Credit Expansion and Financial Instability: Evidence from Stock Prices*

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PRELIMINARY DRAFT

Abstract

This paper examines financial instability associated with bank credit expansion in a set of 23 developed countries over the years 1920-2012. We find that credit expansion, measured by the three-year change in bank credit to GDP ratio, predicts a significantly increased crash risk in the returns of the bank equity index and equity market index in the subsequent one to eight quarters. Despite the increased crash risk, credit expansion predicts both lower mean and median returns of these indices in the subsequent quarters, even after controlling for a host of variables known to predict the equity premium. Furthermore, conditional on credit expansion of a country exceeding a modest threshold of 1.5 standard deviations, the predicted excess return for the bank equity index in the subsequent four quarters is significantly negative, with a magnitude of nearly -20%, while the positive predicted excess return subsequent to a credit contraction of the same size is substantially more modest. These findings present a challenge to the views that credit expansions are simply caused by either banks acting against the will of shareholders or by elevated risk appetite of shareholders, and instead suggest a role for optimism of bankers and stock investors.

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Economists have long argued that credit expansion by banks and other intermediaries can lead to instability of the financial system and the economy, e.g., Fisher (1933), Minsky (1977), and Kindleberger (1978). Given the potentially severe consequences of credit expansion, which were evident from the experience of the recent global financial crisis, it is important to understand its origin. There are several distinct views. First, credit expansion may reflect active risk seeking by bankers and financial intermediaries as a result of agency frictions. Such acts can arise from the misaligned incentives of financial intermediaries with their shareholders, e.g., Allen and Gale (2000) and Bebchuk, Cohen, and Spamann (2010), or from the implicit too-big-to-fail guarantees provided by the government, e.g., Rajan (2006, 2010) and Acharya, et al. (2010). A second view posits that credit expansion may also reflect largely increased risk appetite of financial intermediaries due to relaxed Value-at-Risk constraints faced by financial intermediaries (Danielsson, Shin and Zigrand, 2012; Adrian, Moench and Shin, 2013). Lastly, credit expansion may be driven by widespread optimism shared by financial intermediaries and other agents in the economy. This view can be traced back to Minsky (1977) and Kindleberger (1978), who emphasize that prolonged periods of economic booms tend to breed optimism, which in turn leads to credit expansions that can eventually destabilize the financial system and the economy. Recent literature has proposed various mechanisms that can lead to such optimism, such as neglected risk (Gennaioli, Shleifer and Vishny, 2012, 2013), group think (Benabou, 2013), extrapolative expectations (Barberis, 2012), and this-time-is-different syndrome (Reinhart and Rogoff, 2009).

In this paper, we empirically examine credit expansion and associated financial instability through the lens of equity prices. Several reasons motivate such an analysis. First, price fluctuations of bank stocks and equity indices, which are readily available for a large set of countries and going back for substantial periods of time, provide a convenient measure of financial instability induced by credit expansion of the financial sector and the overall economy. Second, and perhaps more important, since equity prices aggregate expectations and preferences of equity investors, the joint dynamics of equity prices, especially of bank stocks, with credit expansion provide a channel to analyze the expectations and preferences of equity investors regarding the financial instability associated with credit expansion.

We focus on three questions regarding credit expansion from the perspectives of equity investors: First, does credit expansion predict an increase in the crash risk of bank stocks and the equity market index in subsequent quarters? This question is motivated by the aforementioned views that credit expansion exposes the financial sector and the economy to instability. Our second question is concerned with whether increased stock crash risk is compensated by a higher equity premium. This question is not only a natural continuation of the first, but also serves as an entry point to evaluate different views about the origin of credit expansion. If credit expansion is simply caused by bankers acting against the will of their shareholders (e.g., active underwriting of poor quality loans), we expect the shareholders to demand a higher equity premium as compensation for the increased crash risk they have to bear. On the other hand, credit expansion may also reflect over-optimism or elevated risk appetite of bankers and their shareholders, in which case there may not be a higher equity premium to accompany the increased crash risk. Finally, we further compare the equity premium following credit expansions with that after credit contractions. The beliefs view emphasizes the overvaluation of equity during expansions and contrasts with key predictions of the risk-appetite view on the increased equity premium during crises.

Our data set consists of 23 developed economies with data from 1920 to 2012. We measure credit expansion as the three-year change in bank credit to GDP ratio in each country. In contrast to the perception that credit expansions are often global, bank credit expansion actually exhibits only a small cross-country correlation throughout our sample period.

To analyze the first question, we test whether credit expansion predicts a significant increase in the negative skewness of future returns of the bank equity index and broad equity market index. Our analysis adopts a panel quantile regression approach with credit expansion and other control variables as predictive variables for various quantiles of stock returns in the subsequent one to eight quarters. We use two measures of negative skewness in stock returns: the distance from the median to the lower tail (5^{th} quantile) minus the distance to the upper tail (95^{th} quantile), and the difference between the mean and median. Our analysis shows that bank credit expansion predicts a significant increase in the negative skewness of subsequent returns of the bank equity index and equity market index. The increase in negative skewness is particularly strong for the bank equity index. In addition, we also verify increased crash risk by estimating a probit panel regression that shows that credit expansion significantly predicts a higher probability of stock crashes in subsequent quarters.

Next, we address the second question regarding whether increased crash risk associated with credit expansion is compensated by a higher equity premium. We find that one to eight quarters after bank credit expansions, despite increased crash risk, the mean excess returns of the bank equity index and broad equity index are significantly *lower* rather than higher. One concern is that the lower mean excess returns might be caused by a small number of stock crashes in our sample. Interestingly, bank credit expansion also predicts significantly lower *median* excess returns of the bank equity index and equity market index, which are robust to this small sample concern. The lower median excess return predicted by bank credit expansion suggests that not only there is no premium to compensate for the increased crash risk, the equity premium after credit expansions is lower even in the absence of the occurrence of tail events.

One might argue that the lower mean and median returns predicted by bank credit expansion may be caused by a correlation of bank credit expansion with a time-varying equity premium, which is indeed present in the data. However, even after controlling for a host of variables known to be predictors of the equity premium, including dividend yield, book to market, inflation, the term spread, and several other variables, bank credit expansion remains strong in predicting lower mean and median returns of the bank equity index and equity market index. Furthermore, we also find that the predictability of future equity excess returns using credit expansion works not just in-sample, its out-of-sample predictability is notably better than that of the control variables, which are standard predictors of the equity premium.

Taken together, our analysis shows that bank credit expansion predicts increased crash risk in the bank equity index and broad equity index, and the increased crash risk is accompanied by a lower, rather than higher, equity premium. The first part of this finding, while perhaps not surprising, confirms the common theme in the literature of financial instability being associated with bank credit expansion. The second part is more surprising and sheds light on different views about the origin of credit expansion.

To the extent that shareholders do not demand a higher equity premium to compensate them for the increased crash risk, there does not appear to be an outright tension between bankers and shareholders during credit expansions. The lack of such a tension presents a challenge to the narrowly-focused agency view of credit expansion and suggests a need to account for optimism and risk taking by shareholders during credit expansions to fully describe the data.

Finally, we examine equity excess returns subsequent to credit expansions exceeding a certain threshold and compare them with equity returns after credit contraction exceeding a threshold of the same size. Interestingly, for a modest threshold for credit expansion of 1.5 standard deviations, the predicted excess return for the bank equity index in the four quarters after the expansion is substantially negative at -23.3%, while the return after a credit contraction of the same magnitude is only modestly positive at 4.9%. The significantly negative equity premium after credit expansion and the asymmetrical equity return following credit expansions versus contractions pose a challenge to theories that explain variation in equity premia during credit expansions simply based on elevated risk appetite of intermediaries and shareholders.

Taken together, our findings point to a need to account for potential over-optimism of bankers and stock investors to fully understand credit expansions in the data. It is important to note that our findings by no means exclude the presence of distorted incentives of bankers and elevated risk appetite of shareholders in driving credit expansions. To the contrary, it is likely that these factors are jointly present. In particular, in the presence of over-optimism or elevated risk appetite by shareholders, bankers will have even greater incentives to underwrite poor quality loans and seek risk in order to cater or take advantage of their shareholders, e.g., Stein (1996), Bolton, Scheinkman and Xiong (2006) and Cheng, Hong and Scheinkman (2013).

Our paper is structured as follows. Section discusses the related literature. Section II presents the empirical hypotheses and empirical methodology used in our analysis. Section III describes the data and presents some summary statistics. We then discuss our empirical results in Section IV and conclude in Section V.

I. Related literature

A large literature investigates real and financial effects of credit expansion from both domestic macroeconomic and international finance perspectives, highlighting various consequences of credit expansion such as bank runs, output losses, capital outflows, and currency crashes.[1] In the aftermath of the recent global financial crisis, a quickly growing literature strives to integrate financial instability and systemic risk originating from the financial sector into mainstream macroeconomic models, e.g., Gertler and Kiyotaki (2012), He and Krishnamurthy (2012, 2013), and Brunnermeier and Sannikov (2014). In contrast to this literature, our paper, by examining credit expansion through the lens of stock prices, highlights the roles of shareholders' beliefs leading up to crises driven by credit expansions.

In closely related work, Schularick and Taylor (2012) construct a historical data set of bank credit for 14 developed countries over the years of 1870-2008 and find that a high growth rate of bank credit predicts banking crises. We expand their data sample to a larger set of countries and show that the growth rate of bank credit is a powerful predictor of equity crashes. More importantly, our analysis further finds that increased crash risk is not compensated by a higher equity premium, which helps understand the origin of credit expansions.

Our finding of bank credit expansion predicting an increased equity crash risk reflects reduced credit quality during credit expansions, which is consistent with several recent studies. Greenwood and Hanson (2013) find that during credit booms the credit quality of corporate debt borrowers deteriorates and that this deterioration forecasts lower excess returns to corporate bondholders. Mian and Sufi (2009) and Keys, et al. (2010) show that the credit boom of the U.S. in the 2000's allowed households with poor credit to obtain unwarranted mortgage loans, which led to the subsequent subprime mortgage default crisis. By showing the poor performance of bank equity returns subsequent to credit expansions, our analysis helps further establish that credit expansions involve not just bankers taking advantage of their bond investors and depositors or implicit guarantees from the governments, which would have also benefited their shareholders, but also entail the presence of optimism or risk taking by their shareholders.

By highlighting a possible role of over-optimism in driving credit booms, our analysis echoes some earlier studies regarding the beliefs of financial intermediaries during the housing boom that preceded, and arguably led to, the recent global financial crisis. Foote, Gerardi, and

[1] Bernanke and Gertler (1989), Kashyap, Stein and Wilcox (1993), Kiyotaki and Moore (1997), and Holmstrom and Tirole (1997) show that credit frictions can have significant and persistent effects on the real economy. Mishkin (1978), Bernanke (1983), and Eichengreen and Mitchener (2003) study the role of credit in the propagation of the Great Depression in the U.S. Demirgüç-Kunt and Detragiache (1998), Kaminsky and Reinhart (1999), Eichengreen and Arteta (2002), Borio and Lowe (2002), Laeven and Valencia (2008), and Mendoza and Terrones (2008) analyze the role of credit in international financial crises.

Willen (2012) argue that before the crisis top investment banks were fully aware of the possibility of a housing market crash but “irrationally” assigned a small probability to this possibility, as revealed by their investment reports. Cheng, Raina and Xiong (2013) find that employees in the securitization finance industry were more aggressive in buying second homes for their personal accounts than some control groups during the housing bubble and, as a result, performed worse.

Our study is also related to the growing literature that analyzes asset pricing implications of balance sheet quantities of financial intermediaries. Adrian, Moench and Shin (2013) and Adrian, Etula and Muir (2013) provide theory and empirical evidence for intermediary book leverage as a relevant pricing factor for both the time-series and cross-section of asset prices. Different from these studies, our analysis builds on total quantity of bank credit to GDP rather than intermediary leverage and has a different objective by focusing the joint dynamics of crash risk and expected returns subsequent to bank credit expansions. Muir (2013) documents that risk premia for stocks and bonds increase substantially during financial crises after financial intermediaries suffer large losses, and highlights reduced equity capital in the financial sector as the key in understanding the largely increased risk premia during financial crises. Different from his focus on risk premia during crises, our analysis is concerned with the increased crash risk and lower equity premium before crises. This difference is also reflected by our finding of an asymmetric pattern of predicted equity returns following credit expansion: the drop in the predicted excess returns after a credit expansion is substantially greater than the increase in the predicted excess returns after a credit contraction of the same magnitude.

There is a large literature following Barro (2006) that emphasizes rare disasters as a compelling resolution of the equity premium puzzle. In contrast, our analysis finds a lower, rather than higher, equity premium associated with crash risk subsequent to credit expansions. In this regard, our study echoes the notion of Gennaioli, Shleifer and Vishny (2012, 2013) that investors may neglect tail risk in reality.

II. Empirical Hypotheses and Methodology

This section introduces the empirical hypotheses and regression methodology used in our analysis.

A. Empirical hypotheses

Our analysis focuses on three hypotheses. First, we examine financial instability associated with bank credit expansions by analyzing crash risk in equity prices. When there is a large bank credit expansion in the economy, credit may flow to borrowers with poor credit quality, either households or non-financial firms. Reduced borrower quality exposes banks to increased default risks, which may be realized only after a substantial deterioration in the economy. When default risk becomes imminent, banks' equity prices may crash due to downward spirals that amplify the initial loss. Various channels leading to downward spirals may include capital outflows from financial intermediaries (e.g., Shleifer and Vishny, 1997), reduced risk bearing capacity as a result of wealth effects (e.g., Xiong, 2001; Kyle and Xiong, 2001; and He and Krishnamurthy, 2012, 2013), margin calls (e.g., Gromb and Vayanos, 2002; Brunnermeier and Pedersen, 2009), and reduced collateral capacities (e.g., Geanakoplos, 2010). Given the critical role played by banks in channeling credit to the economy, investors, anticipating that large losses suffered by banks may spill over to the rest of the economy, will also cause the broad equity index to crash along with the bank index.

Motivated by these considerations, we hypothesize that bank credit expansion predicts greater crash risk in the bank equity index and the equity market index, as summarized below.

