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Boston College Working Papers in Economics, 2017

Originally posted on: http://ideas.repec.org/p/boc/bocoec/939.html

Uncertainty Effects on the Financial Sector: International Evidence

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December 9, 2017

Abstract

We examine the effects of uncertainty on the financial sector in a multidimensional context. In our investigation, using a large country-level unbalanced panel dataset, we show that inflation uncertainty reduces availability of private sector credit; harms banks' efficiency and operational performance, evidenced by lower returns and increased reliance on non-interest income activities; and distorts sectoral stability, as liquidity and banks' appetite for risk increases. Our findings, based on the full dataset and country splits, are economically meaningful and provide evidence that uncertainty harms the overall health of the financial sector.

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Keywords: Bank returns, economic significance; efficiency; financial depth; liquidity; non-interest income; profitability; stability; uncertainty.
JEL classification: C22, C23, D81, E51.

1 Introduction

Financial intermediaries play a vital role in an economy by allocating scarce resources towards potential borrowers with the most promising prospects. Hence, it is not surprising that researchers have been examining the factors that affect the functioning of financial intermediaries as the state of the economy evolves. Yet, to our knowledge, there is no work to date which has scrutinized the overall health of the financial sector under uncertainty. The question is relevant, as one would expect that under uncertainty, bank managers' ability to allocate resources in an efficient manner may be hindered, possibly due to managers' unwillingness to bear risks or, equally, due to a shift in their risk preferences, impacting the availability of credit, profitability and the stability of financial sector. In that sense, although several researchers have examined the impact of uncertainty on the financial sector, focusing on a specific aspect (credit, profitability, stability) of the financial sector,[1] the literature has not provided a comprehensive view on the health of the entire financial system under uncertainty, despite the calls from both academicians and policymakers (see for example, Čihák et al., 2012; Law and Singh, 2014; Arcand et al., 2015).

In contrast to prior studies, we explore the impact of uncertainty on the health of the financial sector as a whole. Given the ongoing debate whether monetary policy should identify and remove balance sheet impairments that obstruct the flow of funds to productive parts in the economy while maintaining stability of financial institutions (e.g., Smets, 2014; Sannikov and Brunnermeier, 2013), an examination of uncertainty effects on financial markets must take into account the multidimensional nature of the question under investigation.[2]

To achieve our goal, using data from 89 countries for 1996–2015, we provide evidence

[1] For example, Louzis et al. (2012) investigated the determinants of banks' non-performing loans; Delis et al. (2014) examined the lending behaviour of US banks during periods of anxiety; and Khan et al. (2017) studied the relationship between funding liquidity and bank risk taking behavior.

[2] Also see Caglayan et al. (2017) who have shown that financial depth plays an important role in the transmission of monetary policy shocks during recessions.

relating to uncertainty effects on 1) the availability of credit to the private sector; 2) the efficiency of financial intermediaries and markets in intermediating resources and facilitating financial transactions; and 3) the stability of financial institutions. To carry out the investigation, we exploit a new dataset, Global Financial Development, which provides country-specific information on an annual basis. An examination that involves several countries at a time is important for us to capture a sufficient number of uncertainty fluctuations across countries and time over the entirety of the data. As a consequence, we can provide a broad view regarding the extent to which uncertainty affects the financial sector.

Scrutinizing the data, we show that uncertainty adversely affects the financial sector. In particular, we find that uncertainty curtails the availability of private sector credit; harms the efficiency of financial intermediaries, as evidenced by a decline in profitability (measured by return to equity) and an increase in reliance on non-interest income activities; and affects the stability of the financial system, as evidenced by an increase in banks' liquid assets and non-performing loans.

Furthermore, our empirical investigation provides evidence that uncertainty effects differ between high-income and low-income countries. In particular, we show that uncertainty effects on financial depth and non-performing loans are more pronounced in low-income countries than high-income economies. In contrast, we find that uncertainty has a significant impact on bank returns, liquidity and non-interest income in high-income countries. Interestingly, our investigation yields evidence suggestive of crowding out effects for low-income countries: changes in GDP leading to a decline in the availability of credit to the private sector in low-income countries. It is also worth noting that during ongoing banking crises, aggregate credit increases. This observation may be explained by the prevalence of efforts to increase the availability of funds in the financial sector to overcome the adverse effects of lack of credit on consumers and businesses alike.[3] Finally, we provide evidence

[3]During an ongoing banking crisis, central banks inject substantial amounts of funds into the financial

that the impact of foreign bank presence on the availability of credit varies between low- and high-income countries, while such differences are not observed for other aspects.

An important question is whether the empirical results that we present have economic significance. Using the parameter estimates for the full sample, we find that a one standard deviation change in uncertainty could induce a 1.4% change in financial depth from its mean value.[4] Even though this seems small, as Bernanke (1983) and Bernanke and Gertler (1989) discuss, even minor changes in the availability of credit can induce large fluctuations in an economy. We also find that bank returns decline in the order of 2% and non-interest income increases by 1.4%, suggesting a decline in efficiency in the banking sector. What is more worrying is that banks' liquid assets increase by 4% and banks' non-performing loans increase almost 10% in response to a one standard deviation change in uncertainty. Considering that uncertainty could increase several-fold in a short period of time, the ultimate effect in all aspects would be much higher than our back of the envelope calculations. Taken together, our empirical results confirm the prediction that uncertainty adversely affects the functioning of the financial sector through several channels.

To ascertain the robustness of our findings, we estimated our models using uncertainty measures driven from dynamic and static inflation forecasting models as well as the intra-year standard deviation of inflation. We used two variables to capture depth, efficiency and the stability of financial system. Furthermore, our models contained several control variables, including the level of inflation, the growth rate of real GDP, trade openness, banking crisis, bank concentration, foreign bank concentration, and international indebtedness relative to GDP, to mitigate omitted-variables bias. For further robustness checks, we examined the

sector while governments reduce tax rates to ensure the stability of the system. For instance, both US and UK central banks along with the ECB have injected trillions of dollars worth of funds into the financial markets to avoid a complete meltdown of the system following the 2007–08 crisis.

[4]The average ratio of private credit to GDP in our sample is around 70%. On average, this implies that the change in availability of credit to private sector in response to a one standard change in uncertainty can easily amount to a figure around 1% of GDP.

association for high-income *versus* low-income country splits to see whether uncertainty effects persist for these two sets of country groups. Overall, our results confirm the adverse impact of uncertainty on the health of the financial sector regardless of the country's level of development.

In what follows, section 2 presents a brief literature review. Section 3 presents the data and discusses the construction of uncertainty measures. In section 4, we initially provide visual evidence of uncertainty effects on the financial sector, and then present the empirical model. Section 5 reports the empirical results, robustness checks and discusses the economic significance of our findings. Section 6 concludes the paper.

2 Literature Survey

Our investigation relates to many earlier studies which have separately focused on financial depth and bank lending behavior, as well as efficiency and stability of financial institutions. In fact, an examination of the literature yields a vast body of work which has examined the impact of financial development on economic growth and economic stability.[5] For instance, using aggregate data, Bernanke and Gertler (1989) suggest that the development and deepening of financial markets enable firms to have easier access to external funds, dampening the impact of negative shocks on the economy. da Silva (2002), using data from 40 countries, shows that countries with deeper financial markets experience smoother business cycles. Similar conclusions have been provided by researchers examining industry-level or firm-level data. For example, Raddatz (2006) found that greater financial depth significantly reduced output volatility, especially in sectors which required a high level of liquidity.

Another strand of literature has focused on the role of financial sector development on growth volatility. Caglayan et al. (2013), for example, point out that industries that are

[5]See Levine (2005) and Demirgüç-Kunt and Levine (2008) for detailed reviews.

more dependent on external finance tend to grow faster in countries with developed financial systems. Aghion et al. (2009) show that exchange rate uncertainty more severely reduced the productivity growth of manufacturing sectors with higher financing needs in countries with weaker financial depth. A handful of researchers show that bank lending varies over the business cycle, declining during periods of extreme uncertainty or financial crisis (e.g., Ivashina and Scharfstein, 2010; Puri et al., 2011; Delis et al., 2014; and Kosak et al., 2015). Taken together, most empirical studies have used financial depth as a proxy for financial development, and suggested that financial deepening plays an important role in relation to economic growth and smooth functioning of the economy as well as the transmission of shocks. However, to our knowledge, there is no earlier research that has specifically focused on the direct impact of uncertainty on financial depth.

Turning to studies that have focused on bank efficiency, we see that researchers have associated significant reductions in bank profitability as a signal of an impending financial crisis (Demirgüç-Kunt and Huizinga, 1999, Bourke, 1989, Cornetta et al., 2010). In a similar line, Albertazzi and Gambacorta (2009) provide evidence that bank returns decline during periods of high risk. Bolt et al. (2012) further show that each percentage point of contraction in real GDP during severe recessions would lead to a quarter of a percentage point decrease in banks' return on assets. Separately, researchers who have examined banks' non-interest income have suggested that an increased level of income from this category leads to higher systemic risk and lower efficiency (e.g., see Brunnermeier et al., 2012). In this context, DeYoung and Roland (2001); and Lepetit et al. (2008) argue that changes in banks' non-interest income in periods of uncertainty can be taken to signal banks' risk appetite and deterioration of the efficient functioning of financial intermediaries.

Several other researchers have examined factors that promote stability of the financial system and confirmed that liquidity plays an important role, an issue which was under the spotlight during the 2008 financial crisis. Banks create liquidity on their balance sheet

by transforming illiquid assets (e.g., bank loans) into cash and other liquid assets as part of their overall strategy to manage liquidity risk (Berger and Bouwman, 2009). Hence, maintaining the right amount of liquidity is essential to achieve stability, for loans do not have to be liquidated to overcome cash shortages. Furthermore, Gatev and Strahan (2006) and Gatev et al. (2009), among others, have shown that deposit withdrawals and commitment drawdowns are negatively related to market stress. In addition to liquidity, researchers have used non-performing loans (NPLs) as a separate indicator to monitor stability of banks. NPLs capture the asset quality of banks: higher NPLs flag that banks are taking on riskier assets. To that end, most studies that examined the relation between the macroeconomic environment and loan quality have generally found a significant negative relationship between economic conditions and NPLs (e.g., Louzis et al., 2012; Klein, 2013). It is interesting to note that higher management quality can reduce problem loans, as shown in Berger and DeYoung (1997) and Louzis et al. (2012).

In what follows, we provide empirical evidence that uncertainty adversely affects the financial system. In doing so, we examine several aspects of the financial system rather than just one to develop an understanding on the whole system, and show that these effects are economically significant on all facets.

3 Data

To carry out our investigation, we acquired data from various sources including the World Bank Global Financial Development (GFD), World Bank World Development Indicators (WDI) and DataStream. From the GFD database, we extracted two different measures of financial depth which provided information on the amount of credit available to the private sector. Our first financial depth measure, ($FD1$), is the domestic credit to private sector relative to GDP ($GFDD.DI.14$). This variable gauges the financial resources provided to

the private sector through loans, purchases of non-equity securities, and trade credit and other accounts receivable that establish a claim for repayment. Our second financial depth measure, ($FD2$), which we used for robustness purposes, is the private credit to the real sector by deposit money banks and other financial institutions to GDP ($GFDD.DI.12$).[6]

To examine the efficiency of banks, we extracted banks' return of equity ($GFDD.EI.06$) and non-interest income to total income ($GFDD.EI.03$) from the GFD database. To examine the stability of financial institutions, we examined the ratio of liquid assets to total deposits and short-term funding ($GFDD.SI.06$) and non-performing loans ($GFDD.SI.02$) from the GFD database. Furthermore, we use gross domestic product ($NY.GDP.MKTP.CD$), consumer price index ($GFDD.OE.02$), bank concentration ($GFDD.OI.01$), international debt securities as a percentage of GDP ($GFDD.OI.15$) from the same database. We also acquired total exports and total imports from WDI. The monthly consumer price index (CPI), from 1996 to 2015, is downloaded from Datastream. The rest of the data span the period between 1996 and 2015 except for non-performing loans which span 1998–2015.

3.1 Generating measures of inflation uncertainty

To construct measures of inflation uncertainty for each country, we used monthly CPI data and followed three different approaches. The first inflation uncertainty measure is obtained from a static model. We initially estimated an AR(p) model which took the following form:

$$\pi_t = \alpha + \sum_{i=1}^{p} \beta_i \pi_{t-i} + \epsilon_t \tag{1}$$

where π_t is the log difference of CPI and ϵ_t is a random term. Using the parameter estimates, we then computed the sum of squared monthly differences between the actual and

[6]The second measure, therefore, excludes credit issued to governments, government agencies, and public enterprises. It also excludes credit issued by central banks.

the observed inflation for each year:

$$\widehat{h}_y = \sum_{m=1}^{12} (\pi_{y,m} - \widehat{\pi}_{y,m})^2 \tag{2}$$

where $\pi_{y,m}$ denotes inflation in year y and month m. The uncertainty measure, $\widehat{h}_y$, obtained from this approach is our static measure. The process is repeated for each country in the dataset where p is set to 4 for parsimony and uniformity.

The next uncertainty measure uses a similar AR(p) model. However, rather than estimating the model for the full sample, we follow a rolling window approach by including an additional observation in each estimation round after predicting the one-step-ahead inflation. The difference between the predicted and the actual inflation rate is recorded as the observed error. We then computed our dynamic inflation uncertainty measure by following equation (2). In both measures, higher levels of the unpredicted component of inflation imply higher uncertainty for the future level of inflation.

Our last measure is based on the annual standard deviation of monthly logarithmic differences in CPI. This uncertainty measure has been implemented by several researchers in the literature including Barro (1996), Judson and Orphanides (1999) and Caglayan and Xu (2016).

4 Preliminary Evidence and the Model

In this section, we provide visual evidence that uncertainty adversely affects the availability of credit, efficiency and the stability of the financial system. Subsequently, we present our models. All variables, which are defined and discussed in the text and tabulated in Table 1.

Table 1: Variable Definitions

Variable	Definition	Source
A. Dependent variables		
1). Financial Depth		
Domestic credit to private sector (% of GDP) ($FD1$)	The ratio of domestic financial resources by financial intermediaries to the private sector with respect to GDP ($GFDD.DI.14$).	GFD
Private sector credit to GDP ($FD2$)	Deposit money bank credit to the private sector as a percentage of GDP ($GFDD.DI.12$).	GFD
2). Bank Efficiency		
Bank Return on Equity (ROE)	Commercial banks' pre-tax income to yearly averaged equity ($GFDD.EI.10$)	GFD
Non-interest income to total income (NII)	Bank income that has been generated by non-interest related activities as a percentage of total income ($GFDD.EI.03$).	GFD
3). Bank Stability		
Liquidity	The ratio of the value of liquid assets to short-term funding plus total deposits ($GFDD.SI.06$).	GFD
Non-performing loans $NPLs$	Ratio of defaulting loans to total gross loans ($GFDD.SI.02$) .	GFD
B. Uncertainty proxies		
Unexpected Inflation Volatility ($\hat{h}$)	Constructed based on i) dynamic recursive forecasting ($unexpD$) or ii) static forecasting ($unexpS$) methods or iii) by the within year standard deviation of inflation.	Datastream
C: Control Variables		
Real GDP Growth (ΔGDP)	First difference of real gross domestic production at purchaser's prices ($NY.GDP.MKTP.CD$).	GFD
Openness	The ratio of a country's exports of goods and services to country's GDP ($NE.EXP.GNFS.ZS$).	WDI
oBC	Dummy variable that captures an ongoing banking crisis in the banking system ($GFDD.OI.19$).	GFD
Bank_Concentration (%)	Assets of three largest commercial banks as a share of total commercial banking assets ($GFDD.OI.01$).	GFD
Debt/GDP (%)	The amount of international debt securities as a percentage of GDP. ($GFDD.OI.15$).	GFD
Foreign_Banks (%)	The percentage of the number of foreign owned banks to the number of the total banks in an Economy. A bank is defined as foreign if 50 percent or more of the bank's shares are owned by foreigners ($GFDD.OI.15$).	GFD

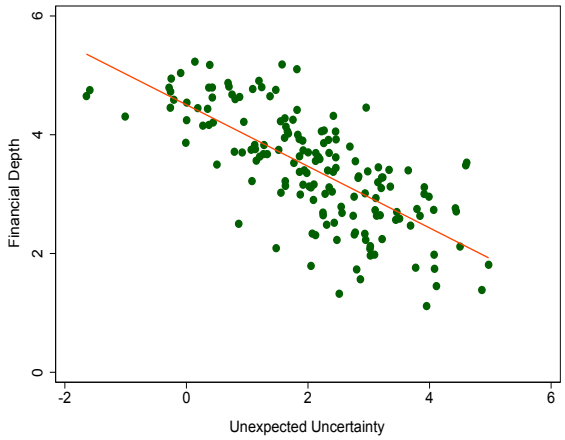
Notes: GFD: Global Financial Development; WDI: World Development Indicator.

4.1 Visual inspection

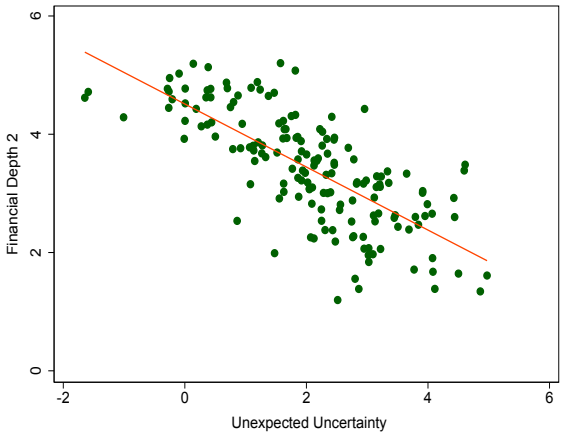
Figure 1 provides the visual association between inflation uncertainty and the variables upon which we focus in this study including financial depth, efficiency and the stability of financial intermediaries. These graphs are constructed by aggregating the data on a country basis, where uncertainty is plotted on a logarithmic scale for convenience. The top two graphs, (a-b), depict the association between uncertainty and average financial depth for two different measures. The middle graphs, (c-d), plot uncertainty against average bank profitability and non-interest income to total income, respectively. The last two graphs, (e-f), plot the average bank liquidity and average bank non-performing loans against average inflation uncertainty, respectively.

Figures (a-b) present a clear and negative relationship between uncertainty and both financial depth measures. These two graphs show that average credit is lower in countries with high uncertainty. Figures (c-d) present mixed evidence in relation to our expectations between uncertainty and efficiency: Figure (c), as expected, shows that banks' non-interest income is increasing with uncertainty. Figure (d), against our expectations, shows that bank returns increase with uncertainty. However, this result is driven by data aggregation, which occludes the negative bank returns. The last two graphs, Figures (e-f) plot banks' liquid asset holdings and banks' non-performing loans, respectively, against uncertainty. The associations depicted in these figures are in line with our expectations.

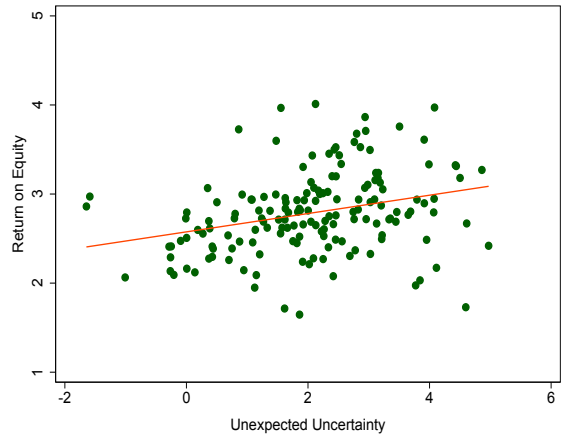
To that end, the statistics in Table 2 confirm that the correlations between uncertainty ($\hat{h}$) and both measures of financial depth ($FD1$ and $FD2$), bank return to equity (ROE), non-interest income (NII), liquidity (Liq) and non-performing loans ($NPLs$) have the expected signs. These correlations provide the first impression that uncertainty adversely affects the functioning of financial intermediaries as hypothesized. Given the *prima facie* evidence gathered from Figure 1 and Table 2, we next embark on a formal empirical investigation. As we examine data from several countries subjected to country-specific shocks, we employ



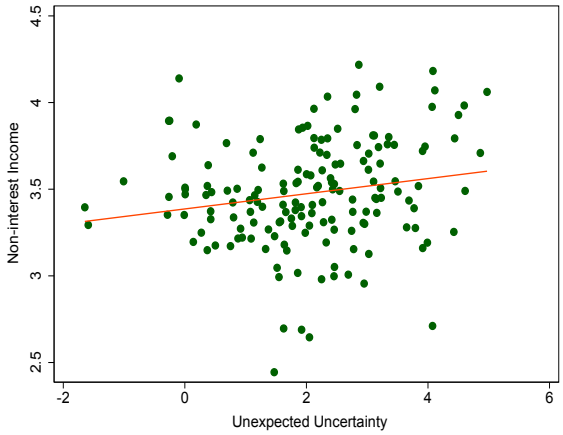
(a) Financial Depth *vs* Uncertainty



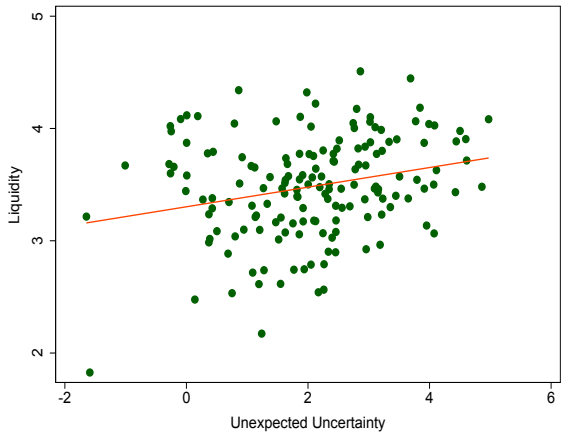
(b) Financial Depth 2 *vs* Uncertainty



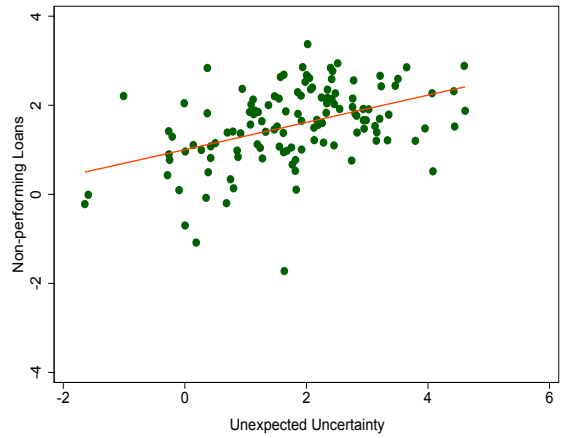
(c) Banks' profitability *vs* Uncertainty



(d) Banks' Non-Interest income to total income *vs* Uncertainty



(e) Banks' Liquidity *vs* Uncertainty



(f) Banks' Non-performing loans *vs* Uncertainty

Figure 1: Cross-country Inflation Uncertainty Effects on Financial Sector

various control variables that may affect the relationship in addition to country fixed effects. In what follows, we present our empirical model, findings and a battery of sensitivity checks to confirm the robustness of our claims. The last section is devoted to examining the economic significance of our findings.

Table 2: Correlation between variables

	$FD1$	$FD2$	ROE	NII	Liq	$NPLs$	$\hat{h}$	$Inflation$	ΔGDP	$Openness$	$Bank\_Con$	$Debt/GDP$	$Foreign$
$FD1$	1												
$FD2$	0.990***	1											
ROE	-0.147***	-0.174***	1										
NII	0.0205	0.0304	-0.0195	1									
Liq	-0.0785**	-0.0715*	0.0604*	0.390***	1								
$NPLs$	-0.203***	-0.179***	-0.264***	0.0447	-0.0475	1							
$\hat{h}$	-0.169***	-0.165***	-0.0522	0.144***	0.0990***	0.181***	1						
$Inflation$	-0.326***	-0.329***	0.0463	0.163***	0.0267	0.209***	0.501***	1					
ΔGDP	0.152***	0.143***	0.0593*	-0.0582*	-0.0805**	-0.138***	-0.385***	-0.361***	1				
$Openness$	0.200***	0.209***	-0.0155	0.0310	0.0808**	-0.0905**	-0.0230	-0.119***	-0.0278	1			
$Bank\_Con$	0.106***	0.118***	0.0307	0.00964	0.0965***	-0.0972***	-0.0211	-0.117***	-0.0736*	0.175***	1		
$Debt/GDP$	0.427***	0.437***	-0.123***	0.183***	0.223***	-0.115***	-0.0720*	-0.168***	-0.0247	0.269***	0.191***	1	
$Foreign$	0.432***	0.441***	-0.120***	0.184***	0.226***	-0.112***	-0.0679*	-0.160***	-0.0266	0.270***	0.186***	0.991***	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.2 Empirical model

In what follows, we examine the impact of uncertainty on three characteristics of financial institutions: financial depth, efficiency and stability. To carry out our investigation we employ the following model:

$$FInd_{jt} = \alpha + \beta_1 \hat{h}_{jt} + \boldsymbol{\gamma Z_{jt}} + i.time_t + \nu_j + \epsilon_{jt} \tag{3}$$

where the dependent variable, $FInd_{jt}$, denotes a variable that relates to the health of financial institutions in country j at time t. All variables are measured as of the end of the year with the exception of the uncertainty measure, $\hat{h}_{jt}$, our key explanatory variable, which is constructed using monthly data over the year.[7] Based on the proxy used, our uncertainty measures capture a different aspect of the observed volatility throughout the year. Hence, we use the model to examine the effects of uncertainty on the health of the financial sector.

We start our investigation by examining the impact of uncertainty on the availability of credit to the private sector. We expect that an increase in uncertainty will lead to a decline in availability of credit to the private sector as bank managers become more conservative in their lending in a volatile environment. Hence, the uncertainty coefficient, β_1, should take a negative sign.

We next examine the impact of uncertainty on the efficiency of the system. To do so, we estimate equation (1) by using two different efficiency measures as a dependent variable: return on equity and the ratio of non-interest income to total income. ROE is a major indicator that researchers have used to investigate the efficiency and operational performance of banks. Similarly, researchers have used NII to capture the extent to which banks resort to riskier strategies.[8] We expect to find a negative impact of uncertainty on bank efficiency, for

[7] Details on uncertainty proxies are given in section 4.1.

[8] NII has been used as a forward-looking measure of risk by several researchers, including Buch et al. (2014), Brunnermeier et al. (2012), DeYoung and Roland (2001).

increases in uncertainty would trigger a fall in bank profitability. In contrast, an increase in uncertainty would encourage bank managers to increase their non-interest activities, as they search for high yield in a period when returns from traditional operations fall and monitoring borrowers and recovery of funds become a difficult task. Finally, to examine bank stability, we use bank liquidity and non-performing loans as a dependent variable in equation (1). In line with the predictions of earlier literature derived from bank-level data, we expect to find that both bank liquidity and non-performing loans would increase with uncertainty.

To overcome specification error, our model contains several control variables ($\boldsymbol{Z}$). Exclusion of the control variables can bias the results and lead one to wrongfully conclude in favor of the second moment effects. In particular, inclusion of a measure of uncertainty in a model without the corresponding level variable may lead the researcher to attribute an impact to the uncertainty variable that is actually explained by the first moment.[9] Hence, our model contains the rate of inflation ($Inflation$). Furthermore, we augment the model with additional control variables including the GDP growth rate (ΔGDP) and a measure of trade openness ($Openness$) to control for changes in domestic and foreign demand, respectively.

We also use a dummy variable (oBC) to capture the effects of ongoing banking crises. This variable is constructed in the spirit of Laeven and Valencia (2013) who defined a banking crisis as systemic if there are 1) significant signs of financial distress in the banking system, as captured by significant bank runs, losses in the banking system, and/or bank liquidations; and 2) significant banking policy intervention measures in response to significant losses in the banking system. The first year that both criteria are met is considered as the beginning of a systemic crisis. The end of a crisis is defined as the year before both real GDP growth and real credit growth are positive for at least two consecutive years.[10] For EU countries, we used banking crisis periods identified by the ECB (Lo Duca et al., 2017). For non-EU countries,

[9] See for instance Huizinga (1993) for a discussion along these lines.

[10] Laeven and Valencia (2013) data only cover up to 2011 starting as of 1970.

we have identified crisis episodes when a country's banking system exhibits significant losses resulting in a share of non-performing loans above 20%.

In addition to the aforementioned variables, three more control variables are used in the model. These variables measure bank concentration ($Bank\_Concentration$), foreign bank concentration ($Foreign\_Banks$), and international indebtedness as a percentage of GDP ($Debt/GDP$). The former two variables control for the country-specific banking environment, and the last variable captures the role of foreign debt. We also include time fixed effects in all models to allow for specific events that our control variables fail to capture. The last two terms of the model depict country-specific fixed effects, ν_j, and the idiosyncratic error associated with country j at time t, ϵ_{jt}.

5 Empirical Findings

In this section, we present our empirical findings. All models are estimated using country and time fixed effects. Robust standard errors clustered by country are reported in the tables.

5.1 Uncertainty effects on aggregate credit

Table 3 presents the results for uncertainty effects on financial depth. The first three columns present results for our first financial depth ($FD1$) measure, which is constructed as a ratio of domestic credit to private sector relative to GDP through loans, purchases of non-equity securities, and trade credit and other accounts receivable that establish a claim for repayment. This is a standard indicator in the finance and growth literature. The last three columns lay out the results for the alternative definition of financial depth ($FD2$) which captures private credit to the real sector from deposit money banks and other financial institutions to GDP,

excluding credit issued to governments, government agencies, and public enterprises.[11] For each group, we initially present results for the uncertainty measure which is obtained from a dynamic inflation forecasting model followed by the uncertainty measure from a static inflation forecasting model and the annual standard deviation of inflation. Regression results for all three uncertainty measures provide a similar view: inflation uncertainty has a negative and significant effect on financial depth.

Table 3: Inflation Uncertainty Effects on Financial Depth

	$FD1$			$FD2$		
	$unexpD$	$unexpS$	$volCPI$	$unexpD$	$unexpS$	$volCPI$
$\hat{h}$	-0.00117***	-0.00189***	-0.0199***	-0.00117***	-0.00188***	-0.0198***
	(0.000242)	(0.000395)	(0.00451)	(0.000235)	(0.000381)	(0.00437)
$Inflation$	0.262	0.209	0.200	-0.230	-0.283	-0.292
	(0.795)	(0.813)	(0.811)	(0.700)	(0.716)	(0.715)
ΔGDP	-0.211	-0.217	-0.220	-0.162	-0.167	-0.170
	(0.145)	(0.145)	(0.148)	(0.128)	(0.128)	(0.131)
$Openness$	-0.183	-0.183	-0.183	-0.168	-0.167	-0.167
	(0.164)	(0.164)	(0.164)	(0.139)	(0.139)	(0.139)
oBC	10.73***	10.72***	10.77***	12.64***	12.63***	12.68***
	(3.980)	(3.980)	(3.977)	(3.720)	(3.720)	(3.716)
$Bank\_Con$	-0.116	-0.116	-0.119	-0.0781	-0.0778	-0.0808
	(0.0953)	(0.0954)	(0.0953)	(0.0922)	(0.0922)	(0.0923)
$Debt/GDP$	0.275**	0.276**	0.274**	0.288**	0.289**	0.287**
	(0.122)	(0.122)	(0.122)	(0.114)	(0.114)	(0.114)
$Foreign\_Banks$	0.0920	0.0922	0.0946	0.0948	0.0950	0.0973
	(0.136)	(0.136)	(0.136)	(0.127)	(0.127)	(0.127)
$Cons$	59.59***	59.57***	59.66***	55.77***	55.75***	55.85***
	(7.993)	(7.991)	(7.995)	(7.653)	(7.652)	(7.649)
N	1504	1504	1504	1496	1496	1496
R^2	0.371	0.371	0.370	0.424	0.424	0.423

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

The level of inflation, change in real GDP, openness, bank concentration and the presence

[11] This proxy is a somewhat narrower indicator, limited to deposit money banks, and excludes credit issued by central banks.

of foreign banks have no significant effect on financial depth. However, we find that the coefficient associated with an ongoing banking crisis (oBC) is positive and highly significant. This result suggests that financial depth increases during periods of banking crisis, reflecting the expansionary policies carried out by governments and central banks to promote recovery. It should be stressed that this finding does not imply a deepening of financial depth in the year of banking/financial crisis, but rather throughout the period of financial crisis. For instance, during the initial stages of the 2007–08 financial crisis, there was an acute credit crunch in the markets. However, as the Federal Reserve, the Bank of England and the European Central Bank carried out expansionary polices, the initial adverse effects of the crisis on credit markets were mitigated and credit was made available to potential investors. In addition, our empirical results show that a country's international debt issues to GDP ($Debt/GDP$) has a positive impact on financial depth. This is sensible as $Debt/GDP$ measures the stock of outstanding international bonds relative to a country's economic activity and increases with countries' income level (Beck et al., 2010). This finding suggests that funds raised from external creditors are injected into the economy through the financial system.

Overall, the results in Table 3 confirm that uncertainty has a negative effect on financial depth. These results are robust to the use of three different uncertainty proxies and two different measures of financial depth. Yet, it would be useful to evaluate the findings reported in Table 3 by considering other studies which have used bank-level data to examine bank loans over the business cycle. It is widely acknowledged that bank loans decline after monetary and financial shocks, making it difficult for bank-dependent borrowers to rely on external finance.[12] In fact, research suggests that the cyclicality of loans can hinder the efficient allocation of resources. For instance, during the upward phase of the cycle, as a result of declining bank lending standards, increasing competition and underestimation of risk, loans may be granted to investment projects with marginally positive or even negative net

[12]See for instance, Gertler and Gilchrist (1994) and Ferri et al. (2014).

present value. In contrast, during an economic downturn, even investments with positive net present value can be rejected due to increased risk premiums, reflecting banks' increased risk aversion.[13] Furthermore, changes in bank risk preferences can also be explained by the presence of asymmetric information. If this mechanism prevails, banks are expected to grant more loans during the upward phase of the cycle than the downward phase because, in general, lenders suffer less from asymmetric information problems during the expansionary state of the economy. In addition, monitoring costs change with the business cycle, which may further affect fluctuations in bank credit.[14] If these bank-level observations are true, then there will be similar implications for overall private sector credit. Given that financial crises trigger deep recessions, our findings complement the findings reported in the literature.

5.2 Uncertainty effects on bank efficiency

In this section, we discuss uncertainty effects on financial institutions' efficiency as we examine banks' return on equity and banks' non-interest income to total income ratio.

Inspecting the first three columns of Table 4, we see that uncertainty has a negative and significant impact on banks' return on equity in all models. As in the previous table, uncertainty measures are based on dynamic and static inflation forecasting models, as well as the annual standard deviation of inflation. In models that focus on ROE, we see that the level of inflation, change in GDP, openness, bank concentration and debt to GDP ratio have no significant impact on bank returns. The results show that bank returns during ongoing banking crisis episodes are negatively and significantly affected at the 1 % level. These observations complement findings reported in the literature. For example, Albertazzi and Gambacorta (2009) have argued that bad economic conditions would worsen the quality of the loan portfolio, generating credit losses and reduction in bank profits. In a similar line,

[13] See for instance, Rajan (1994); Ruckes (2004); Puri et al. (2011) and Bassett et al. (2014).
[14] See Athanasoglou et al. (2014).

Cornett et al. (2010) have reported that banks of all size groups suffered as bank performance decreased before and during the recent financial crisis.

Table 4: Inflation Uncertainty Effects on Efficiency

	ROE			*NII*		
	unexpD	*unexpS*	*volCPI*	*unexpD*	*unexpS*	*volCPI*
$\hat{h}$	-0.000348***	-0.000454**	-0.0153***	0.000585***	0.000973***	0.00828***
	(0.000128)	(0.000222)	(0.00312)	(0.0000932)	(0.000154)	(0.00197)
Inflation	1.623	1.609	1.580	2.902***	2.929***	2.929***
	(1.272)	(1.265)	(1.250)	(0.580)	(0.592)	(0.589)
ΔGDP	0.0798	0.0782	0.0760	0.190**	0.192**	0.194**
	(0.141)	(0.140)	(0.141)	(0.0810)	(0.0813)	(0.0821)
Openness	-0.0372	-0.0371	-0.0369	0.0514	0.0512	0.0511
	(0.0637)	(0.0637)	(0.0637)	(0.0644)	(0.0643)	(0.0645)
oBC	-15.25***	-15.25***	-15.27***	3.440**	3.443**	3.412**
	(2.448)	(2.446)	(2.450)	(1.333)	(1.334)	(1.333)
Bank_Con	-0.00309	-0.00332	-0.00282	0.0434	0.0432	0.0449
	(0.0605)	(0.0606)	(0.0604)	(0.0389)	(0.0389)	(0.0389)
Debt/GDP	0.00152	0.00138	0.00185	0.0187	0.0185	0.0196
	(0.0235)	(0.0236)	(0.0235)	(0.0250)	(0.0250)	(0.0252)
Foreign_Banks	-0.130**	-0.129**	-0.131**	-0.0749	-0.0749	-0.0765
	(0.0555)	(0.0556)	(0.0554)	(0.0650)	(0.0650)	(0.0651)
Cons	22.28***	22.28***	22.30***	30.61***	30.62***	30.57***
	(5.438)	(5.439)	(5.432)	(3.643)	(3.643)	(3.643)
N	1521	1521	1521	1522	1522	1522
R^2	0.186	0.186	0.187	0.383	0.383	0.382

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

In contrast to Table 3 in which we examined the impact of uncertainty on financial depth, foreign bank concentration has a negative and significant impact on banks' return on equity. This is consistent with the literature on foreign banking which argues that foreign bank entry can render national banking markets more competitive, leading to a reduction in the profitability and costs of financial intermediation (e.g., Claessens et al., 2001; and Claessens and Horen, 2014).

Next, we examine the impact of uncertainty on banks' non-interest income activities which includes income from trading and securitization, investment banking and advisory fees, and service charges. These activities are considered differently from the traditional deposit taking and lending functions of banks (see Brunnermeier et al., 2012) and deemed to act as a forward-looking measure of bank risk, which may adversely affect banks' earnings volatility because of a higher degree of financial leverage. We report the impact of uncertainty on banks' non-interest income ratio in the last three columns of Table 4. We find that the uncertainty effect on non-interest income is positive and significant at the 1% level in all models. These results suggest that when income from traditional lines of business decline (which in consequence leads to as a decline in earnings to equity as shown in the first columns), banks engage in other activities to boost their profitability.

In fact, a number of researchers have found a significant positive relationship between non-interest income activities and earnings volatility (DeYoung and Roland, 2001, Stiroh, 2004 and Lepetit et al., 2008). For instance, Lepetit et al. (2008) argued that non-interest income activities (e.g., cash withdrawal fees, bank account management, or data processing) are considered to be riskier than traditional credit business, as it might be easier for customers to switch banks for these types of services rather than traditional banking activities (e.g., lending). More recently, DeYoung and Torna (2013) found that banks with substantial amounts of non-traditional stakeholder activities (e.g., investment banking, insurance underwriting and venture capital) also tended to take more risk in their traditional banking activities. In that effect, such banks were more aggressive in their lending behavior, had less diversified and more fundamentally risky loan portfolios and funded their loans with less stable deposit bases. Hence, an increase in the non-interest income ratio can severely affect the efficiency of banks' operations.

Turning to other variables in the relationship we find that openness, bank concentration, debt to GDP and the presence of foreign banks have no significant role in explaining the

behavior of non-interest income. In contrast, we find that inflation and changes in GDP both exhibit a positive and significant impact. An increase in inflation may be taken as an indicator of increasing economic activity. Hence, as economic activity increases, banks become involved in non-interest income activities to extract more rent. As in the previous models, an ongoing banking crisis takes a positive and statistically significant coefficient indicating that banks' non-interest income activities increase throughout such episodes. In periods of continuing crisis, as banks experience lower lending, their non-interest earning activities increase while managers search for higher returns. Although boosting returns through such activities may sound reasonable, increasing income through these more volatile activities during times of higher uncertainty may adversely affect the efficiency of the financial system.

Taking these findings together, we conclude that uncertainty affects the efficiency of financial intermediaries negatively by reducing banks' operational performance and increasing risk taking activities. The significance of ongoing banking crises in the model constitutes further evidence that efficiency worsens during periods of banking crisis when asymmetric information problems heighten.

5.3 Uncertainty effects on bank stability

Table 5 presents uncertainty effects on banks' liquidity and non-performing loans. We measure liquidity by the ratio of liquid assets to short-term funding plus total deposits.[15] Non-performing loans are defined as a ratio of defaulting loans to total gross loans.

The first three columns show that inflation uncertainty has a positive and significant effect on liquidity at the 1% level. Our finding complements the literature which demon-

[15]Liquid assets include cash and due from banks, trading securities and at fair value through income, loans and advances to banks, reverse repos and cash collaterals. Deposits and short-term funding includes total customer deposits (current, savings and term) and short term borrowing (money market instruments, CDs and other deposits).

Table 5: Inflation Uncertainty Effects on Stability

	Liquidity			*NPLs*		
	$unexpD$	$unexpS$	$volCPI$	$unexpD$	$unexpS$	$volCPI$
$\hat{h}$	0.00150***	0.00250***	0.0278***	0.000782***	0.000920***	0.0302
	(0.000124)	(0.000210)	(0.00275)	(0.0000862)	(0.000101)	(0.0376)
$Inflation$	0.215	0.286	0.301	0.365	0.363	0.367
	(0.511)	(0.502)	(0.506)	(0.742)	(0.741)	(0.734)
ΔGDP	0.0452	0.0522	0.0564	-0.116	-0.116	-0.102
	(0.0901)	(0.0907)	(0.0900)	(0.193)	(0.193)	(0.197)
$Openness$	-0.115	-0.116	-0.116	0.113**	0.113**	0.113**
	(0.0826)	(0.0826)	(0.0827)	(0.0482)	(0.0481)	(0.0481)
oBC	-0.507	-0.499	-0.559	6.480***	6.480***	6.452***
	(2.200)	(2.200)	(2.198)	(1.041)	(1.041)	(1.040)
$Bank\_Con$	0.0838	0.0833	0.0870	0.0317	0.0317	0.0336
	(0.0577)	(0.0576)	(0.0577)	(0.0214)	(0.0214)	(0.0216)
$Debt/GDP$	0.0487	0.0483	0.0505	0.0286**	0.0286**	0.0298**
	(0.0485)	(0.0484)	(0.0487)	(0.0125)	(0.0125)	(0.0122)
$Foreign\_Banks$	-0.280***	-0.280***	-0.283***	-0.0990**	-0.0991**	-0.100**
	(0.0780)	(0.0779)	(0.0783)	(0.0453)	(0.0453)	(0.0453)
$Cons$	37.49***	37.52***	37.40***	4.282	4.291	4.221
	(4.875)	(4.871)	(4.885)	(2.906)	(2.905)	(2.924)
N	1528	1528	1528	1234	1234	1234
R^2	0.149	0.150	0.144	0.411	0.411	0.408

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

strated that during periods of disturbance, banks increase their liquid asset holdings (e.g., Cornett et al., 2011). Gatev and Strahan (2006) and Gatev et al. (2009), among others, have shown that deposit withdrawals and commitment drawdowns are negatively related to market stress. For example, when a crisis occurs outside the banking system (e.g., in the commercial paper market), the funds that investors remove from these instruments would flow primarily into the banking system, because banks would be seen as a safe haven given government guarantees on deposits. In models associated with liquidity, except for foreign banks, other variables do not play a significant role. However, over the years, deregulation of branching, activity restrictions and foreign banks' presence in countries have increased the intensity of competition among banks. Such changes in the financial markets have reduced the cost of financial intermediation and profitability. In that sense, the presence of foreign banks promoted the efficient use of liquid assets, which is captured by a negative and highly significant coefficient in the first three columns of the table.

Nevertheless, access to abundant liquidity may also induce bank managers to seek higher returns as they may misprice the downside risk (e.g. Acharya and Naqvi, 2012). Bubbles are more likely to be formed when the underlying macroeconomic risk is high, as high risk induces investors to save with banks, rather than make direct investments. Hence, an increase in liquid assets may encourage bank managers to engage in riskier activities at the detriment of stability of the financial system.[16] To that end, in Table **??**, we have already shown that banks increase their non-interest income activities in periods of uncertainty.

The next three columns present the impact of uncertainty on non-performing loans. In particular, we find strong positive results based on both static and dynamic uncertainty measures, yet there is no significant impact when we use the standard deviation of inflation

[16] Lepetit et al. (2008) argue that non-interest income activities (e.g., cash withdrawal fees, bank account management, or data processing) are considered to be riskier than traditional credit business, as it might be easier for customers to switch banks for these types of services rather than traditional banking activities (e.g., lending).

as a measure of uncertainty. Furthermore, we find that an ongoing banking crisis displays a positive and significant coefficient. These findings are consistent with the literature on loan quality and macroeconomic environment as expected (e.g., Loutskina, 2011; and Klein, 2013). In particular, during periods of tranquility, banks have fewer problem loans as both businesses and households have sufficient stream of revenues and income to repay their debts. However, rapid growth in an economy is often associated with a deterioration in lending standards. Consequently, debt servicing and repayment of loans would be severely affected by economic downturns and changes in credit markets. As a result, when a recession sets in, the risk of insolvency significantly increases, as weaker and less efficient businesses and consumers with burdensome mortgages fail to pay back their loans (e.g., Louzis et al., 2012; Klein and Olivei, 2008; Klein, 2013; and Claessens et al., 2014).

