Off-balance sheet credit exposure and asset securitisation: what impact on bank credit supply?

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Off-Balance Sheet Credit Exposure and Asset Securitisation: What Impact on Bank Credit Supply?

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Abstract

The present paper analyzes two important aspects in the amplification process of the recent financial crisis to the real economy, that is the securitisation of financial assets (and in particular of loans and mortgages) and the growth of bank off-balance sheet activities, for instance through the development of Special Purpose Vehicles, with specific attention to the US context. In particular, this work aims to examine whether and how the increase in off-balance sheet credit exposure to credit derivatives, mainly due to loan securitisation, may have affected the growth rate of loans over the past few years, also by distinguishing different categories of loans.

For this purpose, we present the results of a panel fixed-effect estimation and of a panel VAR analysis, using quarterly data from the balance sheets of 39 US commercial banks and for a period between 1998 and 2008. The results show that a rise in off-balance credit exposure may have – after some time lags - a negative impact on the growth rate of bank lending, due to the potential and actual losses related to the off-balance sheet activities. However, the effects on the single categories of loans depend on their maturity: the negative effect due to an increase in off-balance sheet exposure is stronger for long-term loans, like mortgages or real estate loans, while some positive impact on bank lending may arise for short-term loans, such as commercial and industrial loans, because of the liquidity/maturity transformation function associated with securitisation activities.

The results of the paper regarding the impact of an increase in off-balance sheet exposures on bank deleveraging process may have some relevant policy implications for the design of financial regulation, particularly in the area of shadow banking, supporting the current policy initiatives for the revision of risk weights in securitisation exposures as well as for the implementation of consolidation regimes concerning bank off-balance sheet activities.

JEL Classification: G20, G21, G28
Keywords: Bank Off-balance Sheet Activities, Securitisation, Shadow Banking, Bank Credit Supply, Panel VAR

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1. Introduction

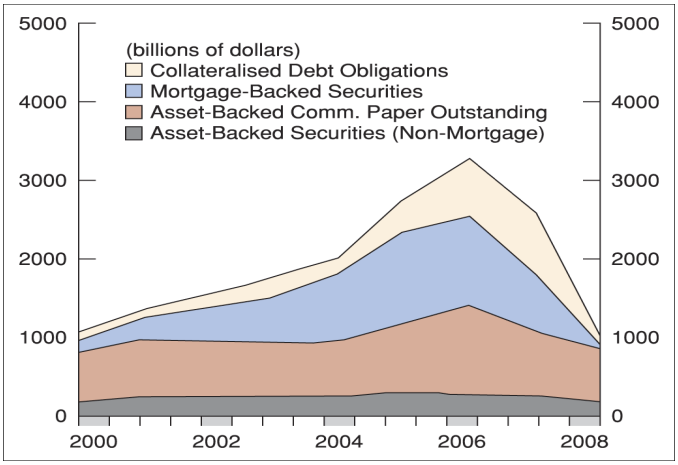
The recent financial crisis, originated in the US subprime mortgage market, has produced an enormous impact on the level of the real activity in the entire world, because of a relevant amplification process of the financial shocks, caused by the high leverage of financial institutions and by the large diffusion of loan securitisations in credit intermediation. Indeed, most banks have registered relevant losses in their on-balance sheet assets due to the write-offs of impaired loans as well as in their off-balance sheet activities related to credit derivatives. Then, such losses have produced substantial effects on bank balance sheets, since many credit institutions had to employ large capital reserves in order to compensate for losses. As a consequence of that, and given the regulatory framework requiring the fulfilment of capital-asset ratios, the reduction of equity capital due to losses has induced a general contraction in credit supply to the private sector.

Given that, the present paper aims to focus on two important elements in this mechanism of financial accelerator, working through the supply side of the credit market. The two aspects of interest, which are intrinsically related in the current process of credit intermediation, are the increase in securitisation activities (in particular of loans and mortgages) and the growth of bank off-balance sheet items, for instance through the development of Special Purpose Vehicles (SPV) or other similar separated legal entities.

Indeed, in the last decade we have observed a dramatic rise in credit securitisation, both in the US and in Europe, even if with some relevant differences. In fact, while in the US banks had largely used loan securitisation already during the nineties, in Europe banks started a systematic use of securitisation techniques only after the introduction of the Euro. However, in both cases, the volume of credit derivative issuances has increased in an impressive way in the last decade and it has registered a decrease only after 2007, as we can notice from figure 1 regarding the US credit derivatives market.