Hypothesis I: *Bank credit expansion predicts subsequent equity price crashes in both the bank equity index and the equity market index.*

If bank credit expansion is indeed accompanied by an increased equity crash risk, it is reasonable to hypothesize a higher equity premium as compensation for the risk, as stated in the following hypothesis.

Hypothesis II: *Bank credit expansion predicts a higher equity premium in both the bank equity index and the equity market index.*

Hypothesis II is motivated by the fact that bank equity prices reflect the aggregate expectations and risk preferences of bank shareholders. If during bank credit expansions shareholders anticipate bankers acting against their will, we expect them to demand a higher equity premium as compensation for the increased crash risk they have to bear. Specifically, option-like compensation contracts incentivize bankers to underwrite poor quality loans and seek risk at the expense of their shareholders and creditors (e.g., Allen and Gale, 2000; Bebchuk, Cohen, and Spamann, 2010). In addition, implicit guarantees from governments create a "too big to fail" problem, leading banks to excessively expand credit to the economy (e.g., Rajan, 2006, 2010; Acharya, et al., 2010). On the other hand, excessive credit expansion induced by implicit government guarantees might even benefit shareholders. Of course, if bankers expand credit to take advantage of implicit government guarantees and if the guarantees provide sufficient protection to equity holders, then there would not be any increased equity crash risk associated with bank credit expansion and equity holders would then earn a reasonable expected return on their equity holdings.

Another view of credit expansion that Hypothesis II can shed light on focuses on the role of beliefs. Bank credit expansion may be accompanied by widely spread optimism in the economy, as long emphasized by Minsky (1977) and Kindleberger (1978), which would lead to a lower equity premium or even predictable losses for equity investors. During prolonged economic booms, both bankers and their shareholders may become overly optimistic about the economy due to neglected risk (Gennaioli, Shleifer and Vishny, 2012, 2013), group think (Benabou, 2013), extrapolative expectations (Barberis, 2013), or this-time-is-different syndrome (Reinhart and Rogoff, 2009). Such over-optimism may cause bankers to expand excessive credit to households and non-financial firms and at the same time induce shareholders to ignore increased crash risk.

It is worth mentioning that the agency view and the belief view are not mutually exclusive, as risk-seeking incentives of bankers and over-optimism of shareholders may be jointly present in driving bank credit expansions. In particular, in the presence of overly optimistic shareholders, even rational bankers may underwrite poor quality loans and seek risk to cater or take advantage of their shareholders' optimism (e.g., Stein, 1996; Bolton, Scheinkman and Xiong, 2006; Cheng, Hong and Scheinkman, 2013).

We next consider a third hypothesis.

Hypothesis III: *Predicted equity returns subsequent to credit expansions are negative for both the bank equity index and the equity market index, reflecting the over-optimism of investors during credit expansions. In addition, the predictable negative returns following credit* *expansions are larger in magnitude than the increased equity premium following credit contractions.*

Hypothesis III is motivated by a view of credit expansion that highlights the role of risk appetite of the financial sector. According to this view, bank credit expansion can be caused by relaxed risk constraints or an elevated risk appetite of bankers and financial intermediaries. Danielsson, Shin and Zigrand (2012) and Adrian, Moench and Shin (2013) develop models to show that falling asset price volatility (which tends to happen during economic booms) relaxes Value-at-Risk constraints faced by financial intermediaries and allows them to expand more credit to the economy. In their framework, the elevated risk appetite leads not only to credit expansions but also reduced equity premia as financial intermediaries are also the marginal investors in stock markets.

In general, it is challenging to fully separate the effects caused by over-optimism and elevated risk appetite. Hypothesis III explores two dimensions to contrast these views. One is based on how much the equity premium can drop during credit expansions. An elevated risk appetite can reduce the equity premium down to zero but not below zero in standard asset pricing models,[2] while over-optimism can cause equity prices to be substantially overvalued and thus cause the equity premium to be negative. This quantitative difference permits a comparison of these two views.

The other dimension we explore is regarding the symmetrical property of equity premium with respect to credit expansions and contractions. The theories in the literature (e.g., He and Krishnamurthy, 2012 and 2013, and Brunnermeier and Sannikov, 2013) typically imply a negative relationship between the risk premia and intermediary capital and, in particular, an asymmetrical pattern in this relationship: the increases in risk premia after financial intermediaries suffer large losses are larger than the decreases in risk premia after financial intermediaries replenish their capital. If one broadly interprets financial intermediaries modeled in these theories as representing both bankers and stock investors in our empirical setting, then one would expect a sharp increase in the equity premium of bank stocks and equity market index subsequent to banking crises when bank credit contracts. This implication contrasts with the

[2] A caveat is that a sufficiently strong hedging motive by equity holders together with a certain correlation between equity returns and endowment risk faced by equity holders may turn the equity premium to negative.

beliefs view that over-optimism causes equity holders to over-value their shares during credit expansions, which would lead equity returns to be low and perhaps negative subsequent to credit expansions.

It is important to note that our emphasis on over-optimism as a factor driving credit expansions does not exclude elevated risk appetite of financial intermediaries and investors in driving credit expansions. To the contrary, it is likely that both factors are jointly present.

B. Regression methodology

Our analysis employs two types of panel regressions with fixed effects: the quantile regression model and the standard linear panel model. The first model estimates the best linear predictor (BLP) of the qth quantile of future equity excess returns conditional on the predictor variables:

$$Quantile_q\left[r_{i,t+K} - r^f_{i,t+K} \mid (predictor\ variables)_{i,t}\right]_{BLP}$$

$$= \alpha_{i,q} + \beta_q'(predictor\ variables)_{i,t} \quad (1)$$

This quantile regression allows one to study how predictor variables relate to the entire shape of the distribution of future returns, not just the mean of the distribution. For example, if credit expansion increases the likelihood or severity of a market crash, we should see this effect by looking at the lower tail of returns, for example at the 5th quantile. Thus, to examine Hypothesis I, we employ jointly estimated quantile regressions to compute the following negative skewness statistic to ask whether credit expansion predicts increased tail risk:

$$\beta_{\text{negative skew}} = (\beta_{q=50} - \beta_{q=5}) - (\beta_{q=95} - \beta_{q=50}) \quad (2)$$

where $\beta_{q=x}$ denotes the coefficient estimated for the x quantile. This statistic $\beta_{\text{negative skew}}$ equals the distance from the median to the lower tail minus the distance to the upper tail.[3]

[3] We do not measure just ($\beta_{q=50}$ - $\beta_{q=5}$) because a larger number could simply be indicative of increased conditional variance. Instead, we measure the asymmetry of the returns distribution, the increase in the lower tail minus the increase in the upper tail. In the statistics literature, this measure is called the quantile-based measure of skewness. We use the 5th and 95th quantiles to represent tail events. While looking at more extreme events (i.e. the 1st and 99th quantiles) might be more desirable from the point of view of identifying crashes, there is a trade-off with statistical power since these extreme events get increasingly rarer with smaller quantiles. Using the 5th and 95th

The second regression model is the standard panel regression with fixed effects, which we simply refer to as the "mean regression" to distinguish it from the quantile regressions we run. OLS with country dummies is used to estimate the following model:

$$E\left[r_{i,t+K} - r^{f}_{i,t+K} \mid (predictor\ variables)_{i,t}\right]_{BLP} =$$

$$\alpha_i + \beta^{'}(predictor\ variables)_{i,t} \qquad (3)$$

We write the mean regression in the form above to emphasize the analogy with the quantile regression: Equation (3) is the best linear predictor (BLP) of the mean conditional on the predictor variables. By using a fixed effects model, we test Hypothesis II by focusing on time series co-movements. This is because the levels of predictor variables, which come from different sources for different countries, may not be directly comparable across countries.

For Hypothesis II, we focus on testing whether β_{mean}, the coefficient of credit expansion in the mean regression, is different from zero. Due to the increased crash risk associated with credit expansion, there is a concern that the estimate of β_{mean} might be strongly influenced by a small number of crashes. To address this concern, we also examine the estimate of β_{median}, the 50th quantile regression, which provides an upper bound on β_{mean}.

From an empirical perspective, it is useful to note that bank credit expansion may also be correlated with a time-varying equity premium caused by forces independent of the financial sector, such as by habit formation of representative investors (Campbell and Cochrane, 1999) and time-varying long-run consumption risk (Bansal and Yaron, 2004). A host of variables are known to predict the time variation in the equity premium, such as dividend yield, inflation, the short term interest rate, the term spread, the corporate yield spread, investment to capital, and consumption to wealth. See Lettau and Ludvigson (2010) for a review of this literature. It is thus important in our analysis to control for these variables to isolate effects associated with bank credit expansion.

Returning to Hypothesis I, to study crash risk without relying on a particular choice of quantiles, we also use an alternative measure of the impact of credit expansion on negative

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quantiles is a good compromise, allowing strong statistical power while being indicative of large negative movements in prices.

skewness of subsequent equity returns by computing (β_{median} - β_{mean}), the difference between the coefficient from a median regression (50th quantile regression) and the coefficient from the mean regression.

Taken together, we examine four main statistics: β_{mean}, β_{median}, (β_{mean} - β_{median}), and $\beta_{negative\ skew}$ from the quantile regressions and the mean regression. Special care must be taken to estimate these predictive return regressions in a financial panel data setting. The main concern is that both outcome variables (e.g. overlapping n-quarter-ahead excess returns, n = 1, 2, 4, and 8) and explanatory variables (e.g. bank credit expansion and controls) are correlated across countries (due to common global shocks) and over time (due to the overlapping returns or persistent country-specific shocks). If these concerns are not appropriately accounted for, the standard errors of the regression coefficients can be biased downward. Therefore, we estimate standard errors that are dually clustered on time and country, following Thompson (2011), to account both for correlations across countries and over time.

For the panel regression model with fixed effects, Thompson's dually-clustered standard errors are implemented in Stata using White standard errors adjusted for clustering on time and country separately, and then combined into a single standard error estimate using the formula derived in Thompson (2011). For quantile regression estimates, we estimate standard errors by block bootstrapping, drawing blocks that preserve the correlation structure both across time and country. In the case of testing linear restrictions of coefficients, multiple regressions are estimated simultaneously to account for correlations in the joint estimates of the coefficients. For example, in testing the null H_0: $\beta_{negative\ skew} = (\beta_{q=50} - \beta_{q=5}) - (\beta_{q=95} - \beta_{q=50}) = 0$, standard errors are generated by block bootstrapping *simultaneous* estimates of the q=5, 50, and 95 quantile regression. Similarly, the difference between the mean and median coefficients, H_0: $\beta_{mean\text{-}median} = 0$, is tested by *simultaneously* bootstrapping mean and median coefficients; the resulting Wald statistic is then used to compute a p-value.

To assess the robustness of our skewness coefficients estimated from quantile regressions, we also estimate probit regressions as a simple alternative to our quantile-based approach, using an equity crash indicator as the dependent variables. The idea is to predict future stock crashes using bank credit expansion and various controls. Specifically, we estimate the following probit model:

$$\Pr\left[Y = 1 \,\middle|\, (predictor\ variables)_{i,t}\right] = \Phi[\alpha_{i,q} + \beta_q'(predictor\ variables)_{i,t}] \tag{4}$$

and compute marginal effects, where Φ is the CDF of the standard normal distribution, and Y is a future crash indicator ($Y = 1_{crash}$), which takes on a value of 1 if there is an equity crash in the next K quarters (K = 1,4, and 8) and 0 otherwise.[4] Given that an increased crash probability may be driven by increased volatility rather than increased negative skewness, we also estimate equation (4) with ($Y = 1_{boom}$), where 1_{boom} is a symmetrically defined positive tail event, and compute the difference in the marginal effects between the two probit regressions.

To examine Hypothesis III, we estimate an alternative non-linear model of the predicted equity excess return subsequent to a significant credit expansion:

$$r_{i,t+K} = \alpha_i + \beta \cdot 1_{\{credit\ expansion>x\}} + k \cdot controls + \epsilon_{i,t}, \tag{5}$$

where $x > 0$ is a threshold for credit expansion, expressed in standard deviations from each country's mean. In the absence of controls, this model is equivalent to computing a simple average conditional on credit expansion exceeding the given threshold x. The advantage of this formal estimation technique over simple averaging is that it allows us to add control variables and also to compute dually-clustered standard errors in the hypothesis testing, since the error term $\epsilon_{i,t}$ is possibly correlated both across time and across countries. This model specification is non-linear with respect to credit expansion and thus also serves to ensure that our analysis is robust to the linear regression models described earlier. After estimating this model, we report a z statistic to test whether the predicted equity premium $E[r_{i,t+K} \mid \cdot]$ is significantly different from zero.

Furthermore, to determine whether the predicted equity excess return is symmetrical with respect to credit expansions and contractions, we also estimate a similar model by conditioning on credit contraction, i.e., credit expansion lower than a negative threshold $y < 0$:

$$r_{i,t+K} = \alpha_i + \beta \cdot 1_{\{credit\ expansion<y\}} + k \cdot controls + \epsilon_{i,t}. \tag{6}$$

[4] Note that the crash indicator probit regressions have a slightly different interpretation from quantile regressions: the indicator variables suggest the frequency of tail events, while quantile movements indicate the severity of tail events.

III. Data and Summary Statistics

We construct a panel data set of 23 countries from 1920 to the present using quarterly data. The main outcome variables in our dataset are excess returns of the bank equity index and equity market index. The main predictor variable is three year change in bank credit to GDP. In addition, we employ a host of financial and macroeconomic variables, which are known to predict the equity premium and serve as controls.

The data set is complete for most countries from 1950 onwards, and for about half the countries from 1920 onwards. The sample length of each variable for each country can be found in Table A1 in the appendix.

A. Key variables

Our main predictor variable is the three year change in *bank credit to GDP*. *Bank credit* refers to credit extended from banks to domestic households and private non-financial corporations. It excludes interbank lending and thus only includes non-public end users of credit.[5] Our time series on bank credit to GDP is derived from two sources: "bank credit" from the BIS's "long series on credit to private non-financial sectors," which covers a large range of countries but generally only extends back a few decades, and from the data of Schularick and Taylor (2012) on "bank loans," which extend back over a century but only for 14 countries.

