Правительство Российской Федерации

Федеральное государственное автономное образовательное учреждение высшего образования

“Национальный исследовательский университет “Высшая школа экономики”

Факультет мировой экономики и мировой политики

Образовательная программа Мировая Экономика

ВЫПУСКНАЯ КВАЛИФИКАЦИОННАЯ РАБОТА

На тему
«Determinants of Systemic Risk in Italy’s Banking System in 2000-2023.»

Студент группы № БМЭ204
Фам Тху Чанг

Научный руководитель
Приглашенный преподаватель
департамента мировой экономики,
Мухаметов Оскар Рустямович

Москва, 2024 г.

TABLE OF CONTENTS

LIST OF USED ABBREVIATIONS

ΔCoVaR	Delta Conditional Value-at-Risk
BCI	Business confidence index
BoI	Bank of Italy
CCyB	Countercyclical Capital Buffer
DFR	Deposit facility rate
ECB	European Central Bank
EMU	European Monetary Union
ES	Expected shortfall
FED	Federal Reserve System (the US central bank)
G&S	Goods and services
GFC	Global financial crisis
GG	General government
HHs	Households
IBC	Italian banking crisis
IPI	Industrial production index
ISTAT	Italian National Institute of Statistics
MES	Marginal expected shortfall
NFCs	Non-financial corporations
NPL	Non-performing loans
QE	Quantitative easing
SDC	Sovereign debt crisis
SES	Systemic Expected Shortfall
SRISK	Systemic Risk Measure
VaR	Value-at-risk

LIST OF TABLES AND FIGURES

INTRODUCTION

Systemic risk is the concept that gained popularity since the outbreak of the global financial crisis (GFC) in 2007 as participants of the world's financial markets found themselves highly exposed to the collapse of others. Before the GFC, researchers of banking studies as well as regulators mainly focused on the individual default probability of a financial institution rather than its contribution of individual risk to the system, or vice versa, its exposure to the default risk of the whole system in case of extreme events (Allen & Carletti, 2013). The catastrophic consequence of the GFC raised concerns over not only risk management in the banking industry but also the transmission of a financial collapse onto the real economy. Indeed, the overflow of failures from financial markets to different economies, manifested by the Global Recession following the GFC, signifies that financial stability not only holds its relevance in the financial world but also in the real economy. Since then, an extensive number of studies have put emphasis on the topic of systemic risk in terms of its measurement and determinants. Additionally, another unprecedented outcome from the GFC is the introduction of unconventional monetary policies (UMPs) to counter the prolonged period of low inflation. While studies focusing on the impact of UMPs on economic and banking activities are abundant (after all, the main goal of which is keep inflation stable and spur economic growth), the strand of literature that specializes in UMP's influence on systemic risk is of a lower volume.

In recent years, the Italian banking sector has been strengthening its resilience and is now among the largest banking sector in the euro area. As part of the European Monetary Union (EMU), its financial stability is of great importance since the collapse of which would unavoidably result in the disruption of capital allocation in the euro area. While the Italian banking sector was not substantially affected by the GFC, the sovereign debt crisis (SDC) that came in 2010 revealed Italy's banking system to its reliance on domestic fundings, of which a large part is government bonds. Furthermore, while the banking industry itself performs well on its own, the two consecutive crises from 2007 to 2013 damaged the Italian economy severely, which negatively affected the banking sector that involves much with internal banking activities with domestic clients and traditional lending methods. In the years during the implementation of the ECB's UMPs, a banking crisis hit the industry and major structural changes were introduced to counteract the issue, and not without the active engagement of the governemnt. Therefore, the Italian banking sector represents an interesting case as it is strongly connected to its domestic private and public sectors, as well as stands under the influence of monetary policies applied for the whole euro area. Finally, while there is an abundance of studies that focus on systemic risk in the euro area, to the best of the author's knowledge, there has only been one thorough study of the influence of systemic risk on Italy specifically by Borri and his co-authors in 2012, in which the ECB's UMPs had not yet been introduced. Hence, this paper also hopes to provide new insights into systemic risk in a country-centric approach with the case of the Italian banking sector.

The purpose of this study is to study various determinants and their degree of influence on systemic risk in Italy's banking sector from 2000 to 2023 under the influence of economic environment, banking-sector characteristics, and unconventional monetary policies. In order to achieve this goal, the paper sets out the following objects: (i) to identify various factors that determine systemic risk in Italy's banking sector, (ii) to analyze the dynamics of Italy's banking sector and macroeconomic indicators, taking into account the ECB's implementation of UMPs, and (iii), to measure the impacts of potential determinants of systemic risk in Italy by building multiple linear regression models.

In the process of achieving these objectives, this study proposes two hypotheses that serve as basis for the search for determinants and their influence on systemic risk.

Hypothesis 1: The strong intercorrelation between Italy's banking sector and the real economy is a catalyst for increase in systemic risk.

Hypothesis 2: The ECB's unconventional monetary measures have positive effects on systemic risk in the Italian banking sector.

In order to provide a confirmation for the hypotheses, this paper applies multiple linear regression models using the generalized least square (GLS) methods. Using the SRISK ~~indicated~~ indicator calculated by the Volatility Lab (V-Lab) based on Brownlees and Engle's (2017) framework, this study conducts a selection and classification of 32 indicators into three broad categories: the first category includes banking-sector characteristics, the second category concerns macroeconomic indicators, and the third category represents the ECB's employment of UMPs.

The large scope of current literature focuses on the measurement of systemic risk and its determinants. For the banking-sector characteristics, most paper agree with the positive effects of size (González-Hermosillo, 1997; Borri et al., 2012; Vallascas & Keasey, 2012; Black et al., 2016, Varotto & Zhao, 2014; Kleinow & Nell, 2014), leverage ratio (Borri et al., 2012; Vallascas & Keasey, 2012; Varotto & Zhao, 2014; Hautsch et al., 2014), and the negative effect of liquidity on systemic risk (González-Hermosillo, 1997; Acharya & Steffen, 2013). For the macroeconomic indicators, higher GDP ((Demirgüç-Kunt & Detragiache, 1998; Brana et al., 2019), higher inflation (González-Hermosillo, 1997; Demirgüç-Kunt & Detragiache, 1998) and higher sovereign debt (Stolbov, 2015; Brana et al., 2019) tend to be associated with an increase in systemic risk. Finally, for unconventional monetary policy impacts mixed results are achieved. While Kabundi and De Simone (2020) argue for the insufficiency of evidence to prove the influence of monetary policy on systemic risk, Peersman

(2011), Demirgüç-Kunt & Detragiache (1998), Brana et al. (2019) and Dzhagityan & Mukhametov (2023) agree upon the positive impact of expansionary (un)conventional monetary policies on systemic risk.

The rest of this paper is structured as follows: chapter 1 investigates the definitions, measurement, and determinants of systemic risk; chapter 2 observes the implementation of the ECB's unconventional monetary and analyzes dynamics in Italy's economy and banking sector and the evolution of systemic risk, and chapter 3 quantifies the influence of variables across three categories (banking-sector, macroeconomic and UMPs-related) on systemic risk using the GLS method for multiple linear regression models.

Chapter 1: Systemic risk and the search for its determinants

1.1. Emergence and measurement of systemic risk

The definitions of risks and especially risks in the financial sector are important concepts that need to be disseminated before discussing the concept of systemic risk. While risk in general can be understood as the probability of loss as a result of negative events, financial risks involve potential losses in monetary terms caused by one event or a series of events that cause downward effects on returns on investments. As argued by Artzner et al. (1998), the definition of risk should concern only the future value of a position because of its association with the shifting future values caused by unknown events, such as market changes. This idea is relevant even today, as the understanding of risk still typically revolves around potential losses that an entity can incur in the future. While the classification of risks in financial systems typically comprises credit risk, market risk, liquidity risk as the most three commonly discussed ones[1], this points to risks that evolve within a single financial institution, rather than the whole systemic. However, when the global financial crisis swept through every corner of the world's largest banking sectors in the late 2000s, the concept of systemic risk began to gain ground.

Before the 2007 – 2009 global financial crisis, risk management focused rather on the risks within each institution itself, than the contribution of an institution to the potential failure of the whole system. However, it was not until the unpredicted magnitude of failure on Wall Street damaged the major financial sectors that attention on systemic risk started to increase in terms of number of studies from both macroprudential regulators and scholars. While the larger part of this catastrophic event was due to the overaccumulation of bad loans (or to be more precise, mortgage-backed securities) and the troubled financial institutions' last efforts of "pushing" these loans across the financial sector, it is also because the practice of risk management never considered how large the transmission from the failure of a single firm to the whole system could be when risk measure exceeds the estimated maximum value. From then on, the definition, sources and measurement of systemic risk became the focal point of all discussions that concerns risk management in the financial industry, and more importantly, the mere concept of financial stability became strongly attached with systemic risk.

Because of the high level of uncertainty, complexity and ambiguity in systemic risk, there has been no universally used definition, but variations of the concept of which echo the basic ideas of what systemic risk stands for. While the number of attempts to define systemic risk in order to

[1] In reality, risks that concern loss of monetary resources can also include solvency risk, country risk, interest rate risk... and these specific risks can also be decomposed into different types of risk in narrower senses.

measure it appropriately boomed at the outbreak of the global financial crisis in 2007 - 2009, as mentioned above, the understanding of systemic risk also appeared earlier.

In 2009, Eijffinger attempted to provide a conceptualization of systemic risk with reference to Bini Smaghi's speech in Venice of the same year at the 13th Annual Conference on "Financial Supervision in an Uncertain World". At the conference, Bini Smaghi quoted the definition of systemic risk provided by G10 in 2001[2] and referred to the shocks that threaten financial stability mentioned in the ECB's Financial Stability Report[3]. From G10's definition of systemic risk and the ECB's definition of financial stability, Eijffinger concludes that the financial system is considered stable as long as the shocks caused by systemic risk do not cause impairment to the functioning of the financial sector and the economy, and these shocks include deterioration of confidence and the escalation of uncertainty that involve a considerable part of the financial system. More definitions of systemic risk are also delivered by Adrian and Brunnermeier (2016), Benoit et. al. (2015), IMF (2013), Taylor (2009), who all stress the key ideas of the spread of risk across the sector and the spillover effects to the real economy. Subsequently, systemic risk can be understood as the probability of which the fall of a single financial institution causes the collapse of other institutions, which ultimately leads to the breakdown of the entire financial system, and thus, the economy.

With the continuation of globalization after the GFC with increasing interrelation between international financial markets and economies, it is as well important to acknowledge that systemic risk is perhaps even more relevant in today's context. Whereas one can reasonably argue that the age of globalization is likely already on the downside of the hill, it is nevertheless undeniable that as a result of the strengthened interconnectedness in the global economy, the correlation reflected in interactions within the banking sector itself and the connection between banks' activities and other sectors in the economy have become even more complex. More specifically, the financial sector plays the role of the mediator in world's economy as it regulates both the input of resources from one side of the economy (i.e. economic agents who lend or/and invest) and the output of resources to the other (i.e. borrowers) (Rodriguez-Meoreno, 2012). Therefore, in a wider sense, systemic risk manifests

---

[2] In 2009, Bini Smaghi quotes the definition of systemic risk provided by G10 in 2001, which refer to systemic risk as "*...the risk that an event will trigger a loss of economic value or confidence in, and attendant increases in uncertainty about, a substantial portion of the financial system that is serious enough to quite probably have significant adverse effects on the real economy.*"

[3] The ECB Financial Stability Report explains the concept of financial stability as *"condition in which the financial system – comprising of financial intermediaries, markets and market infrastructures – is capable of withstanding shocks and the unravelling of imbalances, thereby mitigating the likelihood of disruptions in the financial intermediation process which are severe enough to significantly impair the allocation of savings to profitable investment opportunities."*

itself not only in the failure of the whole financial sector but also in the real economy because of the cross-sectional intertwin between the financial sector and the rest of the global economy.

As mentioned above, the financial sector acts as the middleman undertaking both the lending/investing and borrowing activities in the economy, but when decomposed into groups of different institutions, the same understanding of their activities can be applied, as they play the roles of both lenders/investors and borrowers in their mutual relationships. As a result, the transmission of financial risks that evolve from within an individual institution is inevitable via its interactions with other institutions in terms of balance-sheet components, herding behaviors in investment environment and fears of collapse scenarios sweeping through the market (Chou 2020).

Once the understanding had been generally conceptualized, attempts for its measurement also rose. Before the global financial crisis, value-at-risk (VaR) was broadly considered by many financial institutions the ultimate measure when it comes to the calculation of potential financial losses. VaR is the potential maximum loss of a financial institution over a specific horizon at a given confidence level. Even though VaR was first proposed by Harry Markowitz and Roy (Adamko et al., 2015), it was in the mid-1990s that J.P. Morgan - a long-standing US investment bank - initiated the deployment of VaR as the standard measure of portfolio risk for many financial institutions, though methods for calculation might differ. Discussions on the shortcomings of VaR started from the early 2000s, and finally rose to extreme popularity as soon as the fall of the Lehman Brothers triggered the offset of a chain of failures in the financial world. While this paper does not aim to discuss whether VaR is obsolete or underestimated in today's post-GFC context, it is regardlessly important to understand why VaR gradually lost part of its significance to other modern measures of financial risks, and more importantly, systemic risk.

As mentioned above, skepticism over the effectiveness of VaR appeared even before the breakout of the global financial crisis. In particular, investors might overlook underlying risks while using VaR as a risk measure as they try to maximize the profits out of their portfolio positions, since there are losses lying above the threshold of VaR that might go unnoticed (Yamai & Yoshiba, 2005; Basak & Shapiro, 2001). Additionally, more criticisms can be taken into account such as the incoherence of VaR for the lack of subadditivity[4] (Artzner et al., 1998), VaR's underperformance (Yamai & Yoshiba, 2005) in the identification of risks imder extreme market conditions (Elliot & Miao, 2009), and the inability to recognize increasing credit concentration risk conditions (Elliot & Miao, 2009) or even the possibility of increasing it (Yamai & Yoshiba, 2005) while relying on VaR

[4] Subadditivity as a feature of portfolios in terms of risks means that the total risk of more than one portfolio is either less than or equal to the sum of the risk that each portfolio holds.

in risk management. Regarding systemic risk itself, the fact that VaR only accounts for the risk of an individual financial institution "in isolation" does not reflect its contribution to the systemic risk of the entire system (Adrian & Brunnermeier, 2014).

Therefore, whereas VaR is undeniably an useful and widely popular tool used in the field of risk management today, GFC was necessarily the event that triggered the transition from VaR to expected shortfall (ES). ES was first introduced by Artzner et al. (1998)[5] when they wanted to propose a measure of risk that brings out the "worst conditional expectation". In particular, while VaR only measures a specific amount of money to be lost when the institution and/or the system is under distress, ES goes over this limit by calculating the average loss that could be incurred when the loss exceeds VaR. As presented by Elliot & Mao (2009), in rare instances of extreme events, ES can predict the potential loss, whereas VaR provides information on the minimum amount of expected loss. As a result, this gives ES a more representative characteristic of what happens "at the tail", or in extreme events. Additionally, expected shortfall also holds a coherent feature which is missing in VaR, since it guarantees the subadditive character that implies the reduction of risk thanks to the diversification of a portfolio as compared to a less diversified one (Elliot & Mao, 2009; Yamai & Yoshiba, 2004).

The offset of the transition from VaR to ES in risk assessment creates a foundation for more work on variations and development of both VaR and ES to be undertaken. More importantly, under the context of the 2007 - 2009 catastrophic black-swan event, a new strand of literature started to focus on different methods of measurement for systemic risk. While Di Cesare & Picco (2018) classify measures of systemic risk based on the perspectives of regulator (ability to predict, implementability and frequency of updates), researchers (various methodologies), and risk (different characteristics of systemic risk), Benoit et al. (2015) categorize the measures based on different sources of systemic risk, including systemic risk-taking, contagion, and amplification mechanisms. However, as pointed out by Benoit et al. (2015), the larger part of literature prefers measures that are not oriented towards a specific source of systemic risk, and therefore follow approaches of a global scale and via many channels. While not addressing particularly origins of risk, these market-based measures are both regulator- and researcher-friendly as they rely on indicators related to market efficiency and are easy to calculate and implement, which allows them the capacity to identify abnormal fluctuations in systemic risk regimes.

---

[5] ES was introduced by Artzner et al. (1997). However, in his work, he was not the one who coined the term "expected shortfall".

The most popular systemic risk indicators that are calculated based on market data include Delta Conditional Value-at-Risk (ΔCoVaR) – a successor of VaR, Marginal Expected Shortfall (MES), Systemic Expected Shortfall (SES), and Systemic Risk Measure (SRISK) – successors of ES. One of the common advantages of these measures lie in their ability to capture systemic risk in its buildup phase, in which the economy is in a calm, or more noteworthily, booming state with more interactions across different sectors and as well as funding activities from different sources both within the economy and across the border (Blancher et al., 2013; Adrian, T., & Brunnermeier, 2014; Engle & Ruan, 2019). Another classification put forward by Chou et al. (2020), which is a rarely interesting and unique way of comparison between these measures, can be summarized as the following: while MES, SES, SRISK belong to the "top-down" approach of determining the expected loss of a single financial institution conditional on the financial system being in trouble, ΔCoVaR is a prominent example of the "bottom-up" approach of measuring the overall systemic risk of the whole financial system based on the risk of collapse of an individual institution.

In 2014, Adrian & Brunnermeier introduced the conditional VaR (CoVAR) as a tool to show how much an institution *i* can contribute to the overall systemic risk when the institution under distress. More specifically, CoVAR is the VaR of the financial system conditional on the loss of an institution being either equal to or larger than its VaR level, and it depends implicitly on the *q%*-quantile given rather than the risk-taking level of the firm, as highlighted by the authors. Consequently, in terms of calculation, ΔCoVAR is the difference between two CoVAR values, reflecting the upward movement in systemic risk of the financial system caused by the shift of an institution from its median state to a troubled state. Moreover, adverse conditioning can also be utilized to receive the "Exposure-ΔCoVaR", which denotes how much an institution *i* can be exposed to losses when the whole financial system is in crisis.

As the idea of CoVaR is built upon the basis of VaR, MES, SES and SRISK are closely related in the sense that they all originate from ES – an alternative of VaR that is widely entrusted when it comes to the studying about what happens "at the tail". More specially, from the post-GFC period when ES was recognized as a more reliable measure of expected loss, the evolvement of ES is manifested in the successive extensions of itself where each measure is an upgrade of the previous one, taking more elements of systemic risk into the calculation.

MES, the first and closest extension of ES in terms of computation, was proposed by Acharya et. al. in 2010. In the formulation of ES, the authors decompose the overall return of a bank *i* into the sum of returns of each group within the bank, multiplied by its weight in the bank's total portfolio. Thus, the MES of a group within bank *i* is the derivative of the bank's ES by the group's weight. In a larger scale, considering the entire financial system that comprises a specific number of banks, the

MES of a bank *i* would be described as the derivative of the financial system's overall ES as to its "weight", i.e. its market capitalization. From the point of view of Idier et al. (2011), MES should be understood as a reflection of the firm's exposure to extreme events, since it measures how much an institution is affected by the downturn of the market with respect to its market share upon the condition that the loss of the financial system exceeds its VaR, which is in alignment with the Exposure-ΔCoVaR explained by Adrian and Brunnermeier (2014). However, as concluded by Acharya et al. (2010, 2017), MES indicates the increase in the system's risk resulted from the marginal increase in the weight of institution *i* in the market and hence, is able to capture institution *i*'s contribution to the overall systemic risk, measured by the system's ES.

In 2017, Acharya et. al. continued their path on extending the strand of literature on measuring systemic risk as they introduced Systemic Expected Shortfall (SES), a measure that takes into account two elements: the MES formulation constructed by themselves in 2010, and a firm's leverage, which are argued to be both significant with regards to systemic risk. In particular, first, MES is computed as the average stock return of a financial institution *i* out of the 5% worst days of the year, then leverage is calculated as the ratio of quasi-market assets to market equity. Next, the author used empirical evidence to prove that MES and leverage are indeed the predictors of SES.

Upon the foundations of MES and SES, in 2017, Brownlees and Engle introduced SRISK as an indicator which denotes a financial institution's contribution to systemic risk in terms of capital shortfall. Similar to SES, there could be no deny about SRISK upon its comprehensibility in terms of computation, as well as the ease in implementability and the high frequency of update. (Di Cesare & Picco, 2018) However, there is an edge to SRISK with regards to its predictivity in terms of temporal dimension, since Achary et al. (2010)'s methodology for SES (or more specifically, its MES component) is not suitable for detecting ex-ante signals of the crisis (Brownless & Engle, 2017). This argument also resonates with that made by Adrian and Brunnermeier (2016), implying that the MES indicator proposed by Acharya et al. (2010) does not address the time series aspect of systemic in which systemic risk builds up under the background of a booming economy with low volatility and matures specifically in the phase of "shock materialization" (Blancher et al., 2013). Therefore, from the perspectives of both regulators and researchers, SES is an inarguably useful indicator to be deployed as it adopts probability and mathematical methods, and give timing warnings about the possibly of financial downturns.

In particular, SRISK measures the capital shortfall a financial institution is expected to find itself facing with, conditional on a systemic crisis, or in terms of calculation, the gap in capital under the normal state and the conditional state of the market being in distress over a certain period of time. In addition, different from SES, SRISK is comprised of three components: long-run MES (LRMES), leverage, and size. Thus, the sum of SRISK indicators for all financial institutions measures the amount of capital needed to rescue the financial sector, and thus, represents the overall systemic risk in the whole financial system.

As a basis of the methodology for SRISK calculation interpreted above, the authors raise the concern that undercapitalization not only poses significant threats to the firm itself but also implies danger to the whole system, and as a consequence, to the economy as it affects the credit-giving ability of these firms to households and businesses when the domino effect of collapse takes place. As a part of this process, a financial institution experiencing capital shortfall would have more exposure to externalities caused by fluctuations in the market, which causes them to trigger the "excessive credit growth" and "deleveraging cycles" that eventually result in a financial catastrophe (Engle & Ruan, 2019). From these arguments, it should be highlighted that SRISK also has the ability to signify certain "red flags" in the capitalization of the financial system before and during a crisis[6], and thus, carries notable implications for activities in the real economy.

Finally, it is also important to note that while this paper has no intention to make one measure (more specifically, SRISK) seem more superior than the others. For the purpose of this research and the approach it plans to adopt to fulfill the objectives that serve the main purpose, SRISK is considered a suitable measure to be employed.

[6] Brownlees and Engel carry out an analysis of US financial firms' contribution to systemic risk from 2005 to 2012 using SRISK and show that aggregate SRISK signals the deterioration of capitalization in the US financial system before the financial crisis really occurs.

1.2. Literature review on determinants and their transmission to systemic risk

González-Hermosillo (1997) conclude that for the case of Mexico, bank-specific variables and banking sector variables (representing contagion effects) are significant determinants of default probability for individual banks, while macroeconomic variables have strong explanatory power for banks' duration under crisis. The panel regression shows that larger asset-based size, higher share of NPLs and non-securitized loans in total loans, higher interbank deposits, higher share of GDP in total loans will result in higher risk of failure. Interestingly, agricultural loans would decrease failure likelihood.

Kleinow & Nell (2014) study European banks. Larger size means a higher probability of running into financial crises. If a system is largely reliable on the limited number of large banks, the likelihood of them getting rescued by any of their competitors is lower (Haq and Heaney, 2012; Black et al., 2016, and Varotto & Zhao, 2014). Loan to total assets ratio, as a proxy for the structure of asset, increases systemic risk of banks by creating more challenges in diversifying risks. Non-performing loan, leverage and deposit ratio are all statistically insignificant as regards to their influence of systemic risk. Liquidity, surprisingly, increases systemic risk contribution and sensitivity of European banks. This result is opposite to those of existing literature, which Kleinow & Nell (2014) argue that perhaps due to when there is too much cash, capital distribution becomes less efficient, leading to lower profitability. Market-to-book ratio is positively correlated to systemic risk (Adrian & Brunnermeier, 2011; Varotto & Zhao, 2014; and Weiß et al., 2014).

Borri et al. (2012) study European banks, using CoVaR to determine banks' contribution to systemic risk. They found that market-based variables with high frequency have substantially more predictive power for systemic risk than balance sheets-based ones, perhaps because balance sheets information are less useful in terms of underlying risk by accounting rules as compared to market data. Black et al. (2016), however, argue that market prices are more volatile than accounting measures, thus, their relationship to systemic risk may also be unstable. They confirm that both size and leverage have an important role in systemic risk contribution. Regulations to limit bank size are inadequate to mitigate systemic risk. However, leverage restriction should be carried out to decrease systemic risk, especially since leverage essentially matters under financial crises. Concentration (the total assets of five largest banks) also increases systemic risk. Price-to-book ratio and returns volatility also have positive impact on systemic risk contribution.