But the increase in securitisation issuances is just one element of the overall issue. Indeed, in the run-up to the crisis, many banks have extensively invested in these structured finance products, such Asset-Backed Securities (ABSs) and Collateralized Debt Obligations (CDOs), also because attracted by the high credit rating assigned to some of these derivatives. In particular, since the exposures to securitisation activities were subject to quite lax risk-based capital requirements due to their assumingly low credit risk, this has created

Figure 1: The increase in credit derivative issuances in the US from 2000 to 2008



Source: Blanchard (2009)

opportunities for regulatory arbitrage: then, the investment in high rating credit derivatives has been exploited by credit institutions in order to increase bank leverage and to improve their capital charge regime at the same time. As a consequence of that, at the beginning of the crisis many banks had quite substantial exposures to credit derivatives. In fact, banks were exposed both because they had bought some tranches of structured credit products for loans originated by other banks, and because they had kept some tranches of credit derivatives based on their own loans.

Moreover, in many cases, when it was allowed by the consolidation regimes, those investments have been undertaken by using shadow banking entities, outside of the official banking sector. Indeed, particularly in the US before the crisis, a substantial part of the credit exposure related to securitisation activities was born by banks through special purpose vehicles or, more generally, through legal entities not included in the bank balance sheets. This was also the result of distortionary incentives created by the existing regulation for banking institutions. Indeed, the rules on bank capital requirements, not always complemented by appropriate consolidation rules, had created an incentive for banks to increase their off-balance sheet items in particular with securitisation activities.

The facts above summarized provide the actual motivation for this empirical work, which is focused on the US context, as this is quite paradigmatic for the interrelation between asset-backed securitisation and off-balance sheet credit exposure. Indeed, the objective of this empirical study is to analyze the impact of the exponential growth of asset securitisation and off-balance sheet exposure on bank lending in the US over the past few years, also by distinguishing different categories of loans. More precisely, we want to examine whether and how the increase in the off-balance sheet credit derivative exposure, mainly due to a larger diffusion of loan securitisation, may have affected – with some time lags - the growth rate of bank loans for US commercial banks.

This research question can be particularly relevant with regard to the recent events in the banking system: indeed, as a consequence of the crisis, most banks affected by the losses

on their off-balance sheet securitisation activities have implemented a substantial deleveraging process, by tightening the credit supply to the private sector. Moreover, the answer to this research question may also have some significant policy implications for the design of financial regulation, both for the reform of bank capital requirements (as set by Basel agreements, now Basel III) and for the regulation of the financial intermediaries operating in the shadow banking system.

Indeed, the results of the work show that a rise in off-balance credit exposure may have – after some time lags - a negative impact on the growth rate of bank lending, due to the potential and actual losses related to the off-balance sheet activities. The conclusions of the analysis imply that the new bank capital rules should pursue the objective of correctly evaluating the credit risk of a given exposure and of eliminating all the existing incentives for banks to expand off-balance sheet activities. This problem is particularly important because of the large diffusion –over the past few years - of a shadow banking system, including all the entities outside of the regular banking system but still involved in credit intermediation, either because they directly take part in the securitisation process at different stages (loan warehousing, derivative structuring or securities distribution) or because they support the maturity/liquidity transformation process (for instance through credit enhancements)[1]. Moreover, in many cases, the shadow banking system comprises also some bank-owned entities (as it is for many special purpose vehicles), which are used by banks simply to circumvent and undermine banking regulation: this clearly raises additional concerns in terms of regulatory arbitrage.

The paper is organized as follows. Section 2 provides an overview of the theoretical literature on the transmission of financial shocks to the real economy. Section 3 summarizes the existing empirical evidence on macro-financial linkages, focusing on the literature regarding the impact of bank capital shocks and the role of securitisation for bank lending. Section 4 discusses the link between asset securitisation and bank off-balance sheet credit exposure and introduces the hypotheses to be tested in the empirical analysis. Section 5 describes the data and defines the variables considered in the study. Section 6 introduces the econometric methodology and explains the reasons for using a panel VAR model. Section 7 presents the outcomes of the panel fixed effects estimation and section 8 describes the results obtained from the panel VAR analysis. Then, section 9 concludes and section 10 provides some insights for further research.

[1] For a discussion on the definition of the shadow banking system and on the identification of the credit intermediaries to be included under this label, see the report by the Financial Stability Board (2011)

2. The Transmission of Financial Shocks to the Real Economy: a Theoretical Overview

Before the events of the financial crisis, the literature on macro-financial linkages had already provided some important contributions to explain the process through which financial shocks can produce effects on the real side of the economy, given the frictions existing in the credit market (and then affecting the level of firms' investments): in particular, the theory of the financial accelerator by Bernanke, Gertler and Gilchrist (1998) and the theory of credit cycles by Kiyotaki and Moore (1997). These studies focus the attention on the balance sheet of the borrowers and so on their creditworthiness, evaluated according to the value of their collaterals: in a lending relationship characterized by asymmetric information, a decrease in the value of the collaterals implies an increase in the external finance premium required by lenders and then a flight to quality in the loan supply, as creditors are willing to lend only to debtors offering large collaterals. As a consequence of that, the financial shocks which affect the borrowers' balance sheet may produce a contraction of credit supply to the private sector, either because banks refuse to lend to firms with insufficient collaterals or because such firms cannot afford to pay an interest rate sensibly higher because of the external finance premium.

