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Post-crisis Re-regulation of Financial Markets

Author: **Bc. Petr Filipec**

Supervisor: **PhDr. Zdeněk Kudrna, Ph.D.**

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Declaration of Authorship

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Prague, July 30, 2013

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Abstract

This paper analyzes the causes of financial crises, and on this basis it proposes possible changes in financial regulation. Throughout the paper we work with a hypothesis that the major roots of financial distress are excess credit growth and substantial capital inflows. We test this hypothesis on a dataset comprising entries from Australia, Japan, the UK, and US over the approximate period 1970-2010. The results confirm that there is a consistent relation of credit development to financial crisis incidences and a somewhat less consistent effect of capital inflows. Furthermore, since we find a robust positive effect of past credit growth on the probability of a crisis occurrence, we propose a change in interest rate policy. Our suggestion implies a consideration of credit to GDP ratio during the execution of the monetary policy decisions on interest rates.

JEL Classification	E44, E51, E52, G01, G18, G21, G38
Keywords	Financial regulation, financial markets, financial crisis, causes

Author's e-mail	p.filipec@gmail.com
Supervisor's e-mail	zkudrna@gmail.com

Abstrakt

Tato práce analyzuje příčiny finančních krizí a v této souvislosti navrhuje možné změny v regulaci finančních trhů. Pracujeme zde s hypotézou, která předpokládá, že hlavními důvody vzniku finančních krizí jsou nepřiměřený nárůst kreditu a značné přítoky kapitálu do systému. Tuto hypotézu testujeme na databázi složené z údajů týkajících se Austrálie, Japonska, Velké Británie a Spojených států amerických z let 1970-2010. Výsledky potvrzují konzistentní vztah mezi růstem kreditu a výskyty finančních krizí a také o něco méně konzistentní efekt přísunu kapitálu. Jelikož jsme zjistili robustní a pozitivní efekt vývoje kreditu na pravděpodobnost vzniku krize, navrhujeme změnu v rozhodování o úrokových mírách. Náš návrh doporučuje brát v potaz míru celkového kreditu k HDP při nastavování monetární politiky úrokových měr.

Klasifikace JEL	E44, E51, E52, G01, G18, G21, G38
Klíčová slova	Finanční regulace, finanční trhy, finanční krize, příčiny

E-mail autora	`p.filipec@gmail.com`
E-mail vedoucího práce	`zkudrna@gmail.com`

Master Thesis Proposal

Author	Bc. Petr Filipec
Supervisor	PhDr. Zdeněk Kudrna, Ph.D.
Proposed topic	Post-crisis Re-regulation of Financial Markets

Topic characteristics

The recent financial crisis demonstrated how human greed can cause a global collapse in an out of control financial industry, and therefore how irresponsible is to leave it unregulated. During the last 30-40 years the financial sector has gone through major changes such as development of new technologies leading to immense amount of transactions, creation of derivatives providing a new playground for banks and incorporating more complexities into the system, and finally the overall deregulation of the industry. This led to the global collapse of financial system resulting in a worldwide recession. Therefore, it has suddenly provoked quite a few discussions about how to fix this toxic system. Essentially, a new regulation of the industry belongs to the emerging topics, and it is the central interest of this paper as well.

The main goal of this paper is to assess whether the current proposals of financial regulation will prevent repetition of financial crises. To do so it will first review the causes of all know financial crises from the banks perspective and quantify their importance using the available data. As a next step, it will examine if they are properly addressed in the current proposals by analyzing the impact on banking sector. In academic literature we can find numerous suggestions regarding causes of financial crises. For instance according to Summers (2000) among main causes belong capital withdrawals, which are usually driven by price shocks in fundamental assets for specific countries, linkages between countries (such as exporter-importer or lender-borrower relationships), insufficient liquidity in the market, and panic-like behavior (bank runs or investors movements). Whereas Mishkin (1992) suggests that traditional causes of financial crises are high interest rates (which is either due to a previous credit boom or insufficient money supply), downturn of and uncertainty

in stock markets (e.g. after the failure of important financial institution), bank panics leading to bankruptcies, and decrease in aggregate price level (nominal value of debt remains unchanged). Finally, Acharya et al. (2009) comment on the causes of the recent financial crises and blame mostly the credit and housing bubbles, which is in line with the previous statements. Therefore, we would like to link these general suggestions to the behavior and performance of banking sector in order to reveal what are the causes from the banks perspective. Then, we can show their development in time and estimate the correlation between crisis occurrence and these variables in order to assess their significance. Also, we will try to address other potential factors leading to crises, if we find a gap in the data suggesting the need of further examination. In addition, we can use this initial analysis to evaluate current proposals of financial regulation described in academic literature as well as the actual regulation represented by Basel III that is coming into effect these days. For example Schwarcz (2010) suggests an approach to regulate complexities in financial markets by introducing a lender of last resort with a competence to invest in panicked markets to prevent collapse. Another study by Hart and Zingales (2009) introduces mechanisms to regulate the amount of capital in banks and also their portfolio. Thus, we will estimate the impact of these proposals on the banks to find out whether or not they would have been able to avert the past crises. The expected conclusion of this paper is to come up with potential adjustments of current regulation proposals, which would sharpen them in order to prevent occurrence of further crises and to maintain a healthy financial system.

Hypotheses

Hypothesis #1: Credit boom, asset prices shocks or bubbles, bank panics, decrease in aggregate price level, and linkages between countries belong to the main causes of global financial crises.

Hypothesis #2: The current academic proposals of financial regulation do not address the critical causes, and hence they would not be able to prevent previous crises.

Hypothesis #3: Basel III will lower the banks' profitability, which in effect could be a threat to the properly working financial system.

Methodology

In the first part, we will utilize time series to demonstrate possible causes of financial crises and also estimate correlation between crises occurrences and specific variables. Moreover, we might develop an econometric model describing the relationships between these variables and probability of crisis. In the next sections, we will employ econometric analysis to calculate how the proposals would influence proxy variables of the causes.

Outline

1. Introduction
2. Previous findings on the causes of financial crises
3. Methodology description to find the roots of financial collapses
4. Empirical analysis
5. Evaluation of current regulation proposals
6. A new regulation scheme
7. Conclusion

Core bibliography

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Author

Supervisor

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1 Introduction

The recent financial crisis showed how fragile the global economy can be and how important is to arrange a stable financial system. We have seen that during the last 30-40 years the financial sector has gone through major changes such as the development of new technologies leading to immense amount of transactions, emergence of derivatives providing a new playground for banks and incorporating more complexities into the system, and finally the overall deregulation of the industry. This possibly led to one of the most severe financial meltdowns in human history, which was triggered in 2008 by a bankruptcy of a major investment bank. It has already started many discussions across the whole world, and undoubtedly many more are yet to come.

In addition, this event should be more than familiar, since this is not at all the first financial crisis, and it is almost certainly not the last one either. Quite a few similar crises have occurred in the past already, thus we can infer that there is some pattern, which can be traced. Furthermore, as the recent development confirmed the influence of such an event is without doubt undesirable, thus if it is possible to prevent it, the economists of the world should direct a significant share of their endeavors to find a sustainable solution. Yet, in reality the academic opinions about most of the financial crisis aspects still seem to be rather ambiguous. The motivation to bring a consensus to these discussions is therefore evident.

We believe that one of the most important issues that academicians can resolve is how to design a system, which would allow smooth financial flows and would be stable in the long run as well. Effectively, this implies developing the rules and boundaries for financial sector, which clearly define the manners of its operation. Therefore, this is nothing else than recreating the regulation scheme. In order to identify the crucial areas of the regulation, we should first start with finding the core causes of financial crises. Thus, that is exactly what this paper examines. We determine the root sources of financial distress of the kind we observed recently and their relative importance, and then we leverage these findings for regulatory implications. In doing so, we employ a thorough econometric methodology, which

helps us derive the most relevant factors leading to the crises as well as identify their relative impact on the crisis occurrence probability. Then, we can link these causes to the regulation scheme and propose changes that would prevent financial crises from happening.

The remainder of the paper is organized as follows. Section 2 discusses the definition of a financial crisis, which can be found in the current academic literature, and describes the one that is used in the analysis. The next section provides a thorough literature review regarding the causes of financial crises and on this basis it outlines the set of the tested hypotheses. Then, Section 4 shows what methodology we use in the empirical analysis, which is consequently performed in the next section together with the data description and results discussion. The implications for the regulatory framework are examined in Section 6, where we also confront them with the previous proposals. And lastly, Section 7 draws conclusions on the determination of the crisis causes as well as the regulatory recommendations.

2 Definition of a financial crisis

2.1 Previous findings

The current academic literature appears to be unclear in marking out the definition of a financial crisis. As Mishkin (1992) points out, there are two major directions. The first, represented by e.g. Minsky (1970) and Kindleberger and Aliber (2011), defines financial crises quite broadly and according to Mishkin (1992) includes substantial decline in asset prices, defaults of financial and non-financial companies, deflation, disinflation, disturbances in exchange markets, or its combinations. On the other hand, the monetarists' stream (e.g. Schwartz (1987)) sees only the banking panics as true financial crises, since they believe those are the ones causing severe downturns in aggregate economy. They also claim that Minsky's and Kindleberger's approach leads to unnecessary government bailouts, since too many events are interpreted as financial crises and therefore causes inefficiency. Also, Mishkin (1992) employs an entirely different approach, which in effect produces a new definition.

He uses the asymmetric information assumption, which says that in financial transactions one party usually has a superior information set than the other. This implies two main problems in financial markets: Adverse selection (before the transaction is executed) and moral hazard (after the execution). Based on this assumption, the author derives that a financial crisis is a situation, when the adverse selection and moral hazard phenomenas become much worse, which results in inefficient channeling of funds through the financial system. This in effect leads to an insufficient supply of funds to subjects with the most productive investment opportunities resulting in a deterioration of aggregate output.

In other studies, Reinhart and Rogoff (2010) and Reinhart and Rogoff (2008) identify basically three different subgroups of financial crises. First, the currency crisis, which is defined as a rapid exchange rate depreciation (at least 15 percent per annum). They also consider periods of high inflation (more than 20 percent per annum) as currency crises, thus hyperinflation is incorporated as well. The authors claim and support with empirical evidence that currency depreciation and high inflation often go hand in hand. Another category of financial crises is a debt crisis. The authors define these events as failures to meet debt obligations incurred in a foreign country, repudiations, or the restructuring of debt into worse terms to the creditors. They also argue that an external debt crisis is usually much more noticeable than a domestic one, since the foreign lenders are involved with them. However, though domestic debt crises often go unnoticed, it does not mean that they do not happen at all. The last subgroup of financial crises defined by Reinhart and Rogoff (2010) involve banking crises. The problems in financial sector arise from two possible sources. Firstly, the trust of the public declines and people start withdrawing their deposits. Because of the self-fulfilling aspect of this behavior, this mostly ends with bank runs and thus with possible government bailouts. Hence, the liability side of banks is affected in this case. Nevertheless, we have also seen banking crises stemming from the asset side. When a bank invests to a particular industry in a higher than optimal proportion and therefore has a high exposure to this sector, there is a possibility that the bank will not be able to maintain liquidity, when the industry performance decreases. In other words, the value of bank's assets declines

and if it exceeds the value of capital, the bank is no longer solvent. This might be especially dangerous, when the companies operating in the financial industry are interconnected, since they can infect each other. Also, Reinhart and Rogoff (2008) develop an event approach, which we partially utilize in our analysis as well. Table 1 describes the definition of a financial crisis as it is stated by the authors.

Table 1: Defining dinancial crises by events

Type of Crisis	**Definition and Criteria**	**Comments**
Banking Crises Type I: systemic/severe Type II: financial distress/ milder	We mark a banking crisis by two types of events: (1) bank runs that lead to the closure, merging, or takeover by the public sector of one or more financial institutions; and (2) if there are no runs, the closure, merging, takeover, or large-scale government assistance of an important financial institution (or group of institutions), that marks the start of a string of similar outcomes for other financial institutions.	This approach to dating the beginning of the banking crises is not without drawbacks. It could date the crises too late, because the financial problems usually begin well before a bank is finally closed or merged; it could also date the crises too early, because the worst of crisis may come later. Unlike external debt crisis, which have well-defines closure dates, it is often difficult or impossible to accurately pinpoint the year in which the crisis ended.

Source: Reinhart and Rogoff (2008)

2.2 Definition of the crisis utilized in the analysis

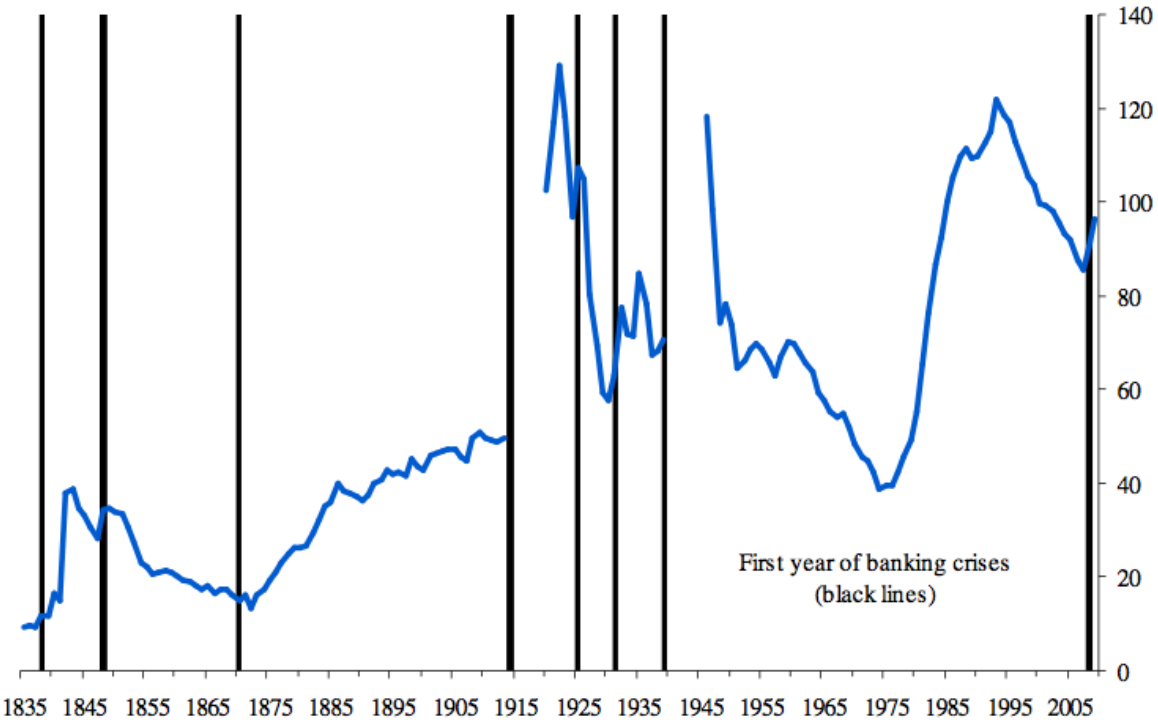
First, we should clearly state that this paper examines the category of banking crises only. Even though all of the subgroups mentioned by Reinhart and Rogoff might be in a way interconnected, as we have seen recently in the case of the Greek sovereign debt crisis, the causes and regulatory implications would be likely different, and thus examining all of them is beyond the scope of this paper. Also, we are particularly interested in the financial crises triggered by the asset side of financial institutions, as those are the ones that have appeared in the last decades even in highly developed economies. This suggests that the solution to such an issue is yet

to be discovered, whereas we believe that the crises arising from the liability side have mostly been overcome in the past, since nowadays they usually appear only in developing countries.