Throughout the paper, we refer to three year change in bank credit to GDP as "bank credit expansion" (or "contraction" when the change is negative). We look at three year changes, rather than levels, for the following reasons. First, as shown later on in Figure 2, bank credit is rising during booms and falling during crises, while the level may still be high *after* the crisis or crash. Thus, the change of credit, not the level, is more indicative of economy-wide expansion and contraction and separates before versus after the start of banking crises. Second, credit as a percentage of GDP exhibits long-term trends presumably related to structural and regulatory factors. Differencing bank credit removes the secular trend and allows us to focus on cyclical

[5] We use bank credit to GDP rather than a measure of bank leverage (such as bank book equity to assets) for a practical reason. Measures of bank leverage are available for most countries only after 1980. As we will show later, bank credit to GDP is highly correlated with bank leverage measures.

movements corresponding to credit expansions and contractions.[6] When estimating regressions, we normalize the three year change in bank credit to GDP by its mean and standard deviation within each country.

The main outcome variable is future excess returns for both the equity market index and the bank equity index for each country. Our main source for both series is Global Financial Data (GFD), and we choose well-known broadly-focused, market-cap-weighted indices for each country. We construct *bank equity excess returns* and *equity excess returns* for all countries by subtracting the *short-term interest rate* from the equity returns. For forecasting purposes, we construct one-quarter-ahead excess returns by applying a lead operator to the excess returns. We also construct 2-, 4-, and 8-quarter-ahead excess returns in an overlapping fashion.[7]

We also employ several financial and macroeconomic variables known to predict the equity premium as controls. The main control variables are *dividend yield, book-to-market*, *inflation,* and the *term spread*. Additional controls include the *short-term interest rate, non-residential investment to capital, the corporate yield spread, real GDP growth,* and *household consumption to wealth*. We also employ various other measures of aggregate credit and leverage of the household, corporate and financial sectors, and measures of international credit. Further information on data sources and variable construction for all variables can be found in the Appendix.

Finally, we also define a *crash indicator*, which takes on the value of 1 if the real return of the underlying equity index is less than -20% in one quarter or less than -30% in two quarters, and 0 otherwise.

B. Summary Statistics

Table 1 presents summary statistics for equity index returns, bank equity index returns and credit growth. Observations in Table 1 are pooled across all time periods and countries. Table 1 reports summary statistics for: equity excess returns, equity total excess returns (excess index

[6] As an alternative approach, we also tried using as our main predictor variable de-trended *levels* of bank credit, using a one-sided Hodrick-Prescott (HP) filter (λ=100,000) to de-trend the series; results were qualitatively similar.

[7] Throughout the paper, we specifically exclude quarters from our analysis when inflation within ±1 year of the given quarter is greater than 30%, because returns and interest rates become unreliable on the quarterly level. Fortunately, this is a rare occurrence in developed countries in the post-war period.

returns + dividends), equity real returns (index returns - inflation), and bank equity excess returns and real returns (defined as above but for the bank equity index). The returns and standard deviations are all expressed as annualized log returns. The label Δ (bank credit / GDP) is the annualized three-year change in bank credit to GDP.

As can be seen in Table 1, the mean equity excess return is 7.0% (3.3% without including dividends). The mean equity real return is 4.9%. Bank stocks have lower mean returns (-0.5% excess returns and 1.5% real returns), though these numbers exclude dividend payments by bank stocks, on which we unfortunately have no historical data. We also report the median returns for all variables. The standard deviations of returns are around 20-30% for equity index returns, with higher numbers for bank stock returns.

Given that we define crash indicator variables and negative skewness statistics from quantile regressions based on 5th percentile events, it is useful to get a sense of what magnitude drops these percentiles correspond to. A 5th percentile drop, which occurs on average once every 5 years, corresponds to a -65.7% annualized real return or a -16.4% quarterly real return. On this basis, the crash indicator defined earlier, based on the real return of the equity index being less than -20% in one quarter or less than -30% in two quarters, corresponds to an event that occurs 3.6% of quarters, or once every 7 years on average.

Table 1 also gives a sense of the magnitudes and variability of credit expansion. On average, bank credit to GDP expanded by 1.3% per year. In terms of the variability of credit expansion, bank credit expansion grew as rapidly as 12.0% of GDP per year (99th percentile) and contracted as rapidly as -6.7% of GDP per year (1st percentile).

The variability of bank and total credit expansion can be seen visually in Figure 1, which plots Δ (bank credit / GDP) over time. The time series for all countries appear mean-reverting and cyclical, with periods of rapid credit expansion often followed by periods of credit contraction. Stock crash events (blue vertical lines) are added to give a visual sense of the relationship between credit expansion and crashes.

Table 2 provides additional characteristics of bank credit expansions. Panel A summarizes several variables that predict future credit expansion based on an OLS panel regression with fixed effects for the three-year change of bank credit to GDP (normalized within each country) against the three-year lagged value of each of the following variables: equity index returns, daily equity market volatility, real GDP growth, the term spread, and the sovereign yield spread. Consistent with our expectations, bank credit expansions tend to follow economic booms. More specifically, high equity index returns, low daily equity market volatility, high real GDP growth, large term spreads, smaller corporate yield spreads, and lower sovereign yield spreads in the past three years tend to precede larger bank credit expansions in the subsequent three years.

Panel B shows that bank credit expansion is positively correlated to changes in other aggregate credit variables (total credit, total credit to households, total credit to non-financial corporations, bank assets to GDP, and growth of household housing assets), leverage (of the household, corporate, and banking sectors), and with change in international credit (current account deficits to GDP and change in gross external liabilities to GDP). All variables here are normalized within each country. In particular, R^2 is high for the total credit, household and corporate credit, bank assets, change in gross external liabilities, and household and corporate leverage, demonstrating the tight correlation between different measures of credit.

In Figure 2, we see that historical banking crises, based on data from Reinhart and Rogoff (2009), are accompanied by large drops in equity markets, and especially in bank stocks. On average, the equity market drop starts roughly one year before the start of the banking crisis and continues until two to three years after the start of the crisis. In addition, credit peaks at the start of the crisis, with credit contraction starting within the first year of the start of the crisis.

Table 3 presents cross-country correlations of a set of variables. To economize on space, Table 3 only presents the cross-country correlations of other countries with the U.S. (except in the case of the sovereign yield spread, in which case we analyze the correlation with the U.K's., given that the U.S. has by definition a constant sovereign yield spread of 0). In general, quarterly equity excess returns are moderately correlated across countries (average correlation = 0.50) and bank equity excess returns are even less so (0.37). Bank credit expansions have historically been quite idiosyncratic in nature (average correlation = 0.10), which is surprising, considering that the two most prominent credit expansions -- those leading up to the recent financial crisis and the Great Depression -- were global in nature. The relatively idiosyncratic nature of historical credit expansions helps our analysis, as their associations with equity returns and crashes may be attributed directly to local credit expansions and not indirectly through spillover from crises in other countries.

IV. Empirical Results

In this section, we report our empirical findings. We first demonstrate that credit expansion predicts an increased equity crash risk in subsequent quarters and then that credit expansion predicts a decrease in the mean and median equity excess returns. Finally, we report mean equity excess returns, conditional on bank credit expansion either exceeding a positive threshold or falling below a negative threshold.

A. Predicting crash risk

To test Hypothesis I, we estimate the quantile regression model specified in Equation (2) of Section II.B to examine the predictability of bank credit expansion (normalized within each country) for the full distribution of subsequent equity returns. Table 4 reports estimates from the quantile regressions. The columns correspond to 1-, 2-, 4-, and 8- quarter-ahead excess returns, first for the bank equity index and then for the equity market index. The first block of rows reports estimates for quantile regressions on credit expansion with no controls, the second block reports estimates on credit expansion with a set of controls, including dividend yield, book to market, term spread, and inflation. The coefficients and t-statistics for credit expansion are reported for the three quantile regressions, $\beta_{q=5}$, $\beta_{q=50}$, and $\beta_{q=95}$, followed by the conditional negative skewness coefficient $\beta_{negative\ skew} = (\beta_{q=50} - \beta_{q=5}) - (\beta_{q=95} - \beta_{q=50})$ and its associated t-statistic. To save space, coefficients on control variables are not reported in Table 4; they are analyzed later in Table 7.

For bank equity index returns without control variables, the coefficients for negative skewness, $\beta_{negative\ skew}$, are estimated to be 0.037, 0.052, 0.091, and 0.075 (all significant at the 1% level) for 1-, 2-, 4- and 8-quarter horizons, respectively. When the controls are added, the coefficients remain similar: 0.04, 0.064, 0.131, and 0.134 (all significant at the 0.1% level except at the 1-quarter horizon) at the 1-, 2-, 4-, and 8-quarter horizons, respectively.

The interpretation of the conditional skewness coefficient is as follows: using the estimate for 4-quarter horizons, a one standard deviation rise in Δ (bank credit / GDP) is associated with a 9.1%

increased drop for a left tail event relative to a right tail event. In other words, left tail events become increasingly severe following credit expansion. This number describes the additional loss associated with a left tail event, in addition to the lowered returns due to lower conditional mean and median returns (see Table 6) and higher conditional volatility associated with credit expansion.

Similar but less pronounced patterns are observed for the equity market index: without the controls, the estimate for $\beta_{negative\ skew}$ is 0.013 for 1-quarter horizon and increases to 0.028, 0.025, 0.020 for 2-, 4- and 8-quarter horizons, respectively (1- and 2-quarter horizons significant at the 5% level). Once the controls are included, the coefficients for the 1- and 2-quarter horizons remain roughly the same and significant at the 5% level, while for the 4- and 8-quarter horizons become smaller and insignificant. As one would expect, tail risk for equity market index returns has a smaller association with bank credit expansion because the crash risk in the equity market index originates indirectly from the financial instability of banks.

As an robustness check for increased crash risk, we also estimate the probit regression model specified in equation (3), and report marginal effects, with the dependent variable being the crash indicator ($Y = 1_{crash}$), defined in Section III and which takes on a value of 1 if there is a future equity crash in the next K quarters (K = 1, 4, and 8) and 0 otherwise. Given that an increased crash probability may be driven by increased volatility rather than increased negative skewness, we also estimate equation (3) with ($Y = 1_{boom}$), where 1_{boom} is a symmetrically defined positive tail event and compute and test the difference in the marginal effects between the two probit regressions.

Table 5 reports the marginal effects for the probit regressions and in general reinforces the conclusion from examining negative skewness in Table 4. Crashes of the bank index are analyzed in panel A, and crashes of the equity index are analyzed in panel B. Regressions are estimated with normalized bank credit expansion and with and without the four standard controls. Table 5 shows that, similar to the estimates of conditional negative skewness from Table 4, bank credit expansion predicts an increased probability of negative tail events. The following control variables also predict increased negative tail risk: lower dividend yield, lower book to market, and higher inflation.

In summary, consistent with Hypothesis I, we find that bank credit expansion predicts an increase in the negative skewness of returns of the bank equity index and equity market index in the subsequent 1 to 8 quarters. This predictability is particularly strong for the bank equity index.

B. Predicting the equity premium

We now turn to testing Hypothesis II. Table 6 estimates the mean regression model specified in equation (1) of Section II.B (the standard OLS fixed effects model) and the median (50th quantile) regression. The mean regression coefficient β_{mean} tells us about the equity excess return predictability conditional on a one standard deviation increase in credit expansion. By comparing β_{mean} to β_{median} from the median regression, we can see, as a function of credit expansion, how much the equity return changes "most of the time" (the median coefficient) and how much of the excess return is driven by tail events (to which the mean coefficient is sensitive).

Table 6 is structured similarly to Table 4. Each column corresponds to 1-, 2-, 4-, and 8-quarter-ahead excess returns, both for the bank equity index and the equity market index, specifically. The first block of rows presents the results of mean and median regressions on credit expansion without controls, the second block presents coefficient estimates for credit expansion after including dividend yield, book to market, term spread, and inflation as controls. Coefficients and t-statistics are reported for the mean and median regressions, along with the (within-country) adjusted R^2 for the mean regressions.[8] In addition, the difference between the mean and median is estimated, along with an associated p-value.

The coefficients from the mean regression measures the change in equity premium associated with normalized credit expansion. For the bank equity index, the coefficients are: -0.013, -0.027, -0.061, and -0.127 for the subsequent 1-, 2-, 4-, and 8-quarter excess returns, respectively, and are all significant at least at the 1% level. The adjusted R^2 ranges from 0.7% for 1-quarter horizons to 8.7% for 8-quarter horizons. When the controls are included, the coefficients generally are slightly lower and have similar statistical significance, and the adjusted

[8] R^2 is a measure of the percentage of variation of the dependent variable accounted for by the model. In calculating R^2 in the context of a fixed-effects panel regression, we properly exclude the variation accounted by the country fixed-effects (the "between" variation) and only measure the variation due to the coefficients on the predictor variables (the "within" variation).

R^2 is increased across all horizons, and in particular, from 1.0% for the 1-quarter horizon to 15.3% for the 8-quarter horizon.

For the equity market index, the coefficients are smaller: -0.009, -0.019, -0.039, and -0.069 (all significant at the 0.1% significance level) for 1-, 2-, 4-, and 8-quarter-ahead excess returns, respectively.[9] Coefficient estimates remain similar in magnitudes after including the controls.

One general point is that, for both the equity market index and the bank equity index, coefficients for mean regressions are roughly proportional to the number of quarters, meaning that the predictability is persistent and constant per quarter for each quarter up to about 2 years.[10]

Due to the increased crash risk induced by credit expansion, one might argue that the lower mean returns might be caused by a small number of crashes in the sample period. To address this concern, we decompose β_{mean} into two components β_{median} and (β_{mean} - β_{median}). β_{median} measures how much the equity premium is lowered "most of the time" when there is credit expansion, while β_{mean} - β_{median} measures how much the equity premium is reduced due to the occurrence of tail events in the sample. β_{mean} - β_{median} also provides an alternative estimate of negative skewness in subsequent equity returns.

Table 6 also reports estimates for median coefficients. Estimates for β_{median} are -0.005, -0.013, -0.032, and -0.092 for the bank equity index and -0.005, -0.013, -0.033, and -0.059 for the equity market index (1-, 2-, 4- and 8- quarter horizons, respectively). All coefficient estimates are significant at the 1% or less significance level, except the bank equity index at the 1-quarter horizon. After including the controls, the estimates remain at similar values. In general, the median coefficients are about 1/2 to 3/4 the level of corresponding mean coefficients, which imply that about 1/4 to 1/2 of the decrease in the mean equity return is driven by an increase in the severity or frequency of negative tail events.

[9] The higher coefficients for bank equity index are not due to bank stocks just having a high market beta, which would simply magnify the effects that credit expansion has on the broad market. The bank equity index has a market beta of about 1); even after subtracting out the market component of bank returns using a computed time-varying beta, the resulting idiosyncratic component of bank returns still has similar coefficients when regressed on bank credit expansion.

[10] The coefficients level off after about 3 years (in unreported results), implying that the predictability is mostly all incorporated into returns within 3 years.

Table 6 also reports the difference between mean and median coefficients, β_{mean} - β_{median}, to be 0.009, 0.014, 0.029, and 0.035 for the bank equity index and 0.005, 0.006, 0.006 (not significant), and 0.009 for the equity market index at the 1-, 2-, 4- and 8- quarter horizons, respectively; all significant at the 5% level or less except for the one marked. After including the controls, the estimates remain at similar values. As β_{mean} - β_{median} provides an alternative measure of the negative skew in equity returns, this result again confirms the finding in Table 4 that bank credit expansion predicts a significant increase in the negative skew of the subsequent returns of the bank equity index and equity market index.

Next, we provide in Figure 3 a visual presentation of the equity excess return predicted by credit expansion. We use the mean regression estimates from Table 6 with a 4-quarter forecast horizon to predict future excess returns. Figure 3 shows predicted excess returns plotted over time for each of the countries in our sample, 1960-2012. The red line shows the predicted excess returns conditional only on credit expansion, and the black line shows predicted excess returns conditional only on the controls, with panel A for the bank index and Panel B for the equity market index. Figure 2 also shows crash indicators plotted using blue vertical lines denoting quarters with a crash in the bank equity index (for panel A) or equity market index (for panel B).

There are several notable points from Figure 2. First, the equity excess return predicted by credit expansion is largely unrelated to that predicted by the controls, despite both being highly variable. This pattern is consistent with the formal results presented in Table 6. Second, the predicted equity excess return is often negative, sometimes highly so, during periods of rapid credit expansions. For the bank equity index (panel A), the predicted excess returns are negative at less than -10% (annualized), for example in various historical episodes of rapid credit expansions in countries such as Finland, Japan, Norway, Sweden, Switzerland, and the UK. More extreme examples occur in such countries as Denmark, Malaysia, the Netherlands, and Spain, where the predicted excess returns can reach -15%. Third, the predicted excess returns are often quite high after crashes. Later in Section IV.D, we examine the robustness of the negative predicted returns after credit expansions and positive predicted returns after credit contractions.

Finally, in Table 7, we analyze control variables, both the four standard controls and other potential controls, using variables that are known to be predictors of the time-varying equity premium. Our first goal is to evaluate whether bank credit expansion predicts the equity premium because it is closely related to one of these control variables or whether it adds new predictive power beyond these other variables. We find the latter, as the coefficient on bank credit expansion is unchanged in the presence of other controls. Our second goal, as a robustness check, is to ask if these control variables predict the equity excess return in the direction and magnitudes previously reported in the literature.

Table 7 reports the results from estimating mean regressions with various sets of controls: 1) normalized credit expansion, 2) the four controls used earlier (D/P, Inflation, Term Spread, and Book to Market), 3) four additional controls (the short-term interest rate, non-residential private investment to capital, the corporate yield spread, and the sovereign spread), 4) plus household consumption to wealth. Our criterion for selecting these subsets is to start with the controls that are most statistically significant and for which there is most availability of data. We save consumption to wealth until the end, due to relatively limited data availability.

Panel A reports coefficients for mean regressions with future excess returns of the bank equity index as the dependent variable, and panel B reports coefficients for mean regressions but using the equity market index. With each horizon, the first column uses just credit expansion with no controls, and each subsequent column adds another set of control variables. The second column adds dividend yield, inflation, the term spread, and book to market. These controls are all highly significant and noticeably increase the R^2 of the regressions; hence they are used as standard controls throughout the paper. The additional variables in the third column (the short-term interest rate, non-residential private investment to capital, the corporate yield spread, and the sovereign spread) are generally less significant. Several of these variables feature limited data, which cuts the sample size for these regressions almost in half. Both these reasons preclude their use as controls in the rest of the paper. Finally, the fifth column adds consumption to wealth, which has especially strong statistical significance and predictive power as measured by R^2. However, despite its high R^2, consumption to wealth is very limited by data availability, so we also exclude consumption to wealth as a standard control in this paper.

In Table 7, we see that dividend yield, book to market, the term spread, consumption to wealth, and the short-term interest rate are all associated with a higher equity premium. Inflation and the sovereign spread are both associated with a lower equity premium. The rest of the variables are not significant. The signs of the coefficients (except for possibly the sovereign spread) are in line with our prior beliefs and the literature about the determinants of the equity premium. In addition, the coefficient for bank credit expansion remains approximately the same magnitude and significance, despite the controls that are added. Thus, bank credit expansion adds new predictive power beyond these other variables and is not simply proxying for a well-known predictor of the equity premium.

Taken together, our analysis so far shows that bank credit expansions are followed by increased crash risk in returns of the bank equity index and equity market index, and that despite the increased crash risk, the predicted equity excess return falls rather than increases. It is important to note that bank credit expansions are directly observable to the public. Thus, it is rather surprising that bank shareholders and stock investors do not demand a higher equity premium from their stock holdings to compensate them for the increased crash risk. This finding challenges the narrowly-focused agency view that bank credit expansions are simply caused by bankers acting against the will of shareholders. Instead, our finding suggests the presence of either over-optimism or elevated risk appetite of stock investors during the periods of bank credit expansions.

C. Robustness

In this subsection, we perform several robustness checks to make sure that our results are not driven by any particular countries or any particular time period: for example, the recent global financial crisis or the Great Depression. We also examine the out-of-sample predictability of credit expansion for mean returns.

C.1 Robustness in subsamples

Table 8 reports mean, median, the difference between mean and median, and negative skewness coefficients for Δ (bank credit / GDP) on future equity excess returns for various subsets of countries and time periods. Using a 4-quarter forecasting horizon, the regressions are exactly the same as those reported above. The only difference here is that, for Panel A, the data is subdivided into geographical regions, and separate regressions are run for each of the regions. In Panel B, we change the time period: one set of regressions is run on the entire time period (1920-2013), another is run excluding the most recent crisis (1920-2007), and a third is run excluding both the recent crisis and the Great Depression (1950-2007).

In Panel A, for both the bank equity index and the equity market index, we see that the coefficients for the mean are similar for each of the geographical subsets as they are for the full sample of developed countries. The mean coefficients are slightly larger for some regions (South Europe, Western Europe, Scandinavia) and slightly lower for other regions (Asia and English Speaking). For the equity market index but not for bank equity index, the statistical power is reduced for several regions, though that is probably due to the smaller sample size in these subsets. The skewness coefficients for both the bank equity index and equity market index are similar across regions, and with somewhat less statistical power due to the smaller sample size.

Panel B shows the estimated mean, median, difference, and negative skew coefficients of Δ (bank credit / GDP) on future excess returns for different sample periods. In general, the coefficients have almost the same magnitude and statistical significance regardless of the sample period we use.

C.2 Robustness in out-of-sample predictions

We now assess out-of-sample mean return predictability. The strength of out-of-sample predictability based on credit expansion demonstrates that stock investors should have been able to forecast negative equity returns when credit was expanding rapidly. In other words, these results demonstrate that the market corrections subsequent to credit expansions are foreseeable before the fact.

Table 9 reports adjusted R^2 values for both in-sample and out-of-sample predictions in the full set of countries. Out-of-sample prediction is computed by estimating the mean regression using only information from year 1950 to year (t-i), where i is the forecast horizon in years.[11] Regressions are estimated with normalized bank credit expansion[12] and with and without the four standard control variables: dividend yield, book to market, inflation, and the term spread. Both in-sample and out-of-sample equity excess return predictions are computed for each quarter in the period 1960-2012. The adjusted R^2 values are reported as the total R^2 for bank credit expansion without controls, as the additional R^2 coming from bank credit expansion over the controls, and as the total R^2 for only the controls.

[11] Due to the interruption of our data sample during the World War II, we use only the data from 1950 onward to perform the out-sample prediction analysis.

As highlighted by Goyal and Welch (2008) in U.S. data, while there is substantial in-sample equity return predictability with standard variables such as dividend yield and book-to-market, out-of-sample predictability is typically poor. Table 9 reveals a consistent result with the total R^2 for the controls (which are similar to the predictors evaluated by Goyal and Welch): for the bank equity index, the in-sample R^2 is substantial, 4.3%, 6.5%, and 8.6% for the 4-quarter, 8-quarter, and 12-quarter ahead forecasts, respectively. However, out-of-sample R^2 for the controls is minimal, 0.0% for the 4-quarter and 8-quarter ahead forecasts and 0.3% for the 12-quarter ahead forecasts. There is a similar drop in the total R^2 of the out-of-sample forecasts of the equity market index.

Interestingly, the out-of-sample R^2 for bank credit expansion is notably more robust than that for the controls. For both the bank equity index and equity market index, the in-sample R^2 of bank credit expansion is comparable to that of the controls. But the out-of-sample R^2 of bank credit expansion, measured by either R^2 without controls or R^2 over the controls, is considerably higher than that of the controls, and can be as high as 2.8% and 2.4% for some horizons for the bank equity index and equity market index, respectively.

D. Excess returns subsequent to credit expansions and contractions

In this subsection, we test Hypothesis III by examining the magnitude of equity excess returns subsequent to credit expansions and contractions by estimating the non-linear regression models (5) and (6) discussed in Section II.B. These regressions robustly test whether the predicted excess return is negative subsequent to a credit expansion and elevated subsequent to a credit contraction. We also compare the magnitude of the predicted excess return conditional on a credit expansion and contraction of the same size to examine whether the effects are symmetrical.

Recall equations (5) and (6) from Section II.B. We regress 4-quarter and 8-quarter-ahead excess returns on either an indicator for credit expansion exceeding a positive threshold or an indicator for credit contraction falling below a negative threshold, along with the four standard control variables. This non-linear specification allows us to compute the predicted excess return

[12] Here, normalization is done using only past information.

conditional on a substantial credit expansion or contraction without relying on the linear specifications used in our earlier analysis.

Figure 4 plots the predicted 4-quarter and 8-quarter-ahead excess returns for the positive threshold varying from 0 to 2.5 standard deviations and the negative threshold from 0 to 2.5 standard deviations. Panel A is for the bank equity index, and panel B is for the equity market index. The black lines are estimates without control variables, and the blue lines are estimates with controls. A 95% confidence interval is computed for each point. The point estimates and z scores are also reported in Table 10, along with number of historical episodes (defined either as separate countries or separate historical periods within one country) meeting the credit expansion threshold to verify that the results are not being driven by a small number of observations.

Figure 4 and Table 10, together, show that the predicted excess returns subsequent to credit expansion are robustly negative. When credit expansion exceeds 1.5 standard deviations (a substantial but reasonably frequent event), the predicted excess return in the subsequent 4 quarters is -22.3% for the bank index and -5.3% for the equity market index (both significant at the 1% level).[13] As there are 57 historical episodes satisfying this criterion, this result is not just driven by a few observations. By varying the credit expansion threshold, the predicted excess returns for both the bank equity index and the equity market index are decreasing with the threshold, and remain negative across the thresholds. In particular, the predicted excess return for the bank equity index is significantly negative for all of the thresholds.

The large and significantly negative excess return predicted by credit expansion confirms the first part of Hypothesis III and presents a challenge for models using only elevated risk appetite to explain the joint presence of increased crash risk and decreased excess return subsequent to credit expansion. We are not aware of any existing model that captures this. Instead, one would need to account for possible over-optimism of shareholders.

Furthermore, Figure 4 and Table 10 also show that subsequent to credit contractions, the excess return is positive, although smaller in magnitude relative to the negative excess returns subsequent to credit expansions of the same size. When credit contraction is greater than 1.5

[13] As our data on excess return of the bank equity index does not include dividend payoff, our measure of the predicted excess return for the bank equity index is downward biased.

standard deviations, the predicted excess return in the subsequent 4 quarters is 4.9% for the bank index and 7.3% for the equity index, both significant at the less than 5% level. As bank credit tends to contract after a banking crisis, the positive equity premium subsequent to a credit contraction is consistent with the findings of Muir (2013) that risk premia tend to be large during financial crises.

Conditional on a credit expansion and a contraction of the same size (for example, 1.5 standard deviations), the magnitude of the predicted negative excess return following the expansion is substantially greater than that of the predicted positive excess return after the contraction. This asymmetrical pattern confirms the second part of Hypothesis III and suggests that our key finding of the decreasing relationship between the predicted equity excess return and credit change is mostly driven by the drastically decreased equity premium after credit expansions rather than the increased equity premium after credit contractions.

V. Conclusion

In a set of developed economies, we find that bank credit expansion predicts significantly increased crash risk in the returns of the bank equity index and equity market index in subsequent one to eight quarters. Despite the increased crash risk, credit expansion predicts both lower mean and median returns of these indices in the subsequent quarters, even after controlling for a host of variables known to predict the equity premium. Furthermore, the predicted equity premium of the bank equity index in the four quarters after credit expansion in a country exceeding 1.5 standard deviations is significantly negative with a magnitude of nearly -20%, while after credit contraction of the same size is only modestly positive with a magnitude of about 5%. It is difficult to explain the joint appearance of increased crash risk and decreased excess return subsequent to credit expansions simply by bankers acting against the will of shareholders or by elevated risk appetite of bankers and intermediaries. Instead, there is a need to account for the role of over-optimism of shareholders.

Appendix

This appendix contains additional information related to data sources and variable construction. The sample length for each country and variable is reported in Table A1. All older historical data was extensively examined country-by-country for each variable to ensure accuracy and was compared across multiple sources whenever possible.

Bank credit expansion. The main explanatory variable is bank credit to GDP. As explained in Section III, bank credit refers to credit extended from banks to private end users of credit: domestic households and private non-financial corporations. The data for this variable are derived from two sources: "bank credit" from the BIS's "long series on credit to private non-financial sectors" and from the data of Schularick and Taylor (2012) on "bank loans." In merging the two series, we scale the level of "bank loans" to avoid breaks in the series. Still, there are slight discrepancies between the two data sources, most likely coming from differing types of institutions defined as banks, differing types of credit instruments considered "credit," and differing original sources used to compile the data. Fortunately, the BIS and Schularick-Taylor data match qualitatively, as their overlap is highly correlated.

Market and bank index excess returns. We chose well-known broadly-focused, market cap weighted indices for each country. Our main data source was Global Financial Data (GFD), though in a few cases we took data directly from stock exchanges' websites. In countries with several internationally-known equity indices (for example, the S&P 500, DJIA and NASDAQ in the U.S.), we favor the index with the broadest scope and the longest time series (the S&P 500 in the U.S.). For bank equity indices, we similarly choose market cap weighted indices of banking stocks, or when a bank-specific index was not available, an index of the financial sector.

Controls. Dividend yield comes from GFD, supplemented by data from Thompson Reuters Datastream. *Book-to-market* comes from Datastream. *Inflation* is calculated from CPI data from GFD. *Long-term interest rates* are the yields on 10-year government bonds taken mostly from GFD and OECD. *Short-term interest rates* are almost always the 3-month government t-bill rates taken from GFD, the IMF, OECD, Schularick-Taylor (2012), and other sources. Occasionally, for older data, the short-term interest rate was taken to be the yield on central bank notes, high-grade commercial paper, deposits, or overnight interbank lending; since some of these rates can rise in times of market distress and also historically have been regulated, care was taken to make sure these alternative rates, when used, were representative of the market short-term interest rate. The *term spread* is the long-term interest rate minus the short-term interest rate.

Household *consumption to wealth* is private consumption expenditure from national accounts taken from GFD divided by aggregate financial assets held by the household sector from Piketty and Zucman (2014). *Investment to capital* is private non-residential fixed investment divided by the outstanding private non-residential fixed capital stock, which comes from the Kiel Institute's database on investment and capital stock. *Daily stock volatility* is computed for each country and quarter as the standard deviation of daily returns by using daily stock returns from GFD of the equity market index. The *corporate yield spread* is the yield spread between the AAA-rated 10-year-maturity corporate bond index from GFD and the 10-year government bond. The *sovereign spread* is the yield on the 10-year government bond minus the yield on the U.S. 10-year Treasury. *Real GDP growth* (year-over-year) is calculated from nominal GDP and the GDP deflator taken from GFD.

Other measures of credit and leverage. The data on bank credit is compared with several other measures of credit: *total credit* refers to credit extended from all sources to domestic households and private non-financial corporations. The variables *total credit to households* and *total credit to nonfinancial corporations* are the same as *total credit* but decomposed into household and corporate components. All variables are normalized by GDP. Like bank credit, these credit aggregates are taken from the BIS's "long series on credit to private non-financial sectors" and cover credit extended to end users (domestic households and/or private non-financial corporations) and excludes interbank lending.

Other indirect measures of credit: *bank assets to GDP*, which comes mainly from Schularick and Taylor (2012), and *household housing asset growth,* which is the real growth in housing assets owned by the household sector, from Piketty and Zucman (2014). We also looked at leverage of the household, non-financial corporate, and banking sectors: specifically, *household debt to assets* (which is aggregate household debt to aggregate household assets from Piketty and Zucman (2014)) and *non-financial equity to assets* and *bank equity to assets* (using book values taken from Thompson Reuters Datastream). Lastly, we also examined international credit flows and aggregates using *current account to GDP* (gathered from the IMF's external debt database and OECD) and *gross external liabilities to GDP* (both public and private liabilities, from Lane and Milesi-Ferretti's (2007) database on countries' external assets and liabilities).

Backfilling/forward-filling. This paper performs all analysis on quarterly data. When data comes only in annual time series, as some of the older historical data does, the annual data (assuming it is an explanatory variable, not an outcome variable) is filled forward for the three subsequent quarters. We fill explanatory variables *forward* to avoid look-ahead bias in forecasting, since forward filled information for each quarter would already be known.

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Figure 1: Three-year change in bank credit to GDP

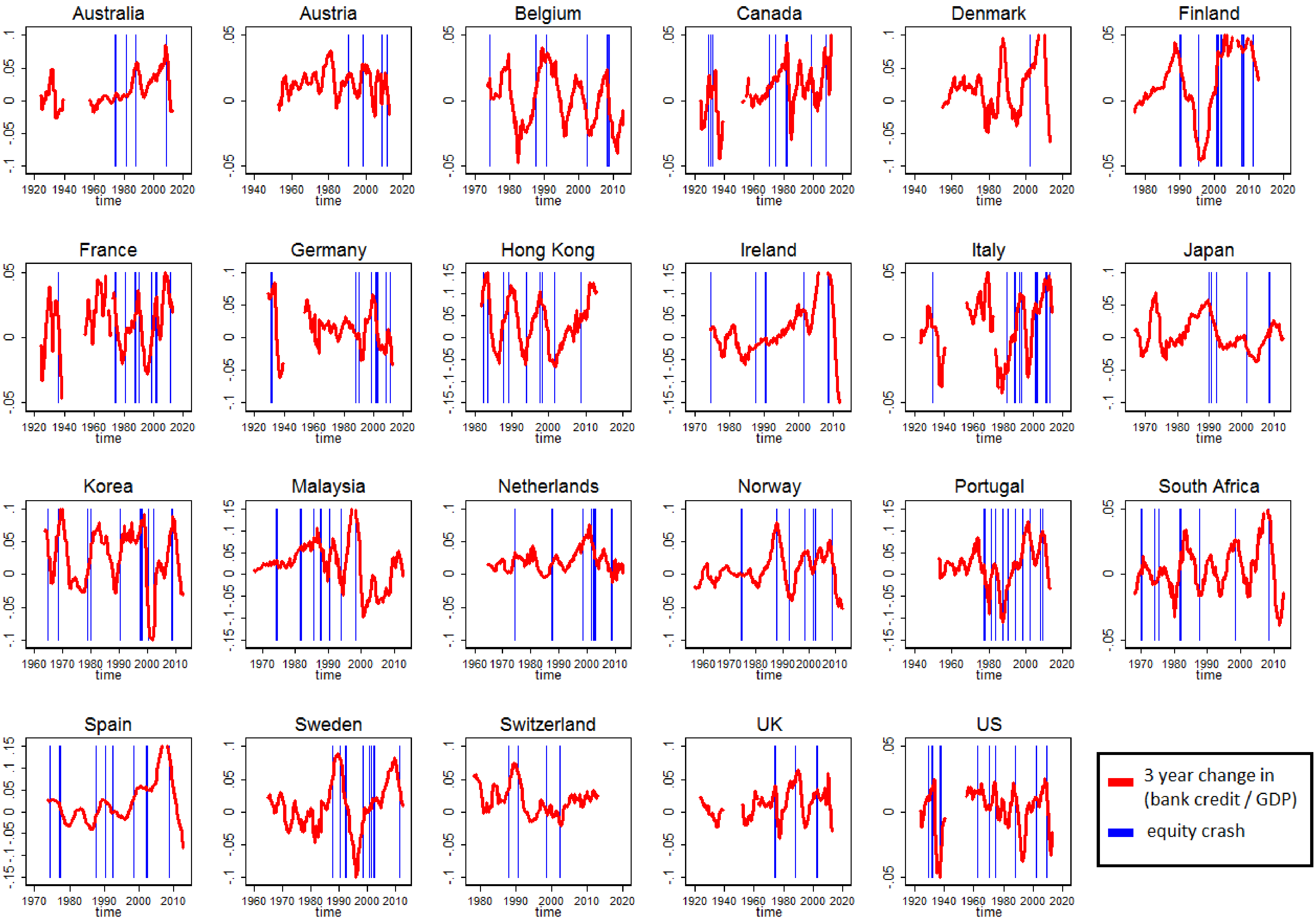


Figure 2: Credit and equity prices before and after banking crises

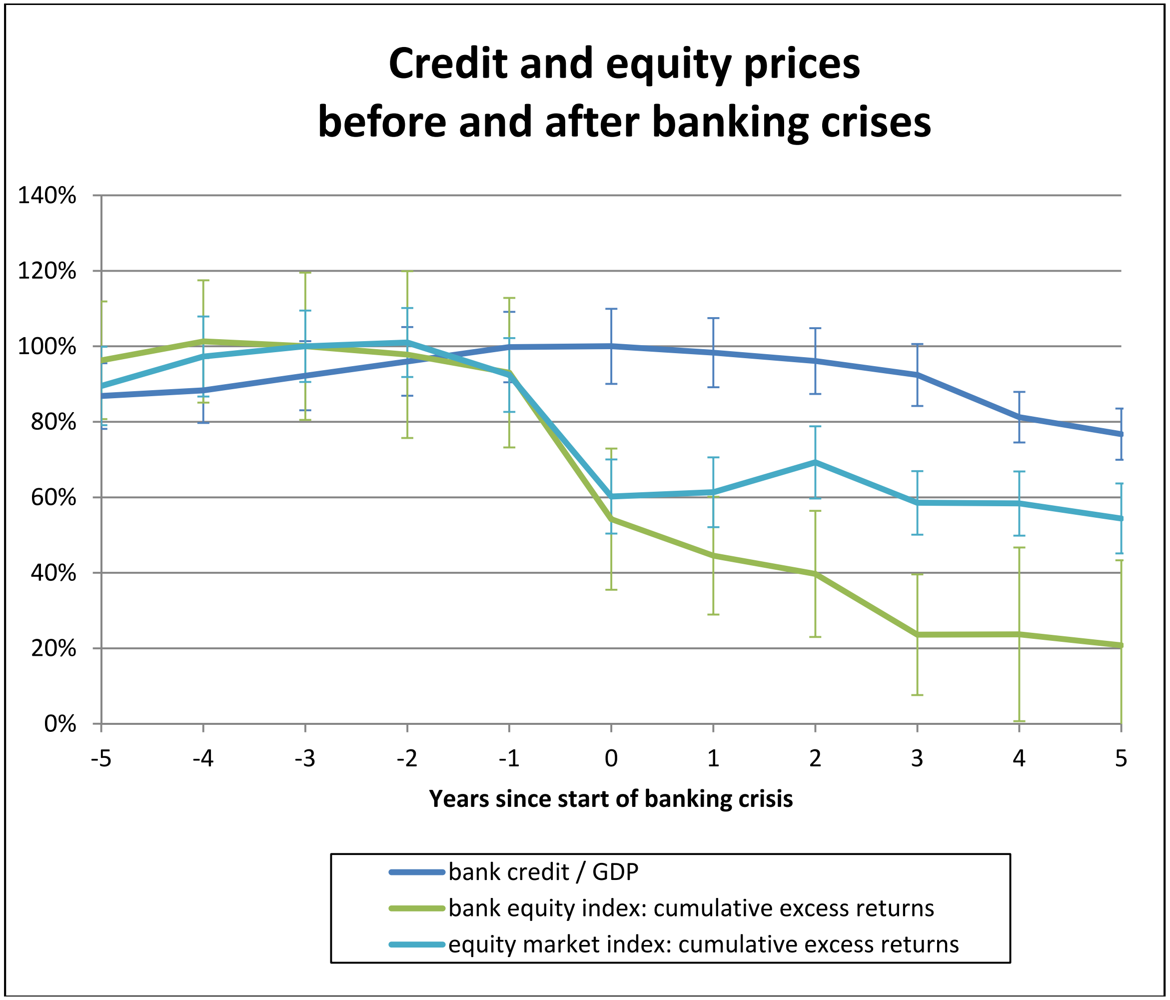


Figure 3, Panel A: Predicted excess returns for the bank index

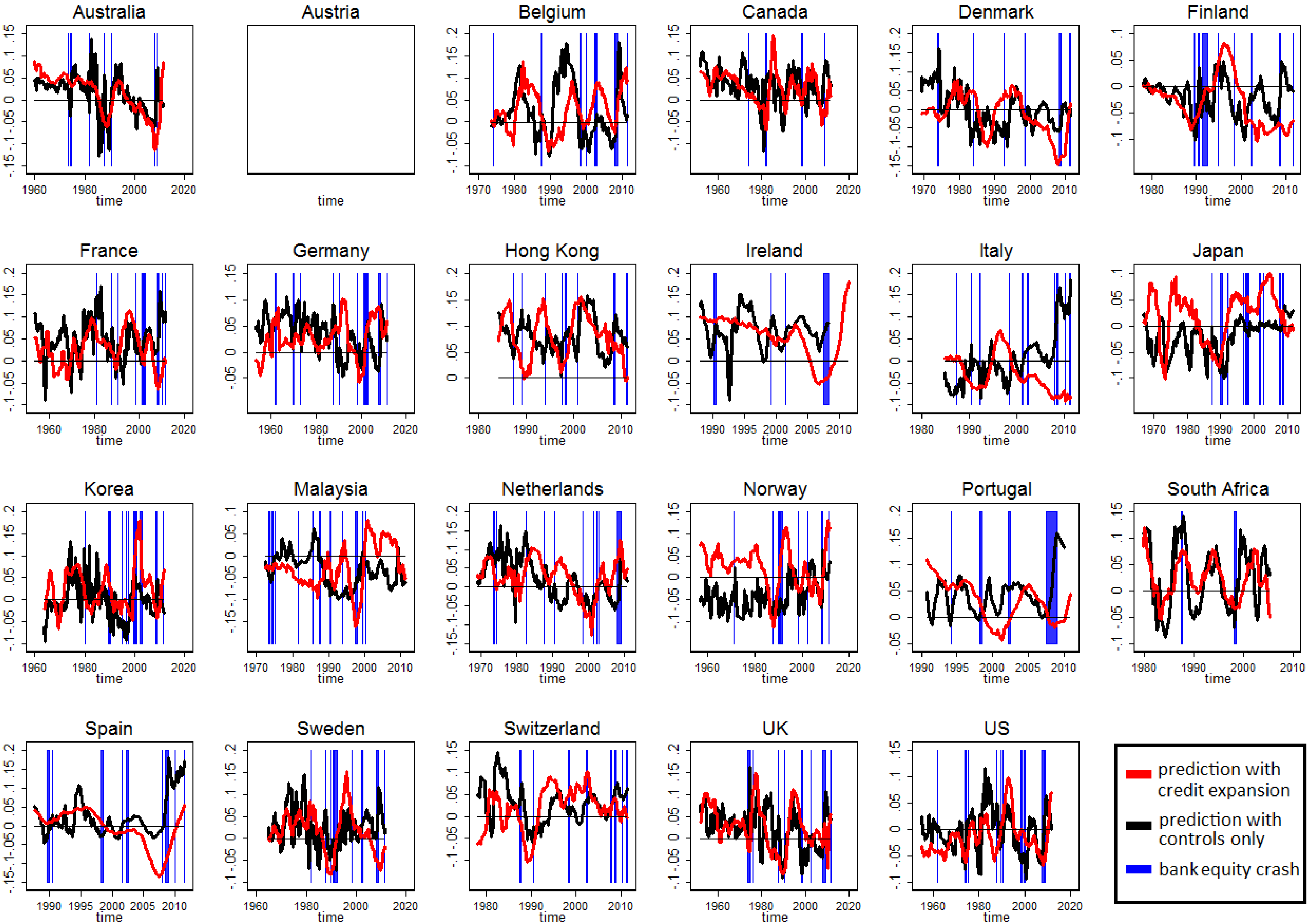


Figure 3, Panel B: Predicted excess returns for the equity index

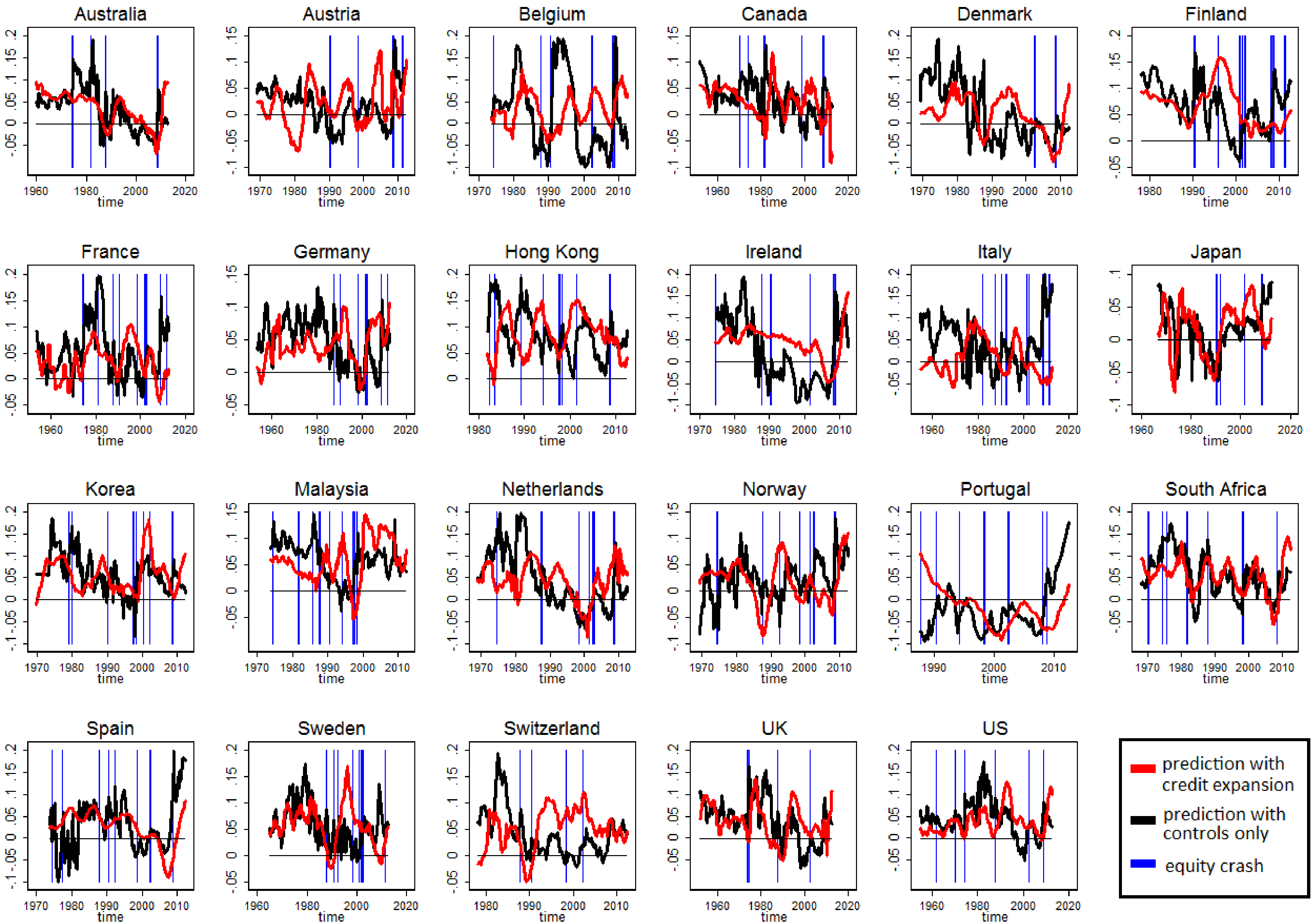
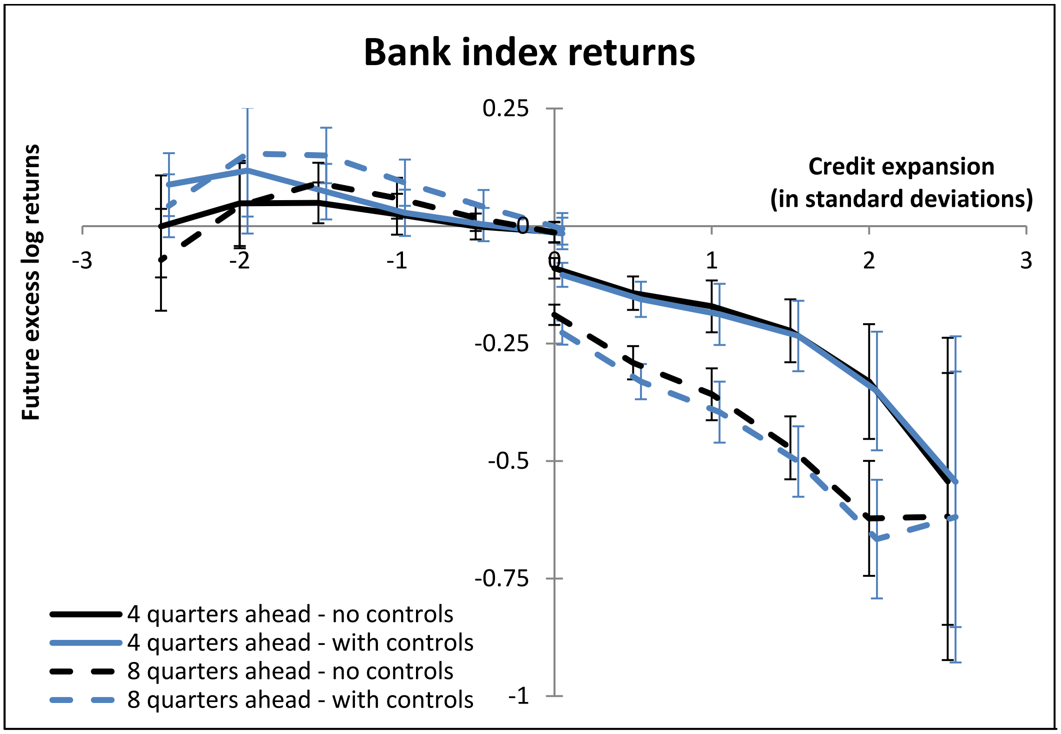


Figure 4: Negative predicted returns and asymmetric effects of credit expansion

Panel A: Bank index returns



Panel B: Equity index returns

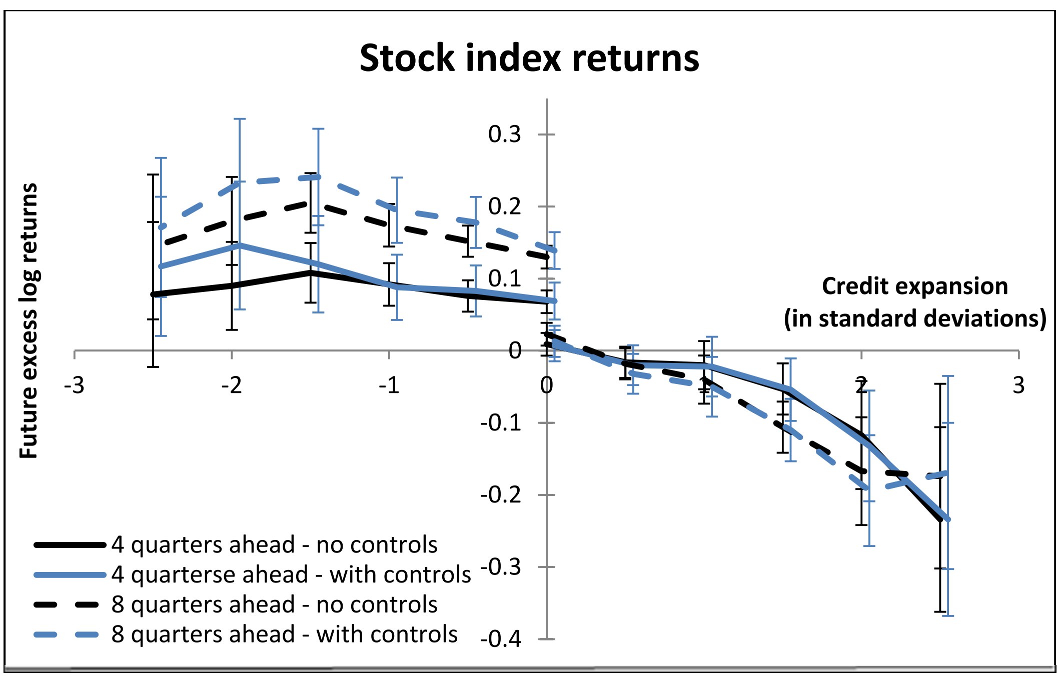


Table 1: Summary statistics

	N	Mean	Median	Stdev.	1%	5%	10%	90%	95%	99%
Quarterly log returns, annualized										
Equity excess returns	5681	3.3%	3.5%	22.8%	-110.8%	-68.3%	-47.6%	50.8%	70.9%	131.4%
Equity total excess returns (incl. dividends)	5214	7.0%	7.8%	22.6%	-107.0%	-65.4%	-45.6%	55.1%	75.7%	131.8%
Equity real returns	6481	4.9%	4.7%	28.9%	-113.9%	-65.7%	-46.5%	51.4%	71.8%	138.5%
Bank stocks excess returns	4704	-0.5%	1.9%	26.9%	-170.6%	-83.0%	-55.5%	53.1%	75.2%	133.7%
Bank stocks real returns	5256	1.5%	2.3%	34.0%	-165.3%	-79.2%	-50.5%	52.4%	75.6%	136.7%
Credit to private households and non-financial corporations, 3 year change										
Δ (Bank credit / GDP)	5004	1.3%	1.1%	3.4%	-6.7%	-3.4%	-2.2%	5.1%	6.8%	12.0%
Δ (Total credit / GDP)	4446	2.3%	2.1%	5.0%	-9.1%	-4.7%	-2.9%	8.2%	10.5%	17.3%

Table 2: Time series correlations

Panel A: Variables that predict future credit expansion

		RHS variable:						
LHS variable:		Past stock returns	Daily volatility	Real GDP growth	Term spread	Corporate yield spread	Sovereign yield spread	Short-rate differential
Future 3-year change in (bank credit / GDP), normalized	β	.139***	-.077***	.161***	.0923***	-.0965***	-.208***	.0424*
	R^2	0.03	0.03	0.04	0.02	0.08	0.06	0.01

Panel B: Contemporaneous variation with other credit variables

		RHS variable:									
LHS variable:		Δ (total credit)	Δ (total credit to HHs)	Δ (total credit to private NFCs)	Δ (Bank assets / GDP)	Growth of household housing assets	HH debt / assets	NFC equity / assets	Bank equity / assets	Δ (gross external liabilities / GDP)	Current account deficit / GDP
Current 3-year change in (bank credit / GDP), normalized	β	.85***	.632***	.684***	.583***	.376***	.192***	-.153***	-.115***	.323***	.153***
	R^2	0.74	0.45	0.52	0.34	0.19	0.13	0.12	0.09	0.13	0.03