For many years, this perspective of analysis has represented the standard paradigm for the study of the relationship between financial frictions and macroeconomic performance. Nevertheless, it doesn't provide any specific consideration for the financial conditions of the banking system and then it doesn't consider those situations where the contraction in credit supply may depend on solvency or liquidity issues directly regarding financial intermediaries, as it has been the case – for example – in the recent financial crisis. Indeed, most of the problems observed in the last few years in the credit market have concerned not only the demand side (through a change in the value of the collaterals of the borrowers, as above described), but much more the supply side of that market (because of the reduction in the value of the assets in or off the balance sheets of the financial institutions, due to the losses in credit derivative instruments).

In the meanwhile, in the past few years, some other studies had also considered the role of bank capital in the transmission of financial shocks to the real activity. Indeed, a reduction in bank capital may determine a decrease in the amount of bank loans available to the private sector, given that in any case the total sum of deposits remains unchanged and provided that the bank has to keep the same capital-asset ratio. For this reason, the literature on the bank capital channel emphasizes how shocks to bank capital may produce a contraction in bank lending and then a reduction in investments, especially in an economy where firms strongly depend on bank credit in order to finance their own investments and cannot rely on other sources of funding.

In particular, Holmstrom and Tirole (1997) develop a model with firms, intermediaries and investors, where investors provide equity capital to banks and then banks supply loans to firms to fund their investment projects. In this framework, since financial intermediaries can finance loans only by capital, a shock to bank capital implies a contraction in total loans. Clearly, this result depends on a strong simplification, given that it takes away a major component of bank liabilities, that is customer deposits. Nevertheless, this

assumption might not affect results so deeply if we consider that - in practice - banks cannot act to induce an increase in customer deposits and that, in a period with relevant shocks to bank capital, depositors might consider – on the contrary – the possibility to withdraw their money from a bank, if they perceive a high probability of a bank run in the next future.

Another reason of the relationship between bank capital and bank lending concerns the non-deposit funds that a given bank obtains from other financial intermediaries in the interbank market. Indeed, also for banks the cost of getting funds in that market sensibly depends on the perceived creditworthiness of the institution, as it is evaluated by the other intermediaries on the basis of its financial position (and then of its capital adequacy to face eventual shocks). Stein (1998) presents an adverse selection based model of bank asset and liability management, where banks can face difficulties in raising funds with instruments other than uninsured deposits. Indeed, while depositors are guaranteed by the existence of deposit insurance, the financial institutions lending funds through the interbank market may get some losses also because they are not fully informed about the effective financial condition of their counterparty. For this reason, they should be induced to demand a higher interest rate on interbank loans to banks with inadequate capital, where this external finance premium negatively depends on the amount of bank capital. In practice, if there exists an adverse selection problem, such that a financial institution cannot distinguish banks with higher or lower capital adequacy, also due to the contagion risk coming from the network connections among banks, the increase in the interest rate will affect all the intermediaries operating in the interbank market. Then, as a final step in this argument, the higher costs faced to obtain interbank loans are reflected in the higher interest rate required by banks for loans to firms and households, with a consequent drop in the amount of bank loans.

3. The Transmission of Financial Shocks to the Real Economy: the Empirical Evidence

In the analysis of the existing empirical evidence, I will focus on the literature studying the impact of bank capital shocks on bank lending and the effects of credit securitisation on bank loans.

The early empirical evidence on the bank capital channel is mostly based on aggregate analyses, aimed at observing the effect of the average capital-asset ratio on the growth rate of loans, like in the paper by Bernanke, Lown and Friedman (1991). After that, most of the literature on the bank capital channel (Hancock and Wilcox, 1994; Hancock, Laing and Wilcox, 1995) has analyzed – using panel data for individual banks - the effects of bank capital shocks on the amount of bank loans, showing how a reduction in bank capital may determine a decrease in the amount of loans available to the private sector. The results of such empirical studies confirm the importance - for the banking system - of keeping an adequate level of capital to face eventual shocks and then provide an important support for the argument requiring a strengthening of bank capital requirements in terms of capital-asset ratio, as provided in the recent reform of Basel agreements.

Nevertheless this approach, simply focused on the impact of bank capital shocks, may present some limitations, both from the empirical point of view, and from the viewpoint of the policy implications. Firstly, this setting for the empirical analysis, assuming the exogeneity of bank capital shocks, doesn't consider the causes which may determine a reduction or an increase of bank capital. In fact, a shock to bank capital may be produced by several factors, but in most cases, when the shocks are negative, the main reason is the compensation of losses in bank assets with a reduction in bank capital reserves. For this reason, it would be interesting to define the causes of such losses and then to identify the categories of assets (securities, loans) on which such losses have been registered. Of course, this type of analysis requires the availability of bank balance sheet data with a high level of disaggregation.