Borri et al. (2014) show results for 32 listed Italian banks from 2000 to 2011, which are insightful to this research despite authors' warning of the inclusion banks that went bankrupt, got merged and/or bought. A broad observation of leverage, total debt and banks' equity's ratio show that they are all affected by the financial crisis: leverage decrease as a result of the regulation for leverage cap; total debt, the large part of which was paid off with long-term debt, increase by two times of its value; and banks' equity tripled under the regulation of Basel III. Size, in terms of book equity, has a considerable impact on systemic risk both before and after GFC. Market-based data such as volatility and beta are also statistically significant. Banks with higher volatility in terms of returns contribute more to systemic risk on both individual and systemic levels, and those with larger betas would contribute less to systemic risk. Leverage and risk are also positively correlated, especially the post-Leman leverage.

According to Black et al. (2016), **size**, in terms of assets, are undoubtedly significant, since it is an input element of the Distress Insurance Premium systemic risk measure. In terms of asset structure, more traditional lending-focused banks and banks with more liquid assets are less likely to increase systemic risk. In terms of capital structure, banks that the higher the reliance of banks to finance their loans with deposits (loan-to-deposit), the less they would contribute to systemic risk in the short run, since deposit-financing is considered rather steady. By contrast, banks that rely more on equity financing (equity/assets) would contribute more to systemic risk as they are more encouraged to take on tail-risks. Banks with more equity, potentially through regulatory requirements, may have incentives to take on tail-risks leading to an increased systemic contribution when these risks are realized. In their investigation of systemically important European banks during the GFC and the European SDC, **Black et al. (2016) found that Italian and Spanish banks contribute substantially to systemic risk during the SDC, while during the GFC their exposure seems to be very minor. This is explained by the fact that these countries have a high level of localization in terms of lending and taking deposit during the GFC, but they hold a substantial amount of sovereign bonds and thus their localization of risk concentration became a threat to Europe financial stability**. This result more or less echoes the findings of Acharya & Steffen (2013) which emphasize that holdings of government debts are a significant factor that influences systemic risk as banks that are more associated with Europe's peripheral states are at riskier positions.

Vallascas and Keasey (2012) present a very insightful paper on prudential policies in terms of size, leverage and liquidity. In particular, while they consider Basel III requirements on leverage and liquidity are justified, more focus should be paid on other bank-specific characteristics, especially size. In particular, they not only show that introducing **size** cap on banks would be more effective than the 2011 Basel III rules, but they also find that when size is confined, systemic risk decreases for larger banks (in terms of relation to their respective countries' GDP). **Leverage** and the ratio of retail deposits to total debts are shown to be non-significant. The result for the latter, considering that it was carried out before the introduction of UMP, is consistent with Bubeck et al. (2020)'s study on the role of difference between share of retail vs whole deposit-holdings of banks before NIRP was implemented. This will be explained in more detail towards the end of this section.

Varotto and Zhao (2014) also conclude that size is a major drive for systemic risk. There are studies that show that size is not that important (Hautsch et al., 2014) or has a negative relationship with exposure to tail-risks (Knaup and Wagner, 2010).

For countries whose institutional frameworks of financial markets are developed and stable at a high level, high government debt ratio does not have a positive impact on systemic risk. Finally, the higher the banks' claims on central government, i.e. the more banks lend to the government, the higher is systemic risk, especially in terms of sensitivity (SRISK). This is because as the higher share of loans for the government in banks' total loans would increase their exposure to the government's bonds, the close and frequent interaction between banks and the government would induce in higher systemic risk of banks when the government is in financial troubles (Kleinow & Nell, 2014)

Stolbov (2017), using ΔCoVaR based on CDS prices, confirm that the government debt-to-GDP ratio indeed plays an important role in shaping fiscal space. State instability is also important for systemic risk based on CDS prices. Inflation seems to be a nonsignificant determinant of systemic risk. Italy, along with the UK and France, are main contributors to systemic risk. Countries under the most economic burden - Spain and Italy, show the highest systemic risk indicators.

Similarly to systemic risk, the popularity of unconventional monetary policies (UMPs) also emerged during the global financial crisis. However, while systemic risk was borne within the financial system, UMPs emerged as an external resolution to counter macroeconomic downturn that originated from collapse of the financial system. Hence, it is also important to understand if there is any direct correlation or/and casual relation between UMPs and systemic risk itself, or if indirect, then through which channels (banking or macro) would UMPs be able to affect systemic risk. While the main objective for introducing UMPs is to preserve central banks' mandate of price stability and promote economic growth during economic downtimes, the "side" effect of these tools on financial soundness, or more specifically, to systemic risk, should also be taken into consideration.

UMPs were adopted widely by developed countries during and after the global financial crisis. While UMPs were introduced first by the central bank of Japan in the 1990s, the evolvement of UMP tools is mostly contributed by the FED and the ECB, since this event affected them the most. The most widely employed unconventional measures by central banks include the pegging of key rates at zero or negative levels (zero/negative interest rate policy) and large-scale asset purchase of securities on the secondary market (quantitative easing). In reality, more tools were utilized by central banks of advanced economies including forward guidance, credit easing, qualitative easing, etc. However, taking into account the suitability of these tools to this research's purpose, this paper shall focus on how zero/negative interest rate policy (ZIRP/NIRP) and quantitative easing (QE) were implemented and what their impacts (either direct or indirect, which will be discussed later) on systemic risk.

ZIRP or NIRP is one of the most widely applied unconventional tools since they can be considered an updated version of the traditional method where central banks adjust policy rates. Thus, central banks, either by pegging key rates at the zero bar or dragging them below the zero level, motivate households and businesses to spend and invest more rather than to save. Before the introduction of NIRP, central banks reached their limit by lowering interest rates to the zero lower bound. Many major central banks pinned their policy rates at the zero level long enough until they continued to cross the zero boundary and sent rates into the negative area, with the exception of the FED and the Bank of England, who only kept their official interest rate very close to zero. Keeping interest rates negative means now commercial banks are "fined" if they want to store their excess reserves at central banks, as policymakers want these excess reserves to be utilized for investing and lending activities, which in turn improve the economy.

Through quantitative easing, central banks try to increase the size of their balance sheets by expanding the number of reserves on the liabilities side, purchasing government bonds on the secondary market[7]. As demand for bonds goes up, bonds prices will follow the pattern and more money will be injected into the economy, increasing the monetary base and liquidity supply. As a result, interest rates would drop, allowing business and household borrowers to take cheaper loans from lending institutions and in the end, the inflation target of central banks will be obtained (Pham, 2023).

After the collapse of the Leman Brothers, the increase on both the assets and liabilities side of central banks under the UMP regime induced the growth of interests in and concerns over the risk-taking channel among policymakers and scholars.

The impact of monetary policy, either conventional or unconventional, is transmitted through both micro and systemic levels of the risk-taking channel, as separated by Kabundi and De Simone (2020). The term "risk-taking channel" of monetary policy was coined by Borio and Zhu (2012), who explained three different mechanisms by which this channel functions. In 2020, Kabundi and De

[7] *This means that instead of purchasing government bonds directly from the government, under quantitative easing, the central bank buys them commercial banks and other financial institutions. This is different from "helicopter money", a policy considered as an alternative to quantitative easing. Helicopter money involves printing a large amount of money and distribute this amount to the public via the government with the hope to increase consumption in the economy. In other words, whereas helicopter money stimulates direct money transfer to the public, quantitative easing increases money supply by expanding the amount of assets on the central bank's balance sheet.*

Simone denotes this as the micro risk-taking channel, e.g. the impact of monetary policy on how risks are perceived and assessed by the market or individual banks, upon which they emphasize what they call "systemic risk-taking channel", implying the importance of the negative impacts a prolonged period of low interest rates on systemic risk in terms of contagion and fragility.

The original risk-taking channel was defined by Borio and Zhu (2012) as the influence that changes in central banks' key rates have on the perception and tolerance of risks. The three sets of mechanisms explained by Borio and Zhu (2012) describe include **(**i) how changes in interest rates affect attitudes and behaviors towards risks through valuations, incomes and cash flows, (ii) how rates of return targets against the background of low interest rates might increase risk-taking level, and (iii) how central banks communicate and conduct their policies would affect behaviors on risk taking.

The first set of mechanisms concerns more with households' and businesses' perception and valuation of risks, where the increase in wealth of these agents (asset and collateral values, incomes and profits) following a period of low interest rates can create the overconfidence in financial markets, hence induce more laxed risk acknowledgment and higher risk endurance, which might facilitate risk-taking actions. This set is close in connection with the financial accelerator proposed by Bernanke et al. (1999), through which entrepreneurs are more encouraged borrow to invest as they perceive an increase in net worth in a climate of low interest rates, which also decreases their expectation on the likelihood of default. As a response, banks will be more ready to give out more loans.

The second set of mechanisms highlights more the alteration in banks' behaviors. Firstly, the widened gap between market rates and tight rate-of-return targets as a result of prolonged low interest rates may facilitate the "search for yield" effect. In particular, when low interest rates lead to reduced returns from short-term investments against the rigid target of rates of return in contracts, in order to ensure their capability of upholding their commitments of long-term liabilities in these contracts, banks are prone to seek higher yields from investments in riskier assets-(Rajan, 2005). Secondly, and as an alternative, this can also create "money illusion" or inflexibility in facing changes in the markets, especially in a prosperous period, thereby increasing risk awareness and assessment. To be clearer, as explained by Afanasyeva and Güntner (2020), when monetary expansion increases the expected financial premium, banks have more incentives to give out more credits to borrowers to increase its share in total profits while charging more for the likelihood of borrowers' default. Together, banks' ability to reach rate-of-return targets in potential investments and their eagerness to increase their parts in total profits of specific investments explain for changes on the asset side of the balance sheet equation. Indeed, the facilitation for increase in credit supply granted by a low-interest-rates environment via changes in banks' risk perception and assessment are also confirmed in many other studies (Altunbas et al., 2010~~)~~; Dell 'Riccia & Marquez, 2006; Brana et al., 2019).

In close connection to both the first and second sets of mechanisms described separately by Borio and Zhu (2012), Adrian and Shin (2010) argue for the effects on both the liability side and the asset side of banks' balance sheet and refer this to the changes in asset prices as a result of low interest rates. In particular, since a surge in asset prices is directly reflected in banks' balance sheets, or more specifically, as "surplus capacity", banks immediately tailor their behaviors accordingly to ~~the~~ market changes: **while simultaneously looking for prospective borrowers with risker positions, banks may also take on more short-term debts to combat falling leverage**. Angeloni and Faia (2009) also agree that banks' leverage increase against a low interest rate background.

Finally, the third set of mechanisms proposed by Borio and Zhu (2012) shows a similar effect as the signaling channel of the forward guidance policy of central banks, by which the commitment and credibility of central banks are transmitted through their announcement of future policy decisions via, respectively, a "transparency effect" and an "insurance effect", hence encourages risk-taking behaviors of both. When banks are led to believe that central banks will do "whatever it takes" (Mario Draghi's speech in 2012) as regard to the downturn of economic situations, they become more willing to add more riskiness to their balance sheets.

Thus, the existent risk-taking channel through which the provision of excessive credit facilitated by means of monetary policy would increase liquidity not only in terms of quantity but also risks that come along. The acknowledgement of changes in risk-taking behaviors before the global financial crisis broke out is shared by many other scholars (Adrian & Shin, 2010; Bruno & Shin, 2011; Disyatat, 2011; Farhi & Tirole, 2009; Diamond & Rajan, 2009; Issing, 2011). Moreover, as an outcome of the global financial crisis, during and after which quantitative easing was widely used to pump liquidity to the economy together with extremely low interest rates, the risk-taking channel only became more relevant. As shown by Brana et al. (2019), there exists an influence of the risk-taking channel on key interest rates during periods of not only before GFC (when traditional tools of MPs dominated) but also after GFC (when unconventional MPs took over). Moreover, they found that there is a negative nonlinear relationship between different tools of UMP (near-zero interest rates and asset purchases) and banks' behavior as regards to risks, with variables representing monetary policies gaining statistically significance or becoming stronger when interest rates and monetary creation crossed certain threshold.

Faia and Karau (2021) argue that while the risk-taking channel on the micro-level had been studied extensively. the implications for aggregate and systemic risk-taking are less popular. At the same time, because more literature employs panel data on banks level, there is a lack of explanation for the external effects on systemic risk caused by monetary policy. Faia and Karau (2021) consider three channels that explain changes in systemic risk. The first channel is correlated with risk-taking on micro levels that induce individual banks to increase their leverage ratio and take on riskier investments. Since the main ideas of this channel can be found in the afore-explained first and second sets of mechanisms introduced by Borio and Zhu (2012), it is more necessary to focus on the remaining channels. Alternatively, the second and third channels account more for systemic risk in terms of contagion and interconnectedness. In particular, the second channel materializes when a low interest rate environment increases banks' mutual dependence on debts from other banks, which pushes up banks' crossholdings. The third channel extends the search-for-yield mechanism mentioned above: low interest rates encourage banks to make more investments in a common pool of risky assets.

It is recognized that it is necessary that there is a harmonized interaction between monetary policies (with the main goal of price stability) and macroprudential policies (the main target of which being financial stability). Kabundi and De Simone (2020), in their study for the eurozone, not only agree on the existence of the micro risk-taking channel, but also the systemic risk-taking channel under the influence of monetary policy. Moreover, they conclude that the cause of systemic risk-taking is because of the contagious and interconnected links in the banking system, and while the type of MPs applied does not necessarily increase the short-term and conditional measures of systemic risk, they do increase systemic risk measured in the form of contagion.

The larger part of literature agrees on the increase in different measures of systemic risk being a consequence of (un)conventional monetary policy**.** To start with, Laseen et al. (2017), taking leverage and time-varying factors into systemic risk function, confirm that whereas output, inflation and asset prices would decrease following an unexpected rise in key rates, systemic risk would not be alleviated, especially when the economic situation is at is at its low moments. In the same vein, Lambert and Ueda (2014) also conclude that while the worse scenario could have happened without UMPs, they did not necessarily improved banks' positions. Moreover, expansionary monetary policy shocks would also enhance credit risk in medium terms for banks in the US, eurozone, and the UK. Deev and Hodula (2016), using SRISK as the measure of systemic risk for the eurozone, find that both before and after the GFC, UMPs in the forms either policy rate cuts or asset purchases increased systemic risk and resulted in heightened financial instability. Colletaz et al. (2018) point out the lack of systemic risk studies on the macroeconomic perspective and emphasize the importance of the temporal dimension, i.e. between short-term and long-term periods, of the casual relationship between ECB's MP and systemic risk-taking channel. In particular, they discover that systemic risk became stronger after a few months of UMPs implementation. Faia and Karau (2021), using SRISK, MES, and ΔCoVAR for the US banking sector, also confirm the existence of the systemic risk-taking channel regardless of the choice of monetary policy measures (interest rates-based and balance sheets-based). Furthermore, they conclude that while there is a co-movement between variables on banks' balance sheets and risk-taking channels (aggregate and systemic), the transmission into systemic risk is not entirely caused by them, which implies the role of contagion and interconnected in the design of systemic risk measures.

Despite the mutual consensus that CMP and UMP indeed create an upward impact on systemic risk in both the pre- and post-GFC periods, there are a few studies that advocate for the opposite result. For example, Kapinos (2017) shows that most of his systemic risk measures (including measures of systemic risk contribution such as SRISK and volatility) decline as a result of monetary shocks in the US banking sector. The study of Verhelst (2017), however, shows mixed results. In particular, while MES increases on the days of announcement of the ECB's asset purchase programs (CBPP, SMP, OMT and QE), when OMT was separated announced on specific days, there was a negative influence on MES. At the same time, FRFA and LTRO announcements produced ambiguous effects on MES in the eurozone. Fratzscher and Reith (2019) document quite a unique analysis, in which they confirm negative impacts on sovereign and bank credit risks produced by OMT and SMP announcements, while the actual implementation of 3-year LTRO also decreases risks, but its announcement increases it.

.

Chapter 2: Overview of Italy's economy and banking sector and the ECB's (un)conventional monetary policy

The main purpose of this chapter is to understand further the dynamics of the potential determinants of systemic risk in Italy's banking sector. As such, sector 2.1 describes the evolution of the ECB's unconventional measures as a consideration for external variables, while sector 2.2. analyzes the dynamics of macroeconomic indicators and banking sector's characteristics as a consideration for internal variables. Finally, the chapter ends with an overview of the evolution of systemic risk in Italy's banking system.

2.1. The ECB's implementation of (un)conventional monetary policy in 2014 – 2023

After the outbreak of the global financial crisis, the Global Recession dragged inflation rate to extremely low levels, and the traditional method of decreasing interest rate showed limitations when it reached the zero lower bound. In order to counter the effects of low inflation that might lead to long-term deflation, major central banks in developed started introducing unconventional monetary measures in order to supplement the adjustment of interest rates. Compared with other major central banks, the ECB can be considered "late to the game" as it only adopted "true" unconventional measures after the sovereign debt crisis that hit the euro area, while during the global financial crisis, the ECB rather used tools for a rather adaptative purpose. However, after Mario Draghi's speech that confirms the ECB would do "whatever it takes" to counter low growth in the euro area, this statement holds true even today, when the ECB still tries to introduce a few non-typical methods as it phases out the main ones.

This study mainly focuses on the two prominent UMP tools adopted by the ECB: the negative interest rate policy (via the deposit facility rate), and quantitative easing and credit easing via asset purchase programme (APP).

The NIRP was a truly unconventional tool as it allows central banks to cross the zero boundary and reduce interest rates to negative area. The purpose of this measure is to encourage commercial banks to also lower the rates at which they lend to customers and provide more liquidity to the real economy. In May 2013, the deposit facilty rate (DFR) was lowered by the ECB for the first time to 0, and in June 2014 the ECB reduced the DFR to -0.1%. The DFR decreased to -0.4% in March 2016 and was pegged at this level till 2019, when the final cut lowered it to -0.5%. Hence, NIRP was introduced from June 2014 to July 2022, when the ECB increased the DFR from -0.5% to the zero level. The ECB has been increasing the DFR moderately since then, and currently the DFR is 4%, constant from September 2023.

For quantitative easing and credit easing, the ECB implemented the large-scale asset purchase programme including 4 main parts: the Covered Bonds Purchase Programme 3 (CBPP3), the Asset-backed Securities Purchase Programme (ABSPP), the Public Sector Purchase Programme (PSPP) and the Corporate Sector Purchase Programme (CSPP). In October and November 2014, the ECB implemented the CBPP3 and the ABSPP and bought covered bonds and asset-backed securities in the secondary market. In March 2015, the ECB conducted the PSPP to tackle the sovereign bond market that involves government bonds and bonds from euro area's authorized agencies, international organizations and multilateral development banks. 90% of these bonds were bought by national central banks, while the ECB purchased the remaining 10%. In June 2016, the ECB adopted the CSBB and purchased bonds from the corporate sectors. In general, these programmes aim at increasing loans to the economy as asset prices increase.

2.2. Characteristics and evolution of Italy's economy and banking sector in 2000 – 2023

This section describes characteristics that define the macroeconomic as well as banking environments in Italy. This section then walks through different periods of economic and financial/banking crises to see the evolution of the Italian economy and banking sector as to how Italy withstands tough times. Furthermore, the threads that define the inter-correlation between the economy and banking sector are identified, and all together the features of Italy's economy and banking sector as well as their relationship will be considered in the analysis of the evolution of systemic risk in the banking sector.

2.2.1. Characteristics and correlation between Italy's economy and banking sector

The Italian economy is the third largest in the European Union and the eighth largest in the world by GDP. The backbone of the economy is the manufacturing industry and exports of high-quality goods, the most internationally recognized among which are of the mark "Made in Italy"s 4As, including *Abbigliamento* (fashion and clothing), *Alimentare* (agri-food products), *Arredamento* (design and furniture), and *Automazione* (automobile and mechanics). Italy can well be considered a nation full of innovations of ideas and products, and it is currently at the second place in Europe as a manufacturing powerhouse and ranks seventh in terms of exports (OEC). However, a major drawback of this sector is that the country itself lacks raw materials and energy resources by geography, making it heavily dependent on external supply sources.

From the World Bank statistics, while Italy's secondary sector accounts for 23.8% of GDP (manufacturing – 15%, industry including construction – 23.8 %) and 27% of the workforce, Italy's service sector plays a major role in the structure of the economy, with 64.8% of GDP and 69.3% of the working population. While the tertiary sector itself is larger than those of France and Spain, growth is significantly lower than its European counterparts, which is in line with the overall situation in the country's economy (Oxford Economics, 2021).

Nevertheless, in the last two decades, the Italian economy has been experiencing a stagnant period, rising from its own structural and chronicle problems, which enhanced its vulnerability on an international front when exogenous crises hit the economy. While in a sense, a positive light can be shed on the economy's resilience against recent worldwide economic downturns (including the energy crisis, high inflation in the euro area), annual economic growth never exceeded 1% in the last 25 years (except for few rare cases), stemming from a number of reasons.

First, Italy has been known for its problem with high government debt, most evidently shown by its high debt-to-GDP ratio compared with other countries. By the end of 2023, Italy recorded 137.3% debt-to-GDP ratio, only after Greece in the eurozone (Eurostat, 2024), and extremely higher than the rest of the eurozone. To further analyze Italy’s debt problem, it is important to understand why the accumulation of budget deficits through the years increased to such high levels. The answer is, as government’s budget has two sides: revenue and spendings, Italy has problems with both sides. On the revenue side, Italy has been notoriously known to have problems with tax invasion and tax avoidance, alongside with a large shadow market that amounts to 24% of its GDP (World Economics). On the spending side, the government has always been overdependent on the state budget to resolve many economic problems, while strategic spheres that involve long-term economic growth such as R&D and education are mostly neglected. Hence, the problem with public debts can be summarized by three characteristics: insufficiency in tax revenue and inefficiency in budget expenditure, with an overdependence on state budget to solve economic problems.

On the structure of government debts, about 30% is held by non-residents, while the share of total government debt held by banks increased evidently in June 2006, which became its main weakness as the sovereign debt crisis occurred (Figure 1).

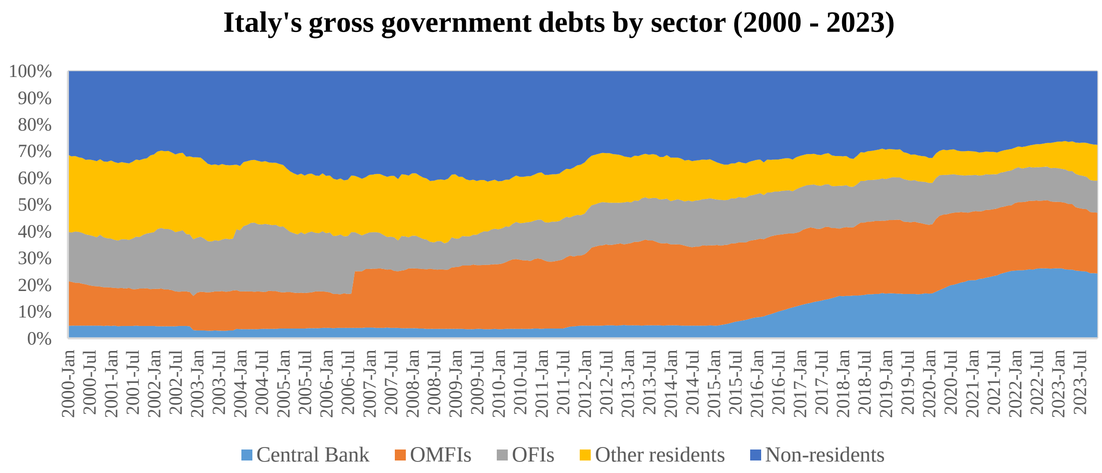


Figure 1: Structure of Italy’s gross government debts in 2000 – 2023.
(*Author’s own visualization based on data made available by Bank of Italy)*

Nevertheless, while Italy has been largely criticized for having a huge amount of government debt or/and a high level of debt ratio to GDP, the more serious problem lies, as a matter of fact, in the low GDP growth rather than the accumulated budget deficits. This has a lot to do with government spendings as Italy has not been investing its resources in training high-skilled workforce, and overall, the Italian governance does not allow innovations to thrive because of the excessive amount of paperwork. The low quality of human capital in Italy is not only caused by the minor investment in talents and the constraining entrepreneurship environment, but also because of an aging population, a serious brain drain problem, an overflow of low-skilled migrants that cannot compensate for the intellectuals that leave the country for a better working environment elsewhere.