Table 3: Cross-country correlations

Correlation with U.S., 1950-2005

	Selected countries	**Quarterly equity excess returns**	**Quarterly bank equity excess returns**	**Equity Crash indicator**	**Bank Equity Crash indicator**	**Δ (Bank credit / GDP)**	**D/P**	**C/A**	**I/K**	**Current account / GDP**	**Sovereign Spread (corr. with UK)**
	US	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	N/A
Commonwealth	Australia	0.53	0.32	0.60	0.36	0.00	0.59	0.02	0.73	0.60	0.20
	Canada	0.82	0.57	0.35	0.32	-0.34	0.92	0.75	0.66	-0.59	0.58
	UK	0.60	0.51	0.61	0.52	0.17	0.74	0.71	0.79	0.43	1.00
W. Europe	Austria	0.29		-0.02		-0.12	0.66		0.55	-0.22	0.44
	Belgium	0.57	0.45	0.66	0.40	-0.24	0.82		0.43	-0.56	0.46
	France	0.51	0.39	0.47	0.35	0.46	0.68	0.61	0.45	-0.13	0.54
	Germany	0.53	0.41	0.32	0.43	0.31	0.22	0.39	0.43	-0.35	0.36
	Ireland	0.52	0.55	0.45	0.33	0.27	0.87		0.67	-0.27	0.78
	Netherlands	0.73	0.45	0.50	0.27	0.15	0.91		0.64	-0.47	0.58
	Switzerland	0.61	0.53	0.76	0.68	0.18	0.88		0.25	-0.82	0.24
Scandinavia	Norway	0.40	0.26	0.53	0.37	0.35	0.64		0.10	-0.67	-0.03
	Denmark	0.38	0.23	0.28	0.20	0.48	0.65		0.64	-0.51	0.60
	Finland	0.46	0.30	0.10	0.20	0.29	0.60		0.18	-0.70	0.88
	Sweden	0.53	0.31	0.25	0.23	0.15	0.71		0.64	-0.70	0.41
S. Europe	Italy	0.40	0.36	0.47	0.28	0.04	0.51	0.39	0.46	0.18	0.35
	Portugal	0.37	0.33	0.22	0.26	0.04	0.05		0.70	0.34	0.05
	Spain	0.56	0.47	0.39	0.27	0.17	0.89		0.17	0.32	0.46
Asia	Japan	0.37	0.15	-0.03	0.25	0.18	0.54	0.12	-0.24	-0.79	0.35
	Korea	0.34	0.17	0.05	0.11	-0.39	-0.18			-0.67	0.76
	Malaysia	0.45	0.25	0.39	0.50	-0.08	0.17			-0.61	0.29
	Average	**0.50**	**0.37**	**0.37**	**0.33**	**0.10**	**0.59**	**0.43**	**0.46**	**-0.31**	**0.44**

Table 4: Quantile regressions and negative skewness

Explanatory variables:		Bank index 1	Bank index 2	Bank index 4	Bank index 8	Equity index 1	Equity index 2	Equity index 4	Equity index 8
Δ (bank credit / GDP)	**Q5**	-.046***	-.071***	-.125***	-.194***	-.021***	-.039***	-.06***	-.085***
	(t stat)	(-7.5)	(-5.4)	(-5.76)	(-10.55)	(-4.65)	(-4.93)	(-5.08)	(-9.44)
	Q50 (median)	-.005	-.013***	-.032***	-.092***	-.005**	-.013***	-.033***	-.059***
	(t stat)	(-1.84)	(-3.79)	(-5.49)	(-11.3)	(-2.63)	(-5.65)	(-6.77)	(-7.29)
	Q95	0.000	-.007	-.029*	-.065***	-.001	-.016**	-.03***	-.053***
	(t stat)	(-.05)	(-1.21)	(-2.41)	(-4.15)	(-.45)	(-2.7)	(-5.39)	(-4.49)
	Negative skew	.037***	.052**	.091***	.075**	.013*	.028**	.025	.02
	(t stat)	(4.05)	(3.28)	(3.95)	(3.06)	(2.14)	(3.08)	(1.92)	(1.11)
	N	3986	3986	3986	3986	4617	4617	4617	4617
Δ (bank credit / GDP) with D/P, book to market, term spread, and inflation as controls (coefficients on controls not shown)	**Q5**	-.045**	-.104***	-.152***	-.234***	-.027**	-.053***	-.074***	-.086***
	(t stat)	(-3.05)	(-6.47)	(-10.31)	(-9.24)	(-2.86)	(-4.36)	(-5.14)	(-6.00)
	Q50 (median)	-.005	-.016***	-.039***	-.103***	-.002	-.009*	-.028***	-.068***
	(t stat)	(-1.33)	(-4.06)	(-5.59)	(-9.4)	(-.85)	(-2.1)	(-4.74)	(-8.56)
	Q95	-.006	.007	-.058***	-.106***	-.002	-.005	-.009	-.03
	(t stat)	(-.81)	(.89)	(-3.99)	(-9.78)	(-.45)	(-.56)	(-.92)	(-1.87)
	Negative skew	.04**	.064***	.131***	.134***	.025*	.039*	.026	-.019
	(t stat)	(2.85)	(3.75)	(4.65)	(3.73)	(2.49)	(2.47)	(1.34)	(-.90)
	N	2473	2473	2473	2473	2679	2679	2679	2679

Table 5: Predictive probit regressions using crash indicators. All reported coefficients are marginal effects.

Panel A: Crash in bank index

		1			4			8		
		Crash	Boom	Difference	Crash	Boom	Difference	Crash	Boom	Difference
No controls	Δ (bank credit / GDP)	0.033***	0.002	0.031**	0.055***	-0.012	0.067***	0.063***	-0.026***	0.090***
		(4.29)	(0.39)	(2.76)	(6.82)	(-1.88)	(5.23)	(8.38)	(-4.47)	(7.13)
	N	4165	4165	4165	4188	4188	4188	4216	4216	4216
With controls	Δ (bank credit / GDP)	0.037***	-0.001	0.038**	0.065***	-0.025***	0.090***	0.081***	-0.050***	0.131***
		(3.75)	(-0.15)	(2.70)	(6.85)	(-3.39)	(5.97)	(8.28)	(-6.92)	(8.30)
	D/P	-1.024	2.030	-3.054	-4.458***	3.723**	-8.182***	-6.124***	4.425***	-10.549***
		(-0.62)	(1.49)	(-1.29)	(-4.11)	(2.92)	(-4.39)	(-7.11)	(5.08)	(-6.61)
	Inflation	0.500	-1.032	1.532*	0.870*	-0.668	1.538*	0.511	-0.217	0.728
		(1.13)	(-1.92)	(1.97)	(2.10)	(-1.52)	(1.99)	(1.13)	(-0.58)	(0.89)
	Term spread	0.502	-0.396	0.899	0.451	-0.629	1.080	1.293	-1.066	2.359
		(0.61)	(-0.64)	(0.79)	(0.51)	(-1.01)	(0.76)	(1.50)	(-1.65)	(1.58)
	Book / market	-0.027	0.033*	-0.060	-0.071*	0.011	-0.082	-0.068**	0.024	-0.092*
		(-0.82)	(2.44)	(-1.48)	(-2.25)	(0.53)	(-1.73)	(-2.75)	(1.22)	(-2.12)
	N	2475	2475	2475	2484	2484	2484	2496	2496	2496

Panel B: Crash in equity index

		1			4			8		
		Crash	Boom	Difference	Crash	Boom	Difference	Crash	Boom	Difference
No controls	Δ (bank credit / GDP)	0.021***	-0.008	0.028***	0.043***	-0.021***	0.064***	0.048***	-0.031***	0.079***
		(4.02)	(-1.72)	(3.99)	(6.29)	(-3.75)	(5.87)	(7.86)	(-5.82)	(7.47)
	N	4864	4864	4864	4872	4872	4872	4880	4880	4880
With controls	Δ (bank credit / GDP)	0.018**	-0.005	0.023**	0.047***	-0.021**	0.068***	0.063***	-0.036***	0.099***
		(2.93)	(-0.86)	(2.58)	(5.63)	(-3.01)	(5.04)	(8.31)	(-5.46)	(7.37)
	D/P	0.781	1.588	-0.806	-2.363	2.920**	-5.283**	-5.040***	3.771***	-8.811***
		(0.66)	(1.78)	(-0.51)	(-1.94)	(2.70)	(-2.74)	(-4.53)	(3.64)	(-4.35)
	Inflation	0.769**	-0.452	1.221**	1.477***	-0.461	1.938**	0.909*	0.150	0.759
		(3.10)	(-1.33)	(2.68)	(4.27)	(-1.13)	(2.85)	(2.37)	(0.38)	(1.02)
	Term spread	-0.052	-0.263	0.211	-0.389	-0.417	0.028	0.092	-0.578	0.670
		(-0.10)	(-0.55)	(0.28)	(-0.72)	(-0.79)	(0.03)	(0.17)	(-1.08)	(0.65)
	Book / market	-0.162**	0.034***	-0.196**	-0.231***	0.087***	-0.319***	-0.217***	0.112***	-0.330***
		(-2.59)	(3.38)	(-3.05)	(-4.26)	(4.49)	(-4.63)	(-5.94)	(5.21)	(-5.98)
	N	2679	2679	2679	2679	2679	2679	2679	2679	2679

Table 6: Mean and median regressions

Explanatory variables:		Bank index 1	Bank index 2	Bank index 4	Bank index 8	Equity index 1	Equity index 2	Equity index 4	Equity index 8
Δ (bank credit / GDP)	**Mean**	-.013**	-.027***	-.061***	-.127***	-.009***	-.019***	-.039***	-.069***
	(t stat)	(-2.88)	(-3.78)	(-5.58)	(-9.83)	(-3.36)	(-4.15)	(-5.35)	(-7.84)
	Adj-R^2, within	.007	.017	.042	.087	.003	.01	.025	.045
	Median	-.005	-.013***	-.032***	-.092***	-.005**	-.013***	-.033***	-.059***
	(t stat)	(-1.84)	(-3.79)	(-5.49)	(-11.3)	(-2.63)	(-5.65)	(-6.77)	(-7.29)
	Difference	.009***	.014***	.029***	.035***	.005***	.006**	.006	.009*
	(p value)	(p<0.001)	(p<0.001)	(p<0.001)	(p<0.001)	(.001)	(.005)	(.063)	(.027)
	N	3986	3986	3986	3986	4617	4617	4617	4617
Δ (bank credit / GDP) with D/P, book to market, term spread, and inflation as controls (coefficients on controls not shown)	**Mean**	-.014*	-.03**	-.073***	-.159***	-.007*	-.017**	-.04***	-.079***
	(t stat)	(-2.05)	(-3.05)	(-5.16)	(-10.8)	(-2.03)	(-3.01)	(-4.69)	(-9.09)
	Adj-R^2, within	.01	.031	.074	.153	.027	.059	.101	.173
	Median	-.005	-.016***	-.039***	-.103***	-.002	-.009*	-.028***	-.068***
	(t stat)	(-1.33)	(-4.06)	(-5.59)	(-9.4)	(-.85)	(-2.1)	(-4.74)	(-8.56)
	Difference	.009*	.014**	.034***	.056***	.005**	.008**	.011**	.012*
	(p value)	(.018)	(.001)	(p< 0.001)	(p< 0.001)	(.01)	(.004)	(.006)	(.018)
	N	2473	2473	2473	2473	2679	2679	2679	2679

Table 7: Mean regressions with control variables

Panel A: Bank index

	1 quarter horizon				4 quarter horizon				8 quarter horizon			
Δ (bank credit / GDP)	-0.013**	-0.014*	-0.009	-0.009	-0.061***	-0.073***	-0.059***	-0.053***	-0.127***	-0.159***	-0.143***	-0.108***
	(-2.876)	(-2.048)	(-1.583)	(-1.421)	(-5.576)	(-5.159)	(-5.624)	(-4.834)	(-9.831)	(-10.798)	(-10.602)	(-6.722)
D/P		0.604	-0.072	-0.425		4.344**	1.602	0.318		7.074***	3.766*	0.789
		(0.511)	(-0.080)	(-0.332)		(3.091)	(1.049)	(0.143)		(5.554)	(2.238)	(0.356)
Inflation		-0.443	-0.510	-0.856		-1.194*	-3.352***	-3.510***		-1.306	-4.355***	-4.302***
		(-1.236)	(-1.014)	(-1.755)		(-2.383)	(-3.404)	(-4.190)		(-1.659)	(-4.337)	(-4.502)
Term spread		0.385	0.855	0.336		1.372	4.980**	3.435*		2.986*	7.693***	6.532***
		(0.690)	(0.985)	(0.407)		(1.314)	(2.819)	(2.522)		(2.407)	(3.536)	(3.524)
Book / market		0.010	0.037*	0.049		-0.007	0.123***	0.100		0.014	0.193***	0.105
		(0.469)	(2.419)	(0.826)		(-0.118)	(4.983)	(0.868)		(0.253)	(8.499)	(0.733)
Short rate			0.285	0.741			2.663**	3.629***			3.639**	5.772***
			(0.485)	(1.439)			(2.642)	(3.861)			(3.177)	(5.410)
Invest. / Capital			-0.245	0.036			0.532	1.119			0.902	1.624
			(-0.497)	(0.070)			(0.556)	(1.081)			(0.908)	(1.119)
Corporate yield spread			-1.240	-0.865			-3.174	-1.301			-4.383*	-0.986
			(-1.346)	(-0.656)			(-1.866)	(-0.582)			(-2.068)	(-0.390)
Sovereign spread			-0.442	-1.167*			-2.929**	-5.026***			-3.804*	-6.881***
			(-0.822)	(-2.295)			(-2.700)	(-5.247)			(-2.585)	(-5.544)
Consumption / wealth				0.323*				1.458***				2.408***
				(2.482)				(5.827)				(7.043)
Adj. R^2	0.01	0.01	0.02	0.02	0.04	0.07	0.11	0.15	0.09	0.15	0.19	0.23
N	3986	2473	1335	832	3986	2473	1335	832	3986	2473	1335	832

Panel B: Equity index

Explanatory variables:	1 quarter horizon				4 quarter horizon				8 quarter horizon			
Δ (bank credit / GDP)	-0.009***	-0.007*	-0.004	-0.005	-0.039***	-0.040***	-0.038***	-0.032***	-0.069***	-0.079***	-0.084***	-0.073***
	(-3.358)	(-2.032)	(-1.013)	(-0.899)	(-5.351)	(-4.688)	(-4.979)	(-3.953)	(-7.839)	(-9.085)	(-10.120)	(-7.917)
D/P		0.663	0.463	-0.752		3.307***	2.506*	-1.572		5.884***	5.002***	-2.099
		(1.125)	(0.726)	(-0.951)		(3.931)	(2.229)	(-1.137)		(6.444)	(3.608)	(-1.468)
Inflation		-0.636**	-0.354	-0.682*		-1.826***	-1.539*	-2.557***		-2.308***	-1.725*	-3.061***
		(-3.199)	(-1.056)	(-2.129)		(-5.059)	(-2.454)	(-4.362)		(-5.131)	(-2.343)	(-4.354)
Term spread		0.374	-0.010	-0.276		1.321*	1.901	0.893		2.482**	4.048**	3.204**
		(1.118)	(-0.015)	(-0.447)		(2.095)	(1.675)	(0.885)		(3.242)	(2.897)	(2.684)
Book / market		0.030**	0.028*	0.095*		0.093***	0.094***	0.264***		0.152***	0.148***	0.382***
		(2.886)	(2.497)	(2.178)		(3.980)	(5.160)	(3.741)		(6.139)	(7.170)	(5.122)
Short rate			-0.163	0.154			0.532	1.496*			0.760	2.706***
			(-0.375)	(0.421)			(0.756)	(2.385)			(0.927)	(3.823)
Invest. / Capital			-0.678	-0.003			-1.164	0.911			-1.696*	1.628
			(-1.767)	(-0.008)			(-1.688)	(1.132)			(-2.377)	(1.759)
Corporate yield spread			-0.893	-1.159			-2.101*	-2.137			-1.713	-0.613
			(-1.852)	(-1.650)			(-2.036)	(-1.367)			(-1.245)	(-0.348)
Sovereign spread			-0.029	-0.453			-1.550	-2.908***			-1.503	-4.698***
			(-0.070)	(-1.126)			(-1.838)	(-3.591)			(-1.462)	(-5.121)
Consumption / wealth				0.264*				1.406***				2.363***
				(2.528)				(6.917)				(8.762)
Adj. R^2	0.00	0.03	0.02	0.03	0.03	0.10	0.13	0.18	0.05	0.17	0.22	0.29
N	4617	2679	1476	845	4617	2679	1476	845	4617	2679	1476	845

Table 8: Subsamples

Panel A: Regressions by geographical regions, 4 quarter forecast horizon

		All	Eight	U.S.	English speaking	W. Europe	S. Europe	Scandinavia	Asia
Bank Index	**Mean**	-.061***	-.046***	-.071***	-.039***	-.073***	-.115***	-.077**	-.056*
	(t stat)	(-5.58)	(-5.56)	(-3.34)	(-3.82)	(-5.33)	(-4.38)	(-3.21)	(-2.23)
	Median	-.032***	-.029***	-.057*	-.017	-.042***	-.101***	-.026	-.025
	(t stat)	(-4.45)	(-3.5)	(-2.5)	(-1.92)	(-5.19)	(-4.79)	(-1.07)	(-1.1)
	Difference	.029***	.017***	.013	.022**	.031***	.014	.051***	.031
	(p value)	(0)	(.001)	(.339)	(.002)	(0)	(.397)	(.001)	(.065)
	Negative Skew	.091***	.036	.033	.059*	.155***	.146	.223***	.052
	(t stat)	(4.61)	(1.68)	(.560)	(2.23)	(4.41)	(1.83)	(3.85)	(.89)
Equity Index	**Mean**	-.039***	-.032***	-.021	-.017	-.052***	-.059**	-.036*	-.02
	(t stat)	(-5.35)	(-4.49)	(-1.32)	(-1.81)	(-6.09)	(-3.32)	(-2.28)	(-1.25)
	Median	-.033***	-.023***	-.014	-.006	-.042***	-.045**	-.028	-.022
	(t stat)	(-6.53)	(-4.3)	(-1.88)	(-1.2)	(-8.43)	(-2.6)	(-1.47)	(-1.2)
	Difference	.006	.009*	.007	.01**	.01**	.014	.008	-.002
	(p value)	(.05)	(.016)	(.578)	(.009)	(.009)	(.228)	(.459)	(.889)
	Negative Skew	.025	.02	.032	.016	.039*	.089	.075	.037
	(t stat)	(1.58)	(.950)	(.560)	(.65)	(2.39)	(1.93)	(1.74)	(.85)

Panel B: Regressions by time periods, 4 quarter forecast horizon

		1920-2013	1920-2008	1950-2008
Bank Index	**Mean**	-.061***	-.058***	-.063***
	(t stat)	(-5.58)	(-5.51)	(-5.36)
	Median	-.032***	-.031***	-.039***
	(t stat)	(-4.86)	(-7)	(-5.39)
	Difference	.029***	.026***	.025***
	(p value)	(0)	(0)	(0)
	Negative Skew	.091***	.099***	.121***
	(t stat)	(4.18)	(5.14)	(6.54)
Equity Index	**Mean**	-.039***	-.041***	-.044***
	(t stat)	(-5.35)	(-5.71)	(-5.53)
	Median	-.033***	-.035***	-.037***
	(t stat)	(-7.43)	(-6.29)	(-6.51)
	Difference	.006*	.006	.007
	(p value)	(.048)	(.112)	(.062)
	Negative Skew	.025	.025	.038*
	(t stat)	(1.83)	(1.83)	(2.36)

Table 9: Predicting out-of-sample

Table 9: Adj-R^2 for in-sample and out-of-sample prediction, 1960-2012

		Total R^2 without controls	Additional R^2 of Δ (bank credit/gdp) over controls	Total R^2 of only controls
Bank index:				
4-quarter ahead forecast	in-sample	5.2%	3.6%	4.3%
	out-of-sample	0.3%	0.4%	0.0%
8-quarter ahead forecast	in-sample	10.7%	7.7%	6.5%
	out-of-sample	1.0%	0.8%	0.0%
12-quarter ahead forecast	in-sample	15.5%	11.3%	8.6%
	out-of-sample	2.4%	1.2%	0.3%
	N	2985	2985	2985
Equity index:				
4-quarter ahead forecast	in-sample	2.7%	1.4%	7.3%
	out-of-sample	0.2%	1.8%	0.9%
8-quarter ahead forecast	in-sample	4.7%	2.7%	11.2%
	out-of-sample	0.2%	2.0%	1.4%
12-quarter ahead forecast	in-sample	5.9%	3.7%	13.8%
	out-of-sample	0.1%	2.8%	1.2%
	N	3311	3311	3311

Note: Out-of-sample predictions for year t use information from 1950 to year (t-K) for K-year ahead forecasts

Table 10: Negative predicted returns and asymmetric effects of credit expansion

Panel A: bank index

	Threshold in S.D.'s:	**-2.5**	**-2**	**-1.5**	**-1**	**-0.5**	**0**	**0**	**0.5**	**1**	**1.5**	**2**	**2.5**
4-quarter ahead returns	E[r]	-0.001	0.048	0.049	0.025	-0.001	-0.013	-0.09	-0.143	-0.171	-0.223	-0.331	-0.543
no controls	z statistic	-0.02	1.04	2.23	1.14	-0.07	-1.18	-8.18	-7.94	-6.11	-6.56	-5.34	-3.50
	N	30	81	228	565	1100	1992	2060	1246	649	303	121	36
	historical episodes	8	29	64	116	149	186	178	135	99	57	25	11
4-quarter ahead returns	E[r]	0.088	0.118	0.073	0.028	0.003	-0.016	-0.104	-0.156	-0.188	-0.234	-0.351	-0.544
with controls	z statistic	2.59	1.74	2.43	1.12	0.17	-0.94	-8.00	-8.21	-5.70	-6.16	-5.48	-3.46
	N	14	44	157	362	648	1123	1408	955	529	265	110	35
	historical episodes	8	29	64	116	149	186	178	135	99	57	25	11
8-quarter ahead returns	E[r]	-0.072	0.043	0.091	0.059	0.017	-0.014	-0.189	-0.291	-0.358	-0.472	-0.622	-0.618
no controls	z statistic	-0.67	0.52	2.28	1.48	0.65	-0.70	-8.59	-8.56	-6.51	-7.04	-4.82	-3.55
	N	30	81	228	565	1100	1992	2060	1246	649	303	121	36
	historical episodes	8	29	64	116	149	186	178	135	99	57	25	11
8-quarter ahead returns	E[r]	0.043	0.154	0.15	0.092	0.041	-0.006	-0.227	-0.331	-0.396	-0.501	-0.666	-0.619
with controls	z statistic	0.29	1.26	2.78	2.09	1.41	-0.21	-9.87	-8.95	-6.09	-6.86	-5.24	-3.75
	N	14	44	157	362	648	1123	1408	955	529	265	110	35
	historical episodes	8	29	64	116	149	186	178	135	99	57	25	11

Panel B: equity index

	Threshold in S.D.'s:	-2.5	-2	-1.5	-1	-0.5	0	0	0.5	1	1.5	2	2.5
4-quarter ahead returns	E[r]	0.078	0.09	0.108	0.092	0.076	0.068	0.009	-0.016	-0.02	-0.053	-0.117	-0.234
no controls	z statistic	1.53	2.90	5.14	6.13	6.91	8.50	1.13	-1.45	-1.18	-2.94	-3.08	-3.60
	N	42	117	299.00	687	1281	2223	2291	1412	729	340	141	39.00
	historical episodes	8	29	64.00	116	149	186	178	135	99	57	25	11.00
4-quarter ahead returns	E[r]	0.117	0.146	0.12	0.088	0.083	0.069	0.007	-0.02	-0.022	-0.054	-0.132	-0.23
with controls	z statistic	2.39	3.24	3.53	3.83	4.61	5.31	0.64	-1.43	-1.05	-2.45	-3.38	-3.44
	N	17	57	191.00	420	749	1246	1506	1021	568	287	126	38.00
	historical episodes	8	29	64.00	116	149	186	178	135	99	57	25	11.00
8-quarter ahead returns	E[r]	0.144	0.18	0.21	0.174	0.152	0.13	0.023	-0.018	-0.04	-0.106	-0.167	-0.17
no controls	z statistic	1.80	3.21	4.77	5.80	6.91	8.67	1.53	-0.86	-1.48	-3.53	-2.46	-1.85
	N	42	117	299	687	1281	2223	2291	1412	729	340	141	39
	historical episodes	8	29	64	116	149	186	178	135	99	57	25	11
8-quarter ahead returns	E[r]	0.171	0.233	0.241	0.195	0.178	0.139	0.013	-0.032	-0.05	-0.11	-0.194	-0.169
with controls	z statistic	2.55	2.51	3.77	4.43	5.56	6.62	0.72	-1.33	-1.56	-3.44	-3.03	-1.92
	N	17	57	191	420	749	1246	1506	1021	568	287	126	38
	historical episodes	8	29	64	116	149	186	178	135	99	57	25	11

Table A1 - Data and sample period

Country	stock_price_index	exchange_rate	three_mo_tbill yield	govt_10yr yield	D / P	Book / market	I/K	housing_i_k	inflation	Currentaccount / gdp	Extdebtliab / gdp	C / W	real_gdp_growth	central_govt_debt / gdp	Totalcredit / gdp	Bankcredit / gdp	HHdebt / totalassets	totalcreditHH / gdp	HH housingassets_growth	NFC equity / totalliab	totalcreditNFC / gdp	BANKassets / gdp	BANKequity / assets
Australia	1920	1920	1928	1920	1920	1980	1960	1960	1920	1960	1970	1960	1920	1920	1954	1920	1978	1977	1961	1981	1977	1920	1983
Austria	1922	1920	1960	1923	1925	1980	1960	1960	1920	1960	1970		1949	1924	1949	1949		1995		1993	1995	1987	1987
Belgium	1920	1920	1948	1920	1927	1980	1960	1960	1921	1960	1970		1935	1920	1970	1970		1980		1981	1980	1981	1981
Canada	1920	1920	1934	1920	1934	1980	1960	1960	1920	1961	1970	1961	1920	1920	1954	1920	1970	1969	1971	1981	1969	1920	1981
Denmark	1920	1920	1921	1920	1969	1980	1960	1960	1920	1960	1970		1922	1920	1951	1951		1994		1981	1994	1920	1979
Finland	1920	1920	1978	1987	1962	1988	1960	1960	1921	1960	1970		1927	1920	1970	1974		1970		2000	1970	1979	1979
France	1920	1920	1922	1920	1920	1980	1960	1960	1920	1960	1970	1960	1921	1920	1969	1920	1970	1977	1971	1981	1977	1950	1988
Germany	1924	1920	1920	1920	1920	1980	1960	1960	1920	1960	1970	1970	1926	1925	1950	1925	1950	1970	1951	1981	1970	1925	1979
Hong Kong	1964	1920	1982	1994	1972	1980			1948		1979		1961		1978	1978		1990		1993	1990		1993
Ireland	1934	1946	1960	1928	1973	1981	1960	1960	1923	1960	1970		1949	1924	1971	1971		2002		1982	2002	1995	1985
Italy	1920	1920	1922	1920	1925	1981	1960	1960	1920	1960	1970	1980	1920	1920	1950	1920	1966	1950	1967	1982	1950	1920	1983
Japan	1920	1920	1920	1920	1921	1980	1960	1960	1920	1960	1970	1980	1920	1920	1964	1963	1970	1964	1971	1980	1964	1953	1980
Korea	1962	1920	1969	1973	1963	1986			1949	1970	1971		1954	1920	1962	1960		1962		1987	1962	1990	1990
Malaysia	1973	1920	1961	1961	1972	1986			1949	1974	1970		1956	1949	1964	1964				1993			1990
Netherlands	1920	1920	1920	1920	1969	1980	1960	1960	1920	1960	1970		1949	1920	1961	1920		1990		1981	1990	1920	1979
Norway	1920	1920	1924	1920	1969	1984	1960	1960	1920	1960	1970		1920	1920	1953	1920		1975		1981	1975	1920	1979
Portugal	1931	1920	1981	1920	1988	1986	1960		1931	1960	1972		1954	1920	1947	1947		1979		1990	1979		1996
South Africa	1920	1920	1936	1920	1954	1980			1920	1962	1970		1920	1920	1965	1965		2009		1993	2009		1991
Spain	1920	1920	1924	1920	1920	1990	1960	1960	1920	1960	1970		1920	1920	1970	1970		1980		1993	1980	1920	1979
Sweden	1920	1920	1920	1920	1920	1982	1960	1960	1920	1960	1970		1920	1920	1961	1920		1981		1982	1981	1920	1979
Switzerland	1920	1920	1920	1920	1920	1980	1960	1960	1920	1960	1970		1930	1924	1975	1975		1999		1993	1999	1920	1979
UK	1920	1920	1920	1920	1923	1980	1960	1960	1920	1960	1970	1960	1920	1920	1962	1920	1971	1962	1972	1981	1976	1920	1981
US	1920	1920	1920	1920	1920	1980	1960	1960	1920	1960	1970	1960	1920	1920	1952	1920	1946	1952	1947	1952	1952	1920	1980