Secondly, once the results of the analysis are used to derive some policy implications in terms of banking regulation, a perspective based exclusively on bank capital may limit the range of policy measures required to preserve the financial stability of the banking system, simply because it might ignore the true and ultimate sources of the financial instability. Indeed, the policy solutions focused on the increase of the regulatory bank capital requirements might not fully eliminate the risks of financial instability for two reasons: either because the threshold fixed for the capital requirement, although substantially high, might not be sufficient and should be further increased, as argued by Miles, Yang and Marcheggiano (2011) [2]; or because the appropriate policy measures should rather focus on the potential sources of bank losses, which may require at some point a reduction in bank capital, and then should aim to reduce the distortionary incentives for securitisation activities.

In fact, some recent papers have also analyzed the impact of securitisation on bank lending, with particular attention to the European Banks. In particular, Altunbas, Gambacorta and Marqués-Ibañes (2009), study the massive increase in securitisation observed in Europe after the introduction of the Euro and examine the corresponding impact on the growth rate of loans, using a sample of 3000 banks in the Euro area for the period 1999-2005. The key objective of their paper is to analyze whether securitisation may affect the bank lending channel of monetary policy, by making bank loan supply independent from the monetary policy stance. Indeed, the results show that securitisation activity increases bank lending,

[2] Miles, Yang and Marcheggiano (2011) propose an analysis on the optimal level of bank capital, based on a comparison between social benefits and costs from having higher levels of loss-absorbing capital. In particular, they estimate the bank financing costs due to an increase in equity funding and then calibrate their impact on the output level for the wider economy. At the same time, they quantify the benefits of higher capital requirements in terms of lower probability of crisis and then compute the expected losses in output implied by a banking crisis. On the basis of such comparison of benefits and costs, the socially optimal level of bank capital would be much larger than the amount held by banks in the recent years and also higher than the targets set by Basel III agreements.

given that banks can use the revenues from securitisation as a funding source to grant additional loans[3].

Moreover, Carbó-Valverde, Marqués-Ibañes and Rodríguez Fernández (2011) analyze the impact of securitisation on bank lending and on credit quality, using a dataset of Mortgage-Backed Securities and Asset-Backed Securities issued by Spanish banks[4] and matching such information with quarterly data from bank balance sheets for a period from 2000 to 2010. The results of the analysis show that an increase in the volume of securitized loans in the last 4 quarters induces a rise in the growth rate of loans and that a credit expansion, fuelled by large securitisations, negatively affects loan performance with a lag of at least two years (by augmenting the ratio of non-performing loans over total assets). Moreover, the overall bank loan performance can explain ex-post rating changes with a lag of four quarters, since lower credit quality (as proved by a high rate of non-performing loans) may induce rating agencies to downward revise the issuer's rating.

4. Why Focusing on Asset Securitisation and Bank Off-Balance Sheet Credit Exposure?

The recent crisis has shown that the off-balance sheet items of a bank can generate relevant losses with a direct impact on the bank balance sheet, especially when such activities – as in the case of credit derivatives - imply a high credit exposure for the bank. For this reason, the present work focuses on the impact of credit derivative exposure, as mainly determined by asset securitisations, on the total amount as well as on the growth rate of loans. Before presenting the methodology and the data used in the analysis, it is worth displaying the main channels through which securitisation may have an impact on bank lending and to explain the link between asset securitisation and off-balance sheet credit exposure, as emerged in the recent approach to bank asset and liability management.

Loan securitisation can affect the supply of bank loans in two different ways. On one side, it may induce an increase in the amount of loans, because the originator banks which securitize their assets (and in particular their loans) can use the additional liquidity coming from securitisation revenues to finance new loans. Let consider the case of a residential mortgage issued for a long time period: in this case loan securitisation may play an important function of liquidity and maturity transformation. Indeed, if the bank couldn't securitize loans, it should keep such an immobilized asset in its balance sheet for that period, waiting

[3] Nevertheless, it is worth to clarify that such result was obtained for a sample of bank balance sheets until 2005, so in a period preceding the recent financial crisis. This implies that the data on bank loans don't consider the impact of significant negative shocks to bank assets or to off-balance sheet activities.

[4] The Spanish case represents a very interesting case-study for the analysis of the causes of the banking crisis and of the effects of the financial shocks on the real economy, because of the large development in loan securitisation – especially for residential mortgages - and of the consequent housing bubble.

for the entire repayment of the mortgage, and then it couldn't use that asset for any other employ (liquidity transformation). Moreover, securitisation allows banks to expand the amount of credit to other borrowers different from households, since the revenues from securitisation of long-term mortgages can be used to finance short-term commercial and industrial loans (maturity transformation). In this way, because of loan securitisation, it is possible for banks to expand their credit in a way which is quite independent from the monetary policy stance (with the effect of reducing the importance of the bank lending channel in the transmission mechanism of monetary policy).

