The Shadow Banking System under Macroeconomic fluctuations

Jury:
Supervisor:
Pierrick CLERC
Reader(s):
Thomas LEJEUNE

Master thesis by
Alix Ina KIM

Academic year
2023/2024

Table of Contents

INTRODUCTION

The financial landscape has undergone significant transformations over the past few decades, particularly with the emergence and growth of the shadow banking system. The term "shadow banking" refers to a diverse set of financial activities and entities that operate outside the traditional banking system, yet perform similar functions such as credit intermediation, liquidity transformation, and maturity transformation. The concept, first introduced in the early 2000s and popularized during the financial crisis of 2007-2008, depicts the complexity and interconnectedness of modern financial markets.

Shadow banking encompasses various institutions and instruments, among them: securitization vehicles, money market funds, asset-backed commercial paper conduits, investment banks, and mortgage companies. These entities and activities, while operating outside the conventional banking regulatory framework, have gradually grown and now represent a significant portion of the global financial system. According to the Financial Stability Board (FSB), the shadow banking sector's assets accounted for approximately 47.20% of the global financial system by 2022.

The growth and evolution of the shadow banking system have been driven by several factors:

1) Regulatory changes post the Global Financial Crisis, aimed at enhancing the stability of traditional banks, inadvertently spurred the migration of financial activities to less regulated shadow banking entities. This allowed financial institutions to overcome strict regulations and capital requirements, thus, participating in the expansion of the shadow banking sector.
2) Moreover, the demand for alternative credit and funding sources, coupled with financial innovation, has fueled the development of shadow banking. Securitization and structured finance have enabled non-bank financial intermediaries to create and distribute credit more efficiently, further integrating shadow banking into the broader financial system. This integration, while beneficial in providing liquidity and funding, also raised systemic risks due to the sector's inherent complexity and lack of regulatory oversight.

Understanding the shadow banking system's impact on financial stability requires a deepen examination of its underlying drivers and mechanisms. Macroeconomic variables such as GDP growth, government bond yields, stock market performance, and liquidity reserves play crucial roles in shaping the dynamics of shadow banking. These factors influence investor behavior, risk appetite, and the overall functioning of non-bank financial intermediaries.

This thesis aims to explore the relationship between those macroeconomic variables and the growth of shadow banking, focusing on six countries: France, Germany, India, Japan, the United Kingdom, and the United States. By analyzing data from 2007 to 2022, this study seeks to identify the key determinants of the Shadow Banking.

CHAPTER 1 - LITERATURE REVIEW

I) Definition and Scoping of the Shadow Banking

The term “Shadow Banking” was mentioned for the first time in the early 2000s. It gained importance during the Financial crisis of 2007-2008 when the risks and the exposure related to the financial sector became an obvious matter at the global scale. “Shadow Banking” was coined by Paul McCulley, from the investment management firm PIMCO, in 2007, during a speech at the annual financial symposium hosted by the Kansas City Federal Reserve Bank in Jackson Hole, in Wyoming, but was made popular by the economist Zoltan Pozsar in the “Shadow banking” titled report of 2007.

The concept “Shadow banking” has sometimes been reflected under a pejorative angle, as a consequence, some alternatives have been quoted, such as “hidden”, “grey”, “black” or “informal economy” as Hassan & Schneider could have quoted. The former US Federal Reserve Chairman Ben Bernanke exposed his definition in 2013 as follows:

"Shadow banking, as usually defined, comprises a diverse set of institutions and markets that, collectively, carry out traditional banking functions—but do so outside, or in ways only loosely linked to, the traditional system of regulated depository institutions. Examples of important components of the shadow banking system include securitization vehicles, asset-backed commercial paper [ABCP] conduits, money market funds, markets for repurchase agreements, investment banks, and mortgage companies"

In other words, the Shadow Banking System (SBS) can be defined as the network encompassing all the financial activities operating outside the traditional banking sector. Less exposed to Regulatory oversights, as per the expression itself states, they often rely on market-based financing which usually takes on risk and presents more volatility (Pozsar, 2008). The concept has been used, following various definitions and interpretations, as pointed out in the literature, susceptible to constant adaptation due to the lack of accuracy of the scope depending on the criteria under study (Bejakovic, 2015).

General studies expose two different approaches, when defining the Shadow Banking, mixing the Entity-Based approach (institutional, entities that conduct shadow banking activities) and the Activity-Based approach:

- On the one hand, the first approach would include all the financial intermediaries that conduct maturity, credit, and liquidity transformation without access to central bank liquidity or public sector guarantees (Pozsar, 2008).
- On the other hand, Claessens (2014) expresses Shadow Banking according to the “financial activities except regular banking, which rely on a private or public backstop to operate”.

In line with both of the above viewpoints, we understand that Traditional Banking system can be implied in the Shadow Banking System, through their activities. Hence, the challenge can be found in the complexity of the system, interconnectedness with the other financial actors.

It has thus, become an important matter to bring ‘the shadows’ into the light by finding a common and most agreed definition of the concept in order to quantify its importance both at the global level and at the country level, as it has been clearly highlighted by Kabelik (2012) stating that only the determination of accurately defined entities, can allow Regulatory measures.

The Financial Stability Board (FSB) further elaborates the scoping, by using two main methods to scope and assess the shadow banking sector:

1) Broad Measure (MUNFI): This encompasses all non-bank financial intermediation that might pose risks to the financial system. Known as the Monitoring Universe of Non-bank Financial Intermediation (MUNFI), it includes the total assets of all financial intermediaries that are not traditional banks, such as pension funds, insurance companies, and other non-bank entities.

2) Narrow Measure (NBFI): This is a more specific subset within the broad measure, termed Non-bank Financial Intermediation (NBFI). It focuses on entities and activities that present bank-like financial stability risks, including liquidity and maturity transformation, leverage, and regulatory arbitrage.

The narrow measure is classified according to the FSB Policy Framework and is broken down into five economic functions. (EFs) that could be a source of systemic risk.

EF1: Management of collective investment vehicles with features that make them susceptible to runs. Examples of entities would include: MMFs, fixed income funds, mixed funds, credit hedge funds, real estate funds.

EF2: Provision of loans reliant on short-term funding. Typical entities would include Finance companies, leasing/factoring companies, consumer credit companies.

EF3: Involves intermediation of market activities dependent on short-term funding or on secured funding of client assets, such as securities finance companies or Broker-dealers.

EF4: Encompasses the facilitation of credit creation, for example, credit insurance companies, financial guarantors.

EF5: Includes Securitization-based credit intermediation and funding of financial entities such as Securitization vehicles, asset-backed securities, or structured finance vehicles.

For our study, we choose to focus on the Narrow Measure (NBFIs) as the main measure of the Shadow Banking.

II) Evolution and development of Shadow Banking

The Shadow Banking has evolved over the years, resulting to a significant increase.

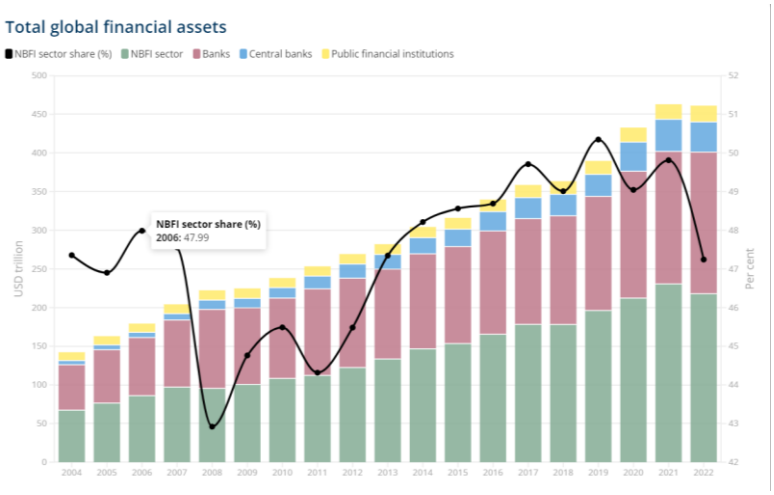

Figure 1 : Evolution of the NBFI sector share from 2004 to 2022

Source: Financial Stability Board, Global Shadow Banking Monitoring, Report 2917. 5 March 2023

The above graph sourced from its Global Shadow Banking Monitoring Report, depicts the percentage of NBFIs' assets in the total financial system in USD Trillions. It shows a clear stress in 2008 and a progressive evolution post the Global Financial Crisis (GFC). In terms of financial assets, the NBFIs represented 47.20% of the Global Financial System in 2022, an increase of 12% compared to 2008, summing up at around $260 trillion in assets under management. The expansion has first been seen in the United States, but Europe and Asia's Shadow Banking System has rapidly increased. Scholars such as Gorton and Metrick (2012) have highlighted that the modern shadow banking system began to take shape in the late 20th century in the decades leading up to the Global Financial Crisis (GFC), driven by financial innovation and the increasing complexity of financial markets. During this period, financial innovation, such as the development of securitization and structured finance, allowed non-bank financial entities to create and distribute credit and liquidity more efficiently than traditional banks.