Moreover, the Italian economy is characterized by the presence of a large number of SMEs. By 2021, 99.9% of Italian enterprises are of small and medium sizes, and they employ a total of 75.9% of the working population (European Commission, 2022), While these SMEs necessarily contribute much to Italy's economy growth, their size does not allow them to expand and enjoy the economy of scale and limit their capacity to withstand economic crises. At the same time, the huge number of SMEs reduce competitiveness levels, therefore most SMEs operate locally and rely on local financial institutions for capital funding, rather than operating on a nation-wide scale or a global-wide scale.

Another major problem concerns Italy's slow growth is digitalization. As a result of an environment lacking investment in the development technical skills for young generation and an aging population reluctant and slow to adopt new technologies, digitalization in Italy is of a lower level its other European counterparts. As of 2022, the Digital Economy and Society Index of Italy ranked 18^{th} among EU member states (European Commission), and while specific efforts have been made in improving its position from previous years by a few ranks in terms of increase in digital connectivity, an important component of digitalization, which is human capital, has still been neglected.

Finally, the Italian is considerably divided as local economies are prioritized over the national economy, and the historically deeply rooted North-South disparity in terms of economic development in Italy is the most evident proof this fragmentation.

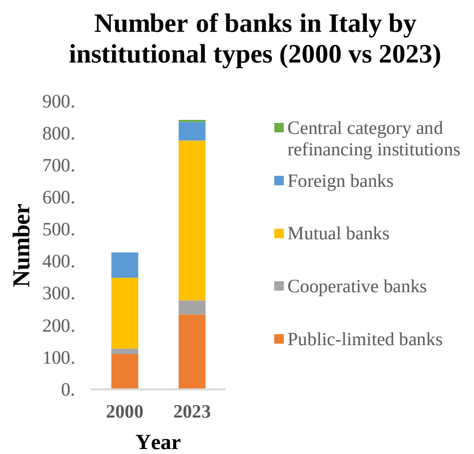
Overall, from the point of view of macroeconomy, Italy has more chronicle and structural concerns that mostly deal with its long-term growth, which have been over and over again mentioned as problems to newly rising economy short-term problems, especially when the global economy does not provide a favorable environment. Chain of economic crises that affected in the Italian economy and revealed its weaknesses to external economic events include the global financial crisis 2007 – 2009, sovereign debt crisis 2010 – 2013 (in which Italy experienced economic recession), the trade war between the US and China in 2018, the COVID-19 pandemic (2020). How these difficult periods affected, and arguably have been affecting the Italian economy shall be analyzed further on.

As for the banking sector, it is perhaps not an overstatement to say that the Italian banking system has shown remarkable resilience in the last decade and is now among the leading ones in Europe. However, it was not without difficulties and challenges, especially when the evolution of banking sector in Italy represents a unique case that requires some rewind to acknowledge the remarkable shift of the banking landscape about three decades ago.

During the 1990s, the Italian banking sector went through two correlated processes: privatization, which leads to consolidation. The privatization process first took place as part of a groundbreaking large-scale privatization process never seen in Italy's heavily state-intervened economic history. The outcome of the banking sector's privatization is consolidation, which was meant to boost Italy's international competitiveness against the background of engagement in the mutual eurozone financial market.

Before the 1990s, about three-fourth of Italian banks belonged to the public sector (Bilotta, 2017). Since over 80% of credits were in public hands (Goldstein, 2003), in 1990 the first law came out and was directed specifically towards the banking sector. It was the Amato Law that obliged publicly owned banks to transform into joint-stock companies. Thus, the Italian government withdrew from the banking sector, marked by the liquidation process of IRI - the largest state-owned industrial group by assets in Europe at that point with the ownership of 3 out of 4 largest Italian banks, that lasted almost a decade till 2000 (Gasperin, 2022).

This liberalization of the credit market was paving ways for Italy as it was at the forefront of the globalization movement with its inclusion in the EMU, and hence the consolidation progress took place simultaneously as a response to a future environment with increased competitiveness. From the mid-1990s to 2007, 347 mergers and 395 purchases were recorded within the Italian banking sector (Bilotta, 2017). After the reforms in the 1990s and early 2000s, the Italian banking system currently consists of four types of banks: public-limieted banks ("*banche S.p.A*"), mutual banks or credit cooperative banks (CCB, "*Banche Credito Cooperativo*" – BCC), cooperative banks ("*Banche popolari (cooperative)*"), and foreign banks. According to Bank of Italy, in terms of number of banks, by December 2023 there are 428 banks operating in Italy, which about half as few as the number of 841 banks in 2000. All three types of Italian banks have been cut down by half, and only the number of foreign banks in Italy increased from 58 to 79. At the same time, the portions of these three types of banks in the banking sector have not changed significantly over the last 20 years, even though the decreased number is impressive. Interestingly, the number of mutual banks in Italy takes up over half of the banking sector, while public banks account for about one fourth (Figure 2).



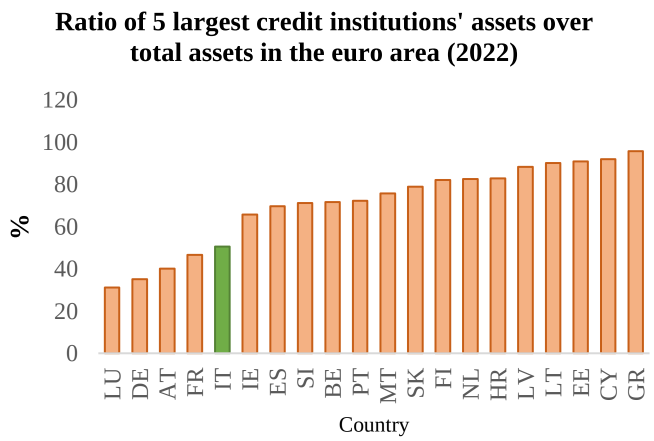


Figure 2: Number of Italian banks by institutional types in 2000 and 2023

Figure 3: Concentration in the financial system in terms of five largest credit institutions' assets in 2022

(*Author's own visualization based on data made available by Bank of Italy and Eurostat)*

While the characteristic of fragmentation in the banking sector remains relevant until today, the outcome from the government's effort to consolidate the banking sector during the 1990s is undeniable. The low level of concentration in the Italian banking system is also pronounced when compared with other European countries in terms of total assets of five largest credit institutions. (Figure 3). In addition, the characteristic of fragmentation largely involves the dominance of Italian cooperative banks ('*credito cooperativo*' and '*popolari cooperative'*) in terms of the strong tie between these (local) banks and local economy (SMEs and households). The fact that the number of mutual banks in Italy decreased has important implications for the Italian banking sector. First of all, mutual banks mostly operate locally to serve the needs for credits of local households and SMEs (Di Salvo, 2003), since the merge and acquisitions of mutual banks into larger banking groups only shifted the cooperative credit system while leaving these banks' size and ownership mostly unaffected. This leads to the maintenance of the significant role of mutual banks in local economies in Italy, considering the correspondence of a large number of local SMEs in the economy itself. As a result, the relationship between these mutual local banks and the real economy is therefore extremely strong. This strong bond also manifests itself in the mutual trust~~s~~ built and maintained by mutual banks with their local customers, which is necessarily the point of "creditability" in the credit business.

In terms of risks, there is both good news and bad news. The good news is, since there is such a fragmentation in banking system, the level of concentration is hence, low, which, according to literature, would likely decrease systemic risk in the environment of low interconnectedness and contagion. Indeed, not only in terms of number of banks, but also with regard to the assets, Italy is also among the lowest in the eurozone with roughly half of total assets owned by its five credit institutions by 2022 (Figure 3). Nevertheless, with the consolidation progress over the last 20 years, the share significantly increased from 26% to 51% (ECB, 2024). The bad news is, however, because of the high level of localization, there is limited room for risk diversification, which leads to a high concentration of credit risks among banks' local clients within the same region, making credit portfolios of these mutual banks be notoriously considered to lie at a higher level of risk compared with other banks (Barbetta at al., 2016).

From the beginning of the 2000s, there have been changes in the structure of loans to Italian residents by Italian banks. In general, in the last 24 years, while share of loans to the non-financial sector and non-profit institutions to total loans has been declining, banks' loans to households, financial corporations, and general government have been taking up larger portions. Significant changes for loans to different sectors can be observed in certain months during periods of crisis. The banking sector in Italy only finally took up in the last few years with the prolonged combat with its non-performing loans (NPLs) problem, which was, as a matter of fact, its main weakness endogenous weakness (Bilotta, 2017). As explained by Bank of Italy, NPLs in Italy are classified into three types: overdrawn and/or past-due, unlikely-to-pay, and bad debts/loans, in which bad debts represent the loans that are certain to be defaulted on completely due to borrowers' insolvency. Further breakdown of Italy's loan structure and dynamics in NPLs and bad debts shall be discussed below.

First, in October 2007 there was a substantial increase in the share of loans to the government by 5.84 percentage points (pp) (from 2.5% in September 2007) after over 7 years of declining trend (Figure 4). Since then, loans to general government have been covering about 8% - 10% of total loans, with apparent higher numbers around periods of SDC (November 2010 - May 2014), COVID-19 (July 2020 - February 2021), and heated discussions on new rules for bad loans (May 2023 - December 2023).

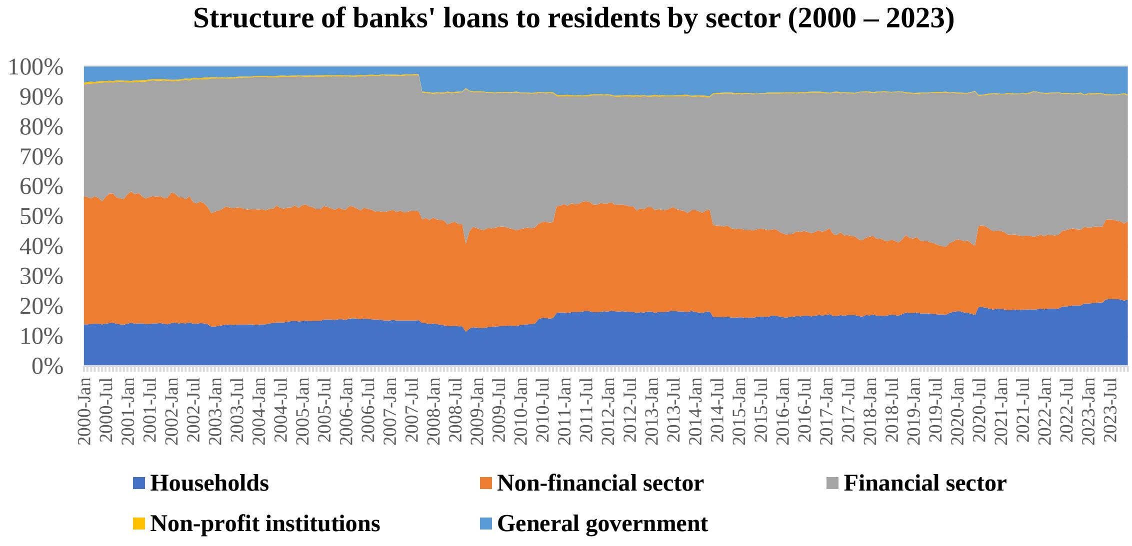


Figure 4: The Italian banking system's structure of loans to residents by sector (2000 – 2023)

(*Author's own visualization based on data made available by Bank of Italy)*

Regarding the other sectors, the 24-year trend in their shares in total loans has been rather steady. For the non-financial sector, share of loans increased evidently from over 40% at the beginning of the 2000s to about 26% towards the end of 2023. Vice versa, an upward trend is recorded for consumer households of from about 14% to 22%, and for the financial sector to a lesser extent, from approximately 37% to 42%. Interestingly, in October 2008 there was an abnormal surge in the share of loans to the financial sector as compared to the previous month (52% vs 44%), while a decline was recorded for the non-financial sector (34% vs 29%). In addition, ~~around~~ during the SDC, from October 2010 to June 2014, trend was reversed for the financial sector (a 6.3 pp drop vs a 6.3 pp increase) and non-financial sector (a 3.6 pp increase vs a 3.3 pp drop).

The growth of NPLs kick started during the Global Recession 2008 - 2009 and in Italy the share of NPLs over total loans was 18% and Italy was the country with the highest net value of NPLs stock (from 50 to 200 billion euros from the end of 2007 to the end of 2015) (Angelini et al., 2017). After changes in definitions of NPLs, available statistics for types of NPLs show that the traditional understanding of NPLs that concerns payment delay for over 90 days only takes up an extremely small portion of Italy's NPLs, while the other two types account for over 95% of NPLs (Figure 5). According to Angelini et al. (2017), who examine the evolvement of Italy's NPLs from 2008 to 2016, it is actually not stocks but flows that are the main attribute to the negative influence of NPLs on lending. In addition, when compared with changes of NPLs in other countries in terms of fluctuations in real estate prices and changes in GDP, Italy's NPLs appeared to be substantially higher. Angelini et al. (2017) conclude that the huge uproar of Italy's NPLs were caused by unfavorable economic environment. They proved their results in two streams of approach: (i) from the historical track down: nearly 90% of NPLs flows could be attributed to the worsened macroeconomic dynamics materialized in the country, (ii) from the international comparison: at least two thirds of increase in Italian NPLs during the GFC is also shown to be caused by bad economic situation.

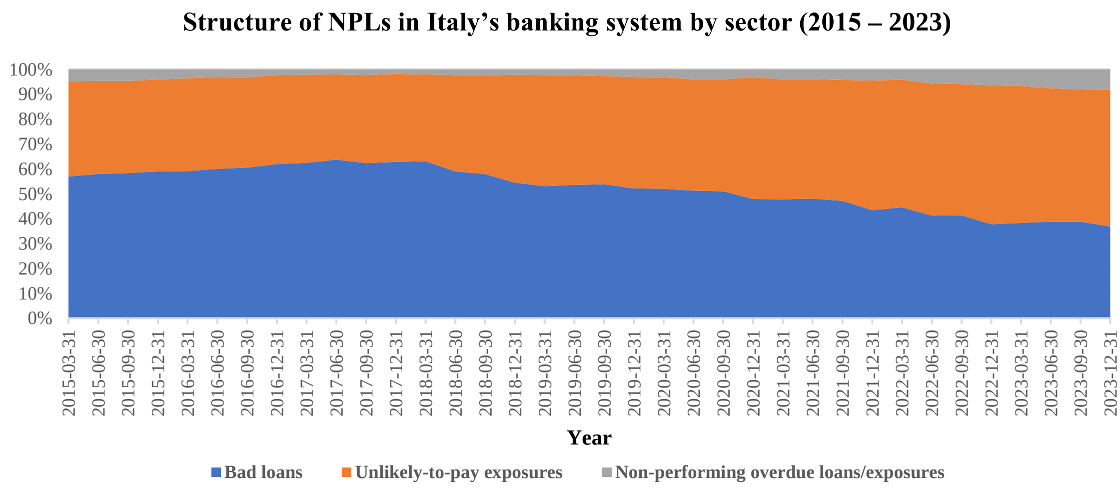


Figure 5: Structure of NPLs in Italy's banking system by sector (2015 – 2023)

(*Author's own visualization based on data made available by Bank of Italy)*

As for bad debts, households and the non-financial sector accounted for over 96% of total bad debts during the whole period of 24 years. Towards 2018, bad debts of non-financial corporations amounted to over three-fourths of total bad debts, and around the banking crisis of 2015 – 2017, approximately 80% of bad debts belonged to this part of the econom**y.** Until the end of 2023, non-financial sector decreased its portion of bad debts to 67%, while bad debts of Italian households rose to roughly 30% in relations to total bad debts from just over 20% in the 2000s (Figure 6). Furthermore, a closer look at the structure of bad debs classified by the economic activities show that while in the pre-SDC period, bad debts held by manufacturing sector took up over third of total bad debts of Italian residents, up to 2018 – 2020, there was a decrease in the share of the manufacturing sector, which was partially exchanged for an increase in the real estate and the construction sector. Altogether, this structure signals the fact that the banking sector is highly exposed to activities by businesses specializing in manufacturing, construction, and real estate (Figure 7).

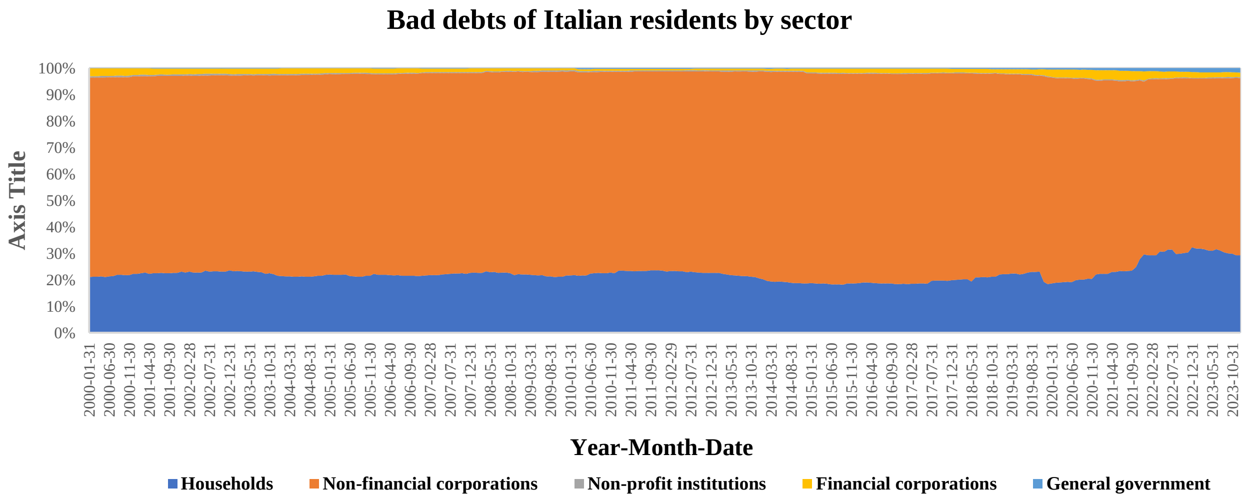


Figure 6: Bad debts of Italian residents by sector in 2000 – 2023.
(*Author's own visualization based on data made available by Bank of Italy)*

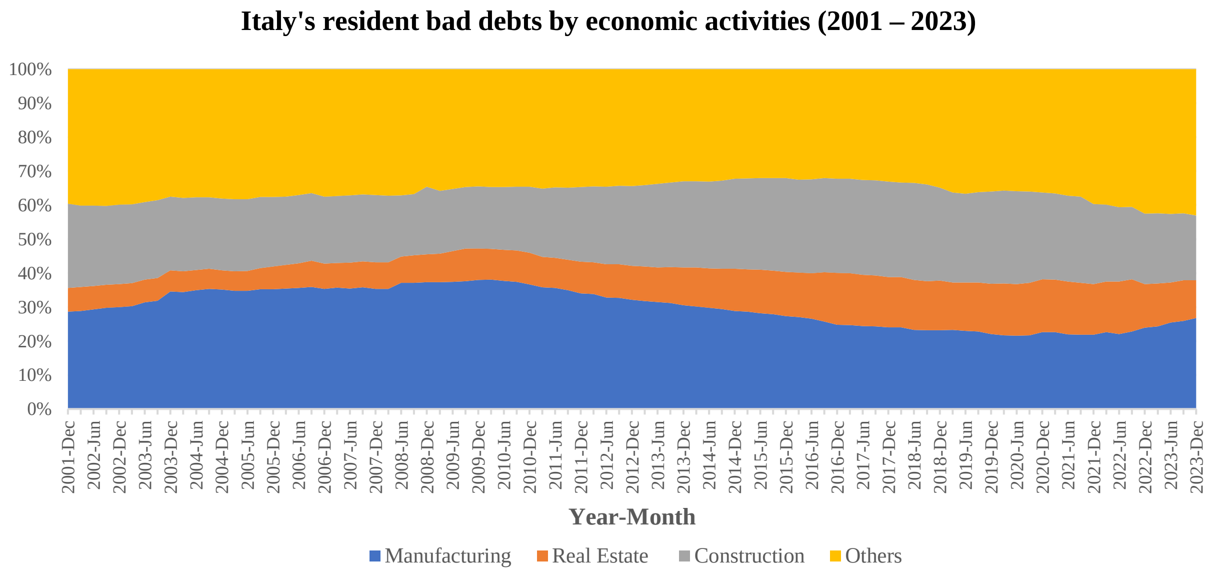


Figure 7: Italy's bad debts holdings by economic activities (2001 – 2023)
(*Author's own visualization based on data made available by Bank of Italy)*

Overall, for the Italian banking sector, it is important to understand its structural problem of a fragmented system, stemming from the inherent tendency to localize in the country, since this has much to do with the impacts of the GFC and the SDC on the banking sector. At the same time, this progress largely involves cooperative banks whose role in providing capital to local economies is hugely important and fixed. In addition, the structures of loans, non-performing loans and bad debts in terms of sector (governemtn, households, financial and non-financial corporations, and non-residents) and economic activities (among which manufacturing, construction and services) can be considered to understand what part the banking sector is more exposed to.

Taken into account the characteristics of the Italian economy and banking sector, there are three features that exist simultaneously in both the economy and the banking sector that represent their strong association.

First, the macro-financial relationship in Italy is extremely strong considering the fact that Italian companies depend much on its financial sector (Levine 2002; Bilotta 2017; Bank of Italy, 2020; Bronzini et al. 2022). SMEs, which represent about 95% (IFA, 2021) of the economy, are much less capable of accessing capital by issuing shares and bonds considering Italy's undercapitalized stock market (Panetta, 2013). According to Panetta (2013), the share of companies' borrowings from banks accounts for roughly two-thirds of total their financial debt, bond issuance as a tool of financing makes up of less than less than 8% of companies' credits, and only about 10 companies issue bonds each year. At the same time, there is hardly any need for them to expand in terms of scope and scale, leading to an under-demand of financial services. According to Pagano et al. (1998), the undercapitalization of Italian stock market can be traced back Italian firms' disinclination to comply certain transparency regulations obliged for listed entities. While in the last 10 years Italy's stock market capitalization has increased to over 30% of GDP (CEIC, 2024), due to the long-rooted characteristics of SMEs, which mostly operate domestically, there is still a tight relationship between SMEs and the Italian banking industry. Moreover, because of the rather localization of Italian SMEs, they are, more precisely, dependent on local financing sources, which, as also mentioned above, are locally based mutual banks. In a nutshell, at the same time as small and medium-sized businesses count on local cooperate credit banks for fundings, these local small banks are established with the main purpose of serving these local economic agents, which forms a strong, long-standing and trustworthy relationship.

Second, Italy's strong macro-financial relationship is also expressed through Italy's public debt, of which nearly 23% is made up of debts to banks (Figure 1). In 2006 the share of Italy's government debt held by banks jumped from about 13% to over 21%, and towards the end of the sovereign debt crisis almost a third of Italy's sovereign debts belonged to the banking sector, which represents the banking sector's high exposure to the debt that was at the heart of the euro area crisis and hence, weakened the banking system as an outcome of the SDC. This also reflects the fact that the Italian banking sector was rather "safe" during the collapse of Wall Street during 2007 - 2009, but afterwards the sovereign debt crisis in euro revealed this weakness of government and banking system's tie.

Third, as mentioned above, there is a strong connection between the Italian economy's private sectors (households and non-financial companies and the banking industry in terms of their share in Italian banks' total loans or their amount of bad debts owed to banks. This exposes the banking sector to the real economy's crises, which indeed have materialized and shall be discussed in the next section.

And, finally, although not equivalently important, the economic disparity between Italy's North and South is also inherent in the banking sector: by the end of 2023, the South and Island makes up only for about 22% of Italy's bank branches, while the North's branches account for over 57% in total (Bank of Italy, 2024). The reason for this is adequately simple enough to comprehend: with an underdeveloped economy in the South, the necessity for financial services gradually diminished with the deteriorating economy. Vice versa, as the North continues to develop, a strong banking industry is needed to back the northern economy, and Milan – Italy's capital of financing, has been performing well in recent years for the Italian economy.

2.2.2. Dynamics of systemic risk against the backgrounds of fluctuations in Italy's economy and banking sector

In this section, changes in Italy's economy and banking sector, as well as the ECB's implementation of unconventional monetary policies shall be observed in order to understand how and why these fluctuations affected the dynamics of systemic risk in the Italian banking sector from 2000 to 2023. Since UMPs started to be introduced by the ECB in 2014, the 2000 – 2013 period can be considered pre-UMP, while 2014 – 2023 period can be considered during-UMP. However, in a more detailed breakdown, 5 different phases should be kept in mind[8]:

- Phase 1 (2000 – 2006): Continuation of low growth in the economy and consolidation in the banking sector
- Phase 2 (2007 – 2009): Global financial crisis (and global recession)
- Phase 3 (2010 – 2013): Sovereign debt crisis (and Italy's economic recession)
- Phase 4 (2014 – 2019): Implementation of the ECB's UMPs and Italy's banking crisis
- Phase 5 (2020 – 2022): COVID-19, the energy crisis and phasing out of the ECB's UMPs.