Furthermore, securitisation may favour a credit expansion also because it substantially changes the risk management approach of the bank: indeed, once a bank securitizes a pool of loans, it doesn't bear anymore the risk for that credit, unless it accepts to keep some tranches of the asset backed securities in its balance sheet or it provides a guarantee for principal and interest payments[5]. However, even in these cases, the credit risk associated with a tranche of asset-backed securities is – or should be – lower than the credit risk born by a bank for a set of homogeneous loans, provided to similar categories of borrowers or in the same geographical area[6] . Indeed, when several loans are pooled and transferred to a vehicle issuer of asset backed securities, the default risk associated with the repayment of a loan becomes idiosyncratic, because in a pool of heterogeneous loans the probability of default is affected by different factors for each debtor. So, on one hand the returns on asset-backed securities are paid by the issuer using the principal and interest payments on securitized loans; but on the other hand, the credit derivative is structured such that a given probability of defaults or delinquencies - for a small fraction of pooled loans – shouldn't affect the flow of returns to investors. As a consequence of that, the credit risk born by a bank should sensibly decrease thanks to loan securitisation: this creates a strong incentive for banks to use securitisations. Moreover, even when a banks plays the role of a credit enhancer, it gets very high income fees from the issuer of the asset-backed security, then it has an additional incentive to get involved in securitisations.

On the other side, an increase in loan securitisation might also induce a decrease in bank lending, under particular financial market conditions affecting the portfolio value of the banks exposed to credit derivatives. But, in order to understand that, we have to adopt another perspective in the setting of the empirical analysis. Indeed, the impact of asset securitisation can be studied not only from the side of the originator banks, but also from the viewpoint of the financial institutions involved in the credit derivative underwriting or more generally bearing the credit risk of such securities. In this perspective, we are interested in introducing

[5] In general, an asset can be securitized if it offers a stable income stream to the investors. Nevertheless, the contemporaneous default of a large number of borrowers, if not taken into account in the process of derivative structuring, may reduce the flow of payments to investors. For this reason, there is still need of a credit enhancer, like a bank or an insurance company, which provides liquidity lines to special purpose vehicles in case of multiple shortfalls created by delinquencies or defaults and receives in exchange the payment of an insurance fee for this service.

[6] This might not be the case, as better explained in the following paragraph, in a situation of financial contagion.

some elements of innovation compared to the empirical literature, discussed in the previous section, which examines the effects of securitisation on the amount of bank lending by the originator banks. In fact, the positive impact observed in such analyses mostly reflects the effect of the liquidity transformation function of securitisation, which is of course quite relevant in determining the expansion of credit supply for the originator banks. For this reason, in the empirical analysis of this paper we prefer to consider the credit derivative exposure of commercial banks, whatever is the source of such exposure: in this perspective, we don't distinguish whether banks are exposed because they have bought some tranches of ABSs for loans originated by other banks, or because they have kept some tranches of credit derivatives based on their own loans, or again because they have offered a guarantee for the repayment of a pool of securitized loans.

Once we take this broader approach for the empirical analysis, we can also explain why, in a situation of high financial distress for the banking system, an increase in asset securitisation may also have a negative impact on bank lending. Indeed, if there is a high risk of contagion across financial institutions, the bank holder of some tranches of asset-backed securities or the bank acting as a credit enhancer for a pool of securitized loans are not able to correctly evaluate the probability of default of a counterparty, and then the credit risk associated with a securitisation exposure, because of the uncertainty related to financial position of the other institution.

In this framework, two possible facts can occur.

a) Without any previous expectation, a counterparty of a credit derivative contract defaults, because it cannot obtain sources of short-term funding. We can consider, for example, the case of a Structured Investment Vehicle, issuer of Asset-Backed Commercial Paper, which doesn't manage to find investors willing to underwrite its financial instruments. This implies actual and unexpected losses for the banks exposed – for different reasons – to the credit derivatives issued by this financial intermediary and then such losses may require a reduction in capital. As a consequence of that, the exposed banks – unless they can further increase their leverage - usually react to the effective losses to capital by reducing the amount of credit available to households and firms. Indeed, this is something which we have observed quite frequently in the recent financial crisis. But the following point is even more relevant for our analysis.

b) In several cases, a bank doesn't know exactly the financial position of a counterparty for a credit derivative contract, but it expects a relatively high probability of default for that intermediary. Because of that, the credit risk associated to a tranche of asset-backed securities issued by that institution can be particularly high, even more than the credit risk of the loans directly provided by the bank to its traditional borrowers. In this case, the exposed bank doesn't bear any effective loss, but – given the increase in the probability of default of the issuer – it has to upward revise the value of the exposures to these securitisation activities.