III) Explanatory Factors of the development of the Shadow Banking

The Global Financial Crisis (GFC) in 2007-2008 exposed vulnerabilities within the shadow banking system. It resulted in significant disruptions and increased regulatory scrutiny. The Regulation enacted in response to the 2008 financial crisis, imposed significant regulatory burdens on Traditional Banks. For instance, changes introduced by Basel III and the Dodd-Frank Act, imposed higher capital and Liquidity requirements and more severe monitoring. These measures, while aimed at enhancing financial stability, have also contributed to the migration of financial activities to the shadow banking sector, where such stringent rules do not apply (Claessens et al., 2012; Duca, 2014).

Financial institutions thus, seek to mitigate the increased cost of compliance by shifting operations to shadow banking entities that are not subject to the same level of oversight. This leads to the notion of regulatory arbitrage, where financial institutions engage in shadow banking activities to avoid traditional banking regulations. This is highlighted in the work of Pozsar et al. (2010), who discuss how institutions seek to exploit regulatory gaps to optimize their financial operations. Garry J. Schinasi's seminal work "Shadow Banking: Scope, Origins and Theories" (2009) provides a comprehensive analysis of how regulatory arbitrage has been a significant driver of the growth and evolution of the shadow banking system by illustrating the case of Money Market Funds (MMFs), where requirements are less strict. Indeed, securitization amplifies this regulatory arbitrage behavior, as the transfer of assets is treated as a true sale. This allows originators to remove securitized assets from their balance sheets and avoid disclosing the assets from securitization as debt. Additionally, originators, including banks, can enhance their capital ratios by securitizing non-performing loans.

Among these strict restrictions, traditional banks are subject to deposit insurance fees and reserve requirements, which can be costly and limit their ability to extend credit. Shadow banks, not being subject to certain of those constraints, can offer higher returns on investment, making them an attractive alternative for investors. This dynamic is highlighted by Adrian and Shin (2008) where shadow banking entities like money market funds play a crucial role in the expansion of asset-backed commercial paper (ABCP) conduits in the financial system before the crisis. These entities played the role of alternative sources of funding for banks, facilitating increased credit expansion across various sectors of the economy. In the United States, for example, the share of short-term business credit of nonfinancial corporations funded by securities markets (nonbank loans funded with uninsured debt, securitized bank loans, and commercial paper directly issued by non-financial corporations) has roughly doubled since the late 1960s. (Duca, 2013).

The Regulations are thus, positively impacting the growth of Shadow Banking in the United States, but some studies showed the reverse scenario in the case of other regions. Dhulika Arora, Smita Kashiramka, analyzed the potential drivers of the NBFIs focusing on 11 emerging markets, finding out that bank regulations have a negative impact on the growth of NBFI. This finding contradicts the results reported for advanced nations (Hodula et al., 2020; De Schryder and Opitz, 2021). Reinhardt and Sowerbutts (2015) examined the impact of macroprudential policies, including capital regulation, on credit distributed by the banking sector in both advanced and emerging markets. They found no evidence of leakages to the non-bank sector when banks in emerging markets tightened their capital, unlike the leakages observed in developed countries. One possible reason for the negative relationship between bank capital regulations and the growth of the NBFIs in emerging markets could be the reliance of NBFIs on banks for funding in these economies. Additionally, emerging markets like India impose restrictions on banks regarding their exposure to NBFIs. Furthermore, regulatory arbitrage, measured through activity restrictions and financial conglomerate indices, showed a positive relationship with the growth of NBFIs. This indicates that restrictions on banks' engagement in certain activities or forming conglomerates can lead to the growth of NBFIs.

Specifically, for the euro area, the increase in non-bank finance seems to have strengthened the impulse of policy measures that work primarily via longer-term interest rates, in particular central bank asset purchases. The implication and role of bank and non-bank finance fluctuates across countries, sectors and firm sizes, such instruments might affect different parts of the euro area economy in different ways (Schnabel, 2024).

The emergence of shadow banking was thus, driven by several factors, including regulatory changes as mentioned previously but also market demands for alternative sources of credit and funding.

Hence, the overall macroeconomic conditions can have a non-neglectable impact on the evolution of the shadow banking. Indeed, the investor's sentiments and their risk appetite when taking on investment decisions, are shaped by different signals. For instance, the economic growth and the Liquidity Reserve of a region can be due to a rise of revenues for the individuals and prosperity leading to an increased behavior of investments in Shadow Banking activities. (Hu, S. Zhong; M., & Cai, Y., 2019). Rounded that investor sentiment has a significant positive impact on market liquidity. This implies that higher liquidity reserves can enhance investor confidence, thereby increasing their participation in the stock market. Furthermore, the financial innovation via the general economic growth has led to more flexibility of alternative investments for the market participants. (Gorton and Metrick, 2012).

Malatesta, Masciantonio, and Zaghini (2016) report that in euro area countries, loans extended by shadow banks to non-financial corporations (an important measure of shadow banking activity) more than doubled from 1999 to 2014. Their study identifies macroeconomic variables, such as the real GDP growth rate, inflation rate, and term spread, as primary drivers of this increase, reflecting domestic demand and supply conditions. Barbu, Boitan, and Cioaca (2016), studied the macroeconomic impacts on shadow banking using data from 15 European countries, to identify the relationship between the growth of shadow banking and various macroeconomic indicators. The results demonstrated a positive correlation between the size of the shadow banking sector and stock market indices, as well as long-term interest rates. This indicates that during periods of rising stock markets or interest rates, investors tend to seek out investment alternatives that offer higher yields.

Isabel Schnabel, a member of the ECB's Executive Board, during the Annual Congress of the European Economic Association (EEA) also pointed out that since most firms in the Eurozone predominantly depend on bank loans for their credit needs, the primary method for influencing economic conditions in the region continues to be the ECB's key interest rates. The bank lending channel remains a critical component of the monetary policy transmission mechanism. In the case of India, growth of bank assets, regulatory arbitrage, search for yield effect, demand from institutional investors (proxied as insurance companies and pension funds), institutional quality, liquidity and stock market development were the important factors affecting the growth of NBFI. (Dhulika Arora; Smita Kashiramka, 2021).

Economic actors, market participants can benefit from credit intermediation borrowing non-bank channels to reach funding and liquidity in a cost-efficient way. Yet, the expansion of the shadow banking system has participated in the systemic risk, due to interconnectedness with the traditional banking system.

Those findings led me to question about what was driving the Shadow Banking System, by focusing on the overall economic and market conditions that could potentially support the search for yield effect from the investors' point of view, and the switch to NBFIs. Given the available literatures, the following factors can possibly be behind the evolution of the Shadow Banking:

1) GDP growth

Economic growth can significantly influence the development of the NBFIs by affecting both the demand and supply of financial services. This demand comes from both businesses and households seeking more diverse financing solutions, thereby broadening the market for NBFIs which offer more specialized financial products, enabling the sector to innovate and expand their operations. This dynamic is supported by the findings of Gorton and Metrick (2010), who highlight that the rise of NBFIs is often closely linked to periods of robust economic growth. Additionally, Beck, Demirgüç Kunt, and Levine (2000), argue that financial development, including the expansion of NBFIs, tends to accelerate as GDP growth allows a more sophisticated financial infrastructure. Therefore, a high GDP growth is a

key driver of NBFI. Hence, we expect a positive relationship between the GDP growth and the extension of Shadow Banking.

2) 10 year government yield

The bond yield is a crucial metric in financial markets, reflecting the interest rate paid by the government for borrowing funds. This yield serves not only as a return on investment for bondholders but also as a proxy for investor confidence and economic sentiment. Due to its full backing by the government, the 10-year Treasury bond is considered a safe investment, making its yield a benchmark for various financial indicators, including mortgage rates. When investor confidence is high, bond prices fall and yields rise, as investors pursue higher returns elsewhere.
On the opposite side, during periods of low confidence, bond prices increase, and yields decrease due to a flight to safety. This yield's movement is closely watched as it signals broader market conditions and has significant implications for shadow banking, where changes in yields can affect liquidity, risk-taking behavior, and the overall stability of non-bank financial institutions (Adrian & Shin, 2010; Gorton & Metrick, 2012; Pozsar et al., 2013).