In models that explain non-performing loans under uncertainty, we find no impact due to inflation, changes in GDP and bank concentration. In contrast, we find that openness has a positive effect. This may be due to the fact that openness, increasing competition, reduces firms' profitability. Hence, in competitive markets, weak firms fail, leading to an increase in non-performing loans of banks. We also find that foreign debt to GDP also has a positive effect on non-performing loans. The presence of foreign banks has a negative impact on non-performing loans, possibly due to their ability to sift firms with low quality investment projects from the loan market (Claessens and Horen, 2014).

In summary, our results reveal that uncertainty affects the stability of global financial institutions negatively with higher liquidity asset holdings and lower asset quality.

5.4 Further evidence based on country-income splits

We examined three different aspects of financial markets, financial depth, efficiency and stability, to provide a broader view on the impact of uncertainty on the health of the financial sector. We augment each model with several country-specific variables as well as country

and year fixed effects which control for annual or country-specific shocks that our control variables fail to capture. Our findings, which are robust to the use of different measures of uncertainty, show that inflation uncertainty has a negative impact on the financial sector. In what follows, we present further evidence in support of our findings, based on high *versus* low-income country splits. In doing so, we can test whether uncertainty effects differ across income groups. For brevity, we present the results only for the dynamic uncertainty measure. The results from other measures provide a similar view and are available from the authors.

Table 6 presents the results for high-income (*H_income*) *versus* low-income (*L_income*) country categories. All models in the table contain the same set of control variables as before. The results are displayed in the same order as we presented earlier: financial depth (wider and narrower definitions), return on equity and non-interest income, liquidity and non-performing loans. The first two columns of the table show that uncertainty has a negative effect on both high- and low-income countries for both financial depth measures. In particular, we find that uncertainty has a larger coefficient for low-income countries: an increase in uncertainty leads to a sharper decline in financial depth in low-income countries, all things equal. This result is expected, as inflation is a bigger concern for low-income countries.

When we turn to variables that measure efficiency in financial institutions, we find that uncertainty has the expected effects as shown in Table 4. Uncertainty effects are significant for bank returns and non-interest income only in high-income countries. Insignificant effects of uncertainty on profitability in low-income countries could be due to the presence of government-owned institutions whose mandate is different from profit maximizing. Similarly, in a financially under-developed environment, banks would not necessarily be experiencing changes in their non-interest income. Hence, a lack of significance in low-income countries should not be too surprising for these variables.

Regarding the stability dimension of financial intermediaries, we find again that the effect

Table 6: Results for Income Groups

	$FD1$	$FD2$	$Profitability$	NII	$Liquidity$	$NPLs$
$L\_inc * \hat{h}$	-0.0563***	-0.0432***	-0.120	0.00398	0.0352	0.0386***
	(0.0158)	(0.0131)	(0.150)	(0.0117)	(0.0270)	(0.00847)
$H\_inc * \hat{h}$	-0.000980***	-0.000980***	-0.000301*	0.000566***	0.00141***	0.000791***
	(0.000230)	(0.000223)	(0.000161)	(0.000101)	(0.000143)	(0.000106)
$L\_inc * Inflation$	-0.986	-0.900	2.164	-1.602	-0.105	0.140
	(1.672)	(1.554)	(4.529)	(2.068)	(2.231)	(1.152)
$H\_inc * Inflation$	0.725	0.226	1.363	2.953***	-0.181	-0.114
	(0.774)	(0.639)	(1.316)	(0.549)	(0.556)	(0.912)
$L\_inc * \Delta GDP$	-2.933**	-2.262*	-3.654	-2.951***	-0.327	-2.267***
	(1.331)	(1.295)	(2.512)	(0.956)	(1.279)	(0.738)
$H\_inc * \Delta GDP$	-0.192	-0.147	0.111	0.217**	0.0442	-0.109
	(0.126)	(0.111)	(0.140)	(0.0828)	(0.0867)	(0.202)
$L\_inc * Openness$	0.432	0.442	-0.0378	0.363***	0.304	0.249***
	(0.348)	(0.325)	(0.190)	(0.119)	(0.323)	(0.0842)
$H\_inc * Openness$	-0.322	-0.310*	-0.0189	0.0207	-0.155*	0.0778*
	(0.197)	(0.164)	(0.0607)	(0.0759)	(0.0846)	(0.0426)
$L\_inc * oBC$	13.88**	15.95***	-29.44***	-0.744	-4.574	7.896***
	(5.328)	(5.487)	(10.93)	(2.859)	(5.296)	(2.586)
$H\_inc * oBC$	9.763**	11.71***	-13.78***	3.830***	-0.0659	6.167***
	(4.407)	(4.075)	(1.977)	(1.369)	(2.342)	(1.081)
$L\_inc * Bank\_Con$	-0.0972	-0.0789	0.126	0.0250	0.0429	-0.0202
	(0.155)	(0.148)	(0.132)	(0.0458)	(0.0703)	(0.0319)
$H\_inc * Bank\_Con$	-0.130	-0.0865	-0.00801	0.0653	0.113	0.0489*
	(0.104)	(0.101)	(0.0522)	(0.0522)	(0.0812)	(0.0281)
$L\_inc * Debt/GDP$	0.294	0.460	-0.771	0.339	-0.203	0.328**
	(0.412)	(0.457)	(0.717)	(0.274)	(0.442)	(0.138)
$H\_inc * Debt/GDP$	0.281**	0.293**	-0.000659	0.0169	0.0529	0.0283**
	(0.122)	(0.114)	(0.0242)	(0.0250)	(0.0494)	(0.0125)
$L\_inc * Foreign\_Banks$	-0.347*	-0.375**	-0.0577	-0.0690	-0.126	-0.177***
	(0.192)	(0.184)	(0.141)	(0.133)	(0.156)	(0.0478)
$H\_inc * Foreign\_Banks$	0.246**	0.257**	-0.135***	-0.0764	-0.319***	-0.0657
	(0.118)	(0.103)	(0.0491)	(0.0591)	(0.0857)	(0.0599)
$Cons$	59.36***	55.34***	21.61***	28.73***	35.37***	3.286
	(7.424)	(6.908)	(4.874)	(3.895)	(5.481)	(2.828)
N	1504	1496	1521	1522	1528	1234
R^2	0.397	0.453	0.227	0.394	0.169	0.453

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

of uncertainty on liquidity and non-performing loans are in line with Table 5. In the case of liquidity, the effect of uncertainty is significant only for high-income countries. Yet, inflation uncertainty is significant at the 1% level for both high- and low-income economies. In fact the uncertainty effect on non-performing loans is significantly higher in low-income countries than that in high-income countries. During periods of banking crises, both high and low-income countries experienced significant lower profitability. In addition, we find that foreign banks were less profitable only in developed countries (Demirgüç-Kunt and Huizinga, 1999).

When we inspect the role of control variables, we find similar results compared to our earlier observations in most cases. One of the most interesting differences relates to the role of changes in GDP. We find that the effect is highly significant and negative for low-income countries for most of the models, whereas it is generally insignificant for the high-income countries. This finding suggests that if government expenditures are the main driver of growth in low-income countries, then expansionary fiscal policies simply crowd out the private sector from the capital markets. The banking crisis variable assumes similar effects in relation to our earlier findings, and we observe no significant differences between high- and low-income country groups except for the case of efficiency. Results in column 3 show that the coefficient of the bank crisis dummy is much larger for low-income countries, while results in column 4 show that the same coefficient is larger for high-income countries. This suggests that the financial sector in high-income countries bounces back from financial crises more quickly than that in low-income countries. This is perhaps due to the fact that banks in low-income countries have to play further roles in supporting the economy, such as holding large stock of sovereign debt.[17]

Furthermore, we find that pooling country income information as we did in Tables 3–5 masks the effect of foreign bank presence on credit between country groups. As columns 1 and 2 show, for high-income countries there is a strong positive relationship between foreign own-

[17]This makes sense if the financial sector in low-income countries is led by large government banks.

ership and credit, while for low-income countries, we find a significant negative relationship. This may be because foreign banks increase access to financial services and enhance financial and economic performance of their borrowers (Claessens et al., 2001). However, research has also shown that foreign banks cherry pick borrowers, which can undermine overall access to financial services by worsening the remaining credit pool and lowering financial development, especially in low-income countries where relationship lending is important (Claessens and Horen, 2014).

Although there is some variation in the impact of uncertainty between low and high-income countries, the results provide support for our claims that uncertainty adversely affects the health of financial intermediaries. In the next section, we will first discuss the economic significance of our findings based on results from Tables 3-5. Then, given the results presented for high- and low-income countries, we will provide further observations in relation to the impact of uncertainty on the financial sector for a set of countries.

5.5 Economic significance of our findings

Examining data that relate to the three characteristics of the financial institutions including financial depth, efficiency and stability, we have demonstrated that uncertainty adversely affects the health of financial systems. However, the coefficient estimates do not necessarily highlight the extent of this adverse effect. To overcome this hurdle, we used the point estimate of the dynamic uncertainty impact coefficient ($\hat{\beta}_h$) for each of the variables in Tables 3–5 and computed the corresponding elasticity. Then, we calculate the implied percentage change of the financial indicator in response to a one standard deviation (sigma) change in dynamic uncertainty.[18] Table 7 presents these findings.

Starting with financial depth, regardless of the measure used, we find that a one sigma

[18]Elasticity is computed at the mean value of the financial indicator and the uncertainty measure using $\partial FInd/\partial h \times \bar{h}/\overline{FInd}$, where $\bar{h}$ and $\overline{FInd}$ denotes the average of inflation uncertainty, and variable corresponding financial indicators, respectively.

Table 7: Economic Impact

A	$\hat{\beta}_h$	Elasticity	Impact	**B**	$\hat{\beta}_h$	Elasticity	Impact
$FD1$	-0.117	-0.076	1.392	$FD2$	-0.117	-0.078	-1.425
ROE	0.035	0.107	-1.963	NII	0.059	0.076	1.389
$Liquidity$	0.150	0.209	3.828	$NPLs$	0.078	0.545	9.983

Notes: β_h is the uncertainty impact coefficient from models (column 1) in Tables 3-6 and has been multiplied by 100; $Impact$ is the implied percentage change in $FInd$ (%) in response to a one standard deviation increase in uncertainty.

increase in uncertainty leads to a 1.4% contraction in credit available to the private sector from its mean.[19] Given that the average ratio of private credit to GDP in our sample is around 70%, the expected change in the size of private credit can be calculated to be in the order of 1% of GDP, which is substantial. Reductions in availability of credit will push the economy into a decline, as businesses and consumers would not be able to raise funds to invest or spend when funds are needed the most. In return, banks will suffer as weaker or less efficient borrowers will fail to pay their earlier debts due to the recession. As a consequence, bank profitability from traditional activities will decline, forcing managers to seek higher returns elsewhere. To that end, we find that a one sigma increase in uncertainty from its mean would lead to almost a 2% contraction of banks' return on equity. Examining the changes in non-interest income of banks in response to a similar change in uncertainty, we see that bank NII activities would increase by 1.38% to a similar size increase in uncertainty. When we turn to the effect of uncertainty on the stability of the financial sector, we find that banks will increase their liquid assets by 3.83% in response to a one sigma increase in uncertainty to weather the difficult times. The largest impact is observed for non-performing loans: non-performing loans increase by almost 10%. In that sense, we see that the adverse effects of an increase in uncertainty will be observed in all financial sectors.

[19]Note that here we report the implied percentage change at the mean value of each financial indicator in response to a one standard deviation shock in uncertainty, i.e. $Elasticity \times h_{sigma}/\bar{h} = \Delta(FInd)/\overline{FInd}$. To compute the percentage point changes in an indicator, one should calculate the product of the value given under Impact and the mean of the indicator.

Given these results, it is clear that an increase in uncertainty significantly undermines the health of the financial system. Although the responses of some variables may appear to be low, it is useful to recall that large fluctuations in aggregate economic activity can arise from seemingly small shocks (see Bernanke, 1983 and Bernanke and Gertler, 1989). For instance, the calculated change in financial depth, although small, may be sufficiently large enough to push the economy into a recessionary phase. Furthermore, the fact that we observe the highest response to a one sigma change in uncertainty on variables which we use to measure stability of the system (bank liquidity and non-performing loans) is worrisome as this confirms Bloom (2009) who argues that sharp drops in economic activity happen in response to shocks to volatility.

At this point, one can also consider the extent to which uncertainty would affect the financial system of a specific country of interest. Although within the context of our analysis it is not possible to provide an exact answer, we can make an educated guess using the parameter estimates estimated for high and low-income countries.Hence, for each variable, we compute separate elasticities for high and low-income countries and then examine the maximum uncertainty effect for a number of countries.[20]

Consider two low-income countries such as the Philippines and Pakistan. Using the point estimates that relate to low-income countries, we compute that financial depth ($FD1$) in these countries would decline approximately by 17% and 35% as uncertainty reaches its maximum observed level. These are substantial changes. In the case of high-income countries we take Spain and the USA as an example. For Spain, we compute that financial depth would decline by 3.1% and in the USA by 2%. When we compute expected changes in bank returns, we find that bank returns would declines by 5% in Spain and 3.4% in the USA. To ascertain these estimates it would be useful to carry out country-specific analyses

[20]Rather than examining the effect of a one standard deviation change in uncertainty, we calculate maximum effects. We follow this approach because uncertainty happens in bursts, for short periods of time, affecting the whole of the economy as discussed in Bloom (2009).

as our predictions are based on elasticities obtained for a large cross-country panel data. Yet, what we present here shows that sudden bursts in uncertainty may have substantial adverse effects on the financial system.

6 Conclusion

There is an ongoing debate whether monetary policy makers should identify and remove balance sheet impairments that obstruct the flow of funds to productive parts in the economy while promoting the proper functioning of the financial sector. To that end, several studies have examined bank behavior over the business cycle or during periods of banking crises, while several others have looked at the efficient allocation of bank loans during periods of instability. Our investigation complements this line of literature, as we examine the extent to which uncertainty affects the functioning and soundness of financial intermediaries. We do so by presenting evidence from three aspects of financial intermediaries, using a panel dataset comprised of 89 countries over 20 years.

Our investigation provides evidence that an increase in uncertainty would reduce the availability of credit from financial institutions, lower bank returns and increase liquidity. Those in turn, incentivize bank managers to engage in more risky activities and harm the overall stability of the sector. Under uncertainty, banks' non-performing loans increase significantly. Our findings are also economically meaningful. For instance, we compute that financial depth would decline in the order of 1.4% for a one sigma increase in uncertainty. Similarly, we compute that banks' return on assets would decline at around 2% and non-interest income will increase in the order of 1.4%, suggesting a deterioration in financial sector efficiency. These figures, coupled with a 10% increase in non-performing loans of banks and 4% increases in bank liquid assets, suggest that uncertainty negatively affects the health of the financial sector.

Given that small changes in the availability of credit can induce large fluctuations in an economy, as Bernanke (1983) and Bernanke and Gertler (1989) discuss, attention should be paid to the overall health of the financial system rather just one aspect when examining factors that affect the financial markets. In that sense, although an article from the *Economist* published on January 14th, 2017 indicated that inflation is on the rise and it is welcomed, given our findings here, too much inflation can cause serious problems.[21] Future research focusing on country-specific bank level data would be desirable to understand uncertainty effects on the financial sectors of many economies.

[21]There is a vast literature which discusses the linkages between inflation and inflation uncertainty.

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