Then, this increase in the credit risk associated with securitisation tranches can be transmitted to the bank capital of the exposed bank following two channels: one working

through the losses to capital, the other one working through the risk-weighted capital requirements. On one side, the rising credit risk related to a securitisation issuance may induce a fall in the value of these structured finance products, which may ultimately affect the bank balance sheets, by generating some substantial losses to the bank capital. At the same time, the increasing credit risk associated with the securitisation tranches may determine an increase in the minimum required capital that the banks have to hold for a given exposure (i.e. the cliff effect for securitisation exposures). The combination of these two elements, i.e. the losses from fair value adjustments and the increase in minimum capital requirements, can then generate a substantial process of de-leveraging in the banking industry, which may ultimately affects bank credit supply and then the amount of bank lending available to the private sector.

In particular, for the purpose of the empirical analysis, it is worth to emphasize the key role of the contagion risk in influencing the bank lending behaviour, especially in the second presented circumstance. In fact, the concerns related to the possible default of a counterparty have played an important role in determining the credit crunch after Lehman Brothers' bankruptcy, since many banks concerned about the potential losses from their credit derivative exposure (because of the financial position of the issuers) decided to contract the amount of loans to the private sector. The motive justifying such reduction in bank lending can be considered mainly as a precautionary reason and in fact it is a function of the degree of the uncertainty related to the financial position of the counterparty.

On the basis of the previous considerations, we can argue that securitisation may induce effects of opposite signs on bank lending, so it is important to understand which effect prevails and under which conditions. Indeed, this impact may be related also to the type of loan, and then to its maturity, because of the liquidity/maturity transformation function of securitisation. For instance, construction loans and residential mortgages are mostly long-term loans, while commercial or industrial loans are prevailingly short-term loans. So an increase in securitisation may affect those categories of loans in a different way depending on their maturity.

For instance, we can think of two possible cases to illustrate the above mentioned argument. Let us consider the case of a bank which securitizes some mortgages or other long-term loans, keeping some tranches of credit derivatives or issuing a partial guarantee for the repayment of loans, such to increase in any case its off-balance sheet credit exposure; after that, the bank will not probably use the securitisation revenues to issue new long-term loans, but it will likely decide to provide new short-term loans, exploiting the liquidity/maturity transformation function of credit securitisation. Then, a similar reasoning can be proposed also for the banks which are not the loan originators in the securitisation but which increase their off-balance sheet credit exposure for providing explicit credit guarantees or committed liquidity lines to SPVs: also in this case, given the potential losses coming from the increase in the off-balance sheet activities, the bank could prefer to keep more liquid assets, and then it could avoid to increase the amount of long-term loans. As we can see from these examples, in the perspective of observing the final impact on bank lending, the position of originator bank

is not necessarily so relevant, while the type of loans can be more important in explaining the effects of an increase in bank off-balance sheet activities.

5. The Data

An empirical analysis aimed at observing the impact of asset securitisation and off-balance sheet credit exposure on bank loans requires the availability of detailed data about bank on-balance sheet assets and liabilities as well as about off-balance sheet activities. While complete data on bank balance sheets can be easily obtained from the reports published by banks for their shareholders, the data on off-balance sheet items are not indicated in a complete way in such reports, because the information duties that financial institutions have to fulfil in such case are rather limited. For this reason, the best source of data for off-balance sheet activities is given by the regulatory reports that banks have to submit to Financial Supervision Authorities. In this way, we can have at least some bank-specific data for the notional amount of credit derivatives, interest rate or foreign exchange contracts, for loan commitments as well as in general for off-balance sheet credit exposure. Indeed, banks have to declare such data, as they are required to compute the equivalent amount of weighted-risk assets, which is relevant for the fulfilment of the regulatory capital-asset ratios.

For this reason, I use the data available through the Bank Regulatory Database, which includes several datasets for regulated financial institutions in the US. In particular, the Commercial Bank Dataset, from the Federal Reserve Bank of Chicago, contains data for all the commercial banks, regulated by the Federal Reserve System and the Federal Deposit Insurance Corporation, which must fill the Report of Condition and Income (named "Call Report"). The Commercial Bank Dataset has quarterly data available from 1976 to 2008 for 1722 US commercial banks.

In particular, for the purpose of this analysis I will consider the data from the 1st quarter of 1998 to the 4th quarter of 2008 (the last one currently available), that is for 44 quarters. The reason for this choice is related to the scope of the empirical study and to the availability of data: even if the foundation of the US public companies involved in credit securitisation - Freddie Mac and Fannie Mae[7] - is chronologically anterior, we can observe a reasonably large diffusion of credit securitisation in the US starting from the nineties but we can have satisfactory regulatory data on bank off-balance sheet activities only from the end of the nineties. Moreover, regarding the banks considered in the analysis, I restrict the dataset to

[7] Freddie Mac is an acronym for Federal Home Loan Mortgage Corporation (FHLMC), while Fannie Mae is an acronym for Federal National Mortgage Association (FNMA). Both of them were created by the US Government to expand the secondary mortgage market by securitizing mortgages in the form of Mortgage Backed Securities.

the largest 39 US commercial banks (according to the value of their assets), because only for these banks I have complete or at least exhaustive data for off-balance sheet activities. In any case, this choice shouldn't determine a substantial selection bias for the results of the empirical analysis, given that the largest 39 US banks (as identified for the last quarter of 2008) represent 79.68% of the total amount of consolidated assets held by US commercial banks. So, the trend in bank lending that we observe for the banks included in the dataset should explain in a relatively satisfactory way the trend in bank lending for the overall US banking system.