For over the last two decades the Italian economy has been known to have recorded extremely low growth, but growth started on a downward trend at least a decade before that. Based on IMF statistics, already from 1990 Italy's real GDP growth rate never exceeded 3% except for few

[8] The indicated years of each phase should be taken loosely, as not all crises or/and phenomena end at the end of a specific year or/and begin at the start of any year.

exceptions in 2000 (3.8%), 2021 (8.3%) and 2022 (4%) (Figure 8). In the years building up to the GFC, Italy's growth rate had been fluctuating above and below the 1% bar, which conveniently created a good condition for the economy to plummet further when the Global Recession hits the country.

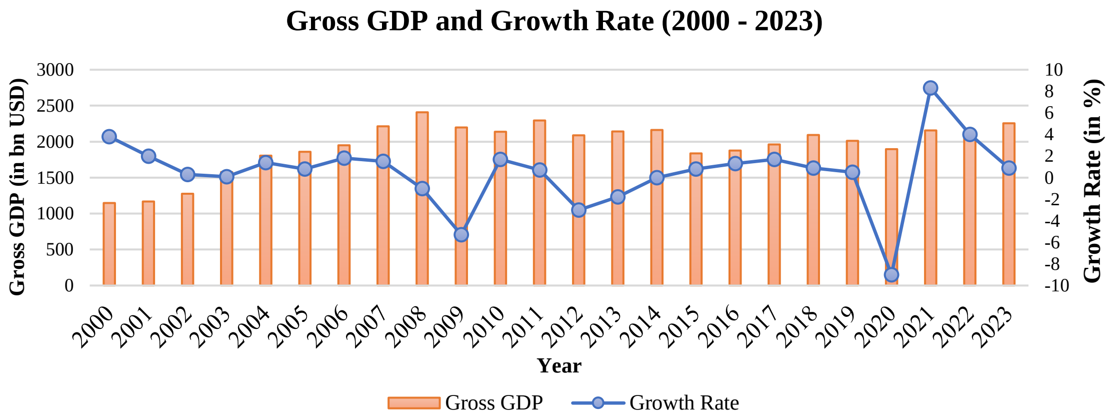


Figure 8: Italy's gross GDP and real GDP growth rate in 2000 – 2023

(*Author's own visualization based on data made available by the IMF)*

Italy's debt-to-GDP ratio also slightly declined in this period from 109% in 2000 to 104% in 2017 (Figure 9). Inflation was quite low during this period and hit zero in 2004Q4. Unemployment, on the other hand, declined from 10.1% in 2000 to 6.1% in 2007 (Figure 10) Overall, this period represents the continuation of Italy's stagnant economy since the 1990s. While unfavorable macro environment would not be a factor to contribute to the build-up of systemic risk during this period, it represents the structural problems of Italy's economy and have long-term effect that weakens the country's ability to withstand external shocks that are to come in the next decade.

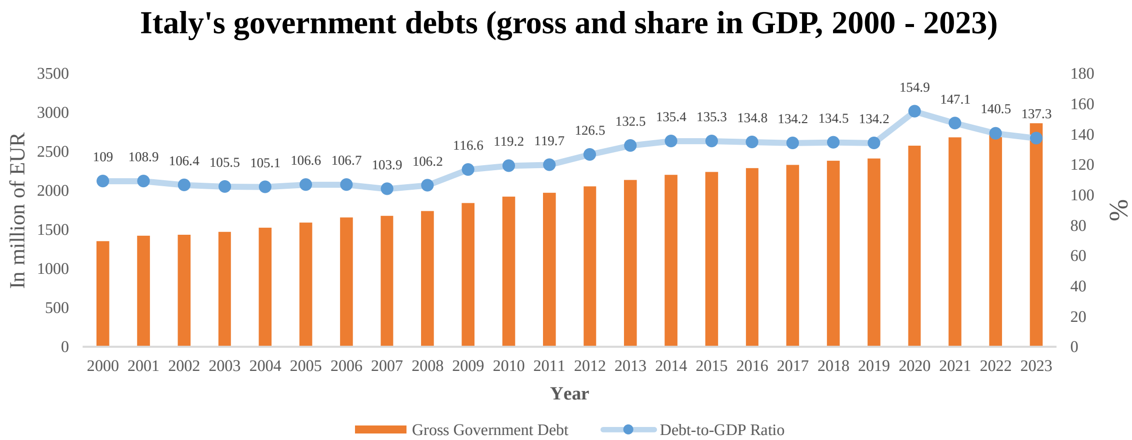


Figure 9: Italy's gross government debt and its share to GDP in 2000 – 2023.

(Author's own visualization based on data made available by IMF)

According to Bank of Italy's Annual Report for 2006, by the end of 2006, the consolidation progress in the Italian banking sector to increase concentration continued forcefully with Italy's strongest banking groups, which are also among the strongest in Europe (Intesa Sanpaolo and UniCredit) conducted more merger and acquisitions. Financial indicators that reflect profitability and capital adequacy have been shown to improve considerably. In addition, credit risk was also at a historically low level for loans offered to manufacturing corporations. However, as reported by Bank of Italy, loan quality, even though improved, remained a challenge for the banking sector because of its high exposure to SMEs. Furthermore, a concern over the real estate sector was given as it accounted for over a third of banks' total loans.

Since Italy is heavily dependent on exports of its high-quality goods and services, the Global Recession that came along with the GFC put pressure on Italy's trade balance, with growth in exports volume plummeted from 10.6% in 2006 to -15.5% in 2009 (Figure 11). Whereas the alignment between GDP and export growth rates did not match 100% at the beginning of the 2000s, the fluctuations of these indicators mostly evolved on the same trend from the GFC period to the years that came after. Since exports do not entirely determine the growth of Italy's economy, its growth or deterioration would not necessarily drag the entire economy to the same direction. However, based on the dynamics between these rates, it can be seen that the patterns were quite similar (Figure 12).

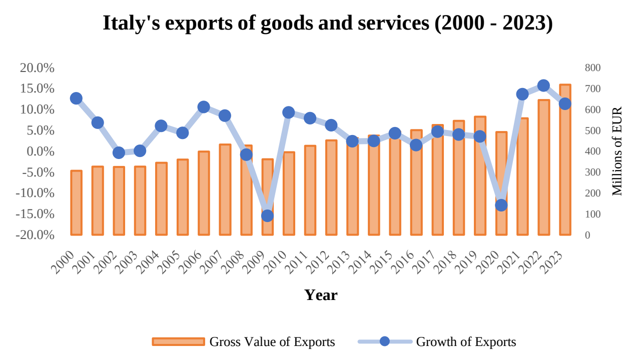


Figure 11: Italy's exports of goods and services (2000 - 2023)

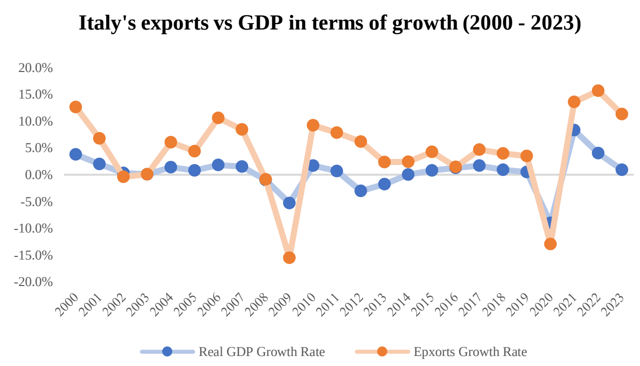


Figure 12: Italy's exports vs GDP in terms of growth (2000 - 2023)

(Author's own visualization based on data made available by ISTAT and the IMF)

From this period onwards, Italy only saw its government debt increasing, especially when compared with GDP as regards to the debt-to-GDP ratio, from 103.9% in 2007 to 116.6% in 2009, both because of the increasing need to resort to the state budget and the stagnant economy. Having a closer look at the real GDP growth rate and the government gross debt "growth rate", in the years building up to the GFC there had been a large gap between these indicators, and when just when the gap closed in 2007, the Global Recession hit the economy, which expanded the difference between debt growth rate and GDP growth rate from -0.3 to 11.1 pp (Figure 12).

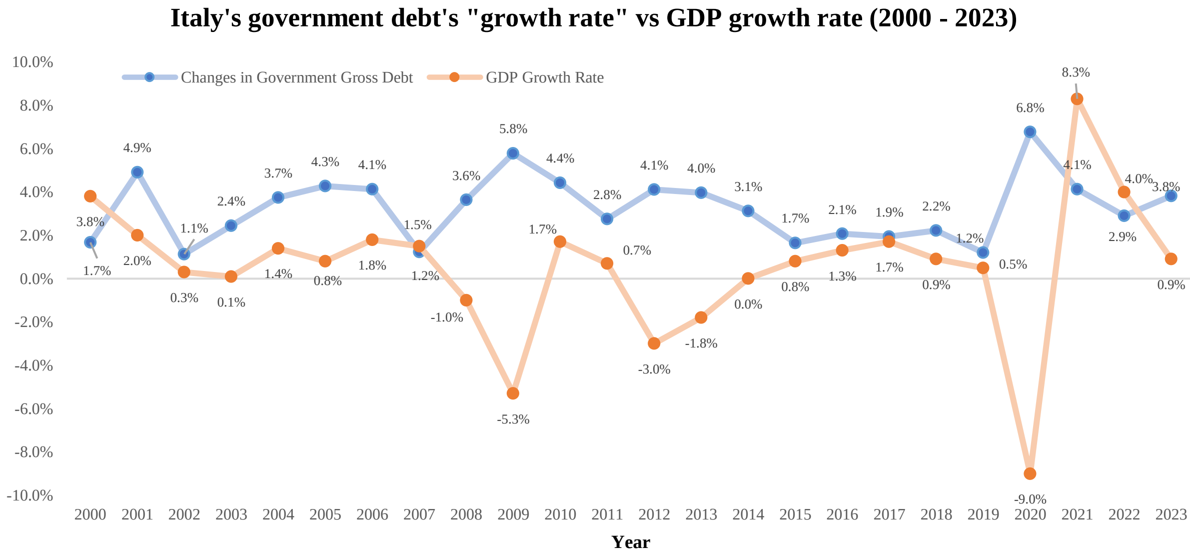


Figure 13: Comparison between Italy's changes in gross government debt and GDP

(Author's own visualization based on data made available by Bank of Italy and the IMF)

The dynamic of inflation rate in this period aligns with Europe's situation. Whereas from 2000 to 2006 inflation was in the 2% - 3% range, in 2008 inflation increased to 3.5% and dropped to 0.8% in 2009, the unemployment rate started increasing again to 7.9% in 2009 and peaked at 12.9% in 2014. Another evidence of how the Global Recession put a toll on the Italian economy is the growth of unemployment rate. While unemployment was at its bottom in 2007 as a result of a declining trend earlier (Figure 10). However, the main problem of Italy's joblessness that was mentioned above lies in youth unemployment, which rose from 20.4% in 2007 to 25.4 in 2009, i.e. over a quarter of young people who do not have a job.

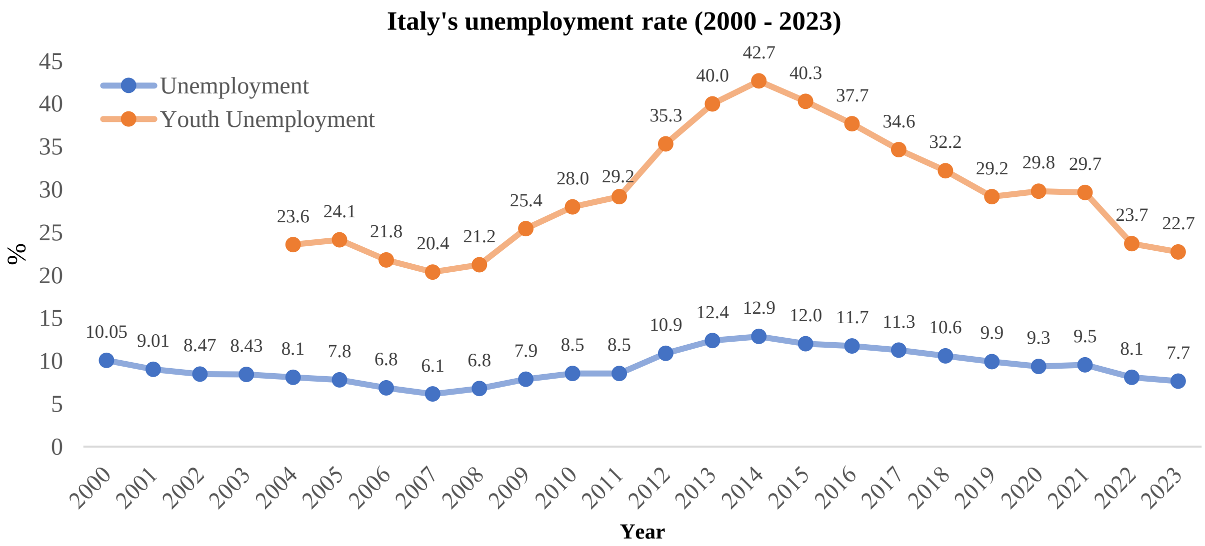


Figure 10: Italy's unemployment rate (2000 – 2023)

(Author's own visualization based on data made available by the IMF)

In 2010, the Italian economy started showing some signs of recovery after the Global Recession. GDP growth increased to the positive zone and recorded 1.7% in 2010 However, as the sovereign debt crisis started to materialize, the economy was again in trouble and GDP growth dropped to -3% at the height of the SDC in 2012 and started climbing up to 0% in 2014 (Figure 8). Exports also slowed in this period. Exports growth rate decreased from 9.2% in 2010 (which was high for Italy but was rather because of the low base effect in the previous year) to 2.4% in 2013 and remained stagnant in the years that come after (Figure 11). This means that after the GFC and SDC exports did not increase at the same pace in the pre-crisis period anymore and the fact that these events affect the Italian so severely and durably is because the economy itself was already having structural problems that seemed to be acceptably embedded in its nature, and not until the crises broke out did the government put efforts into mending the new issues, and the way they provided social supports to those affected by economic recessions - relying on state budget - would only deepen the debt issue in the long run. Again, debt growth and GDP growth went in two opposite directions and the gap between them widened to -7.1 pp. Specifically for the Italian economy, the combination of low GDP growth and high government debt is a perfect recipe for the sovereign bonds to lose the trust of bondholders, which is exactly the case that occurred in the SDC.

According to Bank of Italy's Annual Report in 2007, Italy's banking system was not substantially affected thanks to the limited exposure the mortgage-backed assets in the US, the dependence on conventional loans for financing and a rather strict regulatory environment. However, because of the GFC, threats of decrease in loan quality started to accumulate in flows of new bad debts. As a result, in 2009, loans from Italy's five largest banking group dropped by 4.4 pp, while other banks recorded an increase of 2.8% in lending, which reflects an easing of credit supply. The consolidation progress continued, but at a much slower pace than in the pre-GFC period, which is more likely because of the continuation ex-ante agreements. By 2009, five largest banks of Italy held 52.5% of total banking assets. From Figure 14, it can be seen that the share of banks in Italian government debts surged abnormally in 2006, just before the GFC and continue to increase and reached maximum at 32.15% in June 2013 before gradually decreasing in post-SDC episode as the ECB's UMPs were implemented since 2014.

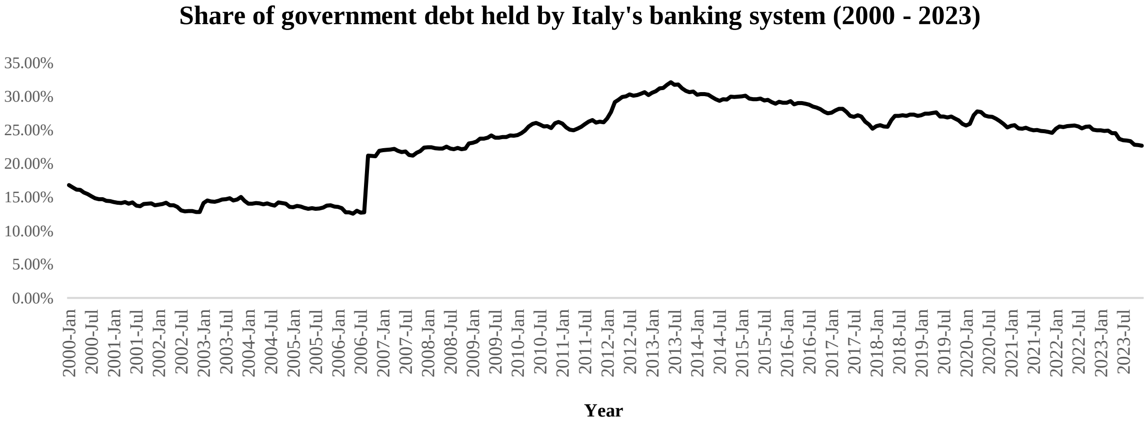


Figure 14: Share of government debt held by Italy's banking system (2000 - 2023)
(*Author's own visualization based on data made available by Bank of Italy)*

In general, it should be highlighted that before the GFC and SDC, a large part of banks' loans was allocated to the non-financial sector. After these world- and region-wide crises, whereas Italian firms' share in banks' total loans decreased, the share of their bad debts still took up the majority of total bad debts for Italian residents. While bad debts represent the extreme case of non-performing loans, due to a lack of available data classification of bad debts by sector is used to understand which economic sector is "at fault" for bad debts. As can be seen, the majority of bad debts belong to Italian companies, most of which are SMEs because after several economic crises in the last two decades, the Italian economy, characterized by SMEs, became only more and more vulnerable.

During the Global Recession unemployment started to grow, then the SDC severely affected the Italian economy and resulted in domestic economic recession and unemployment rate grew at a rapid rate to 12.9% in 2014. Youth unemployment rate skyrocketed from 20.4% in 2007 to 42.7% in 2014 (Figure 10). The beginning of the 2014-2019 period was marked by the burden that the two severe economic crises had left in Italy. GDP growth continued the stagnant state that characterized the pre-crisis period at less than 2% (Figure 8). The debt-to-GDP ratio was also at steady levels during these years, ranging from 134.2% to 135.4% (Figure 9). While the debt-to-GDP ratio did not go on an upward trend as it did during times of crisis, had the economy grown at a faster pace, the ratio would have decreased to less alarming levels. The growth of annual export turnover also slowed down, never reaching the pre-crisis peak of 10.6% in 2006 (Figure 11).

As the rest of the eurozone, during this period inflation was extremely low in Italy at near zero levels, and the economy recorded deflation in 2016 at -0.1% (Figure 15). At the same time, the inflation rate in this period is at lower levels than in the previous before the GFC and SDC: while pre-crisis levels were roughly above 2%, the post-crisis levels were very near 0 or just above the 1% level. Unemployment during this period decreased substantially from the peak of 42.7% in 2014 to 29.2%

in 2019 for youth unemployment, and from 12.9% to 9.9% for unemployment observed in the whole population (Figure 10).

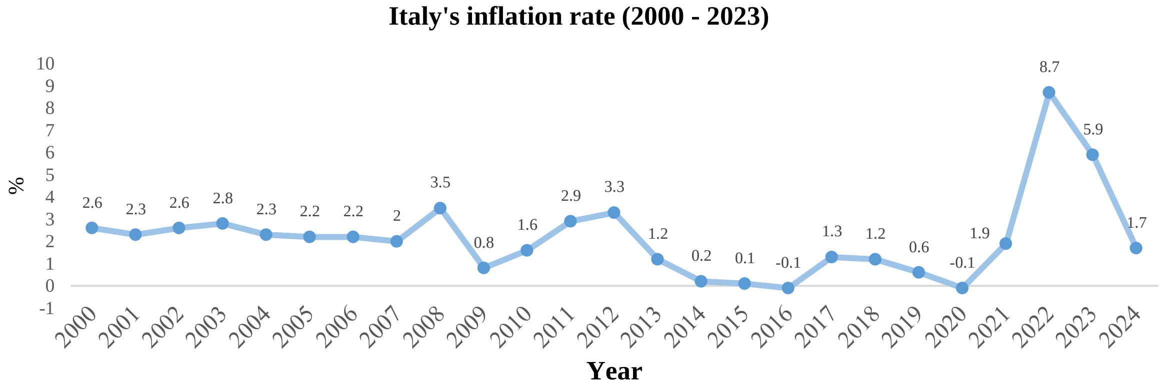
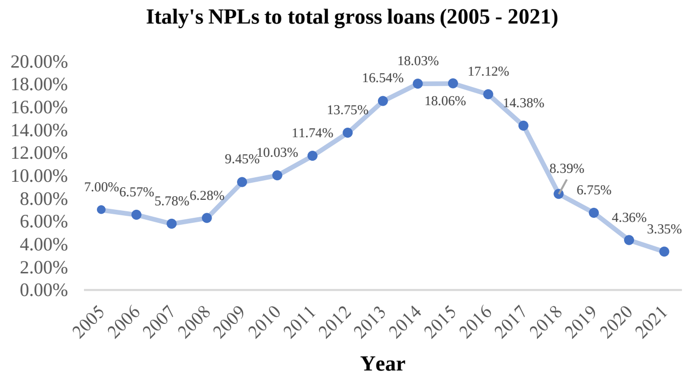


Figure 15: Italy’s inflation rate (2000 – 2023)

(Author’s own visualization based on data made available by ISTAT)

The period of 2015 - 2017 was crucial for the Italian banking system since it was forced to face a huge amount of accumulated NPLs that originated from the GFC and the SDC. As can be seen in Figure 16 and Figure 17, the share of NPLs in Italian banks’ total loans started increasing during the GFC and gradually increased to the peak of 18.1% in 2015 and started to go on a downward trend since then on. By the end of 2023, Italy’s gross amount of NPLs was over €50 billion, a major decline from the height of almost €350 billion in 2015. Holders of NPLs were for the most part SMEs, who as a result of two consecutive economic crises from 2007 to 2013 did not manage to pick up. As Italian banks are more reliant on traditional loans for this category of borrowers, the problematic economic situation that negatively affected businesses damaged the banking system as a whole.



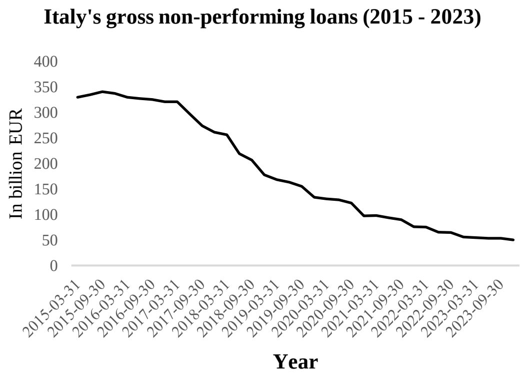


Figure 16: Italy's NPLs to total gross loans (2005 - 2021)

Figure 17: Italy's gross non-performing loans (2015 - 2023)

(Author’s own visualization based on data made available by Bank of Italy)

Furthermore, since this period marks the implementation of the ECB’s UMPs, share of Italy’s central bank in public securities increased in exchange for the decrease in other monetary financial institutions (Figure 4) as part of the PSPP program in which BoI made a purchased of €119 billion securities in the public sector (Bank of Italy, 2016). To counter the impact of the banking crisis, the government stepped in and bailed out three major banks (*Banca Monte dei Paschi di Siena* – the third largest bank in Italy, *Banca Popolare di Vicenza* and *Veneto Banca*) (Bank of Italy, 2016). However, considering the fact that the Italian government already accumulated a large amount of public debt, sovereign bond quality worsened as a result. This pattern also shows a reliance of Italian banks on government's readiness for bailouts, which might increase banks' confidence in choosing riskier assets.

From 2020 to 2023, the global economy was negatively affected by two main events: the COVID-19 pandemic and the Russia-Ukraine conflict. As the rest of the world, the COVID-19 pandemic hit the Italian economy even harder than the Global Recession as lockdowns forced the global economy to practically stop moving or moving in a much slower speed.

Exports in Italy dropped to -12.9% in 2020, and real GDP growth rate plummeted to the -9% rock bottom level (Figure 11). The economy, even though bounced back in 2021 with an 8.3% GDP growth, eventually returned to its stagnant state and recorded 0.9% of growth in 2023 (Figure 8). Unsurprisingly, COVID-19 demanded a lot of financial aids from the government to support the economy and its agents, and Italy's debt-to-GDP ratio surged to 154.9% in 2020 against the background of a negative GDP growth rate and a 6.8% of increase in government debt (Figure 9). This period was the only time when GDP growth exceeds the growth of government's gross debt (in 2021 and 2022), since in 2021 the economy recovered from the 2020 low base and the rate of increase of general government debt started to slow down. By 2023, the typical gap between debt and GDP growth rates appeared again (Figure 6).

Regarding inflation, prices soared to an 8.7% growth rate in 2022 as a result of the energy crises caused by the Russia-Ukraine conflict. Until 2022, Italy was hugely dependent on Russia for the supply of gas[9], and the lack of primary resources in Italy required government's efforts to search for new suppliers in order to maintain production as a major European manufacturing house. Eventually, inflation in Italy started to slow down towards the end of 2023 and has been performing better than other European countries (Figure 15). Unemployment, while still high at over 9% in 2019-2021, finally dropped to 7.7% in 2023. Youth unemployment increased to 29.8% in 2020 and decreased to 22.7% in 2023. Whereas the declining trend in unemployment is a positive sign for the economy, when compared with other European countries the levels are still higher (Figure 10).

[9] According to Reuter (2022), 40% of Italy's gas was from Russian supply before the Russia-Ukraine conflict in 2022.

Phase 5 marks Italy's success in weathering bad economic downturns. During the COVID-19 pandemic, the consolidation process started in 2016 and efforts to reduce NPLs continued. Profitability also improved and in 2021 returned to pre-pandemic and in 2022 reached the highest level since the post-GFC period thanks to more favorable macroeconomic conditions and reduction in loan loss provisions (Bank of Italy, 2020, 2021, 2022). Compared with the pre-GFC period, changes in the share of Italian banks' clients and bad debts holders by sector and economic activities are visible. In the end, the structural changes in the banking sector succeeded, making the Italian banking sector more resilient against counter-supportive economic circumstances.

In general, the most serious weaknesses of the Italian economy were not only inherently revealed but also enhanced from the outbreak of the Global Recession to the eurozone debt crisis in which Italy played a major role. Italy's economy, with its already inflexibility in adapting to sudden shocks, could not immediately pick up after two major crises. The fact that the Italian banking sector is highly exposed to certain economic spheres such as manufacturing, real estate and construction, along with the dominance of corporate sector in banks' lending portfolios, as shown by the share of NFCs in Italian banks' loans, reinforce that fact that macroeconomic environment in Italy should be considered a crucial factor for the unfavorable development of NPLs as a main weakness of the Italian banking system as regards to systemic risk.

In the end, from observations of the Italian economy and banking sector it can be said that the banking sector itself has been improving significantly and has shown remarkable resilience on its own terms. The two events that pushed the Italian banking system in a difficult situation were the SDC (2010 – 2013) and the IBC (2015 – 2017). While both of these events have roots from within the banking sector (for the SDC – exposure to government debts, for the IBC – exposure to private sector), these problems are exacerbated by international and national economies. Hence, as the macroeconomic is vulnerable to external crises, the banking sector is also vulnerable to economic weakening. As the whole economy worsens all together, enterprises of different spheres in the corporate sector experience bad results, which then results in the transformation NPLs and consequently, to the heightened level of risk. In addition, the consolidation progress that had been taking place in Italy since the 1990s was set aside in order to combat the spread of GFC and the direct consequence of SDC, which once again proves that it is the macroeconomic environment that affects the banking sector more than the other way around.

An observation of the Italian banking system's systemic risk shows that before the GFC, systemic risk is rather low at less than $20 billion. During phase 2, the peak of $146.7 billion was reported in February 2009 after a surge of almost 9 times since the start of GFC in August 2007. (Figure 18). Phase 3 sees the highest level of fluctuations in Italy's systemic risk and in July 2012, the banking sector was exposed to $183.4 billion at the midst of the sovereign debt crisis where Italy was in the central attention. The beginning of phase 4 saw the decrease of systemic risk, until it skyrocketed to $150.5 billion in July 2016 as it found itself in a banking crisis cause by a large amount of NPLs accumulated as a result of the two consecutive crises from 2007 to 2013. Phase 5 also saw the frequent volatility of systemic risk at high levels, with a peak of $160.83 billion in July 2022 before decreasing towards the end of 2023.

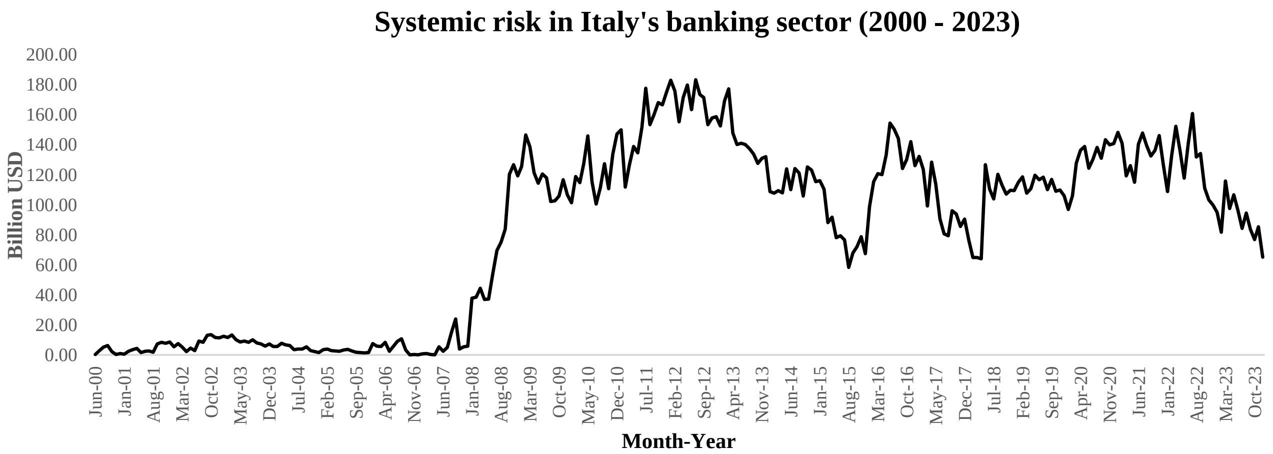


Figure 18. Systemic risk in Italy's banking sector (2000 - 2023)

Author's visualization based on available data provided by Volatility Lab (V-Lab)

Chapter 3: Assessment of determinants' influence on systemic risk in Italy's banking sector

3.1. Description of data and methodology

This study takes into account the period of 2000 - 2023 in terms of monthly and quarterly frequencies. Following the availability of the target variable, the specific period under consideration is June 2000 - December 2023 with end-of-period data. Hence, the total number of observations in the monthly dataset is 283, while that in the quarterly dataset is 95. On the one hand, because of the limited number of observations in quarterly dataset this study mainly focuses on monthly data, while quarterly data are used as supportive evidence. On the other hand, the lack of available monthly data for certain variables is an incentive for the deployment of the quarterly dataset.

The chosen target variable of this study is SRISK, a measure of systemic risk calculated on a monthly basis by the Volatility Laboratory (V-Lab). SRISK indicator represents how much is needed to bail out a systemically important financial institution in terms of the gap between expected equity and equity conditional systemic event, which is when the institution's stock return falls below a certain threshold for a period. Following this, the sum of SRISK for all financial institutions indicates the amount that suffice to save the whole financial system in case of a systemic crisis. This study uses the sum of individual SRISK indicators to proxy for systemic risk in Italy's banking sector.

The set of a total of 32 independent variables is divided into three categories: banking-sector characteristics, macroeconomic indicators, and monetary policy. The first two are considered "internal" predictor variables as they represent the features of Italy's banking sector and economy, and the latter can be understood as "external" explanatory variable since the decision of monetary policy is made by the ECB for a euro-area-wide purpose. Independent variables are obtained from Bank of Italy's Statistical Database, ISTAT, Eurostat, Federal Reserve Bank of St. Louis and Wu and Xia (2017, 2020). All variables are available in the study period of June 2000 - December 2023, with the exception of the ECB's shadow rate (September 2004 - August 2022). For this reason, there will be another of monthly dataset to take into account the ECB's shadow rate. After conclusions are drawn from monthly datasets, quarterly data will be used to test robustness of results. However, due to the limited number of observations, additional econometric models built upon quarterly data will not be further subdivided to include the ECB's shadow rate.

Before proceeding to the explanations of the meanings of input for all independent variables, it should be understood that while all of these variables will be considered, those that reflect a similar characteristic/phenomenon/policy shall not be included simultaneously in one specification in order to preserve variables' independence. This is in alignment with the main purpose of the study, which is to seek potential determinants of systemic risk and assess their influence.

As such, the first category of independent variables is banking-sector characteristics with a total of 5 subcategories: banks' loans, bad debts, ratios, and others.

For the subcategory of banks' loans, there are 5 variables to consider in total. The first explanatory variable in this subcategory is the amount of banks' loans to the government (*b_LOANSto_GOV*). In addition, another variable is used to account for government's share in total banks' loans (*b_LOANStoGOV_s*). As explained in chapter 2, Italy's banking sector of tight association with the government represent a weakness that can lead to the system's collapse in extreme events such as the sovereign debt crisis, which is why these variables are expected to positive effects on systemic risk. Next, interbank loans are taken into account as it represents the mere nature of systemic risk, which is the interconnectedness in the banking sector. The higher the amount of loans banks lend to each other, the more dependent they are on each other, and this necessarily increases systemic risk. The amount of interbank loans (*b_INTERLOANS*) and the share of interbank loans in total banks' loans (*b_INTERLOANS_s*) are expected to assert positive influence on systemic risk. In addition, this study also includes the share of loans to non-residents granted by Italian banks (*b_LOANSNONRES_s*) to understand if the system is vulnerable to "external" customers. This variable is predicted to have a positive impact on systemic risk, since most of loans from Italian banks to non-residents clients are to those in EMU, which increases the banking sector's exposure of non-residents potential defaults if a crisis hits the euro area.

For the subcategory of bad debts held by banks, there are 6 variables to consider in total. This subcategory explicitly deals with debts that are non-payable by clients, which is why all variables in this subcategory are expected to have an upward impact on systemic risk. Hence, for this subcategory, it is more interesting to understand which sector of bad debts holders poses more threat to the stability of Italy's banking system. First, the share of bad debts in total loans (*b_BADDEBTS_s*) is calculated to take into account to consider the loan quality in the whole systemc. As to different types of bad debts holders, there are variables that indicate the amount of bad debts held by non-resident holders (*b_BADDEBTSF*), by resident households (*b_BADDEBTSHHs*), and by non-financial corporations (*b_BADDEBTSNFCs*). In addition, the shares of bad debts held by the latter two sectors (HHs - *b_BADDEBTSHHs_s* and NFCs - *b_BADDEBTSNFCs_s*) are also taken into consideration as models' inputs.

For the subcategory of ratios, there are 4 variables in total. The first ratio is that of the banking sector's total loans to its total assets (*b_LOANS*), which indicates banks' reliance on deployment of traditional lending activities and concentrated allocation of capital that can lead to an increase in systemic risk. Next, the deposit-to-liabilities ratio (*b_DEPO*) is expected to assert negative effects on systemic risk, since a higher deposit ratio indicates less involvement in the security and capital markets, and hence, a lower level of interconnectedness between other market's participants (Kleinow

& Nell, 2015). Another ratio to be considered is the loan-to-deposit ratio (*b_LDR*), a representative of liquidity risk in the banking system. A high loan-to-deposit ratio indicates a potential lack of liquidity, which would increase systemic risk. Therefore, this ratio is expected to have a positive impact on systemic risk. The fourth ratio is the share of cash and securities in total deposits (*b_LIQUIDITY*), a proxy for liquidity in the banking sector. On the one hand, the increase in liquidity indicates that banks are more capable of overcoming capital shortfall (Blancher et al., 2013) hence reduces systemic risk, especially when extreme events occur (Brunnermeier, 2009). On the other hand, higher liquidity ratio can also have positive effects on systemic risk, a reason for which might be the decrease in profitability as a result of non-diverse capital distribution (Kleinow & Nell, 2015). Therefore, the expected effect of liquidity ratio on systemic risk is rather ambiguous.

Finally, the rate at which banks lend to each other (*b_INTBANKRATE*) is included in the models with the implication that the lower this rate is, the easier banks are able to borrow from each other, which indicates a laxer condition of borrowing and hence, potentially increases systemic risk.

The second category of independent variables includes macroeconomic indicators with a total of 3 subcategories: government bonds/debts, economy's well-being, and others.

For the subcategory of government bonds/debts, there are 4 variables in total. In particular, gross government debt (*m_GOVDEBT*) is taken into account since it characterizes one of Italy's main weaknesses, as explained in chapter 2, and is believed to increase systemic risk. Moreover, the amount of government debts held by banks (*m_GOVDEBTBANKS*) and its share in total government debts (*m_GOVDEBTBANKS_s*) are employed as proxy for the banking sector's exposure to government debts, which heightens the systemic risk level.

For the subcategory of economy's well-being, there are 6 variables in total. As explained in chapter 1, literature tends to agree that upon a favorable economic condition, systemic risk tends to increase as confidence levels to include riskier assets in portfolios go up. Hence, the following variables are expected to have positive impacts on systemic risk. First, industrial production index without the inclusion of the construction sector (*m_IPI*) is used as a proxy for economic environment, since data for monthly GDP is not available. In the quarterly dataset, GDP (*m_GPD)* will be used instead of IPI to see if the same conclusion holds for these macroeconomic indicators.

This subcategory also takes into consideration the manufacturing and the construction sectors' contribution to economic well-being, as these sectors hold a large portion of bad debts. As such, industrial production index particularly for the construction sector (*m_IPICONSTR*), as well as business confidence in the construction and manufacturing sectors (*m_BCCONSTR* and *m_BCMANUF*) and shall be included in the models. Another important variable in this subcategory is current account of goods for the total economy. Since the Italian economy relies much on exports, increase in current account of goods is believed to have a positive effect on the economy, and hence indicate a lax environment for systemic risk to be accumulated. Finally, when inflation (*m_INF*) is low, expansionary monetary policy would be introduced, which encourages more risk-taking activities and leads to potential increases in systemic risk. Vice versa, tightening monetary policy introduced to curb high inflation will potentially decrease systemic risk.

For the subcategory of others, there is 2 variables, which is interest rate for house purchase (*m_HOUSE*) and the spread between the Italian and German 10-year government bonds' yield. The consideration for the inclusion of the rate for house purchase variable into this study's model stems from the fact that the real estate sector also represents a considerably higher portion of bad debts in the banking sector, and is closely connected with the construction sector, the bad debts' share of which is also high. Hence, it should be expected that interest rate for house purchase can be an important indicator for the real estate sector, and that the decrease of interest rate for house purchase as a sign for easier access to mortgage loans will increase systemic risk in Italy, with a possible reference to the collapse of the US mortgage crisis back in 2007 - 2009. Next, the spread of bond yields is used as an increase in bond yield spread indicates the deterioration of bond yields, which is necessarily true for the Italian government bonds as their difference compared to the Germany's surged substantially during the heights of euro area's sovereign debt crisis. In addition, this paper also takes into account Verhelst's (2016) initiative of using 10-year bond yield spread between Italy and Germany to capture changes in monetary stance, with the implication that when measures aiming at reducing the sovereign bonds spread are introduced, systemic risk tends to increase. Therefore, the effect of bond yield spread (*m/ump_SPREAD*) is expected to be positive on systemic risk.

Finally, the third category of independent variables includes indicators that reflect the ECB's (un)conventional monetary policy with a total of 2 subcategories that serve as proxy for the ECB's UMPs including NIRP and APP. For all of the variables in this category, a positive effect on systemic risk is expected upon expansionary monetary policy.

For the subcategory of NIRP, the DFR (*ump_DFR) is* employed. When eurozone banks are "fined" to keep reserves at the ECB, they would provide more liquidity to the real economy, which increased systemic risk under more favorable economic conditions.

For the subcategory of APP, there will be alternations between the ECB's and the BoI's change in total assets (*ump_ECBASSETS* and *ump_BOIASSETS*) as well as the euro area's shadow rate *(m_SHADOW*). As such, upon a rise in the ECB's and the BoI's total assets and a decrease in the shadow rate, systemic risk is likely to increase following more favorable conditions granted by accommodative monetary policies.

A summary of data description can be found in Appendix Table 1, and descriptive statistics of data are presented in Appendix Table 2, Appendix Table 3 and Appendix 4.

In order to test the hypotheses proposed at the beginning of the study, each model would also try to provide an answer to specific hypotheses designed to reach a conclusion to the main hypotheses of the paper. As such, the main hypotheses of this paper are:

Hypothesis 1: The inter-correlation between Italy's banking sector and macroeconomic environment is a catalyst for increase in systemic risk.

Hypothesis 2: UMPs implemented by the ECB has positive effects on systemic risk in Italy's banking sector.

After a thorough investigation into related literature and the characteristics of Italy's banking sector and economy as well as the ECB's UMPs, additional supportive hypotheses are formulated:

Hypothesis 1.1: An increase in the total amount of government debts leads to an increase in systemic risk in Italy's banking sector.

Hypothesis 1.2: An increase in the banks' loans to the government leads to an increase in systemic risk in Italy's banking sector.

Hypothesis 1.3: An increase in the share of banks' holdings of government debts leads to an increase in systemic risk in Italy's banking sector.

Hypothesis 2.1: A decrease in the ECB's DFR leads to an increase in systemic risk in Italy's banking sector.

Hypothesis 2.2: An increase in assets purchased in the ECB's APP leads to an increase in systemic risk in Italy's banking sector.

The methodology for data collection, processing and analysis so as to construct econometric models is presented as follows:

The first and foremost task of data processing in this study stationarity check because the input of non-stationary time series, containing seasonality and trend, would make econometric models deliver unreliable results. Using R programme, time series' status of stationarity is checked with the Augmented Dickey-Fuller (ADF) test. Next, the method of differencing is applied until the times series become stationary.

Another step before building regression models is to capture the inter-correlation between all variables in terms of statistical significance, direction of correlation and strength. The result of correlation heatmap is illustrated in Appendix Table 5 and 6.

Initially, the ordinary least squares (OLS) method is applied to build regression models with SRISK as the target variable. After applying the Breusch–Pagan test for heteroskedasticity check, the models turn out to contain heteroskedasticity. In order to fix this problem, instead of OLS, generalized least square (GLS) method is employed. Comparisons of models' results using OLS and GLS indeed confirm that models perform better using GLS, and heteroskedasticity is no longer present. Alongside fixing the heteroskedasticity problem, multicollinearity check is also executed for all OLS models' results by calculating the variance total factor (VIF). Multicollinearity means that there is a high level of co-dependence between independent variables, which means the change in one variable would result in the change of another/the others, and altogether affect the outcome of the models. Preferably, the VIF score for each variable should be close to one. In this study, regressors with a VIF score above 10 are removed alternatively so that their effects on the target variable are separately accounted for. Regressors with VIF scores of less than 5 are considered to have weak multicollinearity, and hence are kept in the models. Results of VIF scores representing multicollinearity for each model are depicted in Appendix Table 7, Appendix Table 8 and Appendix Table 9.

3.2. Results and analysis of multiple linear regression models

The general formula for multiple linear regression models is presented as follows:

$$Y = \beta_0 + \beta_1 * x_1 + \beta_2 * x_2 + \ldots + \beta_n * x_n + \varepsilon$$

in which Y denotes the target variable, β_0 – intercept, xi – independent variable, i – slope coefficient of independent variable, n – the number of variables included in each model, and ε – residual.

Hypothesis 1.1. An increase in the total amount of government debts leads to an increase in systemic risk in Italy's banking sector. *not confirmed*

Hypothesis 1.2. An increase in the banks' loans to the government leads to an increase in systemic risk in Italy's banking sector. *not confirmed*

Hypothesis 1.3. An increase in the share of banks' holdings of government debts leads to an increase in systemic risk in Italy's banking sector. *confirmed*

Hypothesis 2.1. A decrease in the ECB's DFR leads to an increase in systemic risk in Italy's banking sector. *confirmed*

Hypothesis 2.2. An increase in the amount of assets purchased in the ECB's APP leads to an increase in systemic risk in Italy's banking sector. *not confirmed*

Baseline model M1, M2 and M3 takes into account all data available at monthly frequency from June 2000 to December 2023. After second-order differencing, the model includes 281 observations.

BASELINE MODEL M1

Variables	Expected influence	Regression coefficients
BANKING-SECTOR VARIABLES		
b_INTERLOANS	+	-0.0006*
b_BADDEBTS_s	+	1.181758***
b_LOANS	+	-223.4951
b_LIQUIDITY	+/-	1838.0477**
b_INTBANKRATE	-	-22.1336***
MACROECONOMIC VARIABLES		
m_GOVDEBT	+	1.70e-06
m_GOVDEBTBANKS	+	0.0007*
m_GOVDEBTBANKS_s	+	16.1917***
m_IPI	+	7.4447**
m_INF	+/-	2.9102*
m_CURRACC	+	0.0044***
m/ump_SPREAD	+	53.0471***
UNCONVENTIONAL MONETARY POLICY		
ump_ECBASSETS	+	1.36e-05***
ump_DFR	-	-75.9660***

Table 1: Multiple linear regression model for Baseline Model M1.

Regarding banks' exposure to government debts/bonds, baseline model M1 confirms hypothesis 1.3 but rejects hypotheses 1.1 and 1.2. The positive influence of banks' exposure to government debts on systemic risk is reported, but it is consistently true in the case of the share of banks in government debt holdings. In addition, without government debts in the model, banks' share in government debts has an increased coefficient, which indicates that banks' exposure proxied by its portion in sovereign debt has a stronger explanatory power than the gross government debt itself. This means that the macrofinancial relationship, in this case via Italian banks' holdings of government bonds, has a strong explanatory power to systemic risk, while the amount government debt is perhaps an non-statistically significant variable. At the same time, considering the consistently positive effect of spread between Italy's and Germany's 10-year bond yields on systemic risk, it is likely that bond quality is more important.

Baseline model M1 confirms hypothesis 2.1 but cannot fully confirm hypothesis 2.2: While it is true that an increase in systemic risk can be caused by a decrease in DFR (a proxy for NIRP) and an increase in changes in the ECB's total assets (a proxy for QE), when the BoI's total assets become a proxy for the ECB's APP, negative effect remains unchanged across specifications.

This might indicate that while NIRP is indeed a statistically important predictor for systemic risk in Italy's banking sector, either the APP has an ambiguous effect on systemic risk, or BoI's total assets should not be considered a suitable choice for being a proxy of the APP. In addition, inflation shows a negative effect on systemic risk across specifications, indicating that in an environment of price's low growth, UMPs are implemented, which increases systemic risk via risk-taking channel that was discovered during the GFC by previous studies.

Additional worth-noticing findings from baseline model 1 include:

- Lower interbank loans, larger share of bad debts in total debts and lower rate of interbank loans increase systemic risk.
- Surprisingly, an increase in liquidity ratio in the banking sector renders an increase in systemic risk across specifications.
- The results for IPI and current account of goods alter considerably across specifications and hence, are non-reliable.

Before commenting on the additional findings, further observations shelled by conducted alongside with the main results in the next baseline models). For robustness checks of baseline model M1, see Appendix Table 10.

BASELINE MODEL M2

Baseline model M2 builds on the results of baseline model 1 and additionally takes into account the involvement of resident households, resident non-financial sector and non-residents in the Italian banking sector’s systemic risk. At the same time, results baseline model M2 are used to contrast with those obtained in baseline model M1.

Baseline model M2 supports conclusions obtained from baseline model M1 for hypotheses 1.3, 2.1 and 2.2.

Hypothesis M2.1: An increase in the amount of bad debts held by NFCs or its share in total bad debts to residents will lead to an increase in systemic risk.

Hypothesis M2.2: An increase in the amount of bad debts held by HHs or its share in total bad debts to residents will lead to an increase in systemic risk.

Hypothesis M2.3: An increase in the share of Italian banks’ loans to non-residents in total loans will lead to an increase in systemic risk.

Variables	Expected influence	Regression coefficients
BANKING-SECTOR VARIABLES		
b_INTERLOANS	+	6.114e-05*
b_LOANSNONRES_s	+	6.0135***
b_BADDEBTS_s	+	10.7854***
b_BADDEBTSHHs_s	+	20.2938***
b_BADDEBTSNFCs	+	0.0015***
b_LDR	+	-108.0217
b_LIQUIDITY	+/-	3315.2543***
b_INTBANKRATE	-	-81.8701***
MACROECONOMIC VARIABLES		
m_GOVDEBTBANKS_s	+	21.4355***
m_IPI	+	-0.7283*
m_INF	+/-	-2.0137***
m_CURRACC	+	0.0097***
m_HOUSE	-	-144.1954***
m/ump_SPREAD	+	94.8247***
UNCONVENTIONAL MONETARY POLICY		
ump_ECBASSETS	+	7.034e-05***
ump_DFR	-	-78.3487***

Table 2: Multiple linear regression model for Baseline Model M2.

Baseline model M2 cannot fully confirm hypothesis M2.1: The exposure of the banking sector to bad debts held by NFCs only increases systemic risk when it is proxied by the amount, not its share in total amount of bad debts. Likewise, baseline model M2 cannot fully confirm hypothesis 2.2: It is not an increase in banks’ bad debts of by HHs that leads to an increase in systemic risk, but rather the share of bad debts held by HHs in total residents’ bad debts.

Baseline model M2 confirms hypothesis 2.3: When the portion of Italian banks' loans to non-residents increases systemic risk will also increase. This denotes a threat posed by external clients of Italian banks.

Conclusions for effects of the of bad debts in total loans, liquidity ratio, interbank loan rate, banks' share in government debts, NIRP and APP (proxied by both the ECB's and the BoI's total assets) remain unchanged).

However, the addition of sectoral variables renders current account and interbank loans non-statistically significant. At the same time, this model shows that IPI has negative effect on systemic risk. This can be explained by the fact that since lower IPI signals the downturn of the economy, it is logical that the amount of bad debts will increase and positively affect systemic risk. The inclusion of bad debts held by NFCs and HHs in the model increases the influence of the share of bad debts in total loans, and because NFCs and HHs account for over three-fourths of Italian residents' bad debts, under a bad economic environment systemic risk will increase. For robustness checks of baseline model M2, see Appendix Table 11.

BASELINE MODEL M3

Baseline model M3 builds on the results of baseline model 1 and 2 and additionally take into account the construction and manufacturing sectors, both of which hold a large amount of bad debts to Italian banks.

Hypothesis M3.1: An increase in IPI for the construction sector will lead to an increase in systemic risk. *confirmed*

Hypothesis M3.2: An increase in BCI for the construction sector will lead to an increase in systemic risk. *confirmed*

Hypothesis M3.3: An increase in BCI for the manufacturing sector will lead to an increase in systemic risk. *confirmed*

This model confirms the three proposed hypotheses: The construction sector's IPI and the BCI for both construction and manufacturing sectors all increase systemic risk. However, the inclusion of these variables shows that the conclusion obtained for IPI (for all economic activities but construction) is not robust enough.

From the monthly dataset of 281 observations from August 2007 to December 2023, out of the 30 variables that are alternatively or/and simultaneously included in different specifications of baseline models 1, 2, 3, there are 12 variables that perform consistency in terms of their influence on systemic risk.

For the subcategory of bad debts (banking-sector category), the share of bad debts in total loans always increases systemic risk. The same conclusion is applied for the amount of bad debts of NFCs and non-residents, as well as the share of HHs' bad debts out of total. Interestingly, from the conclusion for hypothesis M2.2, it can be suggested that as long as changes in the structure of bad debts of HHs might affect systemic risk in a positive direction. Vice versa, no matter if the share of NFCs' bad debts decreases, as long as the amount of NFC's bad debts increase, systemic risk will follow the pattern.

For the subcategory of ratios (banking-sector category), the liquidity ratio outperforms the others in predicting systemic risk. However, the persistent positive effect of liquidity ratio on systemic risk contradicts with many other papers, such as one by Vallascas & Keasey (2012), while it is approved by Kleinow & Nell (2015). The inclusion of other ratios, especially the loan-to-asset and deposit-to-liabilities ratios decrease credibility of other variables' coefficients.

For the subcategory of government debt (macroeconomic category), the share of Italian banks' holdings of government debts remains robust with a positive effect on systemic risk across specifications of all three baseline models.

For the subcategory of economy's well-being (macroeconomic category), only variables that concern specific economic sectors, including construction's IPI and BCI, and manufacturing's BCI are robust in different specifications for baseline model 3.

For the remaining subcategory in the macroeconomic category, inflation consistently shows negative effects on systemic risk.

For the subcategories of APP and NIRP (UMP category), robustness is reported across all specifications for all of the three baseline models. However, while the expected expansionary UMP proxied by changes in DFR (1-month) and changes in the ECB's total assets (2-month) is achieved, total assets of the BoI always show negative effect on systemic risk. Hence, it is perhaps more reasonable to conclude that the ECB's total assets variable is better-suited proxy for the ECB's APP, because when the ECB's total assets variable is used instead of the BoI's total assets variable, the positive impact of macroeconomic indicators (construction's IPI and BCI, and manufacturing's BCI) and inflation is weakened. This resonates with many studies that the ECB's UMPs have positive effects on macroeconomic environment.

For robustness checks of baseline model M3, see Appendix Table 12.

Baseline models shadow M1, M2 and M3 replace the ECB's total assets and BoI's total assets as a proxy for the ECB's UMPs.

Hypothesis 2.1. A decrease in the ECB's DFR leads to an increase in systemic risk in Italy's banking sector. *confirmed*

Hypothesis 2.2. An increase in the amount of assets purchased in the ECB's APP leads to an increase in systemic risk in Italy's banking sector. *not confirmed*

BASELINE MODEL SHADOW M1

Baseline model shadow M1 serves to answer hypothesis 2.1 and 2.2.

	Expected influence	Regression coefficients
BANKING-SECTOR VARIABLES		
b_INTERLOANS	+	-0.0002***
b_BADDEBTS_s	+	-2.7248*
b_LOANS	+	-223.4951
b_LIQUIDITY	+/-	1338.0067***
b_INTBANKRATE	-	-67.9325
MACROECONOMIC VARIABLES		
m_GOVDEBT	+	1.70e-06***
m_GOVDEBTBANKS_s	+	20.3274***
m_IPI	+	-4.9022**
m_INF	+/-	-0.8701*
m_CURRACC	+	-0.0015**
m/ump_SPREAD	+	-35.0570***
UNCONVENTIONAL MONETARY POLICY		
ump_SHADOW	+	-18.8101***
ump_DFR	+	-16.7178 ***

Table 4: Multiple linear regression model for Baseline Model SHADOW M1.

BASELINE MODEL SHADOW M2

	Expected influence	Regression coefficients
BANKING-SECTOR VARIABLES		
b_INTERLOANS	+	0.0009***
b_BADDEBTS_s	+	10.3307*
b_LIQUIDITY	+/-	2086.5062***
b_INTBANKRATE	-	-15.1742
b_BADDEBTSNFCs	+	0.0003*
b_BADDEBTSHHs_s	+	13.1344
MACROECONOMIC VARIABLES		
m_GOVDEBT	+	8.75e-05
m_GOVDEBTBANKS_s	+	26.6471*

m_IPI	+	-0.9030***
m_INF	+/-	-0.1169***
m_CURRACC	+	-0.0031***
m_HOUSE	-	-91.2901***
m/ump_SPREAD	+	-21.4209***
UNCONVENTIONAL MONETARY POLICY		
ump_SHADOW	+	-22.9567***
ump_DFR	+	-123.3202***

Table 5: Multiple linear regression model for Baseline Model SHADOW M2.

The substitution of shadow rate for the ECB's or BoI's total assets renders changes the direction of IPI and current accounts of goods into negative, which means that these variables now have negative effects on systemic risk. A possible explanation for this result is that shadow rate has always been argued to be capable of capturing the effects of quantitative easing in a low-interest-rate environment and the period of this model is majorly when the Italian economy has not been performing well, which requires the implementation of APP. However, since the Italian economy had always been growing quite slowly, the risk-taking channel, as confirmed by many studies, only became stronger when expansionary monetary measures are introduced. Hence, during this period, the more vigorously is the APP implemented to react to a slow-growing and low-inflation environment, the more incentives are created for banks and its clients to opt for risky assets.

Another reason why shadow rate might be a better proxy for APP instead of the ECB's or BoI's total assets is that the spread of Italy and Germany's bonds yield is persistently negative, which approves Verhelst (2016)'s study that takes into account the effects of APP's announcements by the ECB. As explained by Verhelst (2016), when monetary policies aimed at reducing this spread is introduced, a positive effect on systemic risk is reported.

The baseline model shadow M2 adds the amount of NFCs' bad debts and the share of HHs' bad debts. However, while the conclusions obtained for baseline model shadow M1 remain unchanged for most variables, the substitution of shadow rate as a proxy for APP renders the share of HHs in total bad debts of residents non-statistically significant. In addition, the negative influence of interest rate for house purchase in this model aligns with conclusions in baseline models 1, 2, 3. This might indicate that during the low-interest-rate period, banks' exposure to bad debts of HHs is less to worry about than the decrease in interest rate for house purchase that encourage HHs to borrow.

Apart from the macroeconomic and the additional variables, robustness continues to be observed for the effects of liquidity ratio, interbank loans, share of bad debts in total loans, amount of NFC's bad debts, share of banks' holdings in government debts, and the ECB's DFR.

BASELINE MODEL SHADOW M3

Baseline model shadow M3 adds construction's IPI and BCI, and manufacturing's BCI.

	Expected influence	Regression coefficients
BANKS		
b_INTERLOANS	+	0.0002***
b_BADDEBTS_s	+	4.5628*
b_BADDEBTSHHs_s	+	4.4947**
b_BADDEBTSNFCs	+	0.0002*
b_LIQUIDITY	+/-	195.5651***
b_INTBANKRATE	-	-5.6631
MACRO		
m_GOVDEBT	+	0.0002**
m_GOVDEBTBANKS_s	+	15.5632***
m_IPI	+	0.3177
m_IPICONSTR	+	0.2511
m_BCCONSTR	+	0.0248*
m_BCMANUF	+	0.6618***
m_INF	+/-	-1.7702***
m_CURRACC	+	-0.0023**
m_HOUSE	-	-13.8366
m/ump_SPREAD	-	-62.0204***
UMP		
ump_SHADOW	-	-9.1507***
ump_DFR	-	-63.8605***

Table 6: Multiple linear regression model for Baseline Model SHADOW M3

Baseline model shadow M3 continues the confirmation of previous models for the effects of liquidity ratio, interbank loans, share of bad debts in total loans, amount of NFC's bad debts, share of banks' holdings in government debts, and the ECB's DFR. At the same time, baseline model shadow M3 shows that share of HHs in total resident bad debts is again positive and statistically significant.

Additionally, only BCI for construction and manufacturing sectors have statistically positive impact on systemic risk, while IPI and IPI for construction are non-statistically important in baseline model shadow M3.

BASELINE MODELS Q1, Q2, and Q3

Baseline models Q1, Q2 and Q3 serve to support the conclusions obtained in baseline models M1, M2 and M3 and baseline models shadow M1, M2 and M3. Baseline models Q1, Q2 and Q3 use quarterly data with a total of 70 observations. Consistency of expected effects and statistical importance is observed for liquidity ratio, total amount of bad debts held by NFCs, share of HH's bad debts, spread of Italian and German bonds yield, inflation, total assets of BoI and ECB. See Appendix Table 13, Appendix Table 14, Appendix Table 15.

3.3. Comparison, conclusion, and recommendations

Out of the 32 variables from 3 broad categories (banking-sector, macroeconomic and (U)MP-related), there are seven variables that perform consistency regarding their influence on systemic risk in Italy's banking system in 2000 – 2023.

From the banking-sector category, the total amount of Italian banks' bad debts held by non-financial corporations poses a positive effect on systemic risk. This result somewhat resonates with the threat posed by this sector as discussed in chapter 2 in terms of bad debts. Interestingly, from the obtained results it is suggested that as long as the total amount of NFCs' bad debts increase, systemic risk will also increase. This structural problem can be explained by the fact that the large share of SMEs in Italy finds it difficult to repay debts under difficult economic environments, especially after multiple crises in recent consecutive years. Next, the liquidity ratio, which is calculated as the sum of cash and securities over deposits, also shows consistent positive effects on systemic risk. While this result is not supported by the majority of literature, it corresponds to those studying the impacts of UMPs. While Kleinow & Nell (2015) argue for the inefficiency of capital allocation, there is also a possible explanation that the effect of the risk-taking channel by UMPs, since UMPs not only increase liquidity but also induce banks and investors' risk-taking behaviors simultaneously (Brana et al., 2019). Another reason that might be able to explain for the positive effect of liquidity ratio on systemic risk is that the increase in securities as a component of the liquidity ratio indicates the heightened level of interaction between banks and other participants in the market, hence increase interconnectedness and subsequently, systemic risk. As to cash as another component of liquidity ratio alongside with securities, the increase of cash gathering might indicate the preparation to face potential risks caused by underlying malfunctioning in the banking system.

From the macroeconomic category, the positive effect of the share of banks' holdings in sovereign debt confirms hypothesis 1 on the correlation of the banking system with macroeconomic indicators (which, in this case, is government debt). This result is also agreed on by Acharya and Steffen (2014). It is important to note that positive influence of banks' exposure to government debts on systemic risk is reported specifically for the share of banks in government debt holdings, not the total amount of either governemnt debt or banks' holdings in government debt. In addition, without government debts in the model, banks' share in government debts has an increased coefficient, which indicates that banks' exposure proxied by its portion in sovereign debt has a stronger explanatory power than the gross government debt itself. This means that the macrofinancial relationship, in this case via Italian banks' holdings of government bonds, has a strong explanatory power to systemic risk, while the amount government debt is perhaps a non-statistically significant variable.

From the UMP category, all variables that serve as proxies for the ECB's different unconventional measures (NIRP and APP) show consistency in terms of their effects on systemic risk in Italy's banking sector. In general, this study strongly agrees with previous literature on the positive impact of UMP measures on systemic risk, especially via systemic risk-taking channel (Kabundi & De Simone, 2020; Faia & Karau, 2021; Colletaz et al., 2018; Leitner et al., 2021). When proxied by the ECB's total assets and Wu & Xia's (2017, 2020) shadow rate for the euro area, positive effects are reported. This is largely in line with the conclusions of many studies that UMPs can encourage the opt for riskier assets by banks and investors via the risk-taking channel. However, the use of BoI's total assets shows that the APP has negative effects on systemic risk. In any case, more careful considerations upon the implementation of UMPs should be considered to preserve financial stability. The use of DFR as a proxy for both traditional and nontraditional monetary policy shows persistently negative effects on systemic risk in all specifications. This necessarily means that in the studied period, a drop-in interest rate by the ECB would inevitably result in higher risk in the system.

From the conclusions achieved above, a few recommendations can be proposed. First, it is suggested for Italian banks to regulate its exposure to government debts. This resonates with the reduction of the banking sector's share in sovereign debt holdings following the sovereign debt crisis where Italy was among the main damaged countries. Furthermore, banks should also pay attention to the amount of bad debts that belongs to Italian NFCs. Next, the persistently positive impact of liquidity on systemic risk raises an alarm towards the over-accumulation of liquidity without specific regulations. This point proves the relevance of Countercyclical Capital Buffer (CCyB) that requires banks to reallocate capital more efficiently by setting aside a part large enough to counter potential losses in extreme events. Finally, it is extremely important that the ECB's decision on (un)monetary policy should take into account the impacts on financial instability that come along the way towards the ultimate "mandate" of financial stability, as it is shown that higher systemic risk is connected with the implementation of NIRP and APP.

CONCLUSION

This paper engages itself in the search for potential determinants of systemic risk in the Italian banking sector from 2000 to 2023. Throughout the three chapters, this paper managed to identify potential factors that determine systemic risk in Italy’s banking sector, analyze the dynamics of Italy’s banking sector and macroeconomic indicators, taking into account the ECB’s implementation of UMPs, and quantify the impacts of various factors that influence systemic risk in Italy by building multiple linear regression models.

From chapter 1, it is concluded that current literature lacks country-specific approaches to the study of systemic risk, apart from those that focus on the US. Second, most paper use individual banks’ balance-sheet and market data, while this study takes a more general look at Italy’s banking sector and the macroeconomic environment as well as their interplay in the contribution of systemic risk. Third, most literature agrees on the undesirably positive impact of unconventional measures on systemic risk.

Chapter 2 explains in detail the evolution of the UMPs as well as Italy’s economy and banking sector and the dynamics of systemic risk against the various turbulences that caused impairment to the not only the banking industry but also the real economy. At the same time, the consolidation process in the last three decades and efforts to reduce non-performing loans have successfully strengthened the banking sector’s resilience. Finally, the strong tie in the macrofinancial relationship in Italy is characterized by 4 factors, the dominance of local SMEs that require and rely on local sources of fundings, banks’ high exposure to the public as well as private sectors (households and non-financial firms) and firms in specific spheres (manufacturing, construction and real estate), and finally the fragmentation characterized by the division between the North and the South.

For chapter 3, in the search for the potential determinants of systemic risk in the Italian banking sector, this paper, this study takes into account 32 variables across three categories (banking-sector-wide, macroeconomic and UMPs-related to answer two hypotheses:

Hypothesis 1: The strong intercorrelation between Italy’s banking sector and the real economy is a catalyst for increase in systemic risk.

Hypothesis 2: The ECB’s unconventional monetary measures have positive effects on systemic risk in the Italian banking sector.

From the result of multiple linear regression models, this paper can neither fully confirm hypothesis 1 nor hypothesis 2 on different accounts. For hypothesis 1, the Italian banking sector was found to be highly exposed to the Italian government and non-financial sector as well as companies that specialize in manufacturing, construction and real estate businesses. However, whereas the share of Italian banks in government debt holdings and the amount of NFCs’ bad debts show robust results of positive influence on systemic risk, estimation for those that serve as proxy for specific industries are not consistent enough to reach a positive conclusion. While the chosen variables on macroeconomic well-being and specific economic activities indeed did not always show the expected effects on systemic risk, the fact that an increase in banks' holdings of government debt increases systemic risk emphasizes the problematic nature of sovereign debt in Italy. This holds true not only across literature for other countries/regions but is also in alignment with the overuse of Italy's state budget on solving not only economic but also banking problems, as it has been shown that the government seems to be ready to bail out near-to-default banks (the case of *"Monte dei Pashi di Siena"*, which has been saved twice). Furthermore, it is also confirmed that NFCs' bad debts indeed increase systemic risk, which indicates that importance of the real economy and that more efforts should be made to reduce the risk posed by NFCs.

For hypothesis 2, expansionary unconventional monetary measures implemented by the European Central Bank do increase systemic risk, but only when proxied by the ECB's total assets or shadow rate (for the asset purchase programmmes) and the deposit facility rate (for the negative interest rate policy). This is in alignment with most of previous literature and implies the true existence of the risk-taking channel that accompanies the unconventional monetary measures when more liquidity is bumped into the economy. Surprisingly, an additional finding on the positive effect of liquidity on systemic risk obtained from the models also approves this conclusion. This result suggests that while indeed more liquidity indicates better preparation for extreme events, it is also important that capital is allocated efficiently so as to avoid risk-taking behaviors that have systemic implications. This study also approves previous literature argument that it is highly essential that monetary policymakers taken into consideration macroprudential aspects that hampers financial stabilities, rather than only focus on the "mandate" of providing price stability.

The findings of this paper largely confirm the results of previous literature on the exposure of the banking sector to sovereign debt and unconventional monetary policy and provides support only to a part of literature that takes into consideration unconventional monetary policy for the positive effect of liquidity on systemic risk. Furthermore, this paper provides a new insight into the effect of Italian firms on systemic risk via their holdings of bad debts to the banking system. Finally, this paper has successfully applied the inclusion of a broad range of variables from all three categories specifically for the case of the Italian banking sector on the effect on systemic risk.

From the groundwork of this paper there are more to research about the determinants of systemic risk in Italy's banking sector. First, another measure can be applied to check robustness, since this paper only uses SRISK for the estimate of capital shortfall under extreme conditions. Second, a broader range of variables can also be taken into account for the macroeconomic and banking-sector characteristics, especially those that concern different economic activities. Third, from the conclusions of this paper, further studies can choose to use the balance sheet of major Italian banks as potential determinants of systemic risk.

REFERENCES

Acharya, V., V., Pedersen, L. H., Philippon, T., & Richardson, M. P. (2010, April 23). Measuring systemic risk. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1595075

Acharya, V. V., & Rajan, R. G. (2013). Sovereign Debt, Government Myopia, and the Financial Sector. The Review of Financial Studies, 26(6), 1526–1560. http://www.jstor.org/stable/23470187

Acharya, V. V. & Steffen, S. (2013). Falling short of expectations? Stress-Testing the European banking system. *Social Science Research Network*. https://doi.org/10.2139/ssrn.2370484

Acharya, V.V. & Steffen, S., (2014). Analyzing Systemic Risk of the European Banking Sector. *Fouque/Langsam (ed.): Handbook on Systemic Risk*.

Adamko, P., Spuchľáková, E., Valášková, K. (2015). The History and Ideas Behind VaR, Procedia Economics and Finance, Volume 24, Pages 18-24, ISSN 2212-5671, https://doi.org/10.1016/S2212-5671(15)00607-3

Adrian, T., & Brunnermeier, M. K. (2014). CoVaR. Federal Reserve Bank of New York Staff Reports. Staff Report No. 348 https://core.ac.uk/download/pdf/6612156.pdf

Adrian, T. and H. S. Shin (2008), Liquidity and Financial Contagion Financial Stability Review, Banque de France, February 2008.

Adrian, T., & Shin, H. S. (2010). Liquidity and leverage. Journal of Financial Intermediation. Volume 19, Issue 3, 2010, Pages 418-437, ISSN 1042-9573, https://doi.org/10.1016/j.jfi.2008.12.002.

Adrian, T., & Brunnermeier, M. K. (2016). CoVaR. *The American Economic Review*, *106*(7), 1705–1741. http://www.jstor.org/stable/43861110

Afanasyeva, E., & Güntner, J. (2020). Bank market power and the risk channel of monetary policy. *Journal of Monetary Economics*, *111*, 118–134. https://doi.org/10.1016/j.jmoneco.2019.01.029

Allen, F., & Carletti, E. (2013). What Is Systemic Risk? *Journal of Money, Credit and Banking*, *45*, 121–127.

Amante, A., Segreti, G., Balmer, C., & Lawson, H. (2022). Italy's dependence on Russian gas down to 25% from 40%, Draghi says. Reuters. https://www.reuters.com/business/energy/italys-dependence-russian-gas-down-25-40-draghi-says-2022-06-24/

Angelini, P., & Cetorelli, N. (n.d.). *The effects of regulatory reform on competition in the banking industry*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=931870

Altunbas, Y., Gambacorta, L., & Marques-Ibanez, D. (2009). *Securitisation and the bank lending channel*.

Altunbas, Y., Gambacorta, L., Marques-Ibanez, D. (2010). Does Monetary Policy Affect Bank Risk-Taking? ECB Working Paper 1166.

Angelini, P., Bofondi, M., & Zingales, L. (2017, June). The Origins of Italian NPLs . https://www.bundesbank.de/resource/blob/759084/2f6a4efeb69ed4ce0232b53bc9cce74b/mL/2017-06-15-amsterdam-06-paper-data.pdf

Angeloni, I., & Faia, E. (2009). A tale of two policies: prudential regulation and monetary policy with fragile banks. https://www.econstor.eu/bitstream/10419/30044/1/618295348.pdf

Angeloni, I. and Faia, E. (2013). "Capital Regulation and Monetary Policy with Fragile Banks." *Journal of Monetary Economics, 60,3, pp.3111-382*.

Artzner, P., Delbaen, F., Eber, J., Heath, D., 1998. Coherent Measures of Risk. https://people.math.ethz.ch/~delbaen/ftp/preprints/CoherentMF.pdf

Bank of Italy (2020). Annual Report for 2020. https://www.bancaditalia.it/pubblicazioni/relazione-annuale/2020/index.html

Bank of Italy (2006). Annual Report

Bank of Italy (2009). Annual Report

Bank of Italy (2013). Annual Report

Bank of Italy (2016). The 2016 Annual Report at a Glance. Box: Holders of Italian public sector securities

Bank of Italy (2020). The 2016 Annual Report at a Glance.

Bank of Italy (2021). The 2016 Annual Report at a Glance.

Bank of Italy (2022). The 2016 Annual Report at a Glance.

Bank of Italy (2024, March 29). Banks and Financial Institutions: Branch Network - Year 2023. *Statistics Series.*

Barbetta, G., Colombo, L., Colombo, S., & Grillo, M. (2016). Intra-competitiveness and inter-competitiveness among mutual banks: the case of Trento. *International Review of Economics*, *63*(3), 195–214. https://doi.org/10.1007/s12232-016-0249-0

Basak, S., & Shapiro, A. (2001). Value-at-Risk-Based Risk Management: Optimal Policies and Asset Prices. *The Review of Financial Studies*, *14*(2), 371–405. http://www.jstor.org/stable/2696745

Bernanke, B., Gertler, M., Gilchrist, S., 1999. The financial accelerator in a quantita tive business cycle framework. In: Taylor, J., Woodford, M. (Eds.), Handbook of Macroeconomics, Amsterdam, pp. 1341–1393

Benoit, S., Colliard, J., Hurlin, C., & P´erignon, C. (2015, November 17). Where the Risks Lie: A Survey on Systemic Risk. HEC Paris Research Paper No. FIN-2015-1088 , Available at SSRN: https://ssrn.com/abstract=2577961

Bilotta, N. (2017). The Italian Banking System . Seven Pillars Institute Moral Cents Vol. 6 Issue 2, Summer/Fall 2017. https://sevenpillarsinstitute.org/wp-content/uploads/2017/11/Italian-banking-system-final-EDITED.pdf

Black, L. K., Correa, R., Huang, X., & Zhou, H. (2016). The systemic risk of European banks during the financial and sovereign debt crises. *Journal of Banking & Finance*, *63*, 107–125. https://doi.org/10.1016/j.jbankfin.2015.09.007

Blancher, N., Mira, S., Morsy, H., Otani, A., Severo, T., & Valderrama, L. (2013, July). Systemic Risk Monitoring ("SysMo") Toolkit—A User Guide. IMF Working Paper. WP/13/168. https://www.imf.org/external/pubs/ft/wp/2013/wp13168.pdf

Borri, N., Caccavaio, M., Di Giorgio, G., & Sorrentino, A. M. (2012). Systemic risk in the European banking sector. *Social Science Research Network*. https://doi.org/10.2139/ssrn.2112919

Borri, N., Caccavaio, M., Di Giorgio, G., & Sorrentino, A. M. (2014). Systemic risk in the Italian banking industry. *Economic Notes - Monte Dei Paschi Di Siena/Economic Notes*, *43*(1), 21–38. https://doi.org/10.1111/ecno.12015

Borio, C., & Zhu, H. (2012). Capital regulation, risk-taking and monetary policy: A missing link in the transmission mechanism? *Journal of Financial Stability*, *8*(4), 236–251. https://doi.org/10.1016/j.jfs.2011.12.003

Brana, S., Campmas, A., & Lapteacru, I. (2019). (Un)Conventional monetary policy and bank risk-taking: A nonlinear relationship. *Economic Modelling*, *81*, 576–593. https://doi.org/10.1016/j.econmod.2018.07.005

Bronzini, R., D'Ignazio, A., & Revelli, D. (2022). Financial structure and bank relationships of Italian multinational firms. *Journal of Multinational Financial Management*, *66*, 100762. https://doi.org/10.1016/j.mulfin.2022.100762

Brownlees, C. T., & Engle, R. F. (2017). SRISK: A Conditional Capital Shortfall Measure of Systemic risk. *Social Science Research Network*. https://doi.org/10.2139/ssrn.3723383

Brunnermeier, M. K. (2009). Deciphering the liquidity and credit crunch 2007–2008. *Journal of Economic Perspectives*, *23*(1), 77–100. https://doi.org/10.1257/jep.23.1.77

Bruno, V., & Shin, H. S. (2012, December 1). Capital Flows, Cross-Border Banking and Global Liquidity https://uh.edu/~bsorense/capital_flows_global_liquidity%20by%20SHIN.pdf

Bubeck, J., Maddaloni, Á., & Peydró, J. (2020). Negative Monetary Policy Rates and Systemic Banks' Risk-Taking: Evidence from the Euro Area Securities Register. *Journal of Money, Credit, and Banking/Journal of Money, Credit and Banking*, *52*(S1), 197–231. https://doi.org/10.1111/jmcb.12740

CEIC. (2024). Italy Market Capitalization: % of GDP.

Colletaz, G., Levieuge, G., & Popescu, A. (2018). Monetary policy and long-run systemic risk-taking. *Journal of Economic Dynamics & Control*, *86*, 165–184. https://doi.org/10.1016/j.jedc.2017.11.001

Deev, O. & Hodula, M. (2016). The Impact of the ECB Monetary Policy on Systemic Risk Changes in Eurozone. In Palečková, I. and Szarowská, I. Proceedings of the 15th International Conference on Finance and Banking. Karviná: Silesian University, p. 50-59. ISBN 978-80-7510-186-0. http://icfb2015.cms.opf.slu.cz/sites/icfb.rs.opf.slu.cz/files/deev_hodula.pdf

Dell'Ariccia, G., & Marquez, R. (2006). Lending Booms and Lending Standards. *The Journal of Finance, 61*(5), 2511–2546. http://www.jstor.org/stable/3874718

Demirgüç-Kunt, A., & Detragiache, E. (1998). The Determinants of Banking Crises in Developing and Developed Countries. *Staff Papers (International Monetary Fund), 45*(1), 81–109.

Di Cesare, A., Picco, A. (2018, October). A Survey of Systemic Risk Indicators. Occasional Papers Number 458.

Di Salvo, R. (2003). The Governance of mutual and cooperative bank systems in Europe. *Cooperative Studies*.

Diamond, D., Rajan, R., 2009. Illiquidity and interest rate policy. NBER Working Papers 15197

Disyatat, P. (2011). The bank lending channel revisited. *Journal of Money, Credit, and Banking/Journal of Money, Credit and Banking*, *43*(4), 711–734. https://doi.org/10.1111/j.1538-4616.2011.00394.x

Dzhagityan, E., & Mukhametov, O. (2023). The Effect of the ECB's Unconventional Monetary Policy on Systemic Risks in the Eurozone. *Voprosy Ekonomiki, 12*(1), 86–102.

Eijffinger, S.C.W., 2011. Defining and measuring systematic risk. https://core.ac.uk/display/6416555?utm_source=pdf&utm_medium=banner&utm_campaign=pdf-decoration-v1

Elliott, R. & Miao, H. (2009, September). VaR and expected shortfall: a non-normal regime switching framework. Quantitative Finance, Vol. 9, No. 6, September 2009, 747–755.

Engle, R. & Ruan, T. (2019). "Measuring the probability of a financial crisis," *Proceedings of the National Academy of Sciences, 116 (37) 18341-18346*. https://www.pnas.org/doi/full/10.1073/pnas.1903879116

Eurostat. (2024, April 22). Government debt down to 88.6% of GDP in euro area. *Eurostat*. https://ec.europa.eu/eurostat/web/products-euro- indicators/w/2-22042024-bp

European Commission. (2022, July 1). SME Performance Review 2021/2022 - Italy country sheet. https://ec.europa.eu/docsroom/documents/50693

European Commission. Italy in the Digital Economy and Society Index.

Faia, E. & Karan, S. (2021, November 26). Banks' Systemic Risk and Monetary Policy. International Journal of Central Banking https://www.ijcb.org/journal/ijcb21q5a4.pdf

Farhi, E., & Tirole, J. (2009). Leverage and the Central Banker's Put. *The American Economic Review*, *99*(2), 589–593. http://www.jstor.org/stable/25592463

Fratzscher, M., & Rieth, M. (2018). Monetary policy, bank bailouts and the Sovereign-Bank risk nexus in the euro area*. *Review of Finance, 23*(4), 745–775. https://doi.org/10.1093/rof/rfy024

Gasperin, S. (2022). Lessons from the past for 21st century systems of state-owned enterprises: The case of Italy's IRI in the 1930s. *Structural Change and Economic Dynamics*, *62*, 599–612. https://doi.org/10.1016/j.strueco.2022.03.010

Goldstein, A. (2003). *Privatization in Italy 1993-2002: goals, institutions, outcomes, and outstanding issues*. https://www.econstor.eu/handle/10419/76289/

Gonzalez-Hermosillo, B., Pazarbasioglu, C., & Billings, R. (1997). Determinants of banking System Fragility: A Case Study of Mexico. *IMF eLibrary*. https://doi.org/10.5089/9781451973464.024.A001

Haq, M., Heaney, R. (2012). Factors determining European bank risk. Journal of International Financial Markets, Institutions and Money 22 (4), 696–718. 10.1016/j.intfin.2012.04.003.

Hautsch, N., Schaumburg, J., Schienle, M., 2014. Forecasting systemic impact in financial networks. International Journal of Forecasting 30 (3), 781–794. 10.1016/j.ijforecast.2013.09.004

Idier, J., Lamé, G., & Mésonnier, J. (2011). How Useful is The Marginal Expected Shortfall for the Measurement of Systemic Exposure: A Practical Assessment. *Social Science Research Network*. https://doi.org/10.2139/ssrn.1944043

Innovation Finance Advisory (IFA) (2021). The digitalisation of small and medium-sized enterprises in Italy: Models for financing digital projects. Summary Report. https://www.eib.org/en/publications/the-digitalisation-of-smes-in-italy-summary-report

Issing, M. O. (2011). *Lessons for monetary policy: What should the consensus be?*. International Monetary Fund.

Kabundi, A., & De Simone, F. N. (2020). Monetary policy and systemic risk-taking in the euro area banking sector. *Economic Modelling*, *91*, 736–758. https://doi.org/10.1016/j.econmod.2019.10.020

Kapinos, P. S. (2017). Monetary policy news and systemic risk at the zero lower bound. *Social Science Research Network*. https://doi.org/10.2139/ssrn.3091727

Kleinow, J., & Nell, T. (2014). Determinants of systemically important banks: the case of Europe. *Social Science Research Network*. https://doi.org/10.2139/ssrn.2531326]

Knaup, M. & Wagner, W. (2010, June). Measuring the Tail Risks of Banks! Swiss National Science Foundation. Working Paper No 2009/14 https://www.wti.org/research/publications/97/measuring-the-tail-risks-of-banks/

Lambert, F., & Ueda, K. (2014, August 13). *The effects of unconventional monetary policies on bank soundness*. https://www.imf.org/external/pubs/ft/wp/2014/wp14152.pdf

Laseen, S., Pescatori, M., & Turunen, M. (2015). *Systemic risk: A New Trade-off for Monetary Policy?* International Monetary Fund.

Leitner, G., Zerobin, M., Hübel, T., & Wolfmayr, A. (2021). *How risky is Monetary Policy? The Effect of Monetary Policy on Systemic Risk in the Euro Area*. WU Vienna University of Economics and Business. Department of Economics Working Paper Series No. 312 https://doi.org/10.57938/261deb9d-b8bb-4370-95cb-6547214ac0c0

Levine, R. (2002). Bank-Based or Market-Based financial systems: Which is better? *Journal of Financial Intermediation, 11*(4), 398–428. https://doi.org/10.1006/jfin.2002.0341

Lloyds Bank. Italy: Economic and Political Overview https://www.lloydsbanktrade.com/en/market-potential/italy/economical-context

OEC. Country Profile. Italy. https://oec.world/en/profile/country/ita

Oxford Economics. (2021, June 10). L'evoluzione del settore dei servizi in Italia dal 2010. L'Osservatorio del Terziario di Manageritalia. https://www.manageritalia.it/wp-content/uploads/2024/01/Rapporto-Oxford-Economics.pdf

Panetta, P. (2013). Beyond the crisis: What lies in store for Italian banks? Remark in Perugia by Associazione per lo Sviluppo degli Studi di Banca e Borsa in collaboration with Università Cattolica of Milan. https://www.bancaditalia.it/media/notizia/banks-finance-growth-remarks-by-fabio-panetta-deputy-director-general-bank-of-italy/?com.dotmarketing.htmlpage.language=1

Peersman, G. (2011). Macroeconomic effects of unconventional monetary policy in the euro area. *Social Science Research Network*. https://doi.org/10.2139/ssrn.1950039

Pham, T. (2023). Influence of the ECB's Unconventional Monetary Policy on Macroeconomic Indicators in Italy in 2015-2022. *National Research University Higher School of Economics.*

Rodríguez-Moreno, M., Peña, J. (2012). Systemic risk measures: The simpler the better? Journal of Banking & Finance. Journal of Banking & Finance, Volume 37, Issue 6, 2013, Pages 1817-1831, ISSN 0378-4266, https://doi.org/10.1016/j.jbankfin.2012.07.010

Rajan, R.G. (2005, October). Has Financial Development Made the World Riskier? NBER Working Paper No. 11728 https://www.nber.org/system/files/working_papers/w11728/w11728.pdf

Smaghi, L.B. (2009, September 25-26). Macro-prudential supervision. CEPR/ESI 13th Annual Conference on "Financial Supervision in an Uncertain World" https://www.bis.org/review/r090929e.pdf

Sims, E. & Wu, J. C. "Are QE and Conventional Monetary Policy Substitutable?" *International Journal of Central Banking, 2020, 16 (1), 195-230*. https://drive.google.com/file/d/1mcyU9sW-iG3SjMaD9iEKyrANC8w3Wrk5/view

Stolbov, M. (2017). Assessing systemic risk and its determinants for advanced and major emerging economies: the case of ΔCoVaR. *Int Econ Econ Policy* 14, 119–152. https://doi.org/10.1007/s10368-015-0330-2

Taylor, J. (2009, December). Defining Systemic Risk Operationally

Verhelst, E., 2017. Unconventional Monetary Policy and Systemic Risk in European Banking. Master Dissertation, Universiteit Gent. https://libstore.ugent.be/fulltxt/RUG01/002/351/172/RUG01-002351172_2017_0001_AC.pdf

Vallascas, F., Keasey, K., 2012. Bank resilience to systemic shocks and the stability of banking systems: Small is beautiful. Journal of International Money and Finance 31 (6), 1745–1776. 10.1016/j.jimonfin.2012.03.011.

Varotto, S., Zhao, L., 2014. Systemic Risk in the US and European Banking Sectors, Working Paper ICMA Centre, Reading.

Weiß, G., Bostandzic, D., Neumann, S., 2014. What factors drive systemic risk during international financial crises? Journal of Banking & Finance 41, 78–96. 10.1016/j.jbankfin.2014.01.001

World Bank. Manufacturing, value added (% of GDP) - Italy. https://data.worldbank.org/indicator/NV.IND.MANF.ZS?locations=IT

World Bank. Industry (including construction), value added (% of GDP) - Italy https://data.worldbank.org/indicator/NV.IND.TOTL.ZS?locations=IT

World Economics. Italy's Informal Economy Size https://www.worldeconomics.com/Informal-Economy/Italy.aspx

Wu, J. C., & Xia, F. D. (2017). Time-Varying lower bound of interest rates in Europe. *Social Science Research Network*. https://doi.org/10.2139/ssrn.2946239

Yamai, Y., & Yoshiba, T. (2005). Value-at-risk versus expected shortfall: A practical perspective. *Journal of Banking & Finance*, *29*(4), 997–1015. https://doi.org/10.1016/j.jbankfin.2004.08.010

Zhou, H., Liu, W., & Wang, L. (2020, Febuary 12). Systemic Risk of China’s Financial System (2007–2018): A Comparison between ΔCoVaR, MES and SRISK across Banks, Insurance and Securities Firms The Chinese Economy, DOI: 10.1080/10971475.2020.1720962.

APPENDIX

Appendix Table 1. Data description for all models

Variable	Symbol	Unit of measurement	Data Source	Definition / Calculation
		Dependent variable		
SRISK	SRISK	Billion USD	Volatility Laboratory (V-Lab) - NYU Stern	A measurement of systemic risk that represents how much money the system needs to bail out systemically important banks in case they default
		Independent variables		
Internal variables				
Banking-sector characteristics				
Banks loans to government 1	b_LOANStoGOV	Million EUR	Bank of Italy	Banks' loans to general government
Banks loans to government 2	b_LOANStoGOV_s	Ratio	Bank of Italy	Banks' loans to general government / Total banks' loans to residents
Banks loans to banks 1	b_INTERLOANS	Million EUR	Bank of Italy	Banks' loans to (other) banks
Banks loans to banks 2	b_INTERLOANS_s	Ratio	Bank of Italy	Banks' loans to banks / Total banks' loans to residents
Banks loans to non-residents	b_LOANSNONRES_s	Ratio	Bank of Italy	Banks loans to non-residents / Total banks loans
Bad debts	b_BADDEBTS_s	Percentage	Bank of Italy	Total bad debts / Total loans
Bad debts (foreign)	b_BADDEBTSF	Million EUR	Bank of Italy	The amount of bad debts of non-residents
Bad debts (households) 1	b_BADDEBTSHHs	Million EUR	Bank of Italy	The amount of bad debts of domestic households
Bad debts (households) 2	b_BADDEBTSHHs_s	Ratio	Bank of Italy	Bad debts of domestic HHs / Total bad debts of domestic residents
Bad debts (non-financial sector) 1	b_BADDEBTSNFCs	Million EUR	Bank of Italy	The amount of bad debts of domestic NFCs
Bad debts (non-financial sector) 2	b_BADDEBTSNFCs_s	Ratio	Bank of Italy	Bad debts of domestic NFCs / Total bad debts of domestic residents
Loan ratio	b_LOANS	Ratio	Bank of Italy	Total loans / Total assets
Deposit ratio	b_DEPO	Ratio	Bank of Italy	Total deposits / Total liabilities
Liquidity risk	b_LDR	Ratio	Bank of Italy	Total loans / Total deposits
Liquidity	b_LIQUIDITY	Ratio	Bank of Italy	Cash & Securities / Deposits
Interbank rate (%)	b_INTBANKRATE	Percentage	Federal Reserve Bank of St. Louis	3-month or 90-day interbank rate
Macroeocnomic characteristics				
Gross debt	m_GOVDEBT	Million EUR	Bank of Italy	Gross government debt
Gross debts (banks) 1	m_GOVDEBTBANKS	Million EUR	Bank of Italy	Gross government debt held by banks
Gross debts (banks) 2	m_GOVDEBTBANKS_s	Percentage	Bank of Italy	Gross government debt held by banks / Gross government debt
Industrial production index (without construction)	m_IPI	Index	ISTAT	Industrial production index of all economic activities but construction (seasonally adjusted, base 2021 = 100)
IPI (constructions)	m_IPICONSTR	Index	ISTAT	Industrial production index of the construction sector (seasonally adjusted, base 2021 = 100)
BC (constructions)	m_BCCONSTR	Index	ISTAT	Business confidence index of the construction sector (seasonally adjusted, base 2021 = 100)
BC (manufacturing)	m_BCMANUF	Index	ISTAT	Business confidence index of the manufacturing sector (seasonally adjusted, base 2021 = 100)
Inflation	m_INF	Percentage	Eurostat	Italy's Harmonised Index of Consumer Prices (HICP) - used for euro area
Interest rate (house purchase)	m_HOUSE	Percentage	Bank of Italy	Interest rates to domestic residents for house purchase
Exports (G&S)	m_CURRACC		ISTAT	Total volume of exports for goods and services
Bond yield spread (Italy – Germany)	m/ump_SPREAD	Percentage points	Federal Reserve Bank of St. Louis	Spread of 10-year bond yield between Italy and Germany
External variables				

UMP				
ECB: Assets	ump_ECBASSETS	Million EUR	Federal Reserve Bank of St. Louis	Total assets of European Central Bank
BoI: Assets	ump_BOIASSETS	Million EUR	Bank of Italy	Total assets of Bank of Italy
Shadow rate	ump_SHADOW	Percentage	Wu & Xia (2017, 2020)	Shadow rate calculated in a multifactor term structure model to measure monetary policy in the zero or/and negative interest rate environment
DFR	ump_DFR	Percentage	ECB	The interest rate which banks have to pay if they want to borrow money from the ECB for one week while providing corresponding collateral.

Appendix Table 2. Descriptive statistics of input data for Baseline Models M1, M2, and M3.

	Number of observations	Mean	Median	Standard Deviation	Min	Max
SRISK	283	82139.585	105800.724	58527.792	16.672	183386.848
Banking-sector charactertistics						
b_LOANStoGOV	283	140446386.563	251313116.000	131520374.131	52155.000	276075702.000
b_LOANStoGOV_s	283	7.165	8.530	2.555	2.523	9.893
b_INTERLOANS	283	353288.380	364755.190	95023.102	154895.870	724374.450
b_INTERLOANS_s	283	14.126	13.242	2.919	9.287	22.427
b_LOANSNONRES_s	283	13.016	13.214	2.200	9.191	17.734
b_BADDEBTS_s	283	5.862	5.157	2.937	1.784	11.862
b_BADDEBTSF	283	86710.794	54784.460	54757.696	29275.790	202871.850
b_BADDEBTSHHs	283	18359.162	12130.280	9895.784	8629.950	37873.870
b_BADDEBTSHHs_s	283	22.265	21.967	3.015	18.173	32.310
b_BADDEBTSNFCs	283	66721.741	41952.630	44186.423	19210.540	160996.550
b_BADDEBTSNFCs_s	283	75.298	75.940	3.570	63.747	79.924
b_LOANS	283	0.676	0.678	0.036	0.607	0.732
b_DEPO	283	1.261	1.176	0.145	1.111	1.558
b_LDR	283	0.543	0.540	0.072	0.425	0.639
b_LIQUIDITY	283	0.130	0.128	0.034	0.075	0.204
b_INTBANKRATE	283	1.482	0.998	1.783	-0.582	5.113
Macroeocnomic characteristics						
m_GOVDEBT	283	2034785.577	2021741.400	437861.874	1353569.300	2868075.400
m_GOVDEBTBANKS	283	488608.407	588356.600	194011.147	184190.400	712077.600
m_GOVDEBTBANKS_s	283	23.075	25.212	6.012	12.557	32.154
m_SPREAD	283	1.354	1.308	1.065	0.134	5.183
m_IPI	283	105.504	101.200	11.083	55.500	127.100
m_IPICONSTR	283	109.208	115.300	21.496	26.200	148.700
m_BCCONSTR	283	83.158	84.100	12.076	58.500	108.100
m_BCMANUF	283	90.900	91.800	7.417	63.400	105.700
m_INF	283	2.187	2.000	2.153	-1.000	12.600
m_HOUSE	283	3.648	3.494	1.506	1.587	6.852
m_CURRACC	283	1857.063	1335.288	2545.854	-7153.434	7294.200
(Un)conventional monetary policy						
ump_ECBASSETS	283	3018740.408	2152103.000	2363006.812	770838.000	8835987.000
ump_BOIASSETS	283	3361689.966	3767139.960	818029.295	1687183.770	4247044.510
ump_DFR	283	0.856	0.250	1.360	-0.500	3.750

Appendix Table 3. Descriptive statistics of input data for Baseline Models Shadow M1, M2, and M3.

Variable	Number of observations	Mean	Standard Deviation	Min	Median	Max
SRISK	216	99.047969	52.95151674	0.016671793	115.2138915	183.3868484
Banking-sector charactertistics						
b_LOANStoGOV	216	165426161	128365414.7	52506.25	260543132	276075702
b_LOANStoGOV_s	216	7.792826987	2.305931866	2.522636148	8.613074391	9.893033
b_INTERLOANS	216	389652.1521	73812.97977	258978.61	382634.735	724374.45

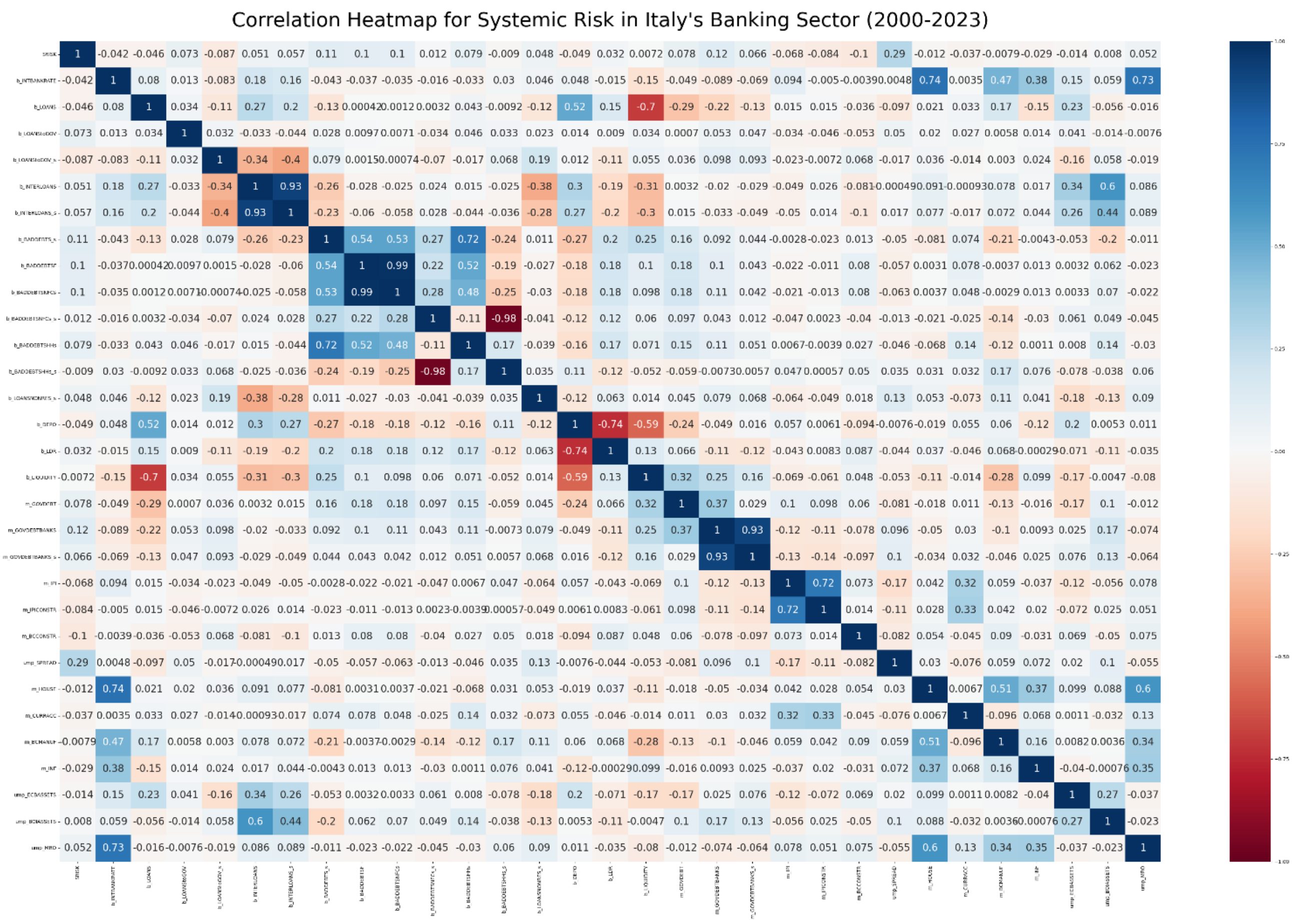
b_INTERLOANS_s	216	14.19609552	2.961001279	9.287485161	13.03820304	22.42748397
b_LOANSNONRES_s	216	12.29291123	1.935508681	9.190856153	11.95225199	16.36363969
b_BADDEBTSD	216	100109.6956	56519.83589	35016.45	76742.055	203325.56
b_BADDEBTS_s	216	6.187667396	3.14072754	1.996426402	5.080945235	11.86219255
b_BADDEBTSF	216	99817.44431	56414.3423	34549.66	76473.525	202871.85
b_BADDEBTSHHs	216	20762.83366	10184.79714	8629.95	16987.67	37873.87
b_BADDEBTSHHs_s	216	21.60559935	2.452448126	18.17278784	21.71401069	31.4680285
b_BADDEBTSNFCs	216	77294.30648	45498.67843	22557.08	58252.26	160996.55
b_BADDEBTSNFCs_s	216	76.17758774	2.905490037	64.4185049	76.34337903	79.92429111
b_LOANS	216	0.668972927	0.035167215	0.606525034	0.670023925	0.732089987
b_DEPO	216	1.269699313	0.142431242	1.12754083	1.188515375	1.557752094
b_LDR	216	0.533265064	0.065180798	0.428354357	0.51823447	0.636807277
b_LIQUIDITY	216	0.13646042	0.034959675	0.075049865	0.131150391	0.203609514
b_INTBANKRATE	216	0.937595833	1.607369539	-0.582	0.2234	5.1131
Macroeocnomic characteristics						
m_GOVDEBT	216	2115391.748	343827.3216	1526400.5	2141383.8	2772390.7
m_GOVDEBTBANKS	216	541467.156	157082.3931	207140.8	631879.7	712077.6
m_GOVDEBTBANKS_s	216	25.10516197	4.900568915	12.55711177	25.95101893	32.15442947
m_SPREAD	216	1.563685656	1.066019496	0.134	1.436965368	5.182909091
m_IPI	216	102.9777778	10.4490688	55.5	100.2	127.1
m_IPICONSTR	216	105.225	22.86142125	26.2	100.2	148.7
m_BCCONSTR	216	80.25347222	11.61921722	58.5	81	106.6
m_BCMANUF	216	90.34027778	8.032955257	63.4	91.65	105.1
m_INF	216	1.705555556	1.624397324	-1	1.5	9.1
m_EXCRATE	216	1.251356944	0.126760631	1.0057	1.2426	1.5774
m_HOUSE	216	3.230964815	1.247358034	1.5867	3.01595	5.9696
m_CURRACC	216	2.018551236	2.777745319	-7.153434	2.2338125	7.2942
(Un)conventional monetary policy						
ump_ECBASSETS	216	3194021.556	2126268.514	884233	2406423.5	8835987
ump_BOIASSETS	216	3658041.411	526859.3457	2203562.77	3841028.795	4247044.51
ump_DFR	216	0.393518519	1.084876857	-0.5	0	3.25
ump_SHADOW	216	-1.55184683	3.6402824	-7.82361874	-0.73334976	4.278509907

Appendix Table 4. Descriptive statistics of input data for Baseline Models Q1, Q2, and Q3

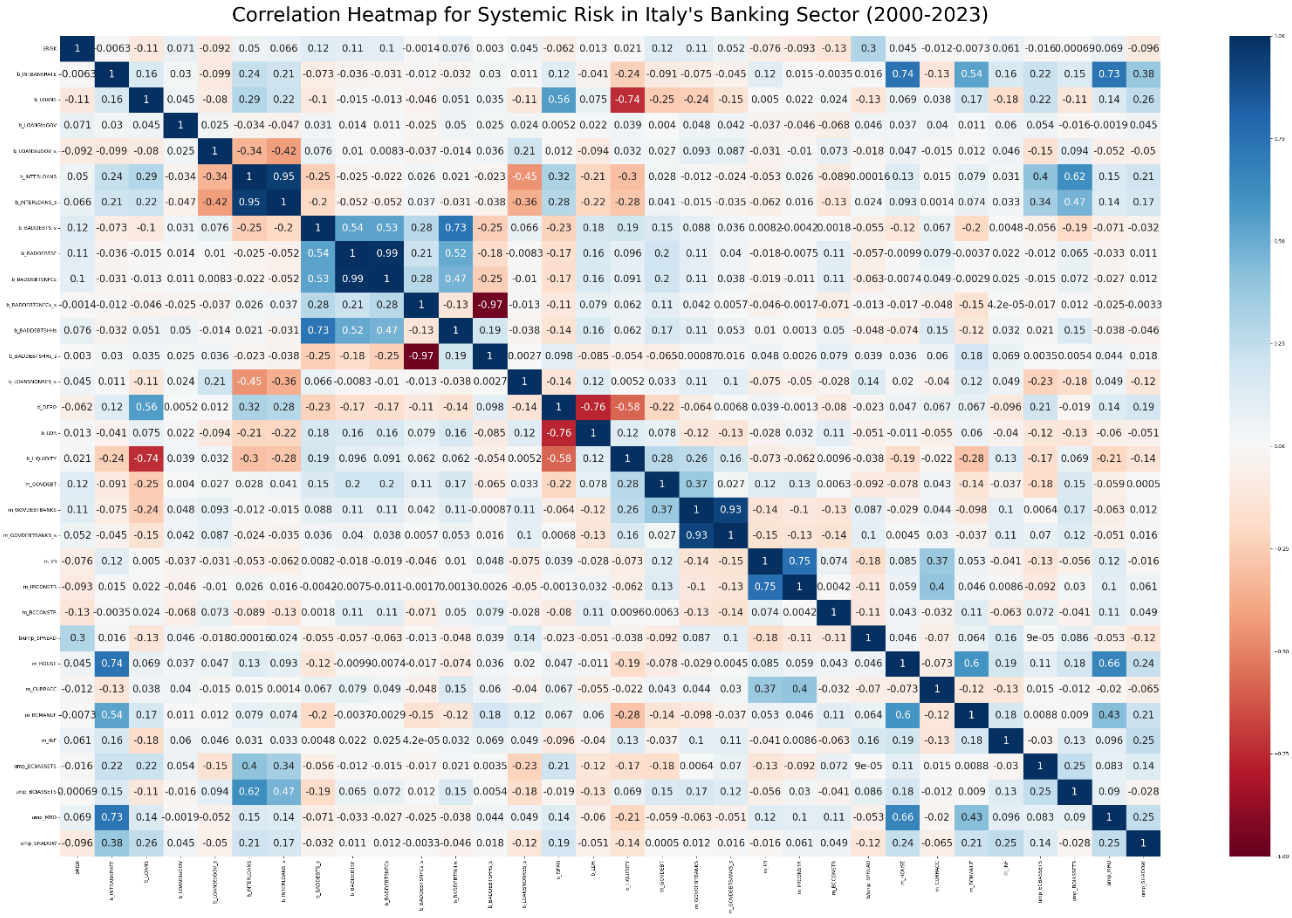
Variable	Number of observations	Mean	Standard Deviation	Min	Median	Max
SRISK	70	1.996008915	17.99456035	-36.07517579	0.39614734	53.32310096
Banking-sector charactertistics						
b_INTBANKRATE	70	-0.034462857	0.341688716	-1.7266	-0.00085	0.5939
b_LOANS	70	-0.000921124	0.00850449	-0.019099059	-0.00138998	0.036688114
b_LOANStoGOV	70	3745577.368	31769064.66	-14317075	1250.565	263348907.1
b_LOANStoGOV_s	70	0.085167137	0.772430009	-0.758000043	-0.030229677	6.03506712
b_INTERLOANS	70	-431.5108571	32343.85783	-165773.7	3513.135	43928.76
b_INTERLOANS_s	70	-0.111371611	0.820086109	-4.260902384	-0.008539353	1.244014359
b_BADDEBTS_s	70	-0.002094984	0.462666325	-1.441373575	0.004433426	1.273360745
b_BADDEBTSF	70	-99.678	7310.785837	-28878.27	39.015	22956.72
b_BADDEBTSNFCs	70	-74.81457143	5917.483476	-23177.91	11.31	19048.19
b_BADDEBTSNFCs_s	70	-0.02469482	1.670780448	-5.945917795	0.068206771	7.47438501
b_BADDEBTSHHs	70	-22.20014286	1701.794194	-6379.12	48.54	6657.68

b_BADDEBTSHHs_s	70	0.023239388	1.551769202	-6.516218614	-0.020231257	5.91987327
b_LOANSNONRES_s	70	-0.002724545	0.972020077	-2.779593617	-0.057554002	2.581458939
b_DEPO	70	-0.000323595	0.022672449	-0.066701546	-0.000463313	0.052856624
b_LDR	70	-0.00274301	0.006701262	-0.031748444	-0.00156811	0.016218732
b_LIQUIDITY	70	9.86595E-05	0.008683359	-0.033345219	-7.42466E-05	0.035469765
Macroeocnomic characteristics						
m_GOVDEBT	70	17799.86	30772.08181	-37198.9	17443.75	96859.1
m_GOVDEBTBANKS	70	7213.382857	25220.15002	-50599.9	6687.6	138341.4
m_GOVDEBTBANKS_s	70	0.173058062	1.225736438	-1.817980414	-0.005987395	8.218915107
m_GDP	70	1742.401429	9714.07803	-45559.4	2054.85	51114
m_SPREAD	70	0.02825034	0.491148087	-1.665835498	-0.019724726	1.991818182
m_HOUSE	70	-0.039144286	0.159278272	-0.9138	-0.0366	0.257
m_CURRACC	70	-33.25842857	1270.284606	-5403.169	-3.1635	2273.539
m_BCMANUF	70	90.31	8.221959814	63.4	91.55	104.6
m_INF	70	0.088571429	0.649981685	-1.5	0	2.6
m_BCCONSTR	70	0.292857143	4.621478571	-11.4	0.2	11.7
m_IPICONSTR	70	-0.014285714	7.488315259	-34.9	-0.4	31.3
(Un)conventional monetary policy						
ump_ECBASSETS	70	113596.4857	221770.9132	-406946	56750	1173456
ump_BOIASSETS	70	24955.66314	81161.41531	-200301.25	25133.2	298320.45
ump_DFR	70	-0.021428571	0.269671221	-1.5	0	0.5

Appendix Figure 5. Correlation heatmap of input data for Baseline Models M1, M2, and M3



Appendix Figure 6. Correlation heatmap of input data for Baseline Models Shadow M1, M2, and M3



Appendix Table 7: Multicollinearity for Baseline Models M1 M2 M3

BANKS	SHADOW M1	SHADOW M2	SHADOW M3
b_INTERLOANS	1.292149	1.893448	1.454349
b_LOANSNONRES_s	1.095137	1.137912	1.238870
b_BADDEBTS_s	1.772641	1.717404	1.398365
b_BADDEBTSHHs_s	x	1.950936	1.164499
b_BADDEBTSNFCs	x	1.328634	1.189641
b_DEPO	1.182344	4.435032	1.956325
b_LDR	1.301086	4.504453	1.236087
b_LIQUIDITY	1.135871	1.208174	2.185898
b_INTBANKRATE	1.151473	1.662138	1.498131
MACRO			
m_GOVDEBT	4.498118	1.614786	1.396145
m_GOVDEBTBANKS_s	1.323029	1.318953	1.408870
m_IPI	4.605930	1.868620	4.934835
m_IPICONSTR	x	x	2.084650
m_BCCONSTR	x	x	6.970813
m_BCMANUF	x	x	2.239426
m_INF	1.097091	2.263517	1.089990
m_CURRACC	2.609793	1.068310	1.018252
m_HOUSE	1.291115	2.200794	1.789643

m/ump_SPREAD	1.277676	1.293952	2.239426
UMP			
ump_ECBASSETS	2.352048	1.319521	1.192901
ump_BOIASSETS	1.826259	3.907255	2.455378
ump_MRO	2.756478	1.126252	2.297046

Appendix Table 8: Multicollinearity for Baseline Models SHADOW M1 M2 M3

BANKS	SHADOW M1	SHADOW M2	SHADOW M3
b_INTERLOANS	1.707624	2.206417	1.343095
b_BADDEBTS_s	2.245770	1.068624	2.574117
b_BADDEBTSHHs_s	x	1.086827	2.611561
b_BADDEBTSNFCs	x	1.011040	1.178269
b_LIQUIDITY	1.308283	1.737718	1.093499
b_INTBANKRATE	2.275030	1.132751	1.248637
MACRO			
m_GOVDEBT	1.282251	1.740990	1.183311
m_GOVDEBTBANKS_s	1.202411	4.402341	1.187524
m_IPI	1.197414	1.334216	2.680352
m_IPICONSTR	x	x	1.280789
m_BCCONSTR	x	x	1.639390
m_BCMANUF	x	x	1.310960
m_INF	2.739359	1.352052	2.442325
m_CURRACC	1.025872	2.459428	2.423405
m_HOUSE	2.581814	2.323593	2.507442
m/ump_SPREAD	4.834841	1.086743	1.262099
UMP			
ump_SHADOW	1.115472	2.606484	1.192397
ump_MRO	1.370951	1.468692	1.293101

Appendix Table 9: Multicollinearity for Baseline Models Q1 Q2 Q3

BANKS	Q1	Q2	Q3
b_INTERLOANS	2.609793	1.089990	1.246879
b_LOANSNONRES_s	1.291115	1.018252	2.282510
b_BADDEBTS_s	1.277676	1.789643	2.194436
b_BADDEBTSHHs_s	x	2.236910	1.067633
b_BADDEBTSNFCs	x	1.272114	1.295801
b_LIQUIDITY	1.068310	2.634570	1.157012
b_INTBANKRATE	1.293952	1.339318	1.011537
MACRO			
m_GOVDEBT	1.364394	1.204201	1.055035
m_GOVDEBTBANKS_s	1.131866	2.227573	2.356801
m_GDP	1.010042	1.045124	2.190946
m_IPICONSTR	x	x	1.095686
m_BCCONSTR	x	x	1.215180
m_BCMANUF	x	x	1.271167
m_INF	x	x	1.308283
m_CURRACC	1.325765	1.707624	2.275030

m_HOUSE	1.121107	2.245770	2.206417
m/ump_SPREAD	1.008505	2.635084	1.068624
UMP			
ump_ECBASSETS	1.086827	1.132751	1.745055
ump_BOIASSETS	1.011040	1.343095	1.326016
ump_MRO	1.737718	1.026884	1.769981

Appendix Table 10. Multiple linear regression model for Baseline Model M1: Robustness checks

	Expected influence	Specification 1	Specification 2	Specification 3	Specification 4	Specification 5
BANKING-SECTOR VARIABLES						
b_LOANStoGOV	+	1.085e-06	x	x	x	x
b_LOANStoGOV_s	+	16.4583	21.3857	x	x	x
b_INTERLOANS	+	-0.0007*	x	-0.0011*	-0.0004***	-0.0013***
b_INTERLOANS_s	+	x	1.4684	x	x	x
b_BADDEBTS_s	+	1.5709***	3.3927**	17.7601***	13.2856***	39.7035***
b_LOANS	+	-6055.0241	5.6598	x	x	x
b_LDR		x	x	2021.0817***	1946.1812***	926.2794***
b_LIQUIDITY	+/-	4188.2671***	1485.6012***	2135.8157***	1205.72589***	1765.0553***
b_INTBANKRATE	-	-22.1336***	-141.8910***	-71.5807***	-32.8839***	-81.8959***
ump/b_SPREAD	+/-	55.5982***	66.9113***	116.9592***	21.8962***	113.7874***
MACROECONOMIC VARIABLES						
m_GOVDEBT	+	0.0002	8.017e-05	x	x	0.0004
m_GOVDEBTBANKS	+	0.0007*	0.0008*	0.0079**	x	x
m_GOVDEBTBANKS_s	+	31.3494***	11.7834***	23.6293***	56.5503***	42.6559***
m_IPI	+	-4.1375**	-0.1906	4.7690	-2.8533	17.4713***
m_INF	+/-	-1.1169***	-0.9149***	-2.6163***	-3.2926***	-8.0776***
m_CURRACC	+	0.0040***	0.0003	0.0061***	0.0037***	0.0067***
UNCONVENTIONAL MONETARY POLICY						
ump_ECBASSETS	+	3.784e-06***	4.415e-07***	2.562e-05***	4.689e-05***	x
ump_BOIASSETS	+	x	x	x	x	-0.0003***
ump_DFR	+	-53.2891***	-76.7865***	-24.9730***	-16.7286***	-49.9743***

Appendix Table 11. Multiple linear regression model for Baseline Model M2: Robustness checks

	Expected influence	Specification 1	Specification 2	Specification 3	Specification 4
BANKING-SECTOR VARIABLES					
b_INTERLOANS	+	-0.0002*	0.0002*	0.0002***	0.0002
b_LOANSNONRES_s	+	9.0767***	10.0309***	3.7641***	0.5304**
b_BADDEBTS_s	+	15.6857***	8.8617***	21.6843***	18.2673***
b_BADDEBTSF	+	x	0.0002	x	0.0021***
b_BADDEBTSHHs	+	x	x	0.0148	0.0138
b_BADDEBTSHHs_s	+	2.1059***	7.0034***	x	x
b_BADDEBTSNFCs	+	0.0012***	x	x	x
b_BADDEBTSNFCs_s	+	x	x	x	x
b_DEPO	+	x	x	x	x
b_LDR	+	x	x	x	-876.0964***
b_LIQUIDITY	+/-	944.9823***	1227.6421***	1008.0520***	634.9224***
b_INTBANKRATE	-	-23.1337***	-38.5687***	-46.2930***	-3.2957

b/ump_SPREAD	+	-4.0108	3.683	5.8491***	-1.3062
MACROECONOMIC VARIABLES					
m_GOVDEBTBANKS_s	+	21.4355***	3.5667*	0.6291*	3.8746***
m_IPI	+	0.4991	1.6928	2.5624	-0.4810***
m_INF	+/-	-3.3700***	-2.6233***	-2.7442***	-4.2935***
m_CURRACC	+	0.0027***	0.0052***	2.735e-05*	0.0004**
m_HOUSE		-144.1954***	-135.0276***		-141.5002***
ump_ECBASSETS	+	x	x	x	3.559e-07***
ump_BOIASSETS	+	-7.614e-05***	-0.0001***	-9.548e-05***	x
ump_DFR	+	-71.9016***	-39.7122***	-49.4729***	-62.5287***

Appendix Table 12. Multiple linear regression model for Baseline Model M3: Robustness checks

	Expected influence	Specification 1	Specification 2	Specification 3
BANKS				
b_INTERLOANS	+	0.0002***	-0.0006***	-0.0006***
b_LOANSNONRES_s	+	4.6632*	10.3465***	10.3504
b_BADDEBTS_s	+	11.9039*	2.3975***	0.9713*
b_BADDEBTSHHs_s	+	2.3327*	2.3716***	0.7377*
b_BADDEBTSNFCs	+	0.0002*	0.0015***	0.0014*
b_DEPO	-	333.2354***	x	51.6695
b_LDR	+	x	x	x
b_LIQUIDITY	+/-	922.7301**	455.0554***	x
b_INTBANKRATE	-	-53.8753***	19.2567***	11.4113*
MACRO				
m_GOVDEBT	+	0.0003	7.346e-05	0.0001***
m_GOVDEBTBANKS_s	+	0.2836***	2.9366***	13.1165***
m_IPI	+	0.1284***	-3.9105***	4.0309***
m_IPICONSTR	+	0.1544***	0.1295***	0.2575**
m_BCCONSTR	+	0.5643***	0.2500***	0.0458***
m_BCMANUF	+	0.4641***	0.2728***	0.3720***
m_INF	+/-	-1.3097*	3.4770***	-2.3733*
m_CURRACC	+	0.0015*	0.0012***	0.0010**
m_HOUSE	-	-26.4799*	-109.2006***	-49.5021***
m/ump_SPREAD	-	19.8639***	-32.6443***	-43.1770***
UMP				
ump_ECBASSETS	+	9.166e-07*	4.13e-05***	4.323e-05*
ump_BOIASSETS	+	x	x	x
ump_DFR	-	-54.4209***	-102.2720***	-81.8734***

Appendix Table 13: Multiple linear regression model for Baseline Model Q1.

	Expected influence	Regression coefficients	Regression coefficients
BANKING-SECTOR VARIABLES			
b_LOANStoGOV	+	7.418e-08	1.062e-06
b_INTERLOANS	+	-1.493e-05**	-0.0004**
b_BADDEBTS_s	+	24.1510	14.9596
b_LIQUIDITY	+/-	0.2488***	636.8943***

b_INTBANKRATE	-	-2.1374	-45.4776
MACROECONOMIC VARIABLES			
m_GOVDEBT	+	0.0002***	0.0002***
m_GOVDEBTBANKS_s	+	6.5278***	19.9874***
m_GDP	+	-0.0006**	-0.0008**
m_INF	+/-	-0.8880*	-7.0284*
m_CURRACC	+	0.0092***	-0.0003
b/ump_SPREAD	+/-	-9.3288***	-7.2832**
UNCONVENTIONAL MONETARY POLICY			
ump_ECBASSETS	+	3.1e-05***	x
ump_BOIASSETS	+	x	-0.003***
ump_DFR	+	-4.4323***	-42.1760***

Appendix Table 14: Multiple linear regression model for Baseline Model Q2.

	Expected influence	Regression coefficients	Regression coefficients
BANKING-SECTOR VARIABLES			
b_INTERLOANS	+	-0.0004*	-0.0018*
b_LOANSNONRES_s	+	10.4731***	7.3960
b_BADDEBTS_s	+	16.9966**	12.5560
b_BADDEBTSHHs_s	+	2.3733**	0.0040**
b_BADDEBTSNFCs	+	0.0022***	3.2883***
b_LIQUIDITY	+/-	433.5127***	1426.5262***
b_INTBANKRATE	-	-34.7118***	-97.1978
MACROECONOMIC VARIABLES			
m_GOVDEBTBANKS_s	+	21.4355***	25.8572***
m_GDP	+	-0.7283*	0.0006
m_INF	+/-	-2.0137***	-8.2063***
m_CURRACC	+	0.0016	0.0034**
b/ump_SPREAD	+	-9.7584***	-9.9104***
UNCONVENTIONAL MONETARY POLICY			
ump_ECBASSETS	+	6.465e-07***	x
ump_BOIASSETS	+	x	-0.0003***
ump_DFR	+	-47.3048***	-89.7947***

Apppendix Table 15: Multiple linear regression model for Baseline Model Q3.

	Expected influence	Regression coefficients	Regression coefficients
BANKS			
b_INTERLOANS	+	0.0011***	0.0004***
b_LOANSNONRES_s	+	4.5633	12.4576
b_BADDEBTS_s	+	10.7162***	14.5281**
b_BADDEBTSHHs_s	+	18.0838	7.9959
b_BADDEBTSNFCs	+	0.0124***	0.0005**
b_LIQUIDITY	+/-	2281.2148***	858.5***
b_INTBANKRATE	-	-12.4997	- 51.2324***
MACRO			
m_GOVDEBT	+	0.0011	0.0002
m_GOVDEBTBANKS_s	+	7.7962***	27.4979***

m_GDP	+	0.0032	0.0072
m_IPICONSTR	+	2.0670***	1.4129***
m_BCCONSTR	+	-1.4940***	-0.2788
m_BCMANUF	+	-7.1628***	-0.3160***
m_INF	+/-	-16.4862***	-17.5657***
m_CURRACC	+	-0.0069***	-0.0065***
m_HOUSE	-	-10.4907	6.782e-05***
m/ump_SPREAD	-	-6.6915***	-68.9869***
UMP			
ump_ECBASSETS	+	4.021e-05***	x
ump_BOIASSETS	+	x	-3.938e-05***
ump_DFR	-	-38.9367***	-115.1282***