Furthermore, we utilize a rather broad definition of a banking crisis, since we are focusing on finding the causes for the general financial distress related to the problems in financial industry. We believe that it has a negative relation to aggregate output with a proportionate size. As we would like to shed more light on the causes of financial crises and find implications for the prevention, we do not need to enter the discussion about whether or not government bailouts are justified. This assumption allows us to some extent utilize the Minsky's and Kindleberger's general definition. Specifically, we see any occurrence of a financial institution becoming insolvent as a form of a financial crisis. Therefore, ideally we would like to utilize a database of such events based on the history books. Unfortunately, such a database does not exist, as far as we know, and since we also want to draw conclusions about the severity of a crisis, we need to measure its depth and length as well. This might be a more challenging task than it appears to be, even though the crises affect various factors in economy. For instance, using the history books we can obtain the beginning of a crisis, nonetheless it is far more difficult to precisely denote its end. One possibility is to consider the date, when asset prices, output, or both reach the levels prior to the crisis. The similar problem arise, when we want measure the depth of a crisis. Again, we can utilize the percentage decline in asset prices and output between the beginning of a crisis and the lowest point before the variables return to its original levels. Furthermore, the change in government debt relative to country GDP offers an alternative proxy measure, which is depicted on Figure 1. We can see that the government debt relative to GDP always increases around the time of a crisis occurrence, which means that it is possible to use it for measuring the scale of a financial crisis. Specifically, the incline of debt is roughly 5 to 20% of GDP depending on the actual crisis, which suggests significant differences across the whole sample. However, even this approach contains several drawbacks, mainly the fact that the rise in government debt is not a direct indicator of financial crises but rather a consequence, which might create a bias. Another more advance method

of measuring the severity of a financial crisis is to weight several indicators such as changes in GDP, asset prices, and government debt mentioned above. This is a more comprehensive and also more challenging approach, since it is necessary to define the weights for computing such a severity index. The easiest solution to this might be employing the equal weighing among all considered factors, which on the other hand, might not be the most accurate, or we can prioritize some of the factors (e.g. GDP) depending on what problems we want to examine.

Figure 1: Central government debt and banking crises in Belgium (% GDP)



Source: Reinhart and Rogoff (2010)

In our analysis, however, we focus on measuring the variance of share prices and use this variable as an indicator of financial crises. Again, such approach is not perfect, but we believe that it has important advantages that outweigh the drawbacks. First, it is the simplicity and thus feasibility of this approach that makes it preferable. The developments of share prices are available for the majority of developed countries in some form, and we can then quite easily transfer these series into the variances of returns. The second important benefit is that the developments of share prices reflect nearly all the crises, though they might not be the most

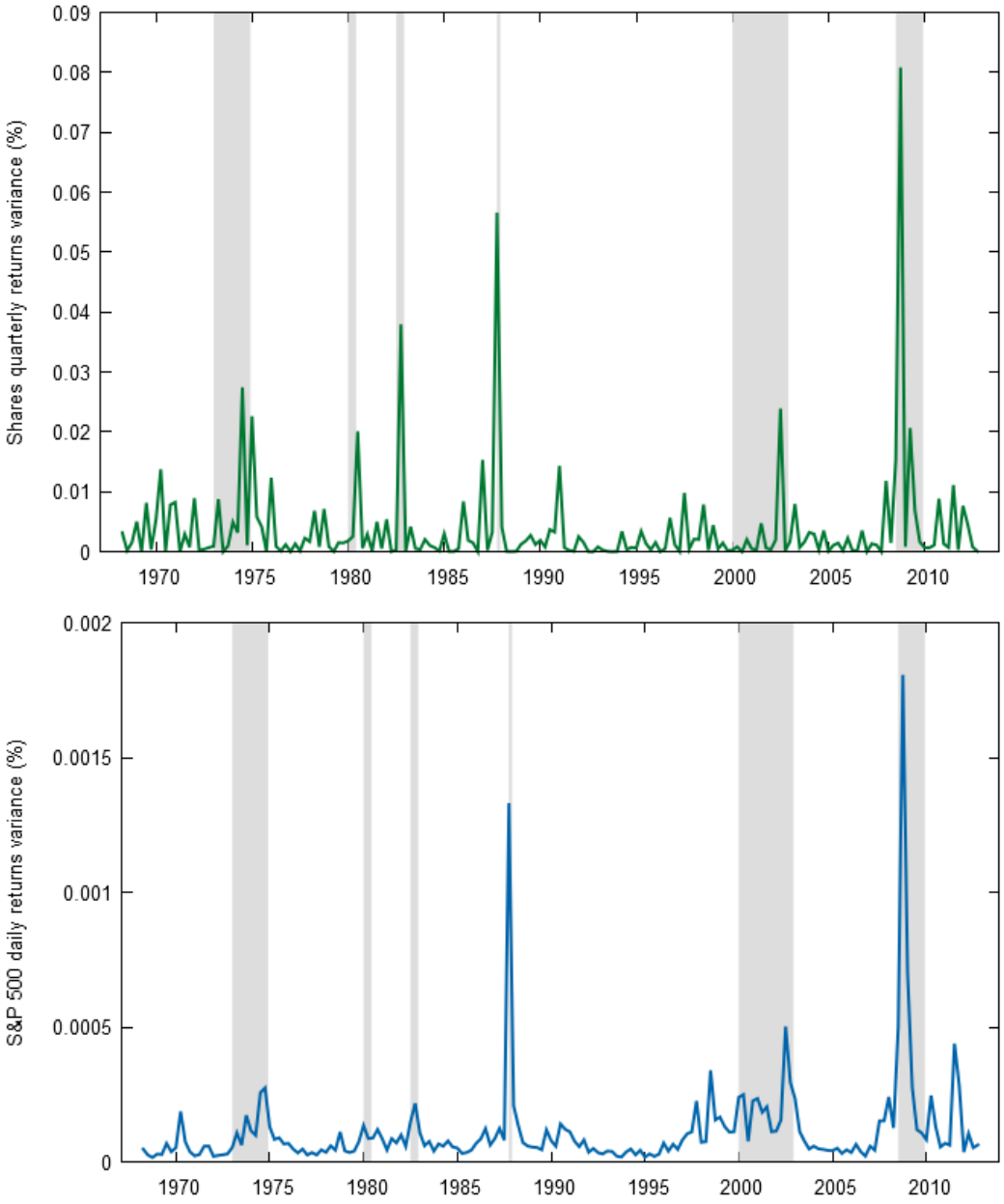
accurate indicator for every one of them. For instance, in the latest subprime crisis it could be superior to utilize the real estate prices, but this does not hold for the remaining distress periods throughout the history. Thus, this can be perceived as both a drawback and an advantage. Another drawback, which we should be aware of, is a plausible overemphasis of certain distress periods, which were accompanied by an immense decrease in share prices, but the impact on financial sector was less than proportionate. Nevertheless, because of the data availability and overall fitness of the series we believe that the variance of share returns is an appropriate proxy, which can be used for defining the crisis periods. To substantiate this claim, Figure 2 provides a comparison between the variances of US stock price indices and approximate dates of financial crises as provided by the history books. As we can see, this indicator appears to have a substantial correlation with the periods of financial distress. Overall, it is important to realize that none of the approaches is completely accurate, and the individual disadvantages of different approaches should be considered before performing the analysis.

3 Causes of financial crises

3.1 Previous findings

The current literature offers only a limited number of papers concerning the sources of general financial distress. For instance Summers (2000) draws several conclusions about universal financial crises. He addresses four main issues: The goal of an efficient financial system, sources of financial crises, designing a system working efficiently and preventing crises, and the effective response. In terms of the causes, he claims that investors' departure after a period of large capital inflows, self-fulfilling aspect of this behavior, and consequent lack of capital belong to the major roots of the crises. Another paper by Cecchetti et al. (2009) investigates financial crises from the general perspective as well, but it focuses mostly on the analysis of their cost and consequences rather than causes. Nevertheless, there has been written a large number of papers about the roots of financial distress and crises mostly

Figure 2: Share returns variance over the period 1968-2012 in the US



Source: IMF's International Financial Statistics, Yahoo! Finance
Note: Shaded areas depict the approximate periods of financial crises in the United States

focusing on the Great Depression of the 1930s or the recent financial meltdown of 2007-2009. Thus, this section comprehends the most important findings presented in the current academic literature chronologically organized by the incidence of the examined event.

3.1.1 Great Depression

Firstly, we provide a review of papers drawing conclusion about the Great Depression of the 1930s. Cole et al. (2005) develop a rigorous model to find out if the decline in output was driven rather by productivity or monetary (deflation) shocks. They claim that the productivity shocks are dominant (2/3 of the effect), and the monetary ones are less important (the remaining 1/3). The authors also compare their results with data and found some evidence of their claims as well as potential origins of these shocks, which are financial panics and changes in the real exchange rate. Gordon (2005) attempts to compare the crises of the 1930s and early 2000s through the analysis of developments over the previous decades. The author in fact finds quite some similarities in both periods such as growth acceleration and overinvesting ultimately accompanied by a stock market crash. However, the paper also provides the differences between both crises, which mostly are the alternative public policy responses (much wiser in the early 2000s crisis, likely due to the experiences from previous crises) and the high fragility of financial system in the 1920s leading to a much deeper crisis. Furthermore, another study by Cecchetti and Karras (1992) deals with the causes of the Great Depression as well, yet they rather explain the development after the stock exchange crash. Through an econometric analysis they find evidence of series of negative aggregate demand shocks after the crash resulting in a high decline of output in 1931. Also, they draw another conclusion about the aggregate supply collapse during the second half of 1931, which is according to the paper bound to the bank panics present in this period. Another paper by Evans et al. (2004) focuses on surveying the literature with regard to the role of monetary policy as a cause of the Great Depression. They conclude that the available research lacks a consensus about the role of monetary policy, which is possible due to the inability of its proper identification and complexity of the crisis both making it difficult for econometrics to provide clear insights. Nonetheless, the authors claim that the monetary history and the Great Depression analysis imply that the monetary policy played a major role in deepening the depression. Overall, the current literature found out that among the main causes of the Great Depression are excessive investing and growth acceleration in 1920s together with a fragile financial system causing the

stock market crash, which we can see as the trigger for the crisis. In addition, the research suggests that a poor monetary policy response after the crash had a negative impact on the economic situation and led to an even deeper depression.

3.1.2 Regional crises after the Bretton Woods system

Further, we discuss the papers, which examine the regional crises around the world during the 1980s and 1990s. We start with Agénor et al. (2006), who analyze the East Asian financial crisis in 1997 affecting mainly South Korea, Thailand, Malaysia, Indonesia, and Philippines. The authors claim that the roots of this crisis lie in the macroeconomic policy adopted in 1990s leading to large capital inflows and increasing risk in the system, which was not prevented by the regulatory policy. Another study by Hahm and Mishkin (2000) also examines the East Asian crisis, but focuses mainly on South Korea and uses the asymmetric information framework. It concludes that the country suffered from an excessive amount of credit leading to the accumulation of bad debt and from the poor financial supervision as well. However, in the case of Korea it is not clear if the financial liberalization led to the credit boom as it was in other countries (e.g. Indonesia), since the boom started earlier than the liberalization, and it declined just before the crisis. Moreover, Gavin and Hausmann (1996) discuss the causes of banking crises related to macroeconomic developments and utilize the case of Latin America in early 1980s to demonstrate their claims. The paper finds the roots of the crises in high macroeconomic volatility, financial fragility, and lending booms. The authors also draw implications for the regulatory scheme such as higher capital adequacy ratios and liquidity requirements in countries with high macroeconomic volatility, or an active monetary policy during lending booms ensuring that the banks would expand their loan portfolios gradually. Within this period, there is also the famous case of the Japanese crisis in the late 1980s and early 1990s, which is discussed for instance by Shiratsuka (2005). The author identifies the following major origins of the crisis: The financial deregulation, aggressive behavior of financial institutions and their poor risk management, monetary easing, overconfidence, and rise in land prices due to the biased taxation and regulation. Therefore, we have seen some similarities in the causes of regional

crises during the 1980s and 1990s and the Great Depression, though some of them differ according to the affected countries. Specifically, the literature denotes credit booms, excessive capital inflows, and insufficient financial regulation (or a period of deregulation) as the main drivers of these crises. In less developed regions, high macroeconomic volatility and financial fragility likely contributes to the probability of a crisis occurrence and to its depth as well.

3.1.3 Subprime crisis

Recently, there has been a large discussion about the financial crisis of the late 2000s, which is the topic we are going to discuss next. We start with FCIC et al. (2011), who comprehend the circumstances of the crisis and attempt to include all possible causes in particular. The report very thoroughly examines the development before, during and after the crisis and makes specific points about the mistakes made by the financial and government representatives. According to the paper, the most evident causes of the meltdown are: The poor financial regulation and supervision, failures of corporate governance and risk management, excessive borrowing and lack of transparency, inconsistence of the government responses, mortgage-lending standards and securitization, OTC derivatives (credit default swaps particularly), and finally the failures of credit rating agencies. Also, Nanto (2010) finds some of the roots of the recent meltdown in the Asian crisis in 1997-98, when these countries had invested in the US technology stocks, which ultimately contributed to the dot-com bubble. After this Fed decreased the interest rates and the investors' appetite turned to mortgages. Other problems such as the securitization, credit default swaps backing, and lack of regulation substantially contributed to the meltdown in 2008. Furthermore, Blundell-Wignall et al. (2008) provide some ideas about causes of the recent financial crisis and use the input from the conference at the Reserve Bank of Australia in July 2008. The paper blames the change in the business model of banks utilizing securitization through collateralised debt obligations and special purposed vehicles. They also point out that the monetary policy failed by setting interest rates to very low levels, which gave banks an additional liquidity, and the changes in regulation (Basel II) in fact promoted the mortgage lending, which was an opportunity to

utilize this liquidity. Furthermore, another study by Brunnermeier (2008) describes the trends in several key factors that led to the housing bubble. It also provides an overview of important events in financial markets during 2007-08, and finally it shows the mechanism through which the crisis became as severe as we have seen. According to the paper, the root causes of this crisis are the creation of securitization, the raise of its popularity among financial institutions, and the consequent inflow of cheap credit. Next, Crotty (2009) claims that the main cause of the recent crisis is the system of institutions and practices called the New Financial Architecture, which is an integrated system of large banks, hedge funds, and special investment vehicles. He sees the problems mostly in the poor regulation of these institutions, which has been due to the assumption of efficient capital markets. The author also shows that the consequences of this system are risk-generating incentives leading to e.g. high leverage, nontransparent mortgage-backed securities, and the bank boom causing the "too big to fail" phenomenon. The criticism of the efficient market paradigm is present in other papers as well. For example De Grauwe (2008) argues that there is enough empirical evidence disproving the financial markets efficiency. Therefore, the Basel regulation scheme, which uses this paradigm to calculate the capital adequacy ratios in order to minimize risk is not useful, since only the tail risks, that are associated with financial crashes, in fact matter. The author thus concludes that the main causes of the recent crisis are the financial deregulation emerging since 1980s and mixing commercial and investment banking, which is a result of the financial liberalization. Furthermore, he sees the solution in returning to narrow banking, where the activities of investment and commercial banks would be strictly separated. Another paper by Scott (2010) deals mainly with three issues: The causes of the crisis, transmission of the emerging risk to the global economy, and the connection of this risk and the losses during the crisis. With regard to the roots of the crisis, the paper implies that the low interest rates leading to predatory lending, slack mortgage administration (e.g. no need of down payment, no liability when walking away from a mortgage), and too optimistic expectations about the future housing prices belong to the major ones. Obstfeld and Rogoff (2009) employ a slightly different approach, when they attempt to relate the implications arising

from the development in the early 2000s to the later financial meltdown. They see the main problem in the combination of several factors making the United States the epicenter of the crisis. According to the authors these factors are mainly the low interest rates, credit market distress, financial innovation, and opportunity to borrow cheaply from emerging markets such as China. Also, Zeckhauser (2010) tries to find the main sources of the crisis through his own observations and utilizing information of other papers. He develops several points about the responsible parties for the meltdown among which are the government for letting the financial industry to innovate without regulation, the central bankers for mistakes in monetary policy, and the financial institutions for taking excessive risk especially in the mortgage business. Hanusch and Wackermann (2009) uses a completely different approach based on a Neo-Schumpeterian perspective to analyze the crisis. They compare the recent crisis with the Japanese one in the 1990s, and find that the causes for both are quite similar. Specifically, Japan also experienced slack monetary policy prior to the crisis, therefore cheaper mortgages leading to astronomic housing prices, high investments in other sectors as well, and speculative development causing high inflation. Moreover, the paper by Du Plessis (2011) focuses on three major topics: The incentives causing the credit boom, contagion from real estate sector to the remaining economy, and reasons for the fragility and failures of large financial institutions. The author blames the process of securitization, which effectively transfered risky assets into risk-free portfolios, the Tax Reform Act of 1986 retaining the possibility of tax deductions stemming from mortgage debt, Fed for severely breaking the Taylor rule, and the moral hazard at financial institutions. Finally, Lin and Treichel (2012) develop some alternative hypotheses for the causes of the financial crisis and support them by empirical evidence. They find the sources of the recent financial meltdown in the loose monetary policy after the dot-com bubble burst, together with financial innovations and deregulation, which caused the US housing bubble. Furthermore, they argue that these policies were in certain matters reasonable (mostly in the short run), but were shortsighted as well in terms of potential risks and negative effects (rather in the long run). Thus, they raise a demand to evaluate every new policy from both perspectives.

In addition, there is a number of papers examining the recent crisis from a regional perspective of other countries than the United States. Spruk (2010) discusses the famous case of Iceland, which experienced one of the worst crises in a small country. The conclusion of this paper is that the major cause of the crisis was a very poor monetary policy, which set the interest rates too high resulting in a rapid currency appreciation and forced banks to borrow at foreign markets. The financial sector then exceeded the size of the whole Icelandic economy by approximately ten times. This together with the banks' stakes mostly held in foreign currencies prevented the central bank to act as a lender of last resort, when the US crisis started and the Icelandic financial sector was on the hook. Another study by Martin and Milas (2009) examines the roots of the financial meltdown analyzing the UK data. Their results imply that the current account deficits and slack monetary policy caused an increased liquidity in the pre-crisis period, and thus we can see them as the roots of the crisis. They also suggest that the focus of monetary policy to stabilize economic growth and inflation might have contributed to this development, and a reaction to the increasing liquidity could have at least mitigate the impact of the crisis. Moreover, Hasan (2010) examines the financial crisis in the United Arab Emirates and Dubai particularly. The paper is focused on the solution of the crisis by the government rather than on the causes leading to this situation, but it still provides some insights. The author argues that similarly as in the US the Dubai real estate industry boomed in the 2000s creating an excessive supply. Hence, the industry went bust in 2008, when the prices fell by roughly 40%. The government then granted a $10 billion bailout in order to repay at least the most urgent debt obligations.

In conclusion, most of the papers seem to agree that to the main sources of the recent financial crisis belong: The slack monetary policy after the dot-com bubble (and possibly 9/11 as well) in the early 2000s causing an excessive borrowing, financial deregulation during the last decades, financial innovation characterized by the securitization, and poor risk management and corporate governance at financial institutions. This is also somewhat similar to the crises we have discussed earlier.

3.2 Hypotheses for the general origins of financial crises

Even though some findings in the previous section differ across individual crises and regions, we can certainly find a pattern. In fact, it seems that there are two kinds of crisis sources: Universal, appearing in all historical events (or in the vast majority) of financial distress, and crisis-specific, which do not show any periodicity and are different for every crisis. Since we want to make implications for the regulation, we must focus on the universal causes. However, this issue raises several questions e.g.: What is the effect of universal and crisis-specific origins on the probability of a crisis occurrence? Or, would a proper regulation of just universal causes be enough for preventing the crises occurrences? We will obtain the answers to these questions at least partially through our econometric analysis, as we can test the importance of universal causes individually leaving the unexplained variance to the crisis-specific ones.

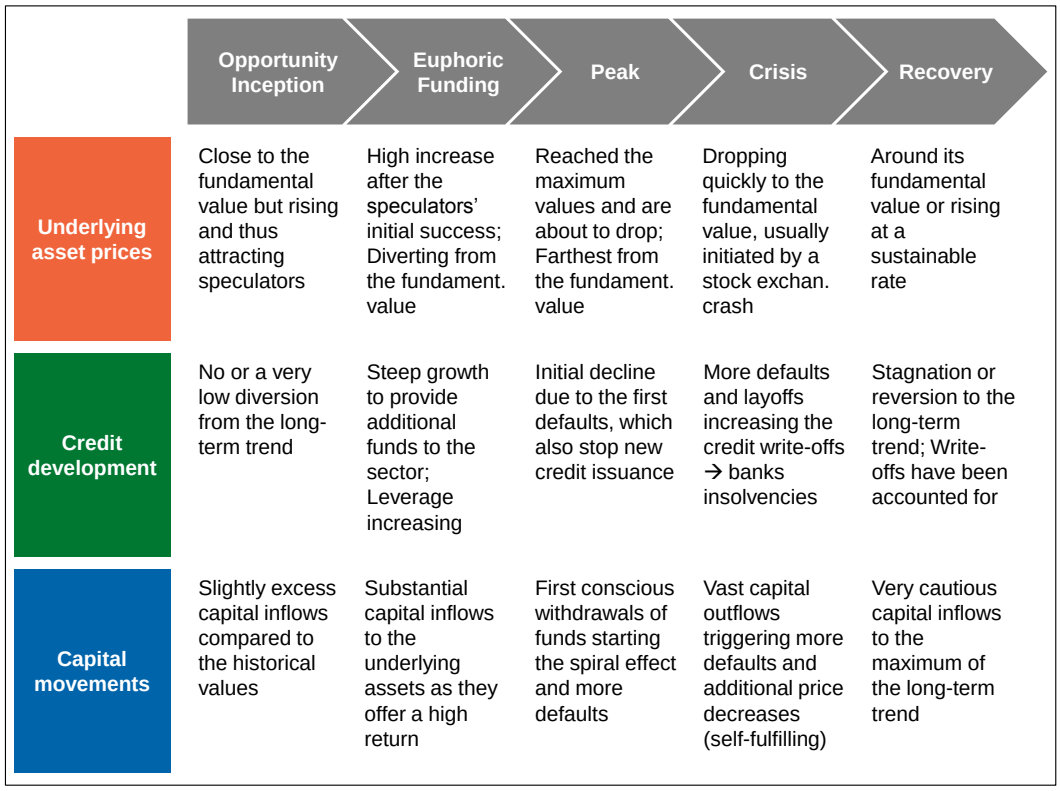
The previous findings can also help us develop hypotheses for the universal causes of financial distress. Generally, it seems that a financial crisis appears every time a considerable innovation emerges. If it produces high returns at the beginning, a substantial part of investors starts contributing to its growth through additional funding, as well as financial companies, which are keen to provide credit for the projects leveraging the innovation. However, as we have seen in the history, every progressive idea has its limits and thus cannot offer high returns infinitely. The system seems to be often unable to recognize this, as the overly optimistic forecasts sustain too long in many cases. The crisis then hits the economy usually in the worst possible moment, because the distribution of funds is skewed to the sector which is about to deteriorate, thus the funds are poorly diversified. Therefore, the phenomena accompanying such a development could be a rapid appreciation of underlying assets, high returns in a particular industry (or industries) and a steep increase in private debt. This likely has to reach quite a high level in order to cause a contagion of banks with stakes at the affected sector, which then need government bailouts. Thus, it is usually accompanied by additional inconvenient circumstances. In the prior literature, we have seen that poor monetary policy and

financial deregulation and liberalization belong to the major ones. This implies at least two important intuitions. First, when executing monetary policy, the possible impact on financial distress should be taken into account, which is for instance not considered by the Taylor rule. And second, the deregulation is a dead end, and financial industry should remain tightly regulated. Actually, the financial system (and so the financial industry) was created to fill the gap between creditors and borrowers, which in effect helps to maximize growth. The ability to make a profit on this activity is a convenient side effect, but it is not a necessity. Therefore, a financial regulation mainly ensuring a stable financial system and smooth flows of funds, offering positive profits of financial companies, but paying a little attention to them is supposed to be an optimal one.

We can also confront the above findings with a general intuition. Using our initial crisis definition, which states that an occurrence of a financial institution (i.e. bank) becoming insolvent is a form of financial crisis, the starting assumption is that whenever a large number of debtors default on their obligations at a particular bank an asset-side driven crisis emerges. More specifically, the amount of bad debt needs to exceed the capital at a given bank in order to cause this kind of financial distress, which is an indicator of more systematic or fundamental issue. As demonstrated by the above literature review, such situations mostly take place when a category of assets reaches their highest value far from the fundamental one. At this point first defaults appear, which are then followed by hysteric capital outflows resulting in more defaults and thus higher credit write-offs. Taking another step back, the departure of fundamental and market values has historically been started by a significant investment opportunity (e.g. innovation), which attracts speculators attempting to make a profit on sort of a synthetic value appreciation. If such an opportunity then catches attention of many market players, who start channeling funds in the associated assets, the ideal environment for a future financial distress emerges. Therefore, we can basically identify 5 general stages of the cycle related to financial crises: Opportunity inception, Euphoric funding, Peak, Crisis, and Recovery. Figure 3 shows these stages with descriptions of influencing factors.

This scheme more or less sums up our hypotheses for the roots of financial

Figure 3: The stages of a typical financial crisis



crises. Since it is rather difficult to test everything depicted in Figure 3, we limit our focus in the paper to examining the relation of crises occurrences and past developments of credit and capital movements. Therefore, we would like to test if an increased growth of credit in the system and capital stock positively influence the chance of a crisis appearance in the near future. In the following section, we show the tools used in the analysis for testing this set of hypotheses.

4 Methodology to examine the causes of the crises

4.1 Crisis indicators

Firstly, it is necessary to explain what methodology is employed to obtain the variances of stock returns. In fact, there are two different ways of transforming the prices into variances, which are used in this paper. The first one is performed by acquiring daily returns and calculating daily variance for each quarter using the

following formula:

$$IndexVariance_t = \frac{1}{n-1}\sum_{i=1}^{n}\left(x_i^2 - \bar{x}\right), \tag{1}$$

where n is the number of trading days in one quarter, x_i is the stock daily return, and $\bar{x}$ is the mean of stock return over the given quarter. The other approach uses quarterly returns and the residuals of the following AR(1) model:

$$Return_t = \alpha + \beta Return_{t-1} + u_t \Rightarrow ArVariance_t = u_t^2 \tag{2}$$

where the residuals are used in their squared form as a proxy for the stock return variance ($ArVariance_t$). The last indicator variable that we present in this section is also based on the residuals from Equation (2), but we select only the negative ones and covert them to their square form. This is due to the fact that only negative excess returns and not the positive ones should trigger a crisis, thus we try to capture only the downside of stock return variance. The variable is defined as:

$$NegVariance_t = \begin{cases} u_t^2 & \text{if } u_t < 0 \\ 0 & \text{if } u_t \geq 0, \end{cases} \tag{3}$$

where u_t is the residual from Equation (2).

4.2 Data analysis

As a next step, we analyze the obtained time series in order to gain preliminary results, which can help us in the more sophisticated econometric analysis. The further sections shows plots depicting pairs of time series, one for a crisis indicator and the other for a crisis cause. We then describe the possible relation of the two variables if some can be traced. This gives us preliminary results and a solid ground for further analysis.

In addition, we employ econometric models, which are supposed to define the exact influence of certain causes on the probability of crises appearances. That

part starts with simple regressions that investigate the relations of crises and causes separately, hence it is sort of a direct extension or formalization of the previous analysis. The estimated equations have the following form:

$$Indicator_t = \alpha + \beta_1 Cause_t + \beta_2 Cause_{t-1} + \cdots + \beta_n Cause_{t-n} + \epsilon_t, \tag{4}$$

where $Indicator_t$ is a crisis indicator variable from Equations (1) or (2) and n is the time span over which is reasonable to suspect some impact on the crisis probability (thus indicator variable as well). Since we use variance as the indicator of financial crises, you can think of these equations as special cases of GARCH models, however we are only interested in Equation (4) and further, not the previous ones from which the variance stems. In this model we might also need to include the lagged observation of the dependent variable in case there is some autocorrelation in the residuals to prevent inconsistency of coefficients.

The further analysis combines all the series and their lagged versions, which provide a satisfactory degree of significance, and brings them together in one equation:

$$Indicator_t = \gamma + \boldsymbol{\delta_1^T Causes_t} + \cdots + \boldsymbol{\delta_n^T Causes_{t-n}} + \varepsilon_t, \tag{5}$$

where $\boldsymbol{Causes_t}$ is the vector of causal time series and $\boldsymbol{\delta_i}$ is the vector of associated coefficients. Combining the causal variables together shows whether the different series are independent of each other or mutually correlated and thus not significant anymore in Equation (5).

Finally, the last step in this set of regressions is robustness analysis. In order to confirm the previous results we need to include other possible series, which can have a relation to our indicator variable. In case we omit them, an endogeneity problem might arise, which creates a bias of the estimated coefficients. The regressions of this form are the following:

$$Indicator_t = \zeta + \boldsymbol{\eta_1^T Causes_t} + \cdots + \boldsymbol{\eta_n^T Causes_{t-n}} + \boldsymbol{\theta^T Corrections_t} + \mu_t, \tag{6}$$

where $\boldsymbol{Corrections_t}$ is the vector of additional possible variables, which can be

related to our indicator variable. This final equation should reveal if there is a consistent causal link between our hypothesized causes and stock market volatility. We are particularly interested in the signs and significance levels of the lagged causal series, as they are essential for rejecting or confirming our previous hypotheses.

5 Empirical analysis

5.1 Data description

First, we want to outline the dataset, which we have put together for our analysis. We have gathered data for four important economies: United States, United Kingdom, Australia, and Japan. The selection was made based on the data availability, level of financial development, and importance for the world economy. Since we work with many series over a substantial time span, and some of them might not be highly demanded, it has been difficult (or even impossible) to extend the dataset with other countries. As financial crises do not occur very often in individual countries, we perform our analysis approximately over the period 1970-2012 and use the quarterly frequency. This setup offers a sufficient statistical power, which allows us to employ econometric techniques on the chosen countries separately. Also, our aim is to avoid the Bretton Woods system period, which essentially prevented the crises we focus on in this paper.

The time series we picked for the analysis can be divided into 3 subgroups. The first one comprehends the base for the crisis indicators. As mentioned earlier, we use share returns volatility, which can be calculated from share prices development of some sort. Namely, we utilize IMF's share prices series and stock indices available at Yahoo! Finance. The next subgroup is related to the causes of financial crises. Based on our hypotheses it is necessary to obtain series of credit development and capital movements. Again, International Monetary Fund as well as some national banks offer credit amounts for most of the developed countries. However, it is far more challenging to acquire a proxy for capital movements, thus we have to settle for the financial account balances, which still partially reflect the flows of

capital. The last group comprises the additional variables, which can have relation with the market volatility as well, thus they need to be taken into account because of the potential endogeneity issue. Frankel and Saravelos (2010) perform quite a comprehensive analysis, which focuses on finding variables relevant for financial crisis developments. Thus, we include some of the important series found in the paper as well as some others based on our intuition. Among these variables belong for example: GDP growth, inflation, interest rates, bank reserves, currency, or deposits amounts. We gathered these data from various sources, mostly from IMF, national statistical offices, or national banks. Table 2 comprehensively shows all the series, data sources, and time spans over which they are available.

Since the stock market variances are stationary series, we need to transform our explanatory variables into stationary forms as well. Therefore, as most of the above mentioned series are trended, we have expressed them in GDP percentages thus correct them for economy size, and we have convert them to quarterly growth rates[1]. For inflation and interest rates we utilize first differences rather than percentage changes, which are extremely high/low (or even nonexistent) in some cases thus not applicable. Furthermore, we define capital flows as quarterly changes in financial account again expressed as GDP percentages.

5.2 Time series analysis

This section starts with the comparison of the different causal and indicator variables and their relevance for each other. First, Figure 4 denotes the development of private credit to GDP. As the figure shows, the series is quite strongly trended, thus the amount of credit in the system grows faster than GDP. Also, the shaded areas represent approximate crises periods as they are recorded in the history books. We see that when the development departs from the long-term trend it is usually followed by a substantial drop and financial crisis. This fact supports our hypothesis so far.

For the further analysis we convert the series into yearly growth rates and relate them to our crisis indicators (market variances). Thus, Figure 5 shows the

[1]For example, in Q1 1975 credit accounted for 80% GDP and in Q2 1976 for 100% GDP, so the percentage growth in this period would be 100/80 - 1 = 25%.

Table 2: Dataset overview (series, sources, and time spans)

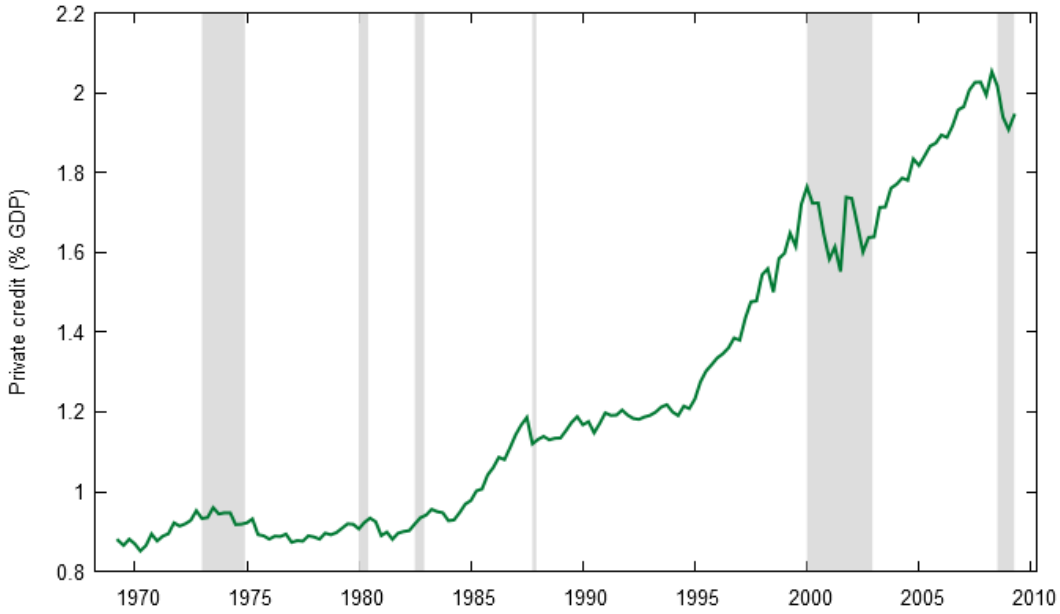
	Australia		Japan	
Variable	**Period**	**Source**	**Period**	**Source**
Stock index	1984-2012	Yahoo! Finance	1984-2012	Yahoo! Finance
Share prices	1968-2012	IMF's IFS	1968-2012	IMF's IFS
Private credit	1976-2012	Res. Bank of Australia	1968-2009	IMF's IFS
Financial account	1968-2012	Res. Bank of Australia	1977-2012	IMF's IFS
Real GDP / GDP growth	1968-2012	IMF's IFS	1968-2012	IMF's IFS
Nominal GDP	1968-2012	Res. Bank of Australia	1968-2012	IMF's IFS
CPI / Inflation	1968-2012	IMF's IFS	1968-2012	IMF's IFS
Short-term interest rate	1969-2012	IMF's IFS	1968-2012	IMF's IFS
Long-term interest rate	1969-2012	Res. Bank of Australia	1968-2012	IMF's IFS
Reserves at central bank	1975-2012	Res. Bank of Australia	1968-2012	Bank of Japan
Private deposits	1975-2012	Res. Bank of Australia	1968-2012	Bank of Japan
Currency in circulation	1968-2012	Res. Bank of Australia	1968-2012	Bank of Japan

	United Kingdom		United States	
Variable	**Period**	**Source**	**Period**	**Source**
Stock index	1984-2012	Yahoo! Finance	1968-2012	Yahoo! Finance
Share prices	1968-2012	IMF's IFS	1968-2012	IMF's IFS
Private credit	1968-2012	IMF's IFS	1968-2009	IMF's IFS
Financial account	1971-2012	IMF's IFS	1968-2012	St. Louis Fed
Real GDP / GDP growth	1968-2012	Office for Nat. Statis.	1968-2012	IMF's IFS
Nominal GDP	1968-2012	Office for Nat. Statis.	1968-2012	IMF's IFS
CPI / Inflation	1968-2012	Office for Nat. Statis.	1968-2012	IMF's IFS
Short-term interest rate	1968-2012	IMF's IFS	1968-2012	IMF's IFS
Long-term interest rate	1984-2012	Bank of England	1968-2012	IMF's IFS
Reserves at central bank	1971-2012	IMF's IFS	1968-2012	St. Louis Fed
Private deposits	N/A	N/A	1968-2012	St. Louis Fed
Currency in circulation	1968-2012	Bank of England	1968-2012	St. Louis Fed

Note: Stock index is the AORD Index for Australia, Nikkei 225 for Japan, FTSE 100 for the UK, and S&P 500 for the US. Short-term interest rate is either money market rate, short-term T-bills rate, or lending rate. Long-term interest rate is 10-years government bonds rate in all cases. The data were obtained at quarterly frequency.

development of the yearly credit growth rates and stock market variances in the United States over the years 1969-2009. The first chart depicts the S&P 500 daily variance and private credit growth, and as we can see, there appears to be a significant relation between the two. Particularly, in the periods of strong growth, which are followed by reductions in credit amounts, the market variance increases notably as well. This is what we would expect, since our hypothesis states that excessive credit growth is one of the causes of financial crises. However, it also appears that the daily variance either misses some of the crises completely or simple gives much higher weight to some others such as the program trading crisis in 1987 or the

Figure 4: Private credit development as a percentage of GDP in the US



Source: IMF's International Financial Statistics
Note: The shaded areas represent the approximate periods of financial crises.

subprime crisis in 2008.

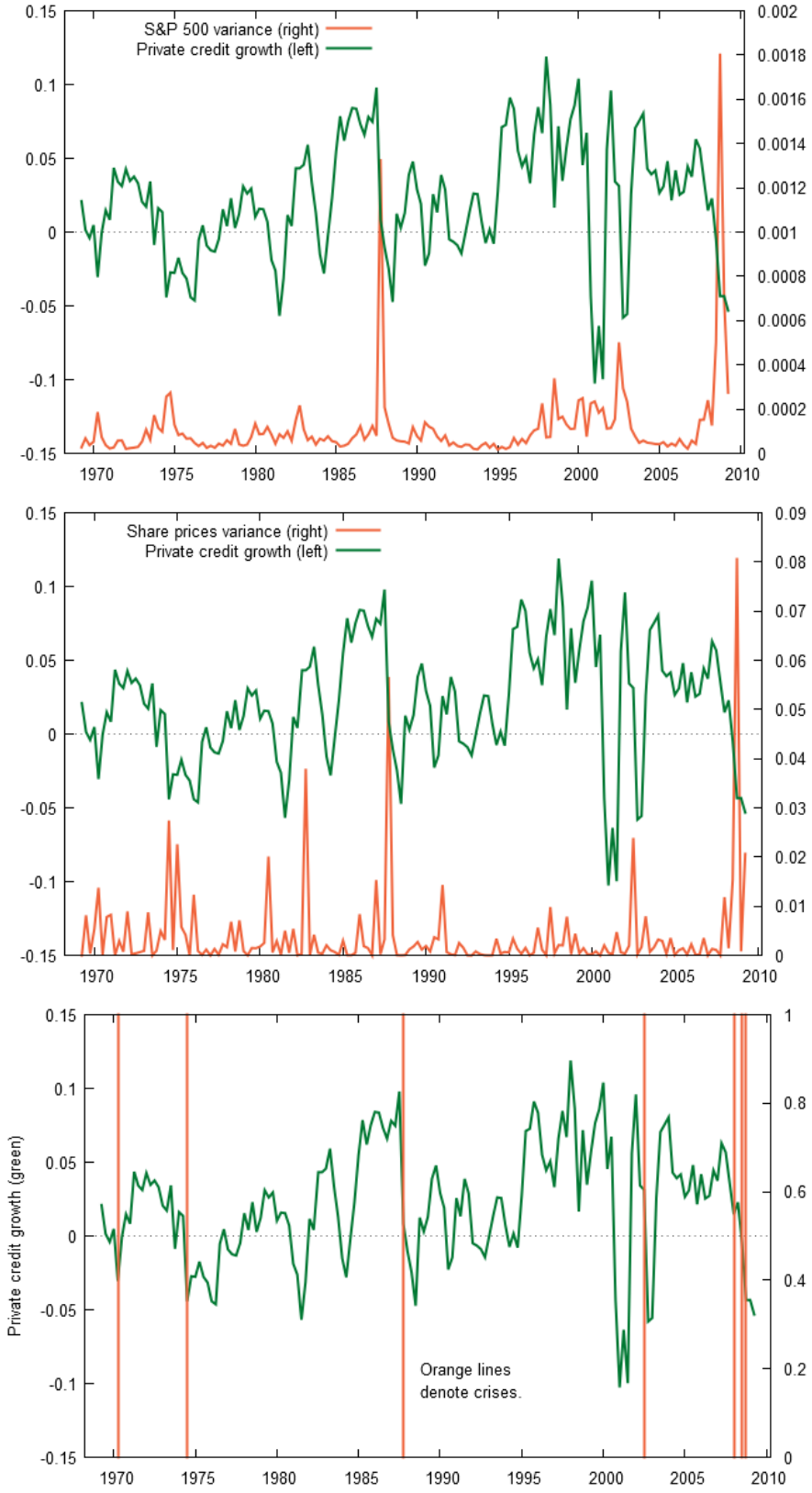
The next chart of Figure 5 denotes the same credit growth rates but a different indicator of financial crises. In this chart we present the quarterly stock return variance from Equation (2). Evidently, the indicator lowers the differences between the periods of high volatility and overall seems to perform better at this initial look. It especially highlights some periods prior to the program trading crisis in 1987 (e.g. oil shocks).

The last part of the graph represents the final indicator we have developed in this paper - the negative variance of Equation (3). This time we show the crisis dates obtained using the indicator rather than the actual series. The crisis incidences are defined as periods with higher variance than the overall average plus one standard deviation, therefore we can formally write it as:

$$Crisis_t = \begin{cases} 1 & \text{if } Indicator_t > \mu + \sigma \\ 0 & \text{otherwise,} \end{cases} \tag{7}$$

where μ is the indicator average in the sample and σ is its volatility. This plot

Figure 5: Credit growth and market variance in the US over the period 1969-2009



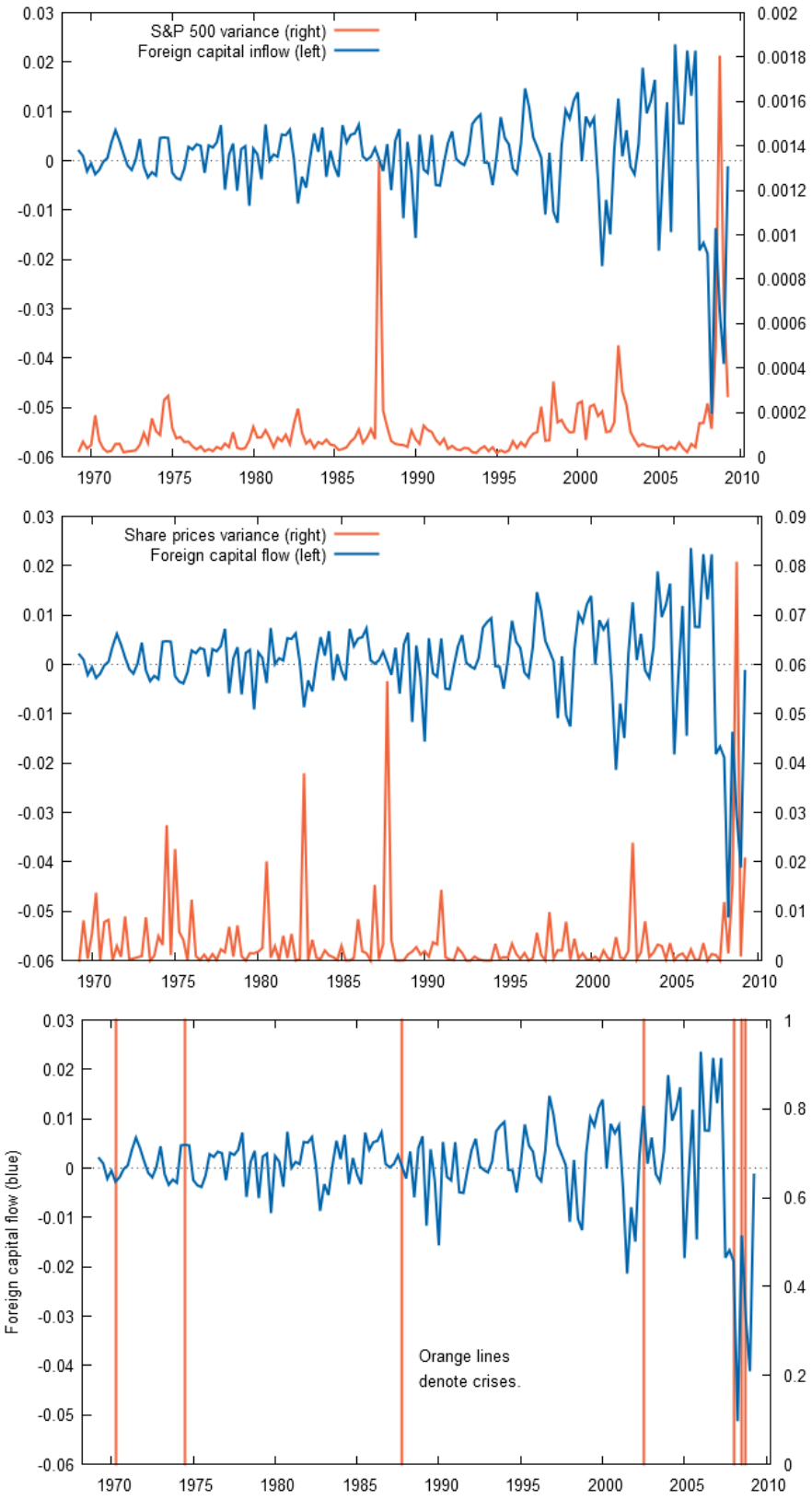
Source: IMF's International Financial Statistics, Yahoo! Finance
Note: Credit growth is calculated on yearly basis, and the crisis dates in the third chart are given by variance values higher than the average plus standard deviation of the whole sample.

demonstrates that a crisis, as we define it, occurs usually during a period of credit decline or at least strong slowdown of credit growth. It makes a lot of sense, since during credit declines the asset side of banks deteriorates and thus some of them may become insolvent, which is our original definition of a financial crisis. Furthermore, it is apparently reflected in the stock market variance as well, as the last part of Figure 5 denotes.

Next, we continue with the analysis by examining similar graphs, but this time we focus on the other hypothesized determinant of financial crises - capital flows. Figure 6 depicts the developments of foreign capital flows defined as changes in financial account balance as percentage of GDP. Again, the three parts compare the different crisis indicators in the same way as for the credit development. All three charts suggest that there is some relevance of foreign capital flows for the market variance, but it is not as evident as in the case of credit growth. Especially, during the later years of the sample the foreign capital flows seem to play a higher role in our analysis, as we can observe a similar relationship with the variances as in the credit graph. This could be due to a more and more slack regulation and rules in terms of international capital flows over the years. Even though this analysis implies that our proxy for capital flows is not perfect, it might still provide some additional information in the econometric models.

We proceed with further analyses of the same graphs, but this time we incorporate other countries for which we have gathered data. As our indicators seem to be quite similar, we show only the variance obtained from Equation (2) in the additional charts. Figure 7 presents the developments of credit growth and stock returns variances for Australia, Japan, and the United Kingdom. In the case of Australia, we observe that some periods of high credit growth and consequent declines are accompanied by substantial variance increases. However, this pattern does not seem to hold for all such periods. For example, during 1992-93 there is a strong decline in credit, but our crisis indicator responds only very slightly. Japan has much more complicated development. First, it is an exception in the overall evolution of credit per GDP, since it remains at more or less constant levels throughout the observed period. Also, the respondence of stock market variance to the periods of strong

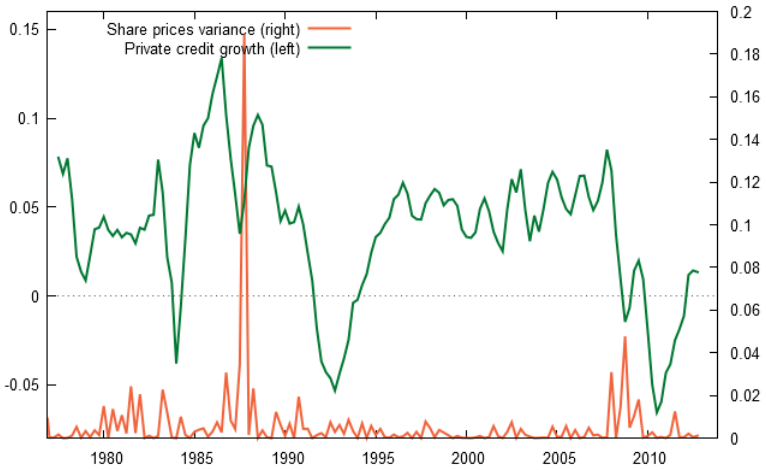
Figure 6: Capital flows and market variance in the US over the period 1969-2009



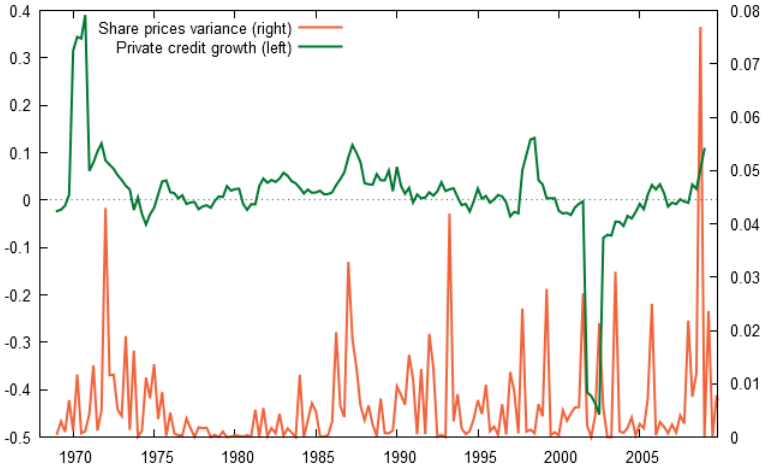
Source: IMF's International Financial Statistics, Yahoo! Finance, St. Louis Fed
Note: Capital flows are calculated on yearly basis, and the crisis dates in the third chart are given by variance values higher than the average plus standard deviation of the whole sample.

Figure 7: Credit growth and market variance in Australia, Japan, and the UK

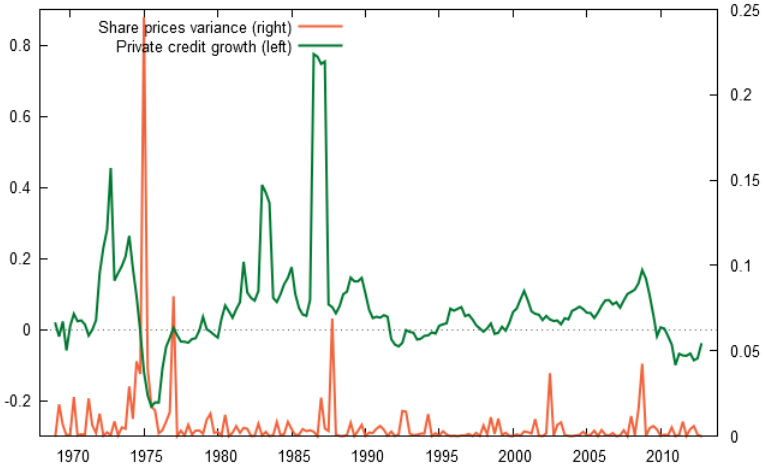
(a) Australia



(b) Japan



(c) United Kingdom



Source: IMF's International Financial Statistics, Reserve Bank of Australia
Note: Credit growth is calculated on yearly basis.

credit growth followed by a decline is quite ambiguous. It holds only in a few cases, and even then the relation is not particularly visible. This might be due to the complicated economic environment in which Japan has been operating since 1990s. Lastly, we take a brief look at the developments in the United Kingdom. Here we see a clearer picture, as again credit expansions are followed by high volatility periods. Nevertheless, in some cases we would expect a more significant response (e.g. subprime crisis).

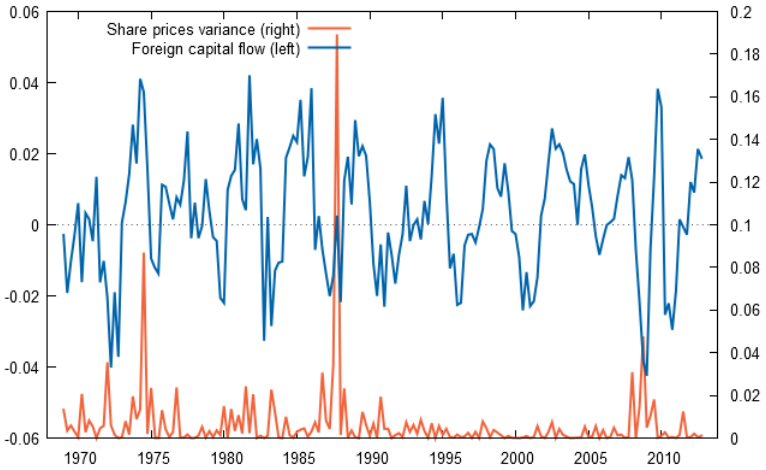
Furthermore, Figure 8 comprises similar charts, but now we would like to take a close look at capital flows, as we have done so in the case of the US. Firstly, we can infer that the foreign capital flows in different countries are not too much alike. However, we still can trace some possible relation at least for some countries. In Australia and Japan we see that some cases have similar properties as we would expect. Periods of strong capital inflows and subsequent outflows are followed by financial crises (i.e. increases in market variance). In the UK we can say that the variables seem either unrelated or the relations is not quite possible to see from these charts. However, we can still use all these variables in the econometric analysis to reveal some relations and their exact terms.

5.3 Econometric analysis

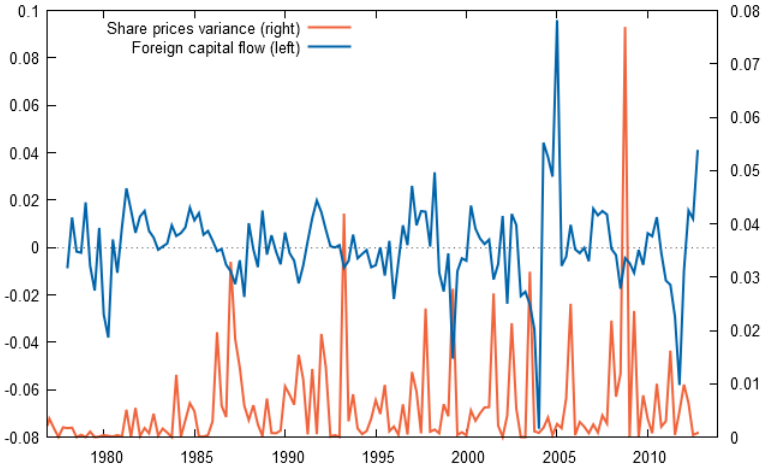
In this section, we estimate the equations which have been described in the methodology part (Section 4). We present the results step by step starting from the basic equations and proceeding with the more complex ones. Moreover, we employ all the different indicators of Equations (1), (2), and (3), which we have developed, to check if our results are consistent. To that end, we also run Durbin-Watson and Breusch-Godfrey tests in each model to check whether there is some autocorrelation in the residuals, since it is a crucial assumption, which assures that the estimated coefficients remain consistent.

Figure 8: Capital flows and market variance in Australia, Japan, and the UK

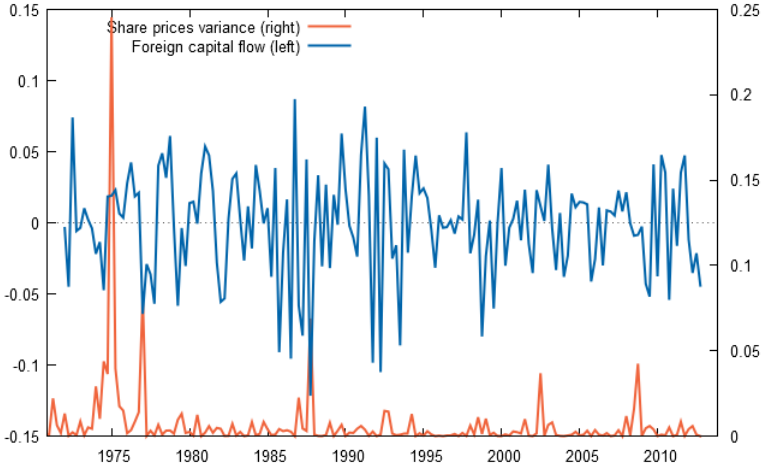
(a) Australia



(b) Japan



(c) United Kingdom



Source: IMF's International Financial Statistics, Reserve Bank of Australia
Note: Capital flows are calculated on yearly basis.

5.3.1 Credit growth as a cause of financial crises

The initial analysis comprises a estimation of Equation (4). Table 3 shows the regression coefficients relating credit growth calculated on quarterly basis to stock market volatility in all observed countries. Though we firstly incorporate 10 lagged series in the models, we omit the coefficients that are highly insignificant, as we believe they would only bias the significant ones. The first three columns in the upper table represent the results for Australia. We can observe that the series further from the presence have a positive relation and the ones closer to the presence have a negative relation with the market variance. This in other words means that credit expansion further in the past (1-2 years) increases the market variance and the opposite holds for credit contraction. In addition, negative credit growth closer to the presence suggests a higher default ratio and thus increases market volatility. The amount of variance explained by the model (R^2) fluctuates around 10%, which seems to be reasonable value for only one explanatory series. This is in line with our hypothesis and the preliminary analysis as well.

The situation for Japan is quite different. For one crisis indicator we cannot find any significant relation with the credit development at all, and the results for the others are not particularly strong either. The signs of the estimated coefficients are quite ambiguous and do not quite match our hypothesis, however we have implied that such results are plausible in our time series analysis, thus this should not come as a surprise. Also, the ambiguity might be due to the endogeneity presence in the model, therefore we could get superior results later on.

The first part of the lower table denotes results for the UK. We see that they are much closer to our first results for Australia. Again, coefficients of some more lagged series are positive and the ones closer to the presence are negative suggesting the same relationship as described previously. This does not hold true for our stock index indicator (FTSE 100 in this case), but again it might change by adding more variables. The coefficient of determination is around 20-30% in this case, which is even higher and thus confirms that credit is an important determinant for the market variance or volatility. The last country, which we have not yet discussed,

Table 3: Regression results of the whole dataset for credit growth

	Australia			Japan		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.04 (0.00)	0.01 (0.11)	0.03 (0.82)	0.08 (0.00)	0.08 (0.00)	0.04 (0.00)
Dependent (t-1)						
Credit growth (t)					0.52 (0.05)	
Credit growth (t-1)						
Credit growth (t-2)						
Credit growth (t-3)	-2.52 (0.01)	-1.35 (0.06)	-1.45 (0.04)		-0.36 (0.09)	-0.39 (0.02)
Credit growth (t-4)						
Credit growth (t-5)	2.51 (0.01)	1.90 (0.01)	1.79 (0.01)			
Credit growth (t-6)						
Credit growth (t-7)					-0.55 (0.01)	
Credit growth (t-8)	1.63 (0.04)	1.73 (0.01)	1.32 (0.05)		0.63 (0.00)	
Credit growth (t-9)						
Credit growth (t-10)						
R-squared	0.12	0.11	0.09	0.00	0.12	0.03
Observations	114	137	137	116	156	164
Autocorrelation	OK	OK	OK	X	OK	OK

	United Kingdom			United States		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.04 (0.00)	0.02 (0.01)	0.03 (0.01)	0.04 (0.00)	0.05 (0.00)	0.03 (0.00)
Dependent (t-1)	0.44 (0.00)	0.24 (0.00)	0.11 (0.11)	0.40 (0.00)		
Credit growth (t)		-0.15 (0.08)		-1.91 (0.00)	-1.68 (0.00)	-2.11 (0.00)
Credit growth (t-1)			-0.26 (0.04)			
Credit growth (t-2)						
Credit growth (t-3)						
Credit growth (t-4)						
Credit growth (t-5)	0.79 (0.00)	0.39 (0.00)	0.83 (0.00)			
Credit growth (t-6)	-0.33 (0.06)			0.40 (0.22)	0.52 (0.21)	0.31 (0.38)
Credit growth (t-7)						
Credit growth (t-8)			0.24 (0.05)	0.93 (0.00)	0.68 (0.11)	0.88 (0.02)
Credit growth (t-9)						
Credit growth (t-10)						
R-squared	0.31	0.19	0.22	0.34	0.11	0.20
Observations	114	174	171	157	157	157
Autocorrelation	OK	OK	OK	OK	OK	OK

Note: These results represent a regression estimation of Equation (4). The values in parentheses are p-values for the significance test. The dependent variables are calculated using Equations (1), (2), and (3).

is the United States. Once again, we observe positive results for past series and in this case, we have negative and significant coefficients directly for the present series across all the crisis indicators. The R-squared is also substantial in our models.

So far, we can conclude that to a considerable extent the initial regression estimations for 3 out of 4 data samples have confirmed our hypotheses. The periods

of high credit growth followed by credit contractions are usually associated with financial crises. Furthermore, even if the following analysis weakens these initial conclusions, the credit development appears to be an important determinants of the market variance.

5.3.2 Capital flows as a cause of financial crises

Next, we move on to the examination of the same relation as in the previous analysis, but this time we focus on capital flows. As mentioned earlier, we utilize foreign capital movements defined as quarterly differences between financial account balances for our regression estimations. Again, in these calculation we check whether there is some autocorrelation remaining in the residuals in order to obtain consistent coefficients.

Table 4 presents the results for the relation between capital flows and the stock market variance in the same structure as our previous table. Thus, the upper part denotes results for Australia and Japan as well. We find that the relation to capital flows in Australia is very similar to the relation to credit growth. The series lagged for about 2 years have a positive relationship with the crisis indicators, whereas another lagged series closer to the presence (i.e. lagged for half a year) has a negative one. This result can be interpreted in the same way as we have done so for credit growth, i.e. the periods of strong capital inflows followed by outflows support crisis occurrences. It is also consistent for all the indicators, however the explained variance in the model is limited to only about 5-10%. These estimation results also confirm our hypotheses and outweight our preliminary time series analysis, which does not offer almost any useful insights.

In Japan, we do not get convincing results once again. In fact, they are even weaker than in the previous analysis. We can trace significant relations with only one crisis indicator, the other two cannot be explained by capital flows. For the market variance obtained from Equation (2) we see that there is a positive relation to series lagged for about 1-2 years, but this explain only 4% of the model variance. There is no negative relationship with a less lagged series, hence this result can be interpreted in a way that high capital inflows in the past can result in financial

Table 4: Regression results of the whole dataset for foreign capital flows

	Australia			Japan		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.06 (0.00)	0.03 (0.00)	0.02 (0.00)	0.09 (0.00)	0.08 (0.00)	0.04 (0.00)
Dependent (t-1)						
Capital flow (t)						
Capital flow (t-1)						
Capital flow (t-2)	-2.35 (0.00)	-1.23 (0.02)	-1.15 (0.03)			
Capital flow (t-3)						
Capital flow (t-4)						
Capital flow (t-5)					1.28 (0.13)	
Capital flow (t-6)					2.07 (0.03)	
Capital flow (t-7)	1.01 (0.18)	0.65 (0.24)	0.66 (0.22)		1.35 (0.12)	
Capital flow (t-8)						
Capital flow (t-9)						
Capital flow (t-10)	1.59 (0.04)	1.01 (0.07)	0.93 (0.08)			
R-squared	0.12	0.05	0.05	0.00	0.04	0.00
Observations	114	169	169	116	136	179
Autocorrelation	OK	OK	OK	X	OK	OK

	United Kingdom			United States		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.06 (0.00)	0.022 (0.00)	0.04 (0.00)	0.05 (0.00)	0.05 (0.00)	0.03 (0.00)
Dependent (t-1)	0.39 (0.00)	0.24 (0.00)	0.16 (0.04)	0.29 (0.00)		
Capital flow (t)		-0.26 (0.11)	-0.21 (0.38)	-2.88 (0.00)	-3.28 (0.00)	-2.82 (0.01)
Capital flow (t-1)				-2.74 (0.01)	-2.55 (0.03)	-2.19 (0.04)
Capital flow (t-2)				-4.27 (0.00)	-4.93 (0.00)	-4.35 (0.00)
Capital flow (t-3)				-1.38 (0.21)	-2.26 (0.06)	-1.92 (0.08)
Capital flow (t-4)				-1.65 (0.12)	-3.39 (0.00)	-2.57 (0.02)
Capital flow (t-5)		-0.26 (0.11)	-0.40 (0.08)	-4.49 (0.00)	-5.35 (0.00)	-5.19 (0.00)
Capital flow (t-6)	0.62 (0.03)			-1.86 (0.10)	-1.27 (0.30)	-1.27 (0.26)
Capital flow (t-7)	0.70 (0.01)			-1.26 (0.22)	-2.45 (0.04)	-0.93 (0.38)
Capital flow (t-8)						
Capital flow (t-9)						
Capital flow (t-10)						
R-squared	0.20	0.08	0.04	0.31	0.20	0.20
Observations	114	162	164	172	172	172
Autocorrelation	OK	OK	OK	OK	OK	OK

Note: These results represent a regression estimation of Equation (4). The values in parentheses are p-values for the significance test. The dependent variables are calculated using Equations (1), (2), and (3).

crises. This estimation is still to be confirmed by robustness checks that we perform in the further sections, and it is not at all unlikely that it will be rejected because of the inconsistency across multiple crisis indicators.

We continue with the lower part of the table, where we can first find the estimations for the UK. Again, the estimated coefficients do not appear to be consistent

across different crisis indicators. The stock index variance brings similar results as in the case of Japan, but the variances obtained using the quarterly data give us a negative coefficient for the present series and also a negative result for one series lagged for more than one year, which is not exactly in line with our hypothesis. It appears that in the UK capital outflows in the past might lead to higher market fluctuations, which is a contrary result to the one given by the stock index variance, thus we have to perform a robustness analysis to find the definite conclusion. The R-squared is higher for the first regression, which might suggest that the positive relation is more likely.

Finally, the last three columns belong to the estimation regarding the United States. Here we have consistent results for all the crisis indicators and moreover, we see the highest number of significant series of capital flows. The more interesting point is that all the coefficients remain negative, which can be translated in a way that strong capital outflows during roughly the last 2 years lead to higher market variance. As this is not impossible, it does not quite fit our hypothesis. It certainly makes sense that a capital outflow in the recent past increases market volatility, however we would expect that it was preceded by capital inflow, thus the result matches only a half of our hypothesis. The next section should reveal whether this result is correct or not.

5.3.3 Robustness analysis

The target of this section is first, bringing the two causes we have examined together in one set of regressions and second, extending the analysis with additional variables, which might have a relation to stock market variance. Thus, we begin with the first step and put together the variables from Tables 3 and 4. The final output is denoted in Table 5 and again, the structure of the table remains the same. We find that in the Australian example all the coefficients remain relevant and have the same signs as in the previous analyses. The coefficient of determination rises to about 20% in all cases. In Japan, we still see rather ambiguous results. Two out of three crisis indicators cannot be explained by our variables almost at all, and the one that has some relation to the explanatory series presents different results than we

Table 5: Regression results combining capital flows and credit growth

	Australia			Japan		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.04 (0.00)	0.01 (0.26)	0.00 (0.64)	0.09 (0.00)	0.08 (0.00)	0.04 (0.00)
Credit growth (t)					0.54 (0.06)	
Credit growth (t-3)	-2.14 (0.02)	-1.01 (0.15)	-1.14 (0.10)		-0.48 (0.09)	-0.39 (0.02)
Credit growth (t-5)	1.95 (0.03)	1.36 (0.06)	1.29 (0.07)			
Credit growth (t-7)					-0.78 (0.01)	
Credit growth (t-8)	1.48 (0.06)	1.59 (0.02)	1.19 (0.07)			
Capital flow (t-2)	-1.85 (0.02)	-1.41 (0.02)	-1.32 (0.03)			
Capital flow (t-5)					1.09 (0.24)	
Capital flow (t-6)					1.64 (0.10)	
Capital flow (t-7)	0.98 (0.18)	1.21 (0.04)	1.04 (0.07)		1.02 (0.27)	
Capital flow (t-10)	1.37 (0.06)	1.22 (0.04)	1.15 (0.05)			
R-squared	0.20	0.20	0.16	0.00	0.13	0.03
Observations	114	137	137	116	121	164
Autocorrelation	OK	OK	OK	X	OK	OK

	United Kingdom			United States		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.05 (0.00)	0.02 (0.01)	0.03 (0.01)	0.06 (0.00)	0.06 (0.00)	0.04 (0.00)
Dependent (t-1)	0.45 (0.00)	0.25 (0.00)	0.12 (0.08)	0.24 (0.00)		
Credit growth (t)		-0.18 (0.04)		-1.49 (0.00)	-1.16 (0.00)	-1.60 (0.00)
Credit growth (t-1)			-0.30 (0.02)			
Credit growth (t-5)	0.74 (0.00)	0.37 (0.00)	0.87 (0.00)			
Credit growth (t-6)	-0.32 (0.06)			0.54 (0.10)	0.51 (0.20)	0.36 (0.30)
Credit growth (t-8)			0.22 (0.07)	0.73 (0.02)	0.43 (0.27)	0.67 (0.05)
Capital flow (t)		-0.19 (0.20)		-2.32 (0.03)	-2.94 (0.02)	-2.08 (0.05)
Capital flow (t-1)				-2.70 (0.02)	-2.50 (0.07)	-1.76 (0.14)
Capital flow (t-2)			0.37 (0.08)	-4.90 (0.00)	-5.52 (0.00)	-4.75 (0.00)
Capital flow (t-3)				-2.83 (0.02)	-2.70 (0.06)	-2.67 (0.03)
Capital flow (t-4)				-3.69 (0.00)	-5.19 (0.00)	-4.17 (0.00)
Capital flow (t-5)		-0.26 (0.08)		-5.89 (0.00)	-6.94 (0.00)	-6.41 (0.00)
Capital flow (t-6)	0.50 (0.05)			-3.23 (0.02)	-3.17 (0.04)	-2.35 (0.08)
Capital flow (t-7)	0.55 (0.03)			-1.21 (0.30)	-2.64 (0.06)	-0.77 (0.52)
R-squared	0.34	0.22	0.25	0.47	0.31	0.38
Observations	114	162	165	157	157	157
Autocorrelation	OK	OK	OK	OK	OK	OK

Note: These results represent a regression estimation of Equation (5). The values in parentheses are p-values for the significance test. The dependent variables are calculated using Equations (1), (2), and (3).

would expect. The lagged observations of credit growth further in the past still remain negative, which goes contrary to our hypothesis, but at least the capital flows coefficients remain positive. The results for the UK show some variety as well, but overall they seem to be rather meaningful. Most of the coefficients associated with more lagged series are positive and vice versa with few exceptions. Also, the

R-squared increases significantly in each model. And finally, in the US we see that the coefficients still have the same signs, and most of them remain significant. The quality of the models measures by R^2 also increases substantially. Thus, overall we have confirmed that there are none or very few overlaps in the series for the two causes we focus on and therefore, they are mutually exclusive, which is what we wanted to verify.

The last step of our econometric analysis is to limit the endogeneity bias by adding other variables to the model, which could have some relationship with stock return variance but not necessarily cause financial crises. Table 6 denotes the estimation results including GDP growth, inflation and interest rates changes, bank reserves, deposits, and currency growths. In these final regression we also run tests for homoskedasticity and normality, but those assumptions are rejected in each model. This does not come as a surprise, because in time-series regressions it is rather challenging to achieve them. We do not need to particularly concern ourselves with this results, because those assumptions do not influence the consistency of the estimated coefficients, which is essential for our analysis.

Firstly, the coefficients for Australia remains similar to the original ones even after including other variables. GDP and reserves growths appear to be important determinants of market volatility, and possibly in some models even interest rate changes and currency growth. However, the main message is that for all the crisis indicators the same causal series are relevant and that they have the hypothesized signs. Also, the R-squared once again increases substantially, which is a confirmation of a superior model setup.

Next, in the case of Japan we do not unfortunately see a large change either. Some correction variables are relevant for the models, namely GDP growth, inflation or interest rates changes, and currency or deposit growth. However, we see that for the model with the indicator obtained from Equation (2) there is no change in the signs and only a slight change in the probability of significance. This means that the previous results hold even after our robustness check, and thus we can finally conclude that they do not match our hypothesis. There can be various reasons for that, but we believe it is due to the specific economic situation, which Japan has

Table 6: Regression results for capital flows, credit growth, and corrections

	Australia			Japan		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.02 (0.26)	-0.00 (0.76)	-0.01 (0.63)	0.10 (0.00)	0.08 (0.00)	0.04 (0.00)
Dependent (t-1)		0.12 (0.14)				
Credit growth (t)					0.52 (0.07)	
Credit growth (t-3)	-2.38 (0.01)	-1.10 (0.11)	-1.24 (0.07)		-0.48 (0.09)	-0.39 (0.03)
Credit growth (t-5)	1.88 (0.03)	1.08 (0.12)	1.00 (0.16)			
Credit growth (t-7)					-0.80 (0.01)	
Credit growth (t-8)	1.83 (0.02)	1.63 (0.01)	1.56 (0.02)			
Capital flow (t-2)	-1.11 (0.15)	-1.46 (0.02)	-1.36 (0.02)			
Capital flow (t-5)					0.80 (0.35)	
Capital flow (t-6)					1.01 (0.23)	
Capital flow (t-7)	1.29 (0.07)	1.52 (0.01)	1.15 (0.04)			
Capital flow (t-10)	1.43 (0.04)	1.48 (0.01)	1.44 (0.02)			
GDP growth	2.48 (0.08)	1.76 (0.05)	1.30 (0.15)	-0.03 (0.00)	-0.14 (0.03)	
Inflation change				-0.03 (0.02)		-0.01 (0.11)
Short-term IR change		-0.04 (0.13)			-0.13 (0.11)	
Long-term IR change		0.10 (0.07)	0.07 (0.16)			
Reserves growth	0.11 (0.00)	0.07 (0.02)	0.08 (0.01)			
Deposits growth				-0.25 (0.32)		
M0 growth	1.07 (0.18)			0.60 (0.09)		0.52 (0.04)
R-squared	0.30	0.28	0.23	0.18	0.17	0.06
Observations	114	137	137	116	122	164
Autocorrelation	OK	OK	OK	OK	OK	OK

	United Kingdom			United States		
Dependent variable	**IndexVar**	**ArVar**	**NegVar**	**IndexVar**	**ArVar**	**NegVar**
Intercept	0.07 (0.00)	0.02 (0.00)	0.04 (0.00)	0.03 (0.00)	0.05 (0.00)	0.01 (0.38)
Dependent (t-1)	0.23 (0.01)	0.20 (0.01)	0.12 (0.09)	0.26 (0.00)		
Credit growth (t)		-0.20 (0.02)		-1.51 (0.00)	-1.32 (0.00)	-1.57 (0.00)
Credit growth (t-1)			-0.26 (0.04)			
Credit growth (t-5)	0.75 (0.00)	-0.29 (0.04)	0.85 (0.00)			
Credit growth (t-6)				0.34 (0.13)		
Credit growth (t-8)			0.23 (0.06)	0.69 (0.00)	0.41 (0.17)	0.55 (0.02)
Capital flow (t-4)				-0.58 (0.38)	-1.48 (0.09)	-0.63 (0.35)
Capital flow (t-5)						
Capital flow (t-6)	0.25 (0.31)					1.06 (0.15)
Capital flow (t-7)	0.29 (0.23)				-2.59 (0.01)	
GDP growth	-0.03 (0.09)	-0.02 (0.04)	-0.02 (0.05)			
Inflation change	-0.02 (0.05)		-0.01 (0.18)		-0.03 (0.01)	-0.01 (0.17)
Short-term IR change		0.05 (0.06)		-0.04 (0.16)	-0.08 (0.01)	
Long-term IR change						
Reserves growth	0.21 (0.14)	0.08 (0.22)		0.09 (0.00)	0.10 (0.00)	0.10 (0.00)
Deposits growth						
M0 growth	2.43 (0.03)	-1.68 (0.00)		0.74 (0.12)		1.01 (0.04)
R-squared	0.45	0.30	0.28	0.70	0.56	0.67
Observations	114	162	165	157	157	157
Autocorrelation	OK	OK	OK	OK	OK	OK

Note: These results represent a regression estimation of Equation (6). The values in parentheses are p-values for the significance test. The dependent variables are calculated using Equations (1), (2), and (3). The homoskedasticity and normality assumptions are rejected for all the models.

been experiencing over the last 2-3 decades.

We observe some changes in the results for the UK as well. Again, quite a few variables, which we have added in the last step, have a relation to the market variance in the UK. We see that the final results are not very consistent across different crisis measures. For the first one, there is a positive relation to credit growth and capital flows, where we would expect it, which is again in line with our hypothesis. The results for the next measure are a bit different, as they have produced a negative coefficient for the current credit growth and also a negative one for the past credit growth, which is not what we would expect. Also, there is no significant relation to capital flows in this equation. The last regression has a relation to credit growth as our hypothesis states, but again we do not see any relevance of capital movements. Therefore, we can say that the credit part of our hypothesis likely holds, but not the capital one in the UK.

Lastly, we comment on the estimates for the United States. Even here we see that including additional variables makes sense, since some of them are significant in all the equations, and the coefficient of determination have increased quite a bit. In fact, these models have the best specification in the whole sample with R^2 reaching up to 70%. In terms of the estimated coefficients, we can observe they have the wanted signs for the credit series - first positive and then negative. Thus, this part of our hypothesis is satisfied. The coefficients for capital flows are somewhat less convincing. We see a negative relationship with a series closer than a year to the presence, which is in line with our hypothesis, and it is consistent across all the indicators. The coefficients for capital movements further to the past are either positive, insignificant, or even negative, thus we cannot conclude much about this relation.

When outlining the hypotheses in Section 3.2, we have divided the causes to the universal and crisis-specific ones. As we have also mentioned, our analysis can reveal only the universal roots, because those are the ones that are common for all the crises. However, the question that remains is what is the relative importance of these two subgroups. We can find a partial answer in the values of R-squared in the results of Table 6, which is in other words the amount of variance that we can explain

with the utilized variables. We see that the results differ rather notably across the countries. If we exclude Japan for which we could not deliver satisfactory results, we still have about a 70-75% unexplained variance in Australia, 55-70% in the UK, and 30-45% in the US. These values seem to be quite high, though not everything can be assigned to the crisis-specific causes. First, every event is unique and thus has a different ratio of the universal vs. crisis-specific origins, so the denoted R-squared represnts just sort of an average value. Second, the unexplained part can be due to three possible factors: the crisis-specific causes, missed correction variables, and pure randomness of the series. Unfortunately, we do not have a tool, which would help us to quantify these factors, thus the only result that remains is the amount of variance, which we can explain through the hypothesized universal causes. Since this value ranges from about 20% to 70%, we conclude that the relative importance is considerable, and hence we should draw implications for financial regulation to limit the crisis occurrence probability.

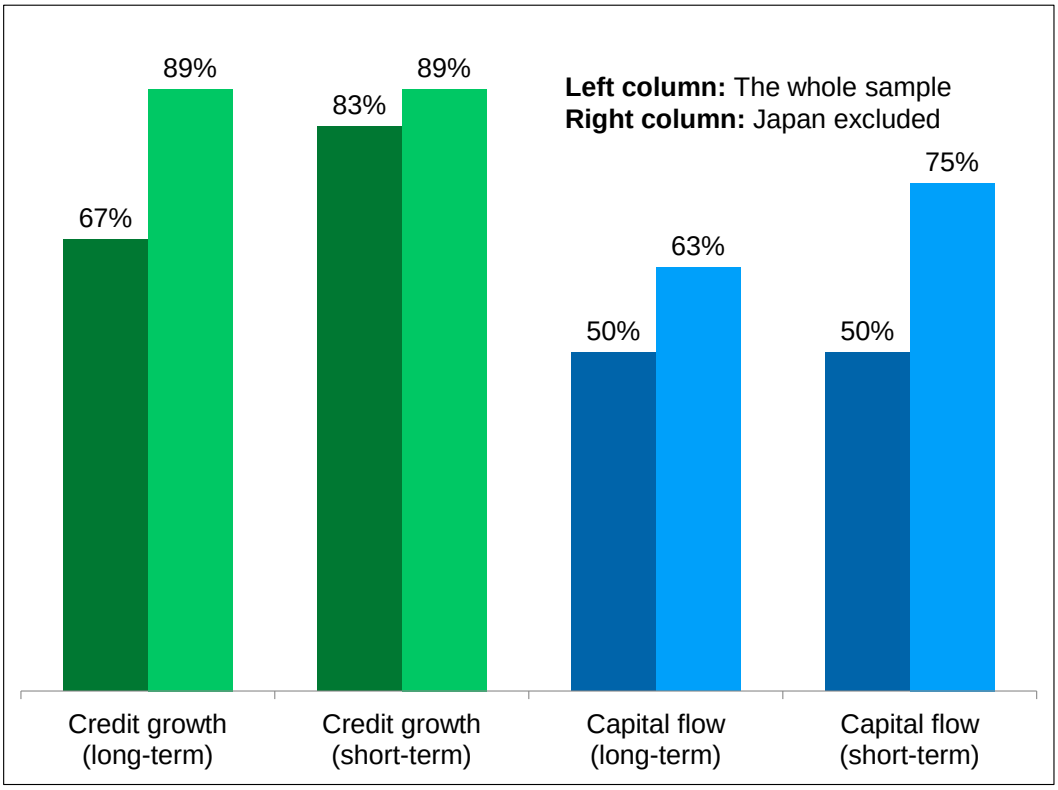
5.4 Discussion of the results

5.4.1 Hypotheses evaluation

Now, when we have the empirical results, we can evaluate how well they overall fit our hypotheses. As mentioned earlier, we mainly focus on examining the relations of capital flows, credit growth, and crisis indicators defined as stock market volatility. Furthermore, we can divide these links into a few subgroups based on the cause and the lag number. Thus, we can say that we would like to see a negative relation between the crisis indicators and credit growth in the short run (less than one year back) and a positive one in the long run (more than one year). The same should hold for the relations in terms of capital flows. This is just a repetition of the hypothesis we have already mentioned quite a few times, which states that periods of high capital inflows and credit growth followed by outflows and declines are breeding grounds for financial crises. In order to evaluate whether this hypothesis is correct we take a look at the share of not very insignificant coefficients, which have the hypothesized signs based on Table 6. This should be a good enough indication for

our conclusion.

Figure 9: Shares of significant coefficients with the hypothesized signs



Note: The values are calculated based on the final results presented in Table 6.

Figure 9 presents the results of this method. The left set of columns denotes the shares of coefficients, which are in line with our hypothesis, and takes into account all estimated equations. A regression is considered to match the hypothesis if there is at least one coefficient, which meets the above conditions. For example, for the long-term credit growth column we count in every regression from Table 6 that has at least one significant coefficient for a credit series lagged for more than one year, and this coefficient has a positive sign. We see that the effect of the short-term credit growth is in 89% cases negative, and thus it is the most consistent from our results. This in other words means that when there is a decline of credit/GDP ratio we can expect higher market volatility in the near future or even a financial crisis. This is probably due to a higher default ratio, which puts banks into a more difficult situation, as they have only a limited buffer of capital. The coefficient, which has the second highest share of hypothesized specification, is the one associated with

the long-term credit growth. In terms of the whole dataset, it is significant and has the correct (positive) sign in 67% cases, which is still fairly consistent. This result has an important implication, since it basically says that an excessive past credit growth leads to higher market fluctuations and potentially to financial crises as well. In terms of capital flows, we see that the shares are in the long run as well as in the short run at 50% level, which is exactly on the threshold of consistency. This can have various reasons, for instance in some countries the relation may be more important than in others. However, we believe that it is mainly due to not particularly strong proxy that we have utilized in the analysis. Nevertheless, the relation cannot be verified nor rejected based on this sole result.

Since we have seen that Japan appears to be sort of an outlier in the analysis, which can be justified with the argument regarding their specific economic situation in the last couple of decades, we also show the shares in Figure 9 with Japan results excluded. The right set of columns represent these shares, and we can see that all of them are quite significantly higher. The results for credit series reach almost 90%, which makes them very consistent, and even the values for capital flows show a considerable degree of consistency. Especially the short-term relation with capital flows appears to be 75% consistent with our hypothesis when Japan is taken out of the sample, which we consider to be a solid result. This would mean that there is a short-term positive effect of capital outflows on market variance, which can be translated in the way that these outflows contribute to the crisis ocurrences.

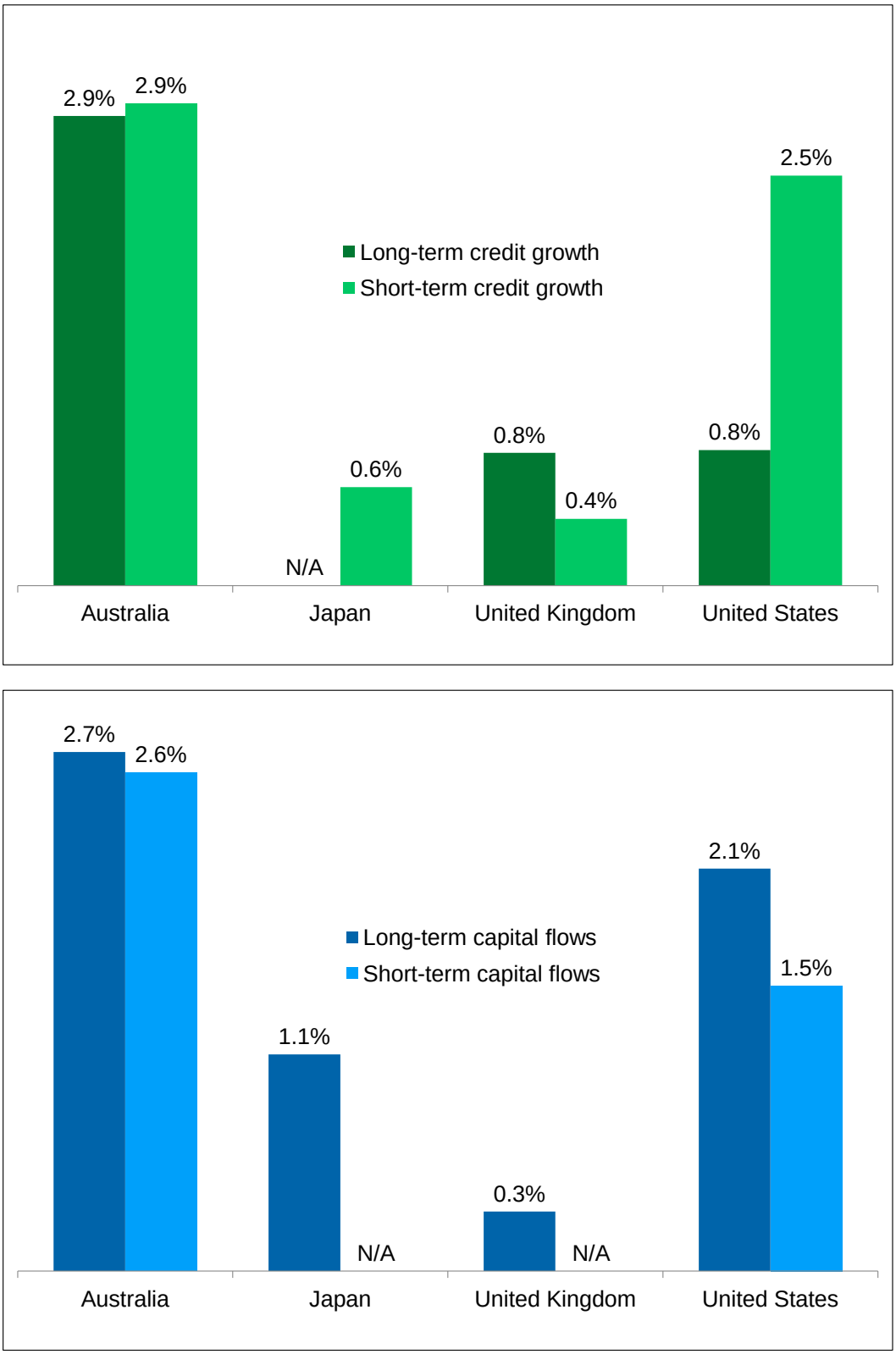
Overall, based on this additional analysis we can confirm with a solid degree of certainty that the results support the credit part of our hypothesis. High credit growth (already corrected for GDP) further in the past and credit declines close to the presence increase market volatility and thus also increase the probability of a financial crisis emergence. The results are somewhat weaker in terms of capital movements. They still rather support our hypothesis than reject it, but the degree of consistency in our results is not particularly high, hence we conclude that the relation cannot be verified.

5.4.2 Quantification of the results

The last evaluation we perform in this section concerns a deeper formalization or rather a quantification of the results. The problem with the final estimates shown in Table 6 is that they quite neatly describe the relationships between the causes and indicators, but we cannot say much about the contribution to the crisis appearances. In order to translate these results into a more comprehensible language, we use our previous assumption about the level of volatility associated with financial crises. In equation (7) we have defined crisis as a period with the variance higher than the overall average plus one standard deviation. Now, we extend it by assuming that whenever the market variance reaches this value, there is a financial crisis going on. Then, we can link the crisis occurrence probability to the causal variables using the estimated coefficients from Table 6 if we further assume that this relation remains linear. Since this is quite unlikely we can think of these probability changes as marginal effects at the median values. Finally, as there are multiple results for some variables, we simply take their average. Even though those assumptions are rather strong, this method still offers an indicative specification of our previous results and provides additional comparison across causes and countries.

Figure 10 presents the effects of credit and capital variables on the probability of a crisis appearance. The denoted effects represent a probability increase with one unit change of the causal variables, which is one percent of credit/GDP ratio growth or one percent GDP of foreign capital flow. Also, the change must be in the correct direction meaning that it should be positive for the long-term credit growth, negative for the short-term credit growth, etc. Based on the results it seems that the long-term credit growth has an effect on the probability from 0.8% to 2.9%, and it is by far the largest in Australia. For Japan we unfortunately do not have any result that we could use. In terms of the short-term credit growth, we observe that a descrease of one percent has a positive effect on the crisis probability from 0.4% to 2.9%. Again, this effect is the largest in Australia, closely followed by the US, and the smallest in the UK. Secondly, we comment on the results for the capital flows variables. The values of the effects are quite similar, as one percent positive change

Figure 10: Effects on the probability of a crisis occurrence



Note: The values denote the increases of financial crisis occurrences with a unit change of the respective variable and are calculated based on the results in Table 6.

in the long-term capital flow causes from 0.3% to 2.7% increase in the probability. Once again, Australia is on the top of this range and the UK is at the bottom. For the short-term capital outflows, we only have two results, since Japan and the UK do not offer any useful results. In the case of Australia and the US we see that the effect is 2.6% and 1.5% respectively.

In conclusion, there are substantial differences between the examined countries. For instance the Australia's effects seem to fluctuate between 2.5-3%, whereas in the UK they do not reach even 1%. This is likely dependent on the financial system and economic situation in the particular countries. We can expect the in the economies with more fragile financial systems the increased amount of credit has a higher impact on the stability. Thus, effectively in some countries one percent excess growth of credit can be a larger threat for the financial stability than in others.

6 Regulatory implications

6.1 Previous findings

Before proposing new regulatory rules that are supposed to minimize the probability of financial crises, we should take a brief look at the current situations and academic proposals. To that end, we review the academic papers that focus on financial regulation in some sense. Since an exhaustive literature review is beyond the scope of the paper, the goal of this section is to provide a rough idea of what kinds of proposals are being developed and what the current situation is. The literature can basically be divided into two subgroups, the first examining whether there is a necessity for financial regulation and the second, delivering different proposals of how to improve it. Some but few papers also investigate both these matters.

We start with the discussion of the first subgroup. Stiglitz (1993) takes more of an analytical approach by examining the role of the government in financial markets and describing seven market failures. His conclusion is that these market failures are a good enough motivation for the state to intervene in financial markets and set policies that would regulate them. Another paper by Atiyas and Ersel (2010) focuses,

as many others, on the subprime crisis of 2008-2009 and points out the shortcoming of the regulation framework prior to that event. For instance the paper highlights the importance of the shadow banking system, which remained unregulated, or the dependence of regulatory system on credit rating agencies. The authors also mention that the new regulation should consider the incentives of bodies enforcing the rules as well. Also, Freixas (2010) recognizes some additional problems with the regulation prior to the last financial crisis. Namely, he claims that risk was not correctly priced or that the contagion effect was not properly perceived. Furthermore, the paper proposes two potential reforms, and the author claims that there cannot be any intermediate options. The first proposal suggests contingent rights, which would transfer some debt to equity in case there is a crisis going on. The other option is to keep bank's operations running even when it has negative equity, which would also raise a need to extend deposit insurance. The last paper that belongs to the first group is written by Adrian and Shin (2009), and it examines the effect of the shadow banking system on the last financial crisis. The authors conclude that securitization has been a reason for the increased fragility of financial system, as it has also been effectively increasing the leverage of financial institutions. In addition, they claim that the shadow banking system is likely to be much more regulated in order to prevent excessive leverage and maturity mismatch at financial institutions in the future.

The next group of papers directly proposes changes in the regulatory framework. Frydman and Goldberg (2009) suggest a limitation of the imperfect knowledge phenomenon present in financial markets. The paper outlines two tools to achieve that. Firstly, the authors recommend to introduce so-called guidance ranges, which are practically confidence intervals of security price indicators (e.g. P/E ratio), and they would be issued for instance by central banks. This would help investors to recognize whether or not the security price is excessive (i.e. above the upper threshold of the guidance range). Furthermore, the other improvement described in the paper is the issuance of twofold credit rating for each security. One rating would be calculated based on the historical patterns and the other assuming the opposite trends of fundamental variables. Next, Hart and Zingales (2011) focus on large

financial institution (i.e. too big to fail), and propose a system of flexible capital requirements. This system is based on the credit default swap prices of financial institutions, which would need to stay within a prespecified range. If the price rose above the upper threshold, the given institution would need to issue equity until the CDS price is back in the range. A different approach developed by Schwarcz (2009) considers the complexities of financial markets as a crucial issue, which triggers market failures. On the basis of chaos theory the author suggests an introduction of a liquidity market provider. Such an institution would invest in securities traded in panicked markets, which would be sort of a hedge against irrational behavior. The author also claims that such a liquidity provider could be privately funded to a large extent, because it should be able to make a profit. Another paper by Hanson et al. (2010) highlights macroprudential regulation in financial markets, which can be characterized as 'an effort to control the social costs associated with financial institution bankruptcies.' They list specific improvements, which they consider to be critical for a more robust financial regulation. Among those improvement are e.g. higher capital ratios with focus on the quality capital, time-varying capital ratios (countercyclical), or minimum haircut requirement on asset-backed securities. Brunnermeier et al. (2009) employ quite a comprehensive approach, which starts with an analytic part considering market failures and the nature of systemic risk, and then it continues with proposing regulatory changes along various categories. The paper also outlines a set of recommendations regarding capital requirements (e.g. capital adequacy ratio, countercyclical macro-prudential regulation, different regulatory ratios across countries, etc.) and liquidity improvements such as linking capital adequacy ratio to the maturity mismatch or the mark-to-funding accounting rule.

Lastly, we take a look at the actual regulatory framework prepared by Basel Committee (2010). The scheme offers many changes along several dimension, namely capital adequacy, risk coverage, capital conservation and countercyclical buffers, leverage ratio, and global liquidity standards. The latests appears to be likely the most interesting part of the new framework, since liquidity standards have not been introduced before. The tools that the Basel Committee develops are essentially two

ratios ensuring that banks keep sufficient amounts of liquid assets, which can be used during financial turmoils. There is also one point, which is particularly interesting for our previous analysis, as it promotes an increase of capital at financial institutions during the period of excess credit growth in order to stabilize the system.

To sum up, there are quite a few prudent ideas on how to either improve the robustness of financial institutions or limit the imperfect information phenomenon. However, it is quite unexpected that most of these suggestions focus on making the system resilient enough when turbulent times come rather than preventing these fluctuations completely. There certainly is a need to make the financial industry more stable, so that it overcomes a period of increased volatility, however we should put at least the same amount of effort into creating a healthy, nonvolatile environment.

6.2 Implications stemming from the empirical analysis

In this final section, we attempt to transfer the result from our previous analysis to potential regulatory concepts that would significantly improve the current ones. As we have seen, the academic proposal appears to concentrate on a higher stability of financial institutions. Though we do not want to challenge these ideas, we rather examine the improvements that can be made in order to achieve a less varying environment, since that seems to be an uncharted territory, and it is undoubtedly equally important.

Our analysis has shown that a highly expansive credit development increases the probability of financial crisis occurrences. We have analyzed the capital flows impact as well, however we do not focus on them in this section, because the results are not particularly strong and also, the regulation of capital movements is a more complicated matter. It is necessary to take into account the implementation cost (and the probability of success) of any measures we propose, thus we channel our effort to the more plausible solution - regulating credit growth. The results confirm that a positive development of credit to GDP ratio in the past is associated with a higher probability of crisis in the future. Now, this essentially makes a lot of

sense, because if an individual takes an additional loan, but she does not get a higher income, it basically means that the probability of default increases, unless she has substantial reserves (either savings or she simply consumes much less than she earns). And the same holds for the whole economy - if credit to GDP ratio is rising then the amount of credit (loans) is growing at a faster rate than GDP (income). As demonstrated above, this is acceptable in case we have significant reserves, which might be the reason why there is a long-term positive trend of this ratio in some countries (see Figure 4). However, if the long-term trend is deducted from the current growth and the remaining number stays positive, we are in the state of excess credit growth, which might be too difficult to handle even if some reserves are available. Evidently, we should be especially cautious when this excess growth sustains over several periods, and if it is significantly above its long-term trend. In that case, as our analysis demonstrated, the probability of a financial crisis occurrence rises rapidly. Therefore, the solution lies in regulating the credit amounts in economy.

One of the simplest ways to reduce positive credit growth is through interest rates. They act as a price for credit, thus as one of the most basic principles in Economics claims - higher the price, lower the demand. The common practice is that we can influence the interest rates to some extent through monetary policy. Hence, one possible solution could be to simply consider credit to GDP ratio when setting the interest rates, since it is likely not a part of the decision process at today's central banks (e.g. Taylor rule). This actually implies that to a certain extent we can blame monetary policy and its poor execution for the crises we have experienced during the last decades. Nonetheless, it could be a more challenging task to push this change through. Since low interest rates are perceived as a way to economic growth, we can certainly think of parties that would lobby against such a change. One possible group comprises financial institutions and banks in particular, because those are the entities of which core business is to sell credit products. Therefore, pushing down the credit amounts would likely result in lower profits for banks, hence we could expect their resistance. The other party would be a certain group of politicians, because as mentioned low interest rates can be utilized to achieve a

higher growth of output. It is necessary to say that this is likely true, but during a period of excess credit growth it overheats economy and consequently contributes to an emergence of a financial crisis, as our analysis has shown. On average, we might have the same economic growth, but if the economy overheats and than "cools down" in a crisis, the growth is much more varying, therefore this solution is inferior.

Another possible way to regulate the financial sector in accordance to excess credit growth includes a set of improvements that would make financial institutions more resilient during the times of strong credit increases. We believe that this solution is worse that preventing these periods from happening, since even if the financial sector survives, the defaults and credit declines would still take place and might even cause recessions. However, because of the above mentioned plausible difficulties to enforce the changes in interest rates setting policy, it is likely more implementable. As we have found in the literature, the current proposal developed by Basel Committee (2010) attempts to push through measures such as higher capital stock and countercyclical buffer in the period of excess credit growth. Nevertheless, the definition of such a period must be properly specified, otherwise this measure will probably be in vain. Furthermore, additional requirements could be strengthened when there is an indication of volatile period ahead. For instance, it may be helpful to make the newly introduced liquidity requirements stricter in these times, because first, it cools down the aggressive business activities of banks and second, it enables them to stay solvent longer, so that they can overcome panics.

Finally, we should emphasize that our recommendations might have several drawbacks as well. Firstly, they are targeted to developed countries only, since our analysis clearly focuses on them. In developing countries the situation is likely quite different, because for example after lowering the restrictions for foreign capital inflows, the credit growth naturally exceeds its long-term trend. Also, this approach assumes that monetary policy has a substantial impact on interest rates throughout the whole economy, which is not necessarily true. Thus, we might want to extend the scope of this regulation to non-bank credit such as leasing or securitization, if it turns out that the original measure is insufficient. Finally, we should consider all possible consequences that higher interest rates have. Particularly, there can be a

notable impact on bank stability, thus we would recommend a rather slow, gradual implementation, which would not threaten the system and reveal these effects.

7 Conclusion

This paper examines the root causes of financial crises in order to draw implications for the regulatory framework. As the development over the last couple of years has shown, periods of financial distress have serious negative consequences on the global economy, thus the motivation to detect the true origins and address them accordingly through regulation is self-evident. Since there is yet no consensus in the academic community on what the proper regulation should be, this paper attempts to further contribute to this discussion and provide new answers.

As others before us, we believe that the role of credit and capital developments as causes of financial crises is eminent. Since capital and debt virtually represent the funding side of the whole economy, their unusual movements must by definition cause disturbances. Thus, the first goal of this paper is to find evidence that there is a strong relation of changes in credit and capital to financial distress. The second goal is to make use of the results and convert them into meaningful measures, which can be implemented into the regulatory framework.

With regard to the analysis, we have gathered data for Australia, Japan, the United Kingdom, and United States, which are countries with highly developed financial sector and robust economies, therefore there is no bias in the results due to for example institutional underdevelopment. The examined time span ranges roughly from 1970 to 2010, which is essentially the longest period documented in the public databases. The analysis is based on a time-series investigation providing preliminary results and a more thorough econometric estimation of time-series regressions.

The results stemming from the time-series as well as the regression analysis reveal a consistent relationship between past credit growth and stock return variance, which we have used as a financial crisis indicator. Furthermore, the relation is positive for the growth further in the past (1-2 years) and negative closer (less than

1 year) to the distress periods. This is in line with our hypotheses, since there is usually an inadequate credit growth at the beginning, which ends up in defaults followed by a financial crisis. In terms of capital flows the results are somewhat less consistent, but they still support our initial hypothesis. The relations are again positive further in the past and negative closer to the presence in most cases, which is again what we would expect. The analysis uses the changes in financial account balances to GDP as the proxy for capital flows, and that is possibly the reason for the lower consistency of our results, because such a variable does not precisely reflect the capital movements in economy. Finally, a quantification of the results in terms of the probability of a financial crisis emergence shows that 1% growth of credit to GDP ratio increases the probability by 0.8-2.9% (depending on the country) in the long run, and 1% decline of credit to GDP ratio causes 0.3-2.7% increase of the probability in the short run. The effects of capital movements are rather similar, the long-term relation of 1% change in capital flows over GDP ratio to the crisis occurrence probability is 0.3-2.7% and the short-term one ranges from 1.5-2.1%.

Since the analysis has confirmed the suspicion that excess credit growth and capital inflows cause financial crises, we can draw respective recommendations for the regulatory framework. As interest rates determine credit developments to a large extent, we propose a change in monetary policy, which would consider credit to GDP ratio as an additional factor when setting the interest rates. This would contribute to a more sustainable and less volatile environment, and we believe the long-term economic growth would remain unharmed. Additionally, a different solution is the introduction of measures making financial institutions more resilient in the period of excess credit growth, which has been partially proposed within Basel III. We see these changes as reasonable, however they should be perceived as rather complimentary to the more systemic change of interest rates policy that we have suggested.

The further research in this area can focus on a variety of improvements. First, there are possible imperfections in the dataset we have used. Specifically, it can be extended with further countries or regions, new correction variables may be found, and we can also look for more suitable proxies especially for capital flows.

Furthermore, the econometric methodology could be improved as well, for instance we might perhaps use other than linear model specifications or probit and logit models for measuring the probability effects. Finally, academicians could analyze the impact of the proposed change in monetary policy on economic growth, financial stability, etc., or alternatively they might develop new solutions for regulation based on our results.

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