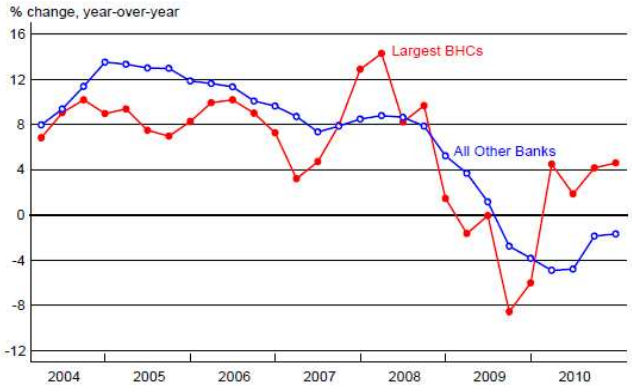
For the dependent variable, I consider the data on the total amount of loans, as well as the specific data for several categories of loans, such as residential mortgages, non-residential mortgages, construction loans, real estate loans, commercial and industrial loans, agricultural loans. Indeed, I am interested in analyzing the impact of credit derivative exposure on each of these categories of loans, given that the effects could be different because of the liquidity and maturity transformation function played by credit securitisation, as described in the previous section.

The graph presented in figure 2 shows the yearly growth rate of loans for the 8 largest domestic bank holdings[8] and for all the other commercial banks from 2004 to 2010, in order to compare the evolution of bank loans before and after the crisis, during the period characterized by the largest diffusion of credit securitisation and off-balance sheet activities. Firstly, we notice that the growth rate of loans by the largest bank holdings follows a quite volatile path, while the growth rate of loans by the other commercial banks is more stable. Moreover, we observe that in both cases, even after the beginning of the financial crisis (August 2007), the growth rate of loans remains positive at least until the beginning of 2009 and, in particular, it even increases for the largest bank holdings. Then, due to the effects of Lehman's bankruptcy, the growth rate of total loans becomes negative in early-2009 for the largest bank holdings and in mid-2009 for the other commercial banks.

For this reason, we can properly talk about a credit crunch for the US economy, in the sense of a sensible reduction in the level of bank lending, only after Lehman's bankruptcy. However, this credit contraction operates in a different way depending on the bank size: while the largest bank holdings register before a sudden drop in the growth rate (up to -8% in September 2009) and then they observe a substantial increase (up to +4% in March 2010), the other commercial banks show a more gradual and persistent decrease for a longer period such that the growth rate of loans is still negative during the entire 2010. This can be explained by two factors: the credit provided by the largest bank holdings depends more on bank-specific supply factors, related to the credit policy chosen by the holding, while the credit granted by the other commercial banks is more affected by the general conditions of loan demand.

[8] The group includes the following banks: JPMorgan Chase, Bank of America, Citigroup, Wells Fargo, US Bancorp, PNC, Bank of New York Mellon and Capital One

Figure 2. The growth rate of loans by US commercial banks from 2004 to 2010



Source: Federal Reserve Bank of New York (2011)

Moreover, the largest bank holdings present a wider drop in credit supply during 2009 because they suffered a larger amount of losses from credit derivatives and from impaired loans, compared to the other commercial banks.

Concerning the explanatory variables, I want to compare the effects on total loans both of the shocks affecting on-balance sheet securities and of the shocks regarding off-balance sheet activities. In order to determine the volume of on-balance sheet securities, I don't consider the classification between held-to-maturity debt securities, trading debt and equity securities and available-for-sale debt and equity, which is based on the bank's intended use of that security, because this distinction is relevant simply to specify the accounting treatment of the single asset in the balance sheet. On the contrary, it is more relevant – from an economic point of view – to consider the total amount of securities at the market value, independently from the previous distinction: indeed, the aim of the analysis is to observe the shocks to the value of securities, as determined in the fluctuations of financial markets, and then to verify whether the changes in the asset portfolio value may have an impact on bank lending, comparing also this impact with the effects of shocks to off-balance sheet credit exposure.