3) Liquidity Reserve

the reserve of liquidity is the readily available funds held by a nation's central bank that can be quickly accessed to manage economic stability, support the national currency. The Shadow Banking sector is sensitive to liquidity shocks (Adrian and Shin, 2009; 2010; Duca, 2016). Thus, when the total liquidity of one economy decreases, the total assets of the Shadow Banking also decrease. (Gorton and Metrick, 2012). For investors, understanding the liquidity reserves of NBFIs is crucial for assessing the risk-return profile of their investments, especially in a sector that operates with less regulatory oversight compared to traditional banking. While higher liquidity reserves can enhance stability and reduce systemic risk, they can also limit the risk-taking capacity of NBFIs, potentially affecting returns. The confidence level of the investors is enhanced, and they are more likely to invest in shadow banking entities if they believe that the financial system is well-supported by substantial reserves.
We expect a positive relationship between the liquidity of the economy and the Shadow Banking.

4) Stock Market Index:

Investors would pursue higher yields, thus, decreasing their investments in Traditional Banks. The investors' sentiment might thus, be driven by the stock market index fluctuations.

Research by Adrian and Ashcraft (2016) indicates that the NBFIs such as hedge funds and mutual funds are often heavily invested in equity markets. When stock market indices rise, the value of these portfolios increases, thereby strengthening their balance sheets and lowering perceived risks. Other academic studies, such as those by Gorton and Metrick (2010), have demonstrated that the cost of capital for NBFIs is closely tied to stock market performance. A rising stock market tends to reduce the cost of raising equity and debt capital, as investors are more willing to provide funding at favorable terms.

Conversely, during market downturns, NBFIs may experience significant mark-to-market losses, leading to liquidity pressures and forced asset sales. This phenomenon was notably observed during the 2008 financial crisis, where the devaluation of assets held by NBFIs contributed to systemic risks (Pozsar et al., 2010). In those scenarios, funding conditions often tighten, leading to higher costs and potential liquidity shortages, particularly for NBFIs that rely on short-term funding markets (Acharya et al., 2013). This is proven in the research led by Gennaioli, Shleifer, and Vishny (2013) indicates that liquidity conditions in the stock market significantly influence the funding available to NBFIs. During

periods of market stress, the shadow banking sector can experience sudden withdrawals of funding, susceptible to bank runs in traditional banking. This risk is further exacerbated when stock market declines reduce the collateral value of assets held by NBFIs, complicating their ability to secure necessary funding. In bull markets, a falling stock market index may thus, signal declining investor confidence and wealth, leading to reduced investment in shadow banking entities (Barberis; Shleiger and Vishny, 1998).

CHAPTER 2 – METHODOLOGY

I) Data used

The study will be extended over a historical period ranging from 2007 to 2022 and considering six countries: France, Germany, India, Japan, the United Kingdom and the United States.

The relevant data has been collected from several sources, such as the Financial Stability Board (FSB) International Monetary Fund (IMF), the Federal Reserve Economic Data and (FRED) and Investing.com websites.

Independent Variables

For the choice of explanatory variables, I chose the Real GDP Growth, the 10-Year Government Bond Yield, the Stock Market Index and the Reserves and Liquidity for each areas under study.

- RealGDP_growth_percent_change: (percentage growth rate of real GDP): Measures the rate of change in real gross domestic product, indicating economic growth/ economic health.

  Source: International Monetary Fund (IMF)

- Gouv_10Year_Bond: (10-year government bond yield): Reflects the yield on long-term government bonds, an indicator of investor confidence and market conditions.

  Source: Federal Reserve Economic Data (FRED)

- Stock_Market(stock market index): Represents the overall performance of the stock market, influencing the investment climate and the confidence of market participants / investors

  Source: Investing.com

- Reserves_and_Liquidity (reserves and liquidity): Encompasses the levels of financial reserves and liquidity in the financial system, (Growth rate of total reserves, except gold), influencing the ability of institutions to provide financial services.

  Source: International Monetary Fund (IMF).

For the RealGDP_growth_percent_change, Stock_Market and Reserves_and_Liquidity, I applied the logarithmic difference in order to stabilize their variance and to ensure the stationarity of the series.

The transformation applied is defined as follows:

$$\boldsymbol{\Delta\, ln(X_{it}) = ln(X_{it}) - ln(X_{it-1})}$$

This method is particularly suitable for processing economic and financial time series due to their multiplicative nature (Jenkins, G.M., and Reinsel, G.C. 2015)

For the Gouv_10Year_Bond, as it contained negative values making a logarithmic transformation inapplicable, a simple differencing was used:

$$\boldsymbol{\Delta X_{it} = X_{it} - X_{it-1}.}$$

This approach involves subtracting the previous value of the time series from the current value to address issues of non-stationarity and negative values.

Evolution of the independent variables

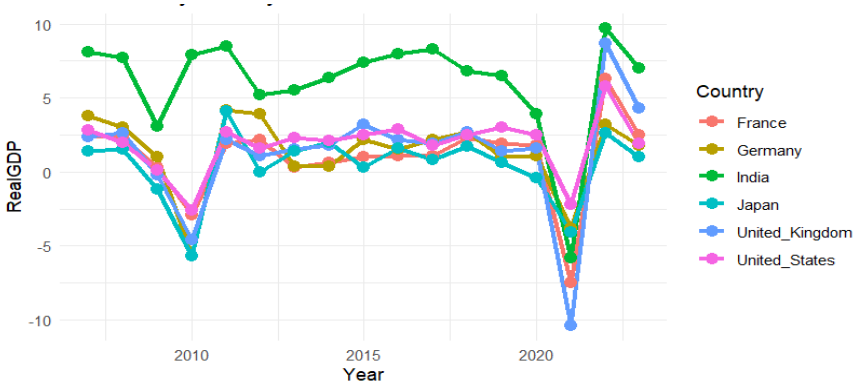

Figure 2 : Evolution of real GDP by country and year

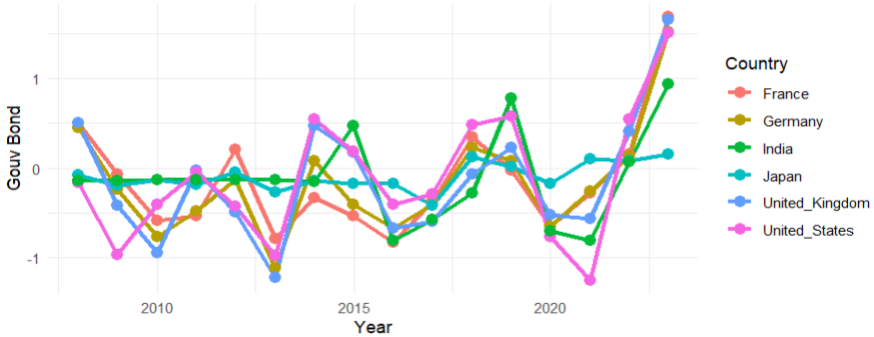

Figure 3 : Evolution of Gouv Bond by country and year

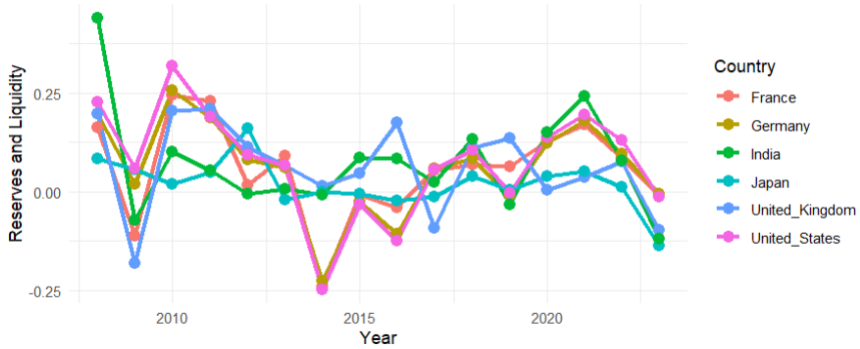

Figure 4 : Evolution of Reserves and Liquidity by country and year

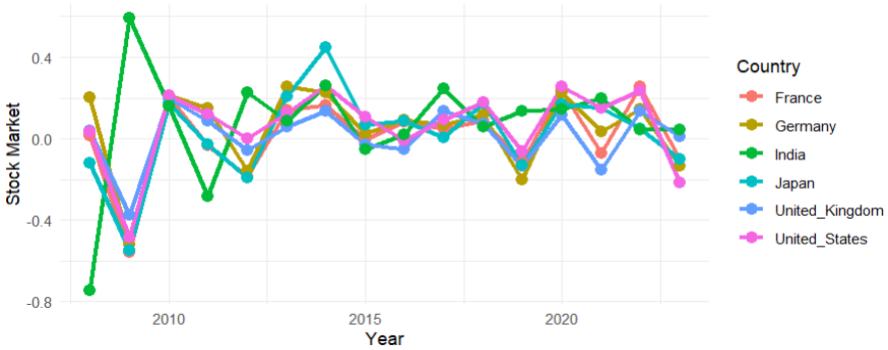

Figure 5 : Evolution of Stock Market by country and year

Dependant variable

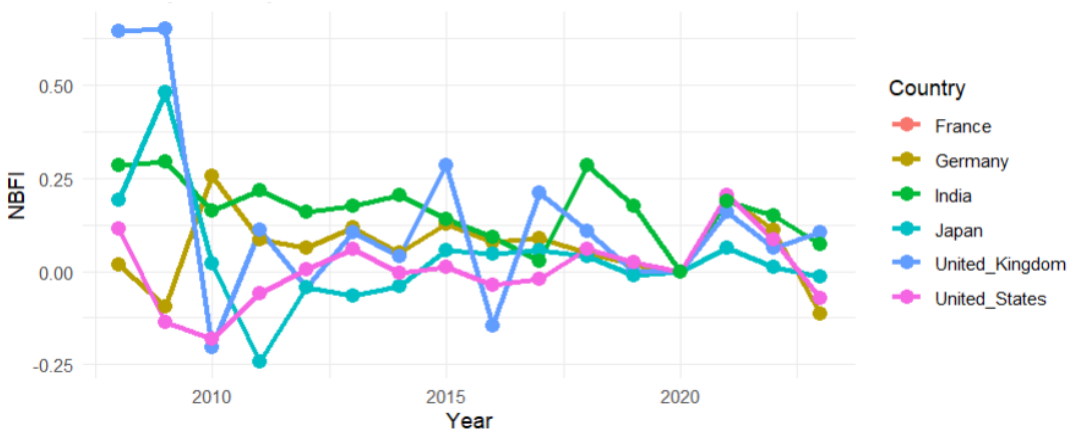

Figure 6 : Evolution of NBFI by country and year

For the dependent variable, I decided to take the NBFI, from the Financial Stability Board, as proxy of shadow banking. Thus, I determined NBFI_USDbln to represent the NBFIs in millions of euros: It reflects the amount of the NBFIs in millions of US dollars, indicating the scale of shadow banking activity in each country.

Temporal analysis

Data is analyzed over a 15-year period, from 2007 to 2022, for each country, providing an in-depth understanding of long-term trends and structural changes in the NBFIs.

II) Methodology used

The methodology used in this study is based on panel data analysis, which makes it possible to examine relationships between several variables over a period of time and across several units.

First, in order to see the global effect of the variables on the NBFI, I start using a simple Ordinary Linear Regression. Then, as the literature shows that there can be some discrepancies between countries, I decided to add the country parameter in the model. And finally, I wanted to see the impact of time in my analysis.

Econometric models

Three main econometric models are used to analyze the data:

- Fixed Effects Model: This model controls for country-specific individual effects by introducing dummy variables for each country. It isolates the effect of explanatory variables on the NBFI, while holding constant the specific characteristics of each country.
- Random Effects Model: The random effects model takes into account both country-specific fixed effects and random effects common to all countries. It makes it possible to model unobserved variability between countries, while taking random effects into account.
- Fixed Effects with Time Effects model: This model includes country-specific fixed effects and fixed time effects for each time period. It allows us to analyze the evolution of the NBFIs over time, while taking into account the specific characteristics of each country.

Hypothesis validation

Several statistical tests are used to validate the hypotheses underlying the econometric models:

- Cross-sectional Dependence: The Breusch-Pagan test is used to detect cross-sectional dependence between countries in panels.
- Temporal Correlation: The Breusch-Godfrey/Wooldridge test is used to detect temporal correlation in panel models.
- Stationarity Test: The augmented Dickey-Fuller test is used to check the stationarity of variables.
- Homoscedasticity Assumption: The Breusch-Pagan test is used to test the assumption of residual homoscedasticity.

Error Correction

Where assumptions were violated, adjustments were made to correct the problems identified. For example, robust error estimation has been used to deal with heteroskedasticity, while other techniques may be considered to address cross-dependence and temporal correlation.

General Common Analysis (OLS)

Model summary

I started my analysis by analyzing the general effect of the different variables studied on the NBFIs in the overall 6 countries. To do so, I first, I use an Ordinary Linear Regression model, namely using the Ordinary Least Square (OLS), to examine the impact of several explanatory variables on the dependent variable NBFI_USDbln (NBFIs in millions of euros). The explanatory variables include: growth rates as a percentage of real GDP, 10-year government bond yields, stock market indices by country, and reserves and liquidity for each country. The model is a simple linear regression applied to the panel data set, without taking into account individual (country) or time (year) specific effects.

The general equation is as follows:

$$\boldsymbol{NBFI_{it} = \alpha + \beta_1 * GDPG_{it} + \beta_2 * G10YB_{it} + \beta_3 * SM_{it} + \beta_4 * RL_{it} + \varepsilon_{it}}$$

Where:

- $NBFI_{it}$: Non-Bank Financial Intermediation for country i in year t
- $GDPG_{it}$: Real GDP growth rate for country i in year t
- $G10YB_{it}$: 10-year government bond yields for country i in year t
- SM_{it} : Stock market index for country i in year t
- RL_{it} : Reserves and liquidity for country i in year t
- α : Intercept
- ε_{it} : Error term

```
Call:
lm(formula = NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +
    Stock_Market + Reserves_and_Liquidity, data = panel_data)

Residuals:
    Min      1Q  Median      3Q     Max
-0.3328 -0.0765 -0.0127  0.0559  0.5889

Coefficients:
                             Estimate Std. Error t value Pr(>|t|)
(Intercept)                   0.07307    0.02031    3.60  0.00052 ***
RealGDP_growth_percent_change 0.00354    0.00469    0.76  0.45196
Gouv_10Year_Bond             -0.01132    0.02950   -0.38  0.70198
Stock_Market                 -0.14293    0.07553   -1.89  0.06162 .
Reserves_and_Liquidity       -0.06661    0.13780   -0.48  0.63000
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.152 on 91 degrees of freedom
Multiple R-squared:  0.0439,    Adjusted R-squared:  0.00185
F-statistic: 1.04 on 4 and 91 DF,  p-value: 0.389
```

Table 1: Summary output Common analysis (OLS) - Source : Own computations on R

Results of Regression

$$NBFI_{it} = 0.07307 + 0.00354 * GDPG_{it} - 0.01132 * G10YB_{it} - 0.14293 * SM_{it} - 0.06661 * RL_{it} + \varepsilon_{it}$$

Estimations of coefficients:

- **Intercept:** The model constant is 0.07307, significant at the 0.1% level (p-value = 0.000522). This indicates that, in the absence of variation in the other explanatory variables, the value of the NBFIs is positive and significant.
- **RealGDP_growth_percent_change:** The coefficient is 0.00354, but not statistically significant (p-value = 0.45196). This suggests that real GDP growth has no significant effect on the dependent variable in this model.
- **Gouv_10Year_Bond:** The coefficient is -0.011323 and is not statistically significant (p-value = 0.70198), indicating that 10-year government bond yields have no significant effect on the NBFIs.
- **Stock_Market**: The coefficient is -0.14293, with a p-value of 0.06162, making it marginally significant at the 10% level. This suggests that a negative stock market performance could be associated with a decline in the value of the NBFIs.
- **Reserves_and_Liquidity:** The coefficient is -0.06661 and not statistically significant (p-value = 0.63000). This indicates that reserves and liquidity have no significant effect in this model.

General Statistics:

Residual Standard Error: The standard error of residuals is 0.152, measuring the dispersion of residuals around the regression line.
Multiple R-squared: The multiple R^2 is 0.0439, indicating that only about 4.39% of the variation in NBFI_USDbln is explained by the model's explanatory variables.
Adjusted R-squared: The adjusted R^2 is 0.00185, which takes into account the number of explanatory variables and is even lower than the multiple R^2, suggesting a very low explanatory capacity of the model.
F-statistic: The F-statistic is 1.04 with a p-value of 0.389, indicating that the overall model is not significant at the 95% confidence level. This means that the explanatory variables, collectively, do not significantly explain the variation in the dependent variable.

Analysis and Implications

The OLS linear regression model shows that, most of the explanatory variables (with the marginal exception of Stock_Market) have no significant effect on the dependent variable NBFI_USDbln. Furthermore, the low adjusted R^2 and overall non-significance of the model suggest that other factors not included in the model could be responsible for variations in the value of the NBFIs.
Thus, the results show no statistically significant impacts of the selected variables on the NBFI. Yet, if we look at the absolute values of the estimates, we can notice that the coefficient of the Stock Market is the highest one. Although not significant, it suggests that the stock markets negatively affect the NBFIs.

The lack of significant results tells us that the model is not precise enough to really capture the variables' effects on the Shadow Banking. As the Literature suggests, important differences can exist in terms of cultural, political aspects. (Hodula et al., 2020; De Schryder and Opitz, 2021). These poor explanatory results could also be due to that no time effect has been captured. That is why, I decided to conduct further analysis, first, by adding a country specific variable in the OLS regression, and then, by considering the time effect.

Model Analysis with Country Dummy Variables

Model summary

The addition of country dummy (or indicator) variables allows us to capture country-specific effects on the dependent variable, NBFI_USDbln (NBFIs). This makes it possible to control for systematic differences between countries that are not captured by conventional explanatory variables. The general equation will be as follows:

$$\boldsymbol{NBFI_{it} = \alpha + \beta_1 * GDPG_{it} + \beta_2 * G10YB_{it} + \beta_3 * SM_{it} + \beta_4 * RL_{it} + \gamma_j * Country_j + \varepsilon_{it}}$$

where $\boldsymbol{\gamma_j}$, $\boldsymbol{Country_j}$ specifies the country-specific characteristics variations.

```
Call:
lm(formula = NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +
    Stock_Market + Reserves_and_Liquidity + factor(Country),
    data = panel_data)

Residuals:
    Min      1Q  Median      3Q     Max
-0.3223 -0.0690 -0.0007  0.0408  0.5414

Coefficients:
                              Estimate Std. Error t value Pr(>|t|)
(Intercept)                    0.04842    0.03715    1.30   0.1960
RealGDP_growth_percent_change -0.00572    0.00537   -1.06   0.2905
Gouv_10Year_Bond               0.00333    0.02817    0.12   0.9063
Stock_Market                  -0.14777    0.07164   -2.06   0.0422 *
Reserves_and_Liquidity        -0.11625    0.13220   -0.88   0.3817
factor(Country)Germany         0.03881    0.05061    0.77   0.4453
factor(Country)India           0.16909    0.05759    2.94   0.0043 **
factor(Country)Japan          -0.00524    0.05088   -0.10   0.9182
factor(Country)United_Kingdom  0.09871    0.05055    1.95   0.0541 .
factor(Country)United_States  -0.01683    0.05093   -0.33   0.7418
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.143 on 86 degrees of freedom
Multiple R-squared:  0.197,     Adjusted R-squared:  0.113
F-statistic: 2.34 on 9 and 86 DF,  p-value: 0.0206
```

Table 2 : Summary output with country dummy vaiables - Source : Own computations on R

Results of Regression

$$NBFI_{it} = 0.04842 - 0.00572 * GDPG_{it} + 0.00333 * G10YB_{it} - 0.14777 * SM_{it} - 0.11625 * RL_{it} + \gamma_j * Country_j + \varepsilon_{it}$$

The coefficients γ_j represent the specific effects of each country on the NBFI, relative to a reference country (usually the country omitted from the dummy variables). I decided to take France as the reference country, meaning that all the results will be interpreted as a benchmark from France perspectives/ characteristics. In other words, this means that the intercept term includes the effect of being in France.

$\gamma_{\{France\}}$ **= reference country**	$\gamma_{\{Germany\}}$ **= 0.03881**	$\gamma_{\{India\}}$ **= 0.16909**
$\gamma_{\{Japan\}}$ **= -0.00524**	$\gamma_{\{UK\}}$ **= 0.09871**	$\gamma_{\{US\}}$ **= -0.01683**

Estimations of coefficients:

- **Intercept:** The model constant is 0.04842, not significant (p-value = 0.1960).
- **RealGDP_growth_percent_change**: The coefficient is -0.00572, not significant (p-value = 0.2905), suggesting that real GDP growth has no significant effect on the dependent variable.
- **Gouv_10Year_Bond:** The coefficient is 0.00333, not significant (p-value = 0.9063), indicating that 10-year government bond yields have no significant effect.
- **Stock_Market:** The coefficient is -0.14777, significant at the 5% level (p-value = 0.0422). This suggests that negative stock market performance is associated with a decline in the value of the NBFIs.
- **Reserves_and_Liquidity**: The coefficient is -0.11625, not significant (p-value = 0.3817).
- **Dummy variables by country:**
    - **Germany:** Coefficient of 0.03881, not significant (p-value = 0.4453).
    - **India:** Coefficient of 0.16909, significant at 1% level (p-value = 0.0043). This indicates that, all else being equal, the NBFIs in India have a significantly higher value.
    - **Japan:** Coefficient of -0.00524, not significant (p-value = 0.9182).
    - **United Kingdom:** Coefficient of 0.09871, marginally significant at the 10% level (p-value = 0.0541).
    - **United States**: Coefficient of -0.01683, not significant (p-value = 0.7418).

General Statistics:

- **Residual Standard Error:** The standard error of residuals is 0.1429, which measures the dispersion of residuals around the regression line.
- **Multiple R-squared:** The multiple R^2 is 0.1968, indicating that 19.68% of the variation in NBFI_USDbln is explained by the model's explanatory variables, which is an improvement on the model without dummy variables.
- **Adjusted R-squared:** The adjusted R^2 is 0.1128, taking into account the number of explanatory variables and remaining relatively low, but better than the previous model.

- **F-statistic:** The F-statistic is 2.342 with a p-value of 0.02058, indicating that the overall model is significant at the 95% confidence level. This means that the explanatory variables, collectively, significantly explain the variation in the dependent variable.

Statistics of Residuals:

- Residuals range from -0.3223 to 0.5415, with a distribution centered around zero (1st quartile: -0.06901, median: -0.0007, 3rd quartile: 0.0408).

Analysis and Implications

The inclusion of dummy variables for countries improves the explanatory power of the model, as evidenced by the higher values of R^2 and adjusted R^2. As suspected with the first simple OLS regression, this model shows that stock market performance indeed, has a significant negative impact on the value of the NBFIs.

Furthermore, we can see that the value of India stands out among the other selected countries. It has a significantly higher value than the other countries. This can be explained by the fact that among the 6 countries selected, India is the only emerging country, whereas the 5 other ones are developed ones.

This model highlights the importance of country-specific differences and the significant impact of stock market conditions on the NBFIs, enlightening the fact that important factors of variations can be explained through the specificities of each country. That is why, in the next section, I decided to further analyze the country effect without taking France as a benchmark using a fixed effects model.

Analysis of the Fixed Effects Model

Model summary

This leads us to capture country by country, the potential differences and explanations that might exist. The fixed-effects model (or within model) is applied, as it is relevant to control for unobservable country-specific effects that may influence the NBFIs, (NBFI_USDbln). (Aquaro, M., & Čížek, P., 2013). This model enables us to focus on intra-country variations, by eliminating biases due to specific, time-constant characteristics for each country. Country-specific fixed effects are taken into account in this model.

$$\boldsymbol{NBFI_{it} = \alpha_i + \beta_1 * GDPG_{it} + \beta_2 * G10YB_{it} + \beta_3 * SM_{it} + \beta_4 * RL_{it} + \varepsilon_{it}}$$

```
Call:
plm(formula = NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +
    Stock_Market + Reserves_and_Liquidity, data = panel_data,
    model = "within", index = c("Country", "Date"))

Balanced Panel: n = 6, T = 16, N = 96

Residuals:
    Min.  1st Qu.   Median  3rd Qu.     Max.
-0.32233 -0.06901 -0.00071  0.04082  0.54136

Coefficients:
                             Estimate Std. Error t-value Pr(>|t|)
RealGDP_growth_percent_change -0.00572    0.00537   -1.06    0.291
Gouv_10Year_Bond               0.00333    0.02817    0.12    0.906
Stock_Market                  -0.14777    0.07164   -2.06    0.042 *
Reserves_and_Liquidity        -0.11625    0.13220   -0.88    0.382
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1.87
Residual Sum of Squares: 1.76
R-Squared:      0.0636
Adj. R-Squared: -0.0343
F-statistic: 1.46148 on 4 and 86 DF, p-value: 0.221
```

Table 3 : Summary output Fixed Effects - Source : Own computations on R

Results of Regression

$$NBFI_{it} = \alpha_i - 0.00572 * GDPG_{it} + 0.00333 * G10YB_{it} - 0.14777 * SM_{it} - 0.11625 * RL_{it} + \varepsilon_{it}$$

Estimated coefficients:

- **RealGDP_growth_percent_change**: The coefficient is -0.00572, insignificant (p-value = 0.291), indicating that real GDP growth has no significant effect on the dependent variable.
- **Gouv_10Year_Bond**: The coefficient is 0.00333, not significant (p-value = 0.906), showing that 10-year government bond yields have no significant effect.
- **Stock_Market**: The coefficient is -0.14777, significant at the 5% level (p-value = 0.042). This suggests that negative stock market performance is associated with a decline in the value of the NBFIs.
- **Reserves_and_Liquidity**: The coefficient is -0.11625, not significant (p-value = 0.382).

Statistics of Residuals:

Residuals range from -0.32233 to 0.54136, with a distribution centered around zero (1st quartile: -0.06901, median: -0.00071, 3rd quartile: 0.04082).

General Statistics:

Total Sum of Squares: 1.87.

Residual Sum of Squares: 1.76.

R-Squared: The R^2 is 0.0636, indicating that 6.36% of the variation in NBFI_USDbln is explained by the model's explanatory variables.

Adjusted R-Squared: The adjusted R^2 is -0.0343, slightly negative, indicating that the model does not significantly improve fit compared to a model without explanatory variables.

F-statistic: The F-statistic is 1.46148 with a p-value of 0.221, indicating that the overall model is not significant at the 95% confidence level.

Summary of Fixed Effects by Country

```
               Estimate Std. Error t-value Pr(>|t|)
France         -0.04742    0.03715   -1.28    0.205
Germany        -0.00862    0.03778   -0.23    0.820
India           0.12166    0.05063    2.40    0.018 *
Japan          -0.05266    0.03603   -1.46    0.148
United_Kingdom  0.05129    0.03768    1.36    0.177
United_States  -0.06425    0.03899   -1.65    0.103
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Table 4 : Summary output Fixed Effects by country - Source : Own computations on R

Estimation of Fixed Effects:

Country	Coefficient	p-value	Comments
France	-0.04742	0.205207	not significant
Germany	-0.00862	0.82014	not significant
India	0.12166	0.018	significant at the 5% level, indicating a significantly higher value for the NBFIs in India
Japan	-0.05266	0.148	not significant
United Kingdom	0.05129	0.177	not significant
United States	-0.06425	0.103	marginally significant

Model Selection Test

Fisher F-test (pFtest):

I then proceed to the Fisher F Test to reveal whether the Fixed Effect is preferred over the OLS.

```
        F test for individual effects

data:  NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +  ...
F = 3, df1 = 5, df2 = 86, p-value = 0.009
alternative hypothesis: significant effects
```

Table 5 : Results of Fisher F-test - Source: Own computations on R

Test F: The F-statistic is 3.2755 with a p-value of 0.009357, indicating that the individual fixed effects are significant. This justifies the use of the fixed-effects model over the simple OLS model.

Analysis and Implications

The fixed-effects model reveals that, although the majority of the explanatory variables are not significant, the stock market has a significant negative effect on the value of NBFIs as seen through the former OLS regressions. The F-test confirms that the fixed effects are significant, justifying their inclusion in the model to capture specific differences between countries.

Country fixed effects show that the NBFIs in India have a significantly higher value, while other countries have no significant effects. As the literature suggests, the different political situations in the countries can explain this result. This could be due to a more dynamic or expanding the NBFIs sector in India compared to France, as an emerging country. Indeed, The Reserve Bank of India (RBI) reports that the contribution of Non-Banking Financial Companies (NBFCs) to India's GDP has grown substantially, highlighting their increasingly significant role in the financial sector. This growth is attributed to supportive regulatory frameworks and robust economic development, which have collectively fostered an environment conducive to the expansion of NBFCs in the country's financial ecosystem. This might reflect differences in regulatory environments, market opportunities, or economic growth trajectories.

Yet, the fixed effect model presents some limits, as other factors can be hidden in the terms of error. Furthermore, the explanatory power of the other variables, such as the GDP_growth, Reserves_and_Liquidity and the Gouv_10Year_Bond remain insignificant. That is why, I conducted a Random Effects Model Analysis, as the country-specific reasons might not be sufficient to measure the effects on the Shadow Banking.

Random Effects Model Analysis

The random effects model is used to analyze panel data, taking into account variations between entities (in this case, countries), but assuming that country-specific differences are random and uncorrelated with the explanatory variables. This makes it possible to consider both intra-country and inter-country variations. The random-effects model is a panel data analysis method that allows some coefficients to be specific to individual units (countries in this case), while others are common to all units.

$$\boldsymbol{NBFI_{it} = \alpha + \beta_1 * GDPG_{it} + \beta_2 * G10YB_{it} + \beta_3 * SM_{it} + \beta_4 * RL_{it} + u_i + \varepsilon_{it}}$$

where $\boldsymbol{u_i}$ is a part of the residuals capturing the unexplained error terms.

```
Oneway (individual) effect Random Effect Model
   (Swamy-Arora's transformation)

Call:
plm(formula = NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +
    Stock_Market + Reserves_and_Liquidity, data = panel_data,
    model = "random", index = c("Country", "Date"))

Balanced Panel: n = 6, T = 16, N = 96

Effects:
                  var std.dev share
idiosyncratic 0.02041 0.14286  0.86
individual    0.00324 0.05691  0.14
theta: 0.468

Residuals:
    Min.  1st Qu.   Median  3rd Qu.     Max.
-0.29824 -0.07599 -0.00442  0.06287  0.56600

Coefficients:
                             Estimate Std. Error z-value Pr(>|z|)
(Intercept)                   0.08735    0.03080    2.84   0.0046 **
RealGDP_growth_percent_change -0.00228    0.00505   -0.45   0.6512
Gouv_10Year_Bond              -0.00198    0.02811   -0.07   0.9437
Stock_Market                  -0.14505    0.07167   -2.02   0.0430 *
Reserves_and_Liquidity        -0.09729    0.13175   -0.74   0.4602
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Total Sum of Squares:    1.96
Residual Sum of Squares: 1.87
R-Squared:      0.0491
Adj. R-Squared: 0.00728
Chisq: 4.69657 on 4 DF, p-value: 0.32
```

Table 6 : Summary output - Random Effects – Source : Own computations on R

Results of Regression

$$NBFI_{it} = 0.08735 - 0.00228 * GDPG_{it} - 0.00198 * G10YB_{it} - 0.14505 * SM_{it} - 0.09729 * RL_{it} + u_i + \varepsilon_{it}$$

Estimated Coefficients:

- **Intercept:** Coefficient of 0.08735, significant at 1% level (p-value = 0.0046). This suggests that there is a significant positive constant in the dependent variable.
- **RealGDP_growth_percent_change:** Coefficient of -0.00228, not significant (p-value = 0.6512).
- **Gouv_10Year_Bond:** Coefficient of -0.00198, not significant (p-value = 0.9437).
- **Stock_Market:** Coefficient of -0.14505, significant at the 5% level (p-value = 0.0430). This indicates a significant negative relationship between stock market performance and the value of the NBFI.
- **Reserves_and_Liquidity:** Coefficient of -0.09729, not significant (p-value = 0.4602).

Statistics of Residuals:

Residuals range from -0.29824 to 0.56600, with a distribution centered around zero (1st quartile: -0.07599, median: -0.00442, 3rd quartile: 0.06287).

General Statistics:

Variance of idiosyncratic residuals: 0.020410 (standard deviation = 0.142864).

Variance of individual effects: 0.003238 (standard deviation = 0.056908).

Theta: 0.4684, indicating the proportion of total variance explained by random individual effects.

Total Sum of Squares: 1.9624.

Residual Sum of Squares: 1.8661.

R-Squared: The R^2 is 0.0491, indicating that only 4.91% of the variation in NBFI_USDbln is explained by the explanatory variables.

Adjusted R-Squared: The adjusted R^2 is 0.00728.

Chisq: 4.69657 with a p-value of 0.32, indicating that the overall model is not significant at the 95% confidence level.

The random effects model shows that the stock market performance has a significant negative effect on the value of the NBFIs, similar to the results obtained with the other models. The other explanatory variables, still show no significant effects.

Given the similarity of the results from both Fixed and Random Effects, I decided to run an Hausman Test to determine which of the two models better fits.

Hausman Test:

```
        Hausman Test

data:  NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +  ...
chisq = 0.9, df = 4, p-value = 0.9
alternative hypothesis: one model is inconsistent
```

Table 7 : Results of Hausman Test - Source: Own computations on R

Hausman Test: The chi-square statistic is 0.9 with a p-value of 0.9. The high p-value indicates that we cannot reject the null hypothesis that the fixed-effects and random-effects models are equivalent. It thus, indicates that the random effects model is appropriate for these data, as there is no significant correlation between the random effects and the explanatory variables. Consequently, the random-effects model is preferred as it is more efficient in this case. The Hausman test result suggests that the variability across different entities, such as countries or firms, is more appropriately captured by the random effects model. This model offers more generalizable insights and is better equipped to manage unobserved heterogeneity without the risk of bias from fixed individual characteristics. (Wu-Hausman Test, 2022)

Analysis and Implications

As a result, the Random effect model having a greater explanatory power, confirms well the significant impact of the Stock Market Index on the Shadow Banking.

A decline in the stock market index can thus, have a negative impact on (NBFIs). This can be explained by the fact that a declining stock market index can signal broader economic distress, leading to higher credit risks and loan defaults, which further constrain the NBFIs' financial health (Allen & Carletti, 2013). Additionally, falling stock markets can reduce consumer and investor confidence, as taken as an index of confidence in the market, leading to lower demand for financial products offered by the NBFIs, such as mutual funds and insurance policies, thereby squeezing their revenue streams (Brunnermeier, 2009).

The other independent variables are still insignificant, but the second greatest coefficient is the Reserves and Liquidity factor. (-0.09729), translated by a negative impact of the overall Liquidity level on the NBFI. This result can thus, be surprising, as we could tend to attribute a high liquidity to an increase of the investments in the NBFI, pursuing higher yields, but it could suggest, again, due to the absence of significance on this output, that more liquidity does not drive this sentiment, due to stricter regulations. This outcome can be understood by considering the broader context provided by existing literature on shadow banking and liquidity dynamics. Further, we can discuss on the shadow banking system that thrives in environments where traditional liquidity metrics are less impactful due to the innovative financial instruments and off-balance-sheet activities that these institutions employ. The complexity and opacity of the financial products used by the NBFIs may reduce the sensitivity of these entities to fluctuations in overall liquidity, explaining why our analysis shows an insignificant relationship between liquidity reserves and the expansion of shadow banking. Research by Adrian and Shin (2010) highlights that while liquidity reserves are crucial for traditional banking institutions in managing liquidity risk and ensuring financial stability, the role of liquidity reserves within the shadow banking system can be more complex. This allows them to maximize short-term returns even in low liquidity environments. As a result, the presence of higher liquidity reserves might not directly influence their operations or risk-taking behavior as strongly as it does in traditional banks.

CHAPTER 3 - CONCLUSION

The analysis conducted aimed at investigating the impact of various macroeconomic variables on the shadow banking sector across six countries: France, Germany, India, Japan, the United Kingdom, and the United States, over a 15-year period from 2007 to 2022. Using a quantitative approach with panel data analysis and econometric modeling including the Ordinary Least Squares (OLS), Fixed Effects, and Random Effects models, this study tried to unwrap the underlying drivers of shadow banking activities.

The OLS regression demonstrated an initial examination of the relationship between macroeconomic variables and the NBFIs proxy. The results indicated that most of the explanatory variables, including real GDP growth, 10-year government bond yields, and reserves and liquidity, did not have a significant impact on the NBFIs. However, the stock market index showed a marginally significant negative effect, suggesting that poor stock market performance could be associated with an increase in shadow banking activities. The low R-squared value indicated that the model had limited explanatory power, highlighting the need for further analysis.

To address potential country-specific effects, a model with country dummy variables was introduced. This model improved the explanatory power, with the inclusion of country-specific factors providing better insights into the variations in the NBFIs across different countries. The stock market index remained significant, reinforcing its negative relationship with shadow banking. Notably, India stood out with a significantly higher NBFIs value, reflecting its unique economic and regulatory environment compared to the other developed countries in the study.

The Fixed Effects model further refined the analysis by controlling for unobservable country-specific effects. This approach confirmed the significant negative impact of the stock market on the NBFIs and highlighted India's higher NBFIs value, consistent with the findings from the country dummy model. However, the fixed effects model also revealed limitations, as it failed to account for significant effects from other explanatory variables and suggested the need to explore additional factors.

The Random Effects model provided a more generalizable approach by considering both intra-country and inter-country variations. This model confirmed the significant negative relationship between the stock market index and the NBFIs while indicating that other macroeconomic variables remained insignificant. The Hausman test validated the appropriateness of the Random Effects model, suggesting it as the preferred model for this study.

Overall, the results consistently demonstrated that stock market performance has a significant negative impact on shadow banking activities. However, the other selected variables, including real GDP growth, 10-year government bond yields, and reserves and liquidity, did not show significant effects. This discrepancy could be explained by several reasons:

- **Limitations of the Dataset**: The use of annual data, as mentioned in your analysis, limits the ability to capture short-term fluctuations and more nuanced dynamics in the shadow banking sector. Higher-frequency data, such as quarterly or monthly data, might have revealed more significant relationships between these macroeconomic variables and shadow banking activities.

- **The Complexity of Shadow Banking**: The shadow banking system's complexity and its role in the global financial markets imply that it may not respond to the selected variables in a straightforward way. Instead, shadow banking activities might be more closely linked to financial innovations, investor behavior, and global liquidity conditions, which are not fully captured by the variables under study only.

This leads us to understand that this study encountered several limitations that require consideration. Firstly, the data for the NBFIs were annual, which limited the accuracy and granularity of the analysis. More frequent data points, such as quarterly or monthly data, could provide a more detailed understanding of the dynamics in the shadow banking sector. Secondly, the scope of the study was broad, covering six diverse countries with varying economic conditions and regulatory frameworks. A different outcome would have evolved if we chose to focus on one specific region or/and by isolating one shadow banking activity. Furthermore, the study's focus on selected macroeconomic variables may have overlooked other influential factors. Regulatory changes, financial innovations, and investor behavior are among the aspects that could significantly affect shadow banking activities. Future research should consider a broader range of variables and potentially employ more sophisticated modeling techniques to capture the complexity of the shadow banking system more accurately. Last but not least, the interconnectedness of the shadow banking system and its complex relationship with traditional banking made it challenging to set apart specific factors and their impacts comprehensively.

Our study finger points the importance of continuous monitoring and regulation to mitigate the risks associated with shadow banking, ensuring financial stability in an increasingly complex and interconnected global financial system.

BIBLIOGRAPHY

Adrian, T., & Shin, H. S. (2010). Liquidity and leverage. *Journal of Financial Intermediation,* 19(3), 418-437.

Adrian, T., & Ashcraft, A. B. (2012). Shadow Banking: A Review of the Literature. *Federal Reserve Bank of New York Staff Report No. 580.*

Allen, F., Carletti, E., & Marquez, R. (2011). Credit market competition and capital regulation. *The Review of Financial Studies, 24*(4), 983-1018.

Arora, D., & Kashiramka, S. (2021). Drivers of non-bank financial intermediation: Evidence from emerging markets. *Journal of Financial Regulation and Compliance, 29*(4), 415-430.

Barbu, T. C., Boitan, I. A., & Cioaca, S. I. (2016). Macroeconomic determinants of shadow banking—Evidence from EU countries. *Review of Economic and Business Studies,* 9(2), 111-129.

Baltagi, B. H. (2005). *Econometric Analysis of Panel Data* (3rd ed.). John Wiley & Sons.

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2000). A New Database on Financial Development and Structure. *World Bank Economic Review,* 14(3), 597-605.

Brunnermeier, M. K., & Pedersen, L. H. (2009). *Market liquidity and funding liquidity.* The Review of Financial Studies, 22(6), 2201-2238. Princeton University. https://www.princeton.edu/~markus/research/papers/liquidity_credit_crunch.pdf

Claessens, S., Pozsár, Z., Ratnovski, L., & Singh, M. (2014). Systemic Risk in the Financial System: Insights from Shadow Banking. *IMF Working Paper.*

Colliard, J.-E., & Nguyen, B. (2018). Shadow Banking and Financial Stability: European Money Market Funds in the Global Regulatory Framework. *Review of Finance.*

De Schryder, S., & Opitz, F. (2021). Macroprudential policy and its impact on the credit cycle. *Journal of Financial Stability,* 53, 100818.

Duca, J. V. (2014). What Drives the Shadow Banking System in the Short and Long Run. *Federal Reserve Bank of Dallas, Working Paper, No. 1401.*

Duca, J. V. (2016). How capital regulation and other factors drive the role of shadow banking in funding short-term business credit. *Journal of Banking & Finance,* 69, S10–S24.

Financial Stability Board. (2011, April). Shadow banking: Scoping the issues. Retrieved from https://www.fsb.org/2011/04/shadow-banking-scoping-the-issues/

Financial Stability Board. (2016). Global Shadow Banking Monitoring Report 2016. Retrieved from https://www.fsb.org/wp-content/uploads/global-shadow-banking-monitoring-report-2016.pdf

Financial Stability Board. (2022, December). Global Monitoring Report on Non-Bank Financial Intermediation 2022. Retrieved from https://www.fsb.org/2022/12/global-monitoring-report-on-non-bank-financial-intermediation-2022/

Gorton, G., & Huang, L. (2004). Banking and shadow banking. *American Economic Review,* 94(3), 455-483.

Gorton, G., & Metrick, A. (2010). Regulating the Shadow Banking System. *Brookings Papers on Economic Activity,* 2010(2), 261-312.

Gorton, G., & Metrick, A. (2012). Securitized banking and the run on repo. *Journal of Financial Economics,* 104(3), 425-451.

Ha, J., Kose, M. A., & Ohnsorge, F. (2023). One-Stop Source: A Global Database of Inflation. *Journal of International Money and Finance,* 137(October), 102896.

Hu, S., Zhong, M., & Cai, Y. (2019). Impact of investor behavior and stock market liquidity: Evidence from China. *Entropy,* 21(11), 1111.

Jenkins, G. M., & Reinsel, G. C. (2015). *Time Series Analysis: Forecasting and Control.*

Malatesta, F., Masciantonio, S., & Zaghini, A. (2016). The shadow banking system in the Euro area: Definitions, key features and the funding of firms. *Italian Economic Journal,* 2(2), 217–237.

Nakamura, H., & Tanaka, K. (2022). GDP Growth and the Expansion of Shadow Banking in Japan. *Journal of Financial Economics.*

Noeth, B. J. (2012, February 1). Traditional versus shadow banking. *Federal Reserve Bank of St. Louis.* Retrieved from https://research.stlouisfed.org/publications/page1-econ/2012/02/01/traditional-versus-shadow-banking/

Pozsar, Z. (2008, July). The Rise and Fall of the Shadow Banking System. Moody's Economy.

Pozsar, Z. (2011). Institutional Cash Pools and the Triffin Dilemma of the U.S. Banking System. *IMF Working Paper No. 11/190.*

Pozsar, Z. (2012). A Macro View of Shadow Banking: Do T-Bill Shortages Pose a New Triffin Dilemma? Is U.S. Government Debt Different? *Wharton Financial Institutions Center.*

Pozsar, Z. (2014). Shadow Banking: The Money View. *Working Paper,* US Treasury, Office of Financial Research.

Pozsar, Z., Adrian, T., Ashcraft, A., & Boesky, H. (2013). Shadow banking. *Economic Policy Review,* 19(2).

Rajan, R., & Acharya, V. V. (2023). Liquidity, Liquidity Everywhere, Not a Drop to Use – Why Flooding Banks with Central Bank Reserves May Not Expand Liquidity. *Working Paper 29680,* DOI 10.3386/w29680, National Bureau of Economic Research.

Schnabel, I. (2021). The rise of non-bank finance and its implications for monetary policy transmission. *European Central Bank.* Retrieved from https://www.ecb.europa.eu/press/key/date/2021/html/ecb.sp210824~38c0c6f438.en.html

Schnabel, I. (2024). The benefits and costs of asset purchases. *European Central Bank.* Retrieved from https://www.ecb.europa.eu/press/key/date/2024/html/ecb.sp240528~3c7a4d8e4e.en.html

Stijn, C., Zoltán, P., Ratnovski, L., & Singh, M. (2014). Systemic Risk in the Financial System: Insights from Shadow Banking. *IMF Working Paper.*

Viral, A. V., & Richardson, M. (2009). Restoring financial stability: How to repair a failed system. *Wiley.*

Wu-Hausman Test: Choosing between Fixed and Random Effects. (2022). SPUR Economics.

Xu, S., He, X., & Cao, C. (2023). Struggle for survival in credit crunch: The effect of interest rate deregulation in China. *China Economic Review,* 77, 101911.

Zoltan, P., Tobias, A., Ashcraft, A. B., & Boesky, H. (2012). Shadow Banking. *Federal Reserve Bank of New York Staff Report No. 458.*

APPENDIX

Analysis of Hypothesis Validation Tests

Hypothesis validation tests are used to assess the robustness and appropriateness of the statistical model used to analyze panel data.

Cross-dependency

```
        Breusch-Pagan LM test for cross-sectional dependence in panels

data:  NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +     Stock_Market + Reserves_and_Liquidit
y + factor(Date)
chisq = 65, df = 15, p-value = 3e-08
alternative hypothesis: cross-sectional dependence
```

Table 8 : Results of Breusch-Pagan test - Source: Own computations on R

Test Breusch-Pagan for serial correlation: The chi-square statistic is 65.214 with a very small p-value (3.135e-08), rejecting the null hypothesis of no cross-dependence. This means that there is significant cross-dependence between the panel units (countries).

Serial correlation

```
        Breusch-Godfrey/Wooldridge test for serial correlation in panel models

data:  NBFI_USDbln ~ RealGDP_growth_percent_change + Gouv_10Year_Bond +  ...
chisq = 17, df = 16, p-value = 0.4
alternative hypothesis: serial correlation in idiosyncratic errors
```

Table 9 : Results of Woolbridge test - Source : Own computations on R

Breusch-Godfrey/Wooldridge test for serial correlation: The chi-square statistic is 16.509 with a p-value of 0.418, which does not reject the null hypothesis of no serial correlation in idiosyncratic errors. There is therefore no evidence of serial correlation in this model.

Stationarity test

```
        Augmented Dickey-Fuller Test

data:  panel_data.set$NBFI_USDbln
Dickey-Fuller = -5, Lag order = 2, p-value = 0.01
alternative hypothesis: stationary
```

Table 10 : Results of ADF test - Source : Own computations on R

Test Augmented Dickey-Fuller: Augmented Dickey-Fuller test: The Dickey-Fuller statistic is -4.9654 with a p-value of less than 0.01, rejecting the null hypothesis of non-stationarity. This indicates that the NBFI_USDbln time series is stationary.

Homoscedasticity assumption

```
        studentized Breusch-Pagan test

data:  Model_fe_time
BP = 43, df = 19, p-value = 0.001
```

Table 11 : Results of Breusch-Pagan test for Homoscedasticity - Source: Own computations on R

Breusch-Pagan test for homoscedasticity: The Breusch-Pagan statistic is 42.79 with a p-value of 0.001385, which rejects the null hypothesis of homoscedasticity. This means that there is significant heteroscedasticity in the model, so the Random Effect is preferred.

To correct for heteroscedasticity, a robust error estimate is used (vcovHC with the “arellano” method). This adjusts the standard errors to take account of heteroscedasticity in the model.

```
t test of coefficients:

                              Estimate Std. Error t value Pr(>|t|)
RealGDP_growth_percent_change -0.00572    0.00765   -0.75    0.457
Gouv_10Year_Bond               0.00333    0.03485    0.10    0.924
Stock_Market                  -0.14777    0.07376   -2.00    0.048 *
Reserves_and_Liquidity        -0.11625    0.17487   -0.66    0.508
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Table 12 : Coefficients outputs of t-test - Source: Own computations on R

Coefficients post correction for standard errors: After correction for heteroskedasticity, standard errors are adjusted. The Stock_Market coefficient remains significant at the 5% level (p-value = 0.048), while the other explanatory variables are not significant.

The tests show significant cross-dependence between panel units, suggesting that common factors may influence observations between different countries (interest of the random effect model). There is no evidence of serial correlation in the idiosyncratic errors. The time series of the dependent variable is stationary, which is favorable for the validity of the model results. Finally, heteroscedasticity is present and has been corrected using robust standard errors. The results after correction indicate that the stock market has a significant effect on NBFI, while the other explanatory variables do not show statistical significance after adjustment for heteroscedasticity. The tests and adjustments carried out ensure the robustness and reliability of the model results.