross-country differences in "*the traditions and institutions by which authority in a country is exercised*" (Kaufmann et al., 2010, p.4), based on three definitions of governance, each existing of two indicators. "*This includes (a) the process by which governments are selected, monitored and replaced*" with the indicators 'Voice and Accountability', and 'Political Stability and Absence of Violence/Terrorism'; (b) "*the capacity of the government to effectively formulate and implement sound policies"* with the indicators 'Government Effectiveness', and 'Regulatory Quality'; and (c) "*the respect of citizens and the state for the institutions that govern*

economic and social interactions among them" with the indicators 'Rule of Law', and 'Control of Corruption' (Kaufmann et al., 2010, p.4).

In addition to the economic control variables, this research also adds institutional control variables following the method used by Inklaar and Yang (2012). The six government quality indicators from Kaufman et al. (2010) are available between the time period 1996-2009. Because this time period does not cover this research period, the numbers are averaged and used for the entire time period of 1970-2016. Furthermore, Inklaar and Yang (2012) have used three institutional rigidity indicators. The index of employment protection comes from Botero et al. (2004), the legal formalism index comes from Djankov et al. (2003), and the dummy variable for case law comes from La Porta et al. (2004). Unfortunately, the legal formalism index and case law dummy variable are not available anymore and are therefore excluded from this research. In short, the following the institutional control variables are added: WGI indicators of voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, control of corruption (Kaufman et al., 2010), and the employment protection index (Botero et al., 2004). All institutional control variables are averages that do not change over time.

4. Hypotheses

The main research question of this research is as follows: how is investment impacted by financial crises, and how does uncertainty avoidance and a country's financial system influence this impact across countries? In order to provide an answer to this main question, three hypotheses have been formulated.

Financial crises

Prior research has shown that financial crises can have a negative effect on investment, and therefore the first hypothesis is that investment declines during times of financial crises.

H1: Financial crises have a negative impact on investment.
H0: Financial crises do not have a negative impact on investment.

Uncertainty avoidance

Countries that score high on uncertainty avoidance are expected to have more difficulty in dealing with uncertainty arising from financial crises. This uncertainty is hypothesized to have a negative effect on a country's investment.

H2: Countries with a higher uncertainty avoidance index have witnessed a larger reduction of investment during financial crises, compared to countries with a lower uncertainty avoidance index.

H0: Countries with a higher uncertainty avoidance index have not witnessed a larger reduction of investment during financial crises, compared to countries with a lower uncertainty avoidance index.

Financial system

The financial system of a country plays an important role in allocating investment funds among companies. Both the bank-based and market-based systems have their pros and cons. However, market-based systems would suffer less of a possible tightening of credit standards by banks after a financial crisis.

H3: Financial crises will have a smaller negative effect on investment in countries with a market-based financial system compared to countries with a bank-based system.
H0: The financial system of a country does not have an effect on investment in times of a financial crisis.

5. Methodology

Baseline model

The methodology for this research is based upon the methodology used in the papers by Inklaar and Yang (2012) and Joyce and Nabar (2009). The dependent variable is Y (investment) in country i in year t. X represents the control variables, and C is a dummy variable that is one if a country experienced a financial crisis in year t and zero otherwise. For this research, a period-based approach for financial crises is used which deviates from the event-based approach used by Inklaar and Yang (2012) because their method provided unsatisfactory results with the analysis of data used in this research (Table 2). The difference is that for the event-based method, the financial crisis dummy will have a value of one only for the year in which a financial crises started, and zero otherwise. Implementing this method while applying a deeper analysis of the data shows that a financial crisis often involves a duration of multiple years in which investment declines year after year. Therefore, results show no negative effect of financial crises on investment when doing a simple analysis of the data, and only a small negative effect for lagged financial crises (Table 2). These unsatisfactory results hold for both low- and high UA countries. However, when adopting the period-based method, where the financial crisis dummy has a value of one for every consecutive year a financial crisis occurs and zero otherwise, shows more meaningful results. Table 2 shows the difference between the average investment for the different dummy variables of financial crises. The event-based approach used by Inklaar and Yang (2012) is shown in Equation 1. The period-based approach is shown in Equation 2.

CrisesEvent	Average of GFGF	Amount
0	23.052	1033
1	23.483	44

L1.CrisesEvent	Average of GFCF	Amount
0	23.111	1032
1	22.120	45

CrisesPeriod	Average of GFCF	Amount
0	23.817	798
1	20.932	279

Table 2: Difference in average investment (GFCF) between the event-based and period-based approach for financial crises. The small difference in "amount" for CrisesEvent and lagged CrisesEvent is due to the fact that in this table, only values are counted if data on GFCF is available for that year. For one year, data on GFCF is available for the lagged CrisesEvent but not for the year before that.

Equation 1:

$$Y_{it} = \alpha_i + \alpha_t + \sum_{j=1}^{n} \beta_j X_{ijt} + \beta_1 C_{it} + \beta_2 C_{it-1} + \gamma_1 C_{it} \, x \, UAI + \gamma_2 C_{it-1} \, x \, UAI + \varepsilon_{it}$$

Equation 2:

$$Y_{it} = \alpha_i + \alpha_t + \sum_{j=1}^{n} \beta_j X_{ijt} + \beta_1 C_{it} + \gamma_1 C_{it} \, x \, UAI + \varepsilon_{it}$$

UAI is the Hofstede uncertainty avoidance index. This variable is only included as an interaction term with the financial crisis dummy. UAI is not included separately because this research is interested in the effect of UA in times of a financial crisis, and not necessarily on the effect of UA on investment in times of no crisis. Furthermore, because this variable does not change over time, it cannot be included in the regressions separately while using a fixed effects model. In Equation 1, a lagged dummy variable for financial crisis is included because it could be that a crisis takes longer than a year to show effect on investment, for example if the crisis occurs at the end of a calendar year (Inklaar & Yang, 2012). For the period-based approach, the lagged financial crisis variable and the lagged interaction with UAI are not included. To account for time-invariant country-specific factors and shocks, α_i and α_t are

added as respectively country- and year fixed effects. The interaction term between the crisis dummy and UAI is included to show the effect of UA on investment in periods of a financial crisis.

The baseline model includes only the lagged dependent variable and lagged GDP growth as control variables, shown in Equation 3. To explore the possible effect of a country's financial system on investment in times of a financial crisis, the baseline model is changed a little bit. The interaction term between the financial crisis dummy and UAI is replaced with an interaction term between the financial crisis dummy and the financial system dummy (Equation 4). Hereafter, the interaction term between the financial crisis dummy and financial system dummy is simply added to the baseline model of Equation 3, in order to test if robustness of the results still holds when controlling for a country's financial system (Equation 5).

Equation 3:

$$Y_{it} = \alpha_i + \alpha_t + \beta_1 C_{it} + \gamma_1 C_{it} \, x \, UAI_i + \beta_2 L1.GFCF_{it-1} + \beta_3 L1.GDPGRWTH_{it-1} + \varepsilon_{it}$$

Equation 4:

$$Y_{it} = \alpha_i + \alpha_t + \beta_1 C_{it} + \gamma_1 C_{it} \, x \, Fin.System_i + \beta_2 L1.GFCF_{it-1} + \beta_3 L1.GDPGRWTH_{it-1} + \varepsilon_{it}$$

Equation 5:

$$Y_{it} = \alpha_i + \alpha_t + \beta_1 C_{it} + \gamma_1 C_{it} \, x \, UAI + \gamma_2 C_{it} \, x \, Fin.System_i + \beta_2 L1.GFCF_{it-1} + \beta_3 L1.GDPGRWTH_{it-1} + \varepsilon_{it}$$

Robustness analysis

The effect of all other control variables is shown in the robustness analysis, hypothesizing that they will not affect the main results from the baseline model. Of specific interest is the interaction term between the financial crises dummy and UAI. The significance of this interaction term provides information about the effect of UA on investment in times of financial crises. If this term is negative and significant, it indicates that countries with a higher UAI have experienced a stronger decline in investment in times of financial crises (Hypothesis 2). Furthermore, by including this interaction term in the baseline model, the other variables show their effect on investment in the hypothetical situation of a country with an UAI of 0. In other words, the significance and effect of the other variables do not

tell us anything when the interaction term is included, but the interaction term itself is important for this research.

Estimation method

The estimation method will be an ordinary least square (OLS) fixed effects. Fixed effects cannot be used with variables that do not change over time. For the baseline model this is not a problem, but with the robustness analysis further in the analysis this will cause a problem with the government indicators. Therefore, all of the baseline regressions will be done with fixed effects (denoted as FE) and random effects (denoted as RE) to see what the differences in results are between these two estimation methods. If FE is still the preferred estimation method, the other regressions will be performed using FE. This would mean that in the robustness analysis of the institutional variables, the coefficient of the control variable cannot be included because it would be omitted by the FE model. However, the interaction term between the institutional control variable and the financial crisis dummy would not be omitted. Besides the FE estimation method, Inklaar and Yang (2012) have also used the Generalized Method of Moments (GMM) estimator, because the specification in the baseline model "*includes a lagged value of the dependent variable as one of the explanatory variables, and OLS no longer is consistent in that case. Moreover, there could be endogeneity concerns not adequately addressed by the inclusion of country fixed effects*" (Inklaar & Yang, 2012, p.472). However, the results for this estimation technique are very similar to the results from the FE model and even more restricting, the GMM estimators turn out to be unsatisfactory models (Inklaar & Yang, 2012). Therefore, the GMM estimators will not be included in this research.

6. Results

This chapter will show the results of this research. Before the analyses, two tests have been performed to test which estimation method should be used. The Breusch-Pagan Lagrangian multiplier test shows that RE would be better than a simple OLS model. The Hausman tests shows that FE would be preferred to RE. However, in obtaining the baseline results, both FE and RE will be used to explore the difference in outcomes. If the results from both estimation methods do not differ too much, the RE model would have the advantage that the institutional control variables and the dummy variables of UAI and financial system can be added separately to the regression model.

6.1. Baseline results

	(1)	(2)	(3)	(4)
GFCF	**FE**	**RE**	**FE**	**RE**
L.GFCF	.759***	.829***	.760***	.836***
	(.016)	(.014)	(.017)	(.014)
L.GDPGrwth	.216***	.182***	.203***	.171***
	(.016)	(.016)	(.016)	(.016)
CrisisPeriod	-.782***	-.606***	.123	-.344
	(.13)	(.127)	(.359)	(.312)
Crisis*UAI			-.013***	-.004
			(.005)	(.004)
_cons	5.078***	3.512***	5.101***	3.370***
	(.376)	(.331)	(.386)	(.334)
Observations	1033	1033	993	993
R-Squared	.817	.820	.817	.821

*Table 3: Regression baseline results for the period-based approach. Dependent variable is investment (GFCF). Columns denoted by 'FE' have used a fixed effects model. Columns denoted by 'RE' have used a random effects model. Standard errors are in the parentheses. *** p<.01, ** p<.05, * p<.1.*

Table 3 shows the results of the baseline model regressions. Column 1 and 2 show the results of the baseline model without the interaction term of the FE and RE model respectively. Lagged investment has a large positive and highly significant effect on investment in both models. The coefficient is even larger in the RE model (0.829) than in the FE model (0.759). These coefficients are approximately the same as found in the research by Inklaar and Yang (2012). This indicates that a country's investment in year t is highly dependent on the investment in year t-1, which is the reason that the baseline model includes the lagged dependent variable. In the FE model, lagged investment accounts for almost 76% of current investment. In the RE model, this percentage is almost 83%. Lagged GDP growth is also positive and highly significant, indicating that the accelerator effect is indeed existent in the data. The idea behind the latter is that if a country's GDP increases, consumers will demand more goods and therefore firms start investing more. This effect is somewhat larger in the FE model (0.216) than in the RE model (0.182), indicating that if GDP in year t-1 grows with 1%, investment in year t increases with approximately 20%. This is different from the results found by Inklaar and Yang (2012), where the accelerator effect was not significantly visible. Another research on the effect of financial crises on investment is that of Joyce and Nabar (2009). Although their country sample exists of emerging markets, the results are interesting to compare. Using a fixed effects estimator, they found a coefficient of 0.622 for lagged investment and 0.150 for lagged GDP growth, both highly significant. These coefficients are comparable to the results found in this research.

As expected, the financial crisis dummy shows a negative and highly significant sign, which is even more negative in the FE model (-0.782) than in the RE model (-0.606). This indicates that investment declines in times of financial crises by quite a large amount. The coefficient of -0.782 indicates that investment declines with more than 78% in times that a financial crisis is present, compared to times in which no financial crisis is present. Based on these results, hypothesis 1 is accepted. Financial crises have a negative impact on investment.

This negative effect of financial crises on investment is much larger than Inklaar and Yang (2012) found. In their research, the financial crisis coefficient shows a negative effect of -0.0533, although the dependent variable has undergone a log transformation. Joyce and Nabar (2009) did not use a log transformation on investment, although they did not use the period-based approach as this research did. They investigated the effect of banking crises and sudden stops on investment in emerging markets. Their research using a fixed effects estimation method found a highly significant negative effect of -1.282 of banking crises on investment. It is possible that banking crises have a stronger effect on investment than overall financial crises, or that investment is more prone to financial crises in emerging markets. It could also be that the period-based approach shows a smaller effect on investment than an event-based approach. To test the latter, the same regressions will be performed

in the following subchapter, implementing the event-based approach used by Inklaar and Yang (2012) and Joyce and Nabar (2009) to see if this strengthens the negative effect of the financial crisis coefficient.

Columns 3 and 4 includes the interaction term between financial crisis and UAI. As mentioned before, the other coefficients now show the results for a hypothetical country in which UAI is zero. Because of this, the financial crisis dummy now becomes insignificant in both the FE and RE models. Of great interest is the coefficient of the interaction term. This coefficient is negative (-0.013) and highly significant in the FE model, but almost zero and insignificant in the RE model. Staying with the FE model, the negative interaction term indicates that a higher UAI strengthens the negative effect of a financial crisis on investment. More specifically, the coefficient of -0.013 indicates that every one point increase on the uncertainty avoidance index would imply an additional 1.3% decrease in investment in times of a financial crisis. Based on these results, hypothesis 2 is accepted. Countries with a higher uncertainty avoidance index have witnessed a larger reduction of investment during financial crises compared to countries with a lower uncertainty avoidance index. Figure 7 shows the average investment each year for countries scoring relatively high on the UAI index (blue line) and countries scoring relatively low on the UAI index (blue line). Interesting to see is that investment in countries scoring relatively low on UA recovers a lot faster after the major 2007-2008 financial crisis.

Comparing the overall results of the fixed effects and random effects models in Table 2, it can be concluded that they do not deviate too much on the coefficients of lagged investment, lagged GDP growth and the financial crisis dummy. However, the interaction term is only significant for the fixed effects and therefore the fixed effects will be the preferred estimation method for the rest of this research.

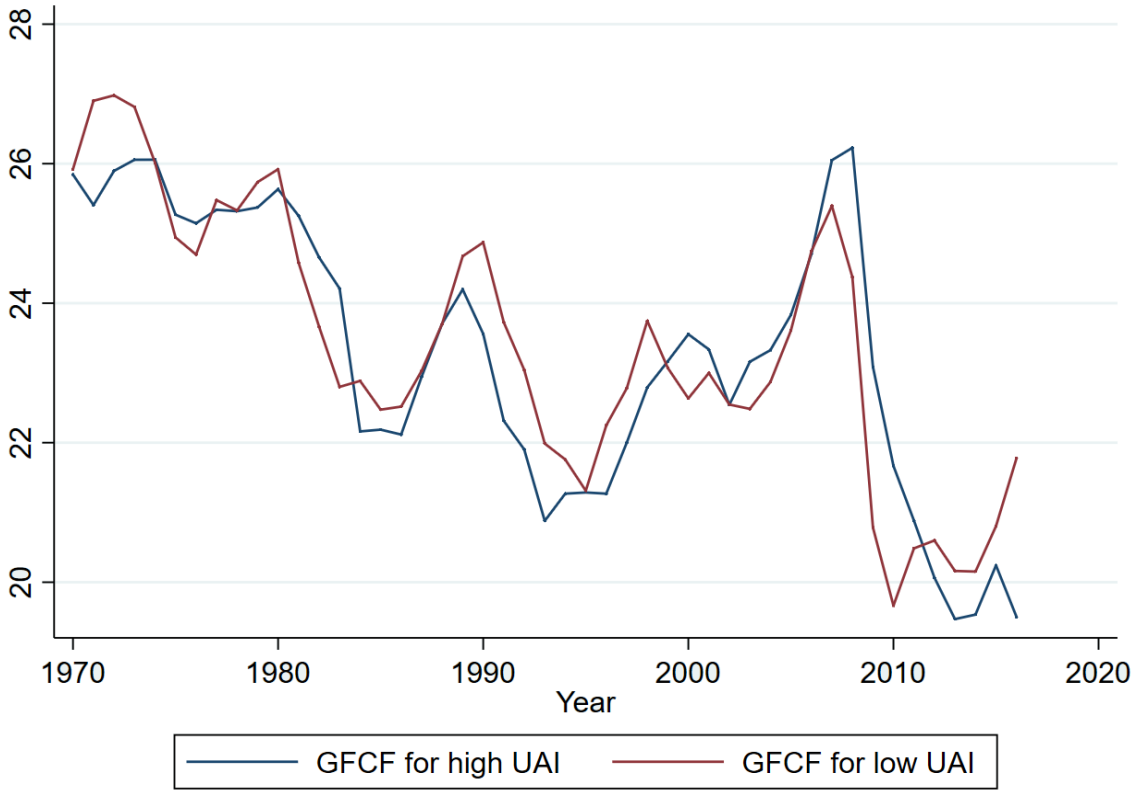

Figure 7: Comparing average investment each year for countries scoring relatively high on UAI and countries scoring relatively low on UAI.

6.2. Event-based approach

The negative effect of a financial crisis on investment found in the previous subchapter is smaller than the effect found by Joyce and Nabar (2009). To find out if the negative effect will be larger with the event-based approach, the same baseline regressions will now be performed using the event-based approach. Column 1 shows the effect of a financial crisis, column 2 shows the effect of a financial crisis and lagged financial crisis, and column 3 shows both the interaction terms of financial crisis and lagged financial crisis times UAI (Table 4).

From column 1 can be seen that the effect of lagged investment and lagged GDP growth is approximately the same as for the period-based approach, both highly significant. The negative effect of a financial crises is larger than the negative effect found with the period-based approach (-0.972 compared to -0.782) but still not comparable to the effect of -1.282 found by Joyce and Nabar (2009). The effect of a lagged financial crisis in column 2 is even more negative (-1.038), which indicates that the effect on investment a year after a financial crisis started is even more considerable. Interesting results are those of the two interaction terms shown in column 3. The interaction term of financial crisis and UAI is still negative, but with a very small amount (-0.007). The interaction term of lagged financial crisis and UAI is positive with a very small amount (0.004). However, both interaction terms

are not significant and therefore these results do not tell us anything about the effect of a country's UA on investment in times of financial crises. There could be different explanations as to why these results differ from the results found using the period-based approach. A plausible reason for this is that the amount of data points is very low: 44 for financial crisis and 45 for lagged financial crisis, in comparison to 279 for the period-based approach (Table 1). For the rest of this research, the period-based approach will be used because of the significance of the interaction term.

	(1)	(2)	(3)
GFCF	**FE**	**FE**	**FE**
L.GFCF	.783***	.787***	.793***
	(.016)	(.016)	(.017)
L.GDPGrwth	.238***	.230***	.219***
	(.016)	(.016)	(.016)
FinancialCrises	-.972***	-1.023***	-.447
	(.275)	(.273)	(.831)
L.FinancialCrises		-1.038***	-1.207
		(.268)	(.825)
FinCrisis*UAI			-.007
			(.012)
L1.FinCrisis*UAI			.004
			(.011)
_cons	4.294***	4.254***	4.165***
	(.361)	(.359)	(.371)
Observations	1033	1033	993
R-squared	.777	.780	.775

*Table 4: Regression baseline results for the event-based approach. Dependent variable is investment (GFCF). Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1.*

6.3. The effect of financial system

Table 5 first shows the regressions of the baseline model without the interaction term of financial crisis and UAI (column 1) and with the interaction term (column 2). To analyse the effect of the type of financial system on investment in times of a financial crisis, two columns are added including an interaction term between the financial system dummy and financial crisis dummy, without (column 3) and with (column 4) the interaction term between financial crisis and UAI. In column 3, the interaction term of financial system and UAI is positive (0.308). Since the financial system dummy has a value of one if a country is market-based, this positive interaction term would indicate that market-based countries suffer over 30% less from financial crises in terms of decline in investment. However, the coefficient is not significant and therefore no conclusion can be drawn. Therefore, hypothesis 3 cannot be accepted. The financial system of a country does not have an effect on investment in times of a financial crisis.

	(1)	(2)	(3)	(4)
GFCF	**FE**	**FE**	**FE**	**FE**
L.GFCF	.759***	.760***	.760***	.760***
	(.016)	(.017)	(.016)	(.017)
L.GDPGrwth	.216***	.203***	.216***	.203***
	(.016)	(.016)	(.016)	(.016)
CrisisPeriod	-.782***	-.123	-.856***	.234
	(.130)	(.359)	(.147)	(.452)
Fin.System*Crisis			.308	-.133
			(.288)	-328
Crisis*UAI		-.013***		-.014**
		(.005)		(.006)
_cons	5.078***	5.101***	5.082***	5.113***
	(.376)	(.386)	(.376)	(.387)
Observations	1033	993	1033	993
R-squared overall	.817	.817	.817	.817

*Table 5: Regression results to explore the effect of financial systems. Dependent variable is investment (GFCF). Standard errors are in parentheses. *** p<.01, ** p<.05, * p<.1.*

An interesting result is that the coefficient of the financial crisis dummy has become more negative (-0.856 in comparison to -0.782), indicating that a financial crisis has an additional 7.4% negative effect on investment when controlling for a country's financial system. The main idea from column 4 is to

test whether the inclusion of the financial system and UAI interaction term would eliminate the negative effect of the financial crisis and UAI interaction term. The results show that is does not, since the negative interaction term is still significant with approximately the same coefficient. Significance of the interaction term has only decreased a little bit, from less than 1% to less than 5%.

6.4. Robustness analysis

To rule out the possibility that impact of the financial crisis dummy can actually be the effect of other incentives to lower a country's investment, robustness of the results will be tested for different economic- and institutional control variables. All regressions have been performed using the fixed effects model. In both regression tables 6 and 7, the first column replicates the baseline model from Table 3, column 3.

Economic control variables

	(1)	(2)	(3)	(4)	(5)	(6)
GFCF	**Baseline**	**Interest Rate**	**Inflation**	**Trade Openness**	**FDI**	**Terms of Trade**
L.GFCF	.760***	.733***	.758***	.754***	.762***	.667***
	(.017)	(.021)	(.017)	(.017)	(.016)	(.029)
L.GDPGrwth	.203***	.259***	.207***	.204***	.213***	.260***
	(.016)	(0.019)	(.017)	(.016)	(.017)	(.024)
CrisisPeriod	.123	-.004	.133	-.508	-.227	1.443
	(.359)	(.351)	(.360)	(.419)	(.363)	(3.068)
Crisis*UAI	-.013***	-.006	-.013**	-.012**	-.011**	-.016**
	(.005)	(.005)	(.005)	(.005)	(.005)	(.008)
Control		.011	.004	-.004	.004*	-.027
		(.016)	(.003)	(.002)	(.002)	(.021)
Control*Crisis		-.035	-.003	-.006***	.036***	-.011
		(.023)	(.004)	(.002)	(.010)	(.030)
_cons	5.101***	5.398***	5.094***	5.558***	5.00***	9.658***
	(.386)	(.478)	(.393)	(.496)	(.381)	(2.157)
Observations	993	660	989	993	961	459
R-squared	0.817	0.855	0.816	0.820	0.826	0.810

*Table 6: Regression results for robustness analysis of economic control variables. Dependent variable is investment (GFCF). Standard errors in parentheses. *** p<.01, ** p<.05, * p<.1.*

In addition to the baseline model, every column adds a different control variable denoted under the column number. For the economic control variables, both the coefficient of the control variable and an interaction term between the control variable and financial crisis dummy is shown. The key test here is to determine whether the addition of an economic control variable would remove the negative interaction term between financial crisis and UAI. In other words, to test if any control variable would remove the moderating effect of a lower UA on investment in times of financial crisis. This is not the case for any control variable. In every column, the interaction term between financial crisis and UAI remains negative, although insignificant with the inclusion of interest rate. Nevertheless, after performing the robustness analysis for economic control variables, hypothesis 2 still holds. Countries with a higher uncertainty avoidance index have witnessed a larger reduction of investment during financial crises compared to countries with a lower uncertainty avoidance index.

Only one economic control variable has a significant effect on investment. The coefficient for FDI is significant at 10% with a coefficient of 0.004. This means that if FDI as a percentage of GDP increases with 1%, investment increases with 0.4%. Furthermore, two interaction terms between a control variable and financial crises are significant, both at 1%. The first is trade openness, with an interaction effect of -.006. This indicates that a higher trade openness in times of a financial crisis, has a negative effect on investment. The second is FDI, with an interaction effect of .036. This indicates that higher FDI in times of a financial crisis has a positive effect on investment

Institutional control variables

The method for the robustness analysis of institutional control variables is the same as for economic control variables, except that the separate coefficients of the institutional control variables are excluded because these do not vary over time and are therefore omitted in the fixed effects model. The interaction term between institutional control variables and the financial crisis dummy is included. This way, the robustness analysis of institutional control variables follows the same method used by Inklaar and Yang (2012).

Prior results in this research have established the hypothesis that uncertainty averse countries respond more heavily on financial crises than uncertainty accepting countries in terms of decline in investment. Robustness holds for economic control variables, but it is also possible that uncertainty aversion gives rise to institutions that act as a barrier for investment in times of uncertainty. Furthermore, the hypothesized results could also be an effect of poor government response to crises (Inklaar & Yang, 2012). Nevertheless, the interaction term between financial crisis and UAI still remains negative although insignificant with the addition of most institutional control variables. However, hypothesis 2 still holds. One important result is that of employment laws in column 8. The interaction term between this control variable and the financial crisis dummy is significant and highly negative,

indicating that the negative effect of employment laws on investment depends on the occurrence of a financial crisis. This effect seems logical, because if the strictness of regulations regarding a firm's ability to fire people is high in times of a financial crisis, the firm will face more uncertainty for the future and will have less resources available for investment. A remarkable result from column 8 is that the financial crisis dummy now becomes highly positive (1.138) and significant at 5%. I cannot think of a logical explanation for this finding.

	1	2	3	4	5	6	7	8
GFCF	**Baseline**	**Voice**	**Stability**	**Effectiveness**	**Reg. Quality**	**Rule of Law**	**Corruption**	**Empl. Laws**
L.GFCF	.760***	.763***	.760***	.762***	.763***	.762***	.762***	.768***
	(.017)	(.017)	(.017)	(.017)	(.017)	(.017)	(.017)	(.017)
L.GDPGrwth	.203***	.202***	.203***	.203***	.202***	.202***	.202***	.213***
	(.016)	(.016)	(.016)	(.016)	(.016)	(.016)	(.016)	(.017)
CrisisPeriod	.123	-.916	-.199	-.567	-1.307	-.635	-.365	1.138**
	(.359)	(.845)	(.574)	(.672)	(.963)	(.669)	(.625)	(.522)
Crisis*UAI	-.013***	-.019	-.012**	-.009	-.005	-.009	-.010	-.010**
	(.005)	(.006)	(.006)	(.006)	(.007)	(.006)	(.006)	(.005)
Control*Crisis		.597	.247	.296	.636	.329	.181	-1.993**
		(.440)	(.343)	(.244)	(.397)	(.245)	(.190)	(.773)
_cons	5.101***	5.038***	5.094***	5.053***	5.042***	5.042***	5.057***	4.936***
	(.386)	(.389)	(.386)	(.388)	(.387)	(.388)	(.389)	(.387)
Observations	993	993	993	993	993	993	993	993
R-squared	0.817	0.816	0.817	0.817	0.816	0.817	0.817	0.834

*Table 7: Regression results for robustness analysis of institutional control variables. Dependent variable is investment (GFCF). Standard errors in parentheses. *** p<.01, ** p<.05, * p<.1*

7. Conclusion

The aim of this master thesis was to find out what effect financial crises have on investment as well as to explore cross-country differences arising from uncertainty avoidance (UA) and a country's financial system. The country sample consisted of all 28 countries that are member of the European Union, including the United Kingdom. The time period in which data for this research was collected is between 1970-2016. This master thesis extends on the paper by Inklaar and Yang (2012), and contributes to the literature in four ways. First, the time period for this research is extended so that the effects of the major 2007-2008 financial crisis can be included, using data from a relatively new database on financial crises constructed for European countries. Second, this research adheres to a different approach to financial crisis. A period-based approach has been used as compared to an event-based approach. Third, the effect of a country's financial system on investment in times of a financial crisis is explored. Fourth, this research explores the effect of a cultural dimension, namely UA, on a macroeconomic phenomenon within a single union consisting of countries that are culturally different from one another.

This research uses a fixed effects estimating method. The results show two interesting main findings. First, financial crises have a significantly negative effect on investment by lowering investment with approximately 78% compared to times in which no financial crisis is present. The negative effect of a financial crisis on investment is even larger when adopting an event-based approach but while doing so, the interaction term between the financial crisis dummy and uncertainty avoidance becomes insignificant. Second, countries that score high on the uncertainty avoidance index are much more vulnerable to financial crises than countries that score low on the uncertainty avoidance index in terms of decline in investment. The negative coefficient of -0.013 indicates that one point increase on the uncertainty avoidance index would reflect a 1.3% additional decrease in investment in times of a financial crisis. A country's financial system has no significant effect on investment in times of a financial crisis. Apart from these results, this research also shows that an accelerator effect is present because lagged GDP growth has a positive and highly significant effect of 0.203.

These results were not affected by the robustness analysis of economic- and institutional control variables. Furthermore, the robustness analysis of economic control variables shows that FDI has a significant effect of 0.004 on. The significant interaction term of 0.036 between FDI and the financial crisis dummy indicates that an increase in FDI in times of a financial crisis positively affects investment. The significant interaction term of -0.006 for trade openness indicates that higher trade openness in times of a financial crisis negatively affect investment. For the institutional control variables, only the interaction term between employment laws and financial crisis has a significant negative impact of -

1.993. A remarkable finding is that with the inclusion of this interaction term, the financial crisis dummy suddenly becomes highly positive and significant.

8. Discussion

Having discussed the findings of this research in the prior chapter, it is imperative to discuss what limitations this research might hold. One important first note is that the dependent variable is gross investment, which means that it includes both public and private investment. Because of the inclusion of public investment, the results could be flawed by the fact that public investment can be an important instrument for governments to overcome recessions and stimulate long-run economic growth. However, in the research by Inklaar and Yang (2012), the authors found that public investment has declined after a crisis in almost all countries. They argue that debt crises in particular have an overall negative impact on government finances and therefore public investment decreases. This contradiction could be explained by the argument that only recently policy makers have stressed the importance of implementing fiscal policy to fight subsequent recession, because monetary policy has proved to have lost its influence in doing so (Petrović et al., 2021). An increase in public investment could have resulted in relatively higher total investment compared to private investment in the 2007-2008 financial crisis. Furthermore, Inklaar and Yang (2012) have made a distinction between the type of asset (productive live span of capital assets) and type of industry (industries with low or high levels of volatility), which gives a more complete view on the effect of financial crises on different components of investment.

The effect of a country's financial system on investment in times of a financial crisis is not significant in this research. A possible reason for this, is that there are only five countries classified as being market-based. Perhaps results on this matter would have been more significant if more countries were included, or if financial system would not have been a dummy variable but simply a variable corresponding to the structure index of a country. For future research, it might be interesting to further explore how financial systems and uncertainty avoidance together have an effect on investment in times of financial crises.

One remarkable finding in this research, is that with the inclusion of the interaction term between employment laws and the financial crisis dummy, the financial crisis dummy suddenly becomes highly positive and significant. It might be interesting for future research to further explore this finding.

There are different ways in which missing data can be treated. For all variables in this research, except the institutional control variables, the choice has been made to do nothing with missing values. It would have been interesting to test if the results were significantly different if another approach for missing values would have been adopted.

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10. Appendix

Appendix 1: Ten differences between weak- and strong- uncertainty avoidance societies

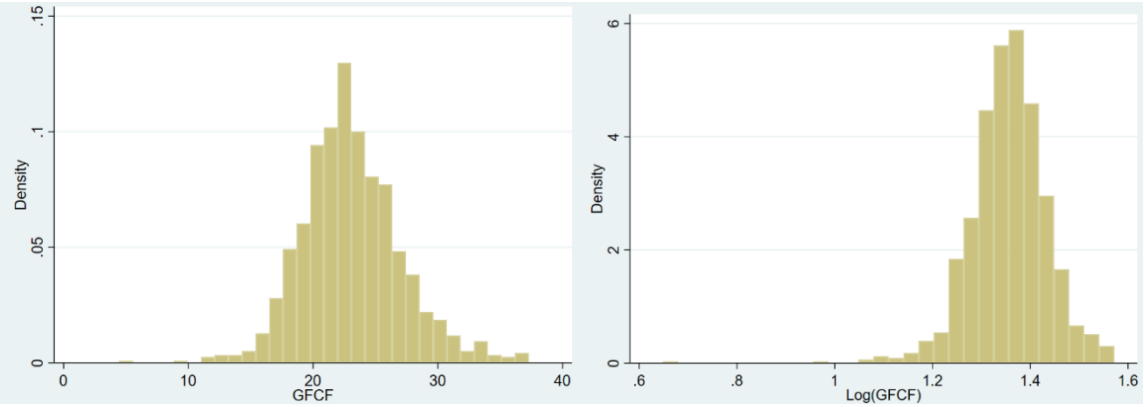
Weak Uncertainty Avoidance	**Strong Uncertainty Avoidance**
The uncertainty inherent in life is accepted and each day is taken as it comes	The uncertainty inherent in life is felt as a continuous threat that must be fought
Ease, lower stress, self-control, low anxiety	Higher stress, emotionality, anxiety, neuroticism
Higher scores on subjective health and wellbeing	Lower scores on subjective health and well-being
Tolerance of deviant persons and ideas: what is different is curious	Intolerance of deviant persons and ideas: what is different is dangerous
Comfortable with ambiguity and chaos	Need for clarity and structure
Teachers may say 'I don't know'	Teachers supposed to have all the answers
Changing jobs no problem	Staying in jobs even if disliked
Dislike of rules - written or unwritten	Emotional need for rules – even if not obeyed
In politics, citizens feel and are seen as competent towards authorities	In politics, citizens feel and are seen as incompetent towards authorities
In religion, philosophy and science: relativism and empiricism	In religion, philosophy and science: belief in ultimate truths and grand theories

Source: Hofstede (2011)

Appendix 2. Summary statistics

Variable	Mean	Std. Dev.	Min	Max	Obs.
Investment, output & UAI					
GFCF	23.070	4.003	4.452	37.287	1,077
GDP Growth	2.819	3.580	-14.839	25.163	1,065
UAI	71.222	22.548	23	112	1,269
Economic control variables					
Interest Rate	5.800	5.603	-0.655	45.475	670
Inflation	17.890	97.344	-4.478	1,500	1,137
FDI	6.999	28.080	-58.232	449.083	1,044
Trade Openness	94.245	55.838	23.110	408.362	1,077
Terms of Trade	98.321	7.075	73.459	140.967	476
Institutional control variables					
Voice and Accountability	1.175	0.346	0.448	1.655	1,316
Political Stability	0.830	0.379	0.075	1.484	1,316
Government Effectiveness	1.191	0.619	-0.268	2.168	1,316
Regulatory Quality	1.246	0.448	0.414	1.921	1,316
Rule of Law	1.171	0.632	-0.098	2.081	1,316
Control of Corruption	1.086	0.817	-0.249	2.442	1,316
Employment Laws	0.591	0.149	0.282	0.809	1,128

Appendix 3: Histograms of GFCF and Log(GFCF)



Appendix 4: Correlation matrix of GFCF and economic control variables

	GFCF	GDPGrwth	Intere~e	Inflat~n	FDI	TradeO~s	Termso~e
GFCF	-						
GDPGrwth	0.2715 (0.0000)	-					
InterestRate	0.1955 (0.0000)	0.0534 (0.1683)	-				
Inflation	-0.1097 (0.0003)	-0.2335 (0.0000)	0.8332 (0.0000)	-			
FDI	-0.0875 (0.0048)	-0.0075 (0.8101)	-0.1733 (0.0000)	-0.0320 (0.3037)	-		
TradeOpenn~s	-0.1358 (0.0000)	0.1501 (0.0000)	-0.3508 (0.0000)	-0.0443 (0.1485)	0.3352 (0.0000)	-	
TermsofTrade	0.1713 (0.0002)	0.1908 (0.0000)	0.3535 (0.0000)	0.1077 (0.0188)	0.0298 (0.5170)	-0.0127 (0.7818)	-

Appendix 5: Correlation matrix of GFCF and institutional control variables

	GFCF	VoiceA~y	Politi~y	Govern~s	Regula~y	RuleOf~w	Contro~n	Employment~s
GFCF	-							
VoiceAndAc~y	-0.0281 (0.3561)	-						
PoliticalS~y	0.0414 (0.1742)	0.6663 (0.0000)	-					
Government~s	-0.0178 (0.5597)	0.9494 (0.0000)	0.6244 (0.0000)	-				
Regulatory~y	-0.0349 (0.2522)	0.9173 (0.0000)	0.6223 (0.0000)	0.9228 (0.0000)	-			
RuleOfLaw	-0.0186 (0.5410)	0.9646 (0.0000)	0.6586 (0.0000)	0.9694 (0.0000)	0.9406 (0.0000)	-		
ControlOfC~n	-0.0447 (0.1424)	0.9468 (0.0000)	0.6138 (0.0000)	0.9735 (0.0000)	0.9290 (0.0000)	0.9678 (0.0000)	-	
Employment~s	0.1328 (0.0001)	0.3199 (0.0000)	0.2218 (0.0000)	0.2713 (0.0000)	0.1113 (0.0002)	0.2078 (0.0000)	0.2202 (0.0000)	-