The other explanatory variable is the current credit exposure to the off-balance sheet derivative contracts covered by the risk based capital standards. Here the credit risk associated to a derivative contract is the risk of losses that will be incurred in the case of default by the counterparty. Then credit exposure must be determined, according to the techniques used in credit risk measurement, as the cost of replacing the contract at the time of default. For the purposes of our analysis, it is important to observe that credit exposure is the maximum amount which can be potentially lost in the event of a default by the counterparty, so it is higher than the actual amount of losses effectively born by the bank. In this way, such variable can capture an interesting aspect in the process of credit intermediation: a bank can deliberately decrease the amount of loans, or the growth rate of loans, if it has a large off-balance sheet credit exposure, not only because it has already registered some effective losses, but because it could bear some substantial losses in the future. This would allow us to take into account not only the effects of the actual losses from off-balance sheet activities, but also the impact of the contagion risk related to the potential default of a counterparty. That is

the reason why I prefer to use the off-balance sheet credit exposure rather than, for example, the allowance for losses on off-balance sheet activities, which reflects the actual losses carried by a bank and compensated through bank capital reserves[9].

6. The Empirical Methodology

After describing the dataset, we can present the framework for the empirical analysis and illustrate the implemented econometric methodology: preliminarily, I estimate a panel fixed effects model for the growth rate of loans; then, I introduce a panel VAR model to analyze the impact of shocks to off-balance credit exposure and to securities market value on the amount and on the growth rate of loans. Given this structure of the work, it is worth analyzing the econometric issues related to each part of the empirical study, in order to explain why the panel VAR approach should be preferred to the panel fixed effects estimation.

In the first part of the work, I analyze a panel with fixed effects for individual banks. Here I use as a dependent variable the growth rate of loans, computed as the difference between the logs of loans in time t and in time t-1. Indeed, the use of the growth rate of loans allows to remove a component of trend stationarity characterizing the variables of this empirical study. Indeed, some of the variables included in the dataset, such as the amount of loans or the off-balance credit exposure, follow an increasing trend, given that they are expressed in monetary values. For this reason, a regression including the logarithm of each variable would present a typical problem of spurious regression. On the other hand, the growth rate of loans doesn't follow any specific trend, so we can examine the impact of a variation in off-balance credit exposure or in securities market value on the loan growth rate, without incurring in problems of non-stationarity. Then the estimated regression equation is:

$$G\_LOANS_{it} = \alpha_i + \beta_1 \ln CRE\_EXP\_DER_{it} + \beta_2 \ln MARKET\_SECUR_{it} + \beta_3 \ln EQUITY\_CAPIT_{it} + u_{it}$$

where α_i is the individual fixed effect for a bank i, G_LOANS_{it} is the growth rate of loans (total loans or specific categories of loans) for bank i in quarter t, $lnCRE\_EXP\_DER_{it}$ is the log of off-balance credit exposure to derivatives, *lnMARKET_SECUR* is the log of the market value of on-balance securities and *lnEQUITY_CAPIT* is the log of the equity capital.

Now, we have to clarify the reasons for choosing a fixed effects estimator rather than a random effects estimator. We can discuss the issue considering two aspects: the objectives and the features of the empirical analysis and the indications provided by the specification tests. Firstly, the framework of the analysis would suggest to employ a fixed effects estimator, given that we are examining the bank lending behaviour of different financial

[9] Moreover, I could also add another practical justification: while the loan loss allowance and the allowance for losses on marketable securities are explicitly indicated in the balance sheet, the allowances for off-balance sheet losses are not clearly presented in the bank financial reports.

institutions over time. So we can suppose that there are some unobserved components characterizing the conduct of the same bank, which don't change over time. In any case, to check the validity of this choice, I also implement a Hausman specification test to verify the hypothesis of no systematic difference between the coefficients resulting from fixed effects and random effects estimators. As shown in table 1, the results of the test - for the specification including the growth rate of total loans as dependent variable - don't provide univocal indications in favour of one or another solution. Indeed, in two cases the chi-square statistics is significant, so indicating that the random effects estimator might be inconsistent due to the correlation between the explanatory variables and the individual random effect; while in other two cases, the chi-square statistics is not significant, so implying that the random effects GLS estimator might be not only efficient but also consistent. In absence of clear results from the Hausman test, the economic logic underlying the empirical analysis induces to employ a fixed effects estimator. This is the reason why, for the regressions including the growth rate of specific categories of loans, I only present the results of a panel fixed effects estimation.

The standard regression equation includes the explanatory variables, observed at the same time of the dependent variable: the results of this specification should then explain the simultaneous effects of credit derivative exposure and securities market value on the current growth rate. Moreover, to take into account the propagation process of the shocks affecting the growth rate of loans, I also use some lagged values of the explanatory variables. Then, depending on the number of lags, the basic regression equation can be written as follows:

$$G\_LOANS_{it} = \alpha_i + \beta_1 lnCRE\_EXP\_DER_{it-n} + \beta_2 lnMARKET\_SECUR_{it-n} + \beta_3 lnEQUITY\_CAPIT_{it-n} + u_{it}$$

where n defines the number of lagged quarters. This specification with lagged explanatory variables should then capture the lagged effects – if there are - that changes in off-balance credit exposure or in securities market value can produce on the growth rate of loans.

Nevertheless, the introduction of lagged values of the explanatory variables could not be sufficient to fully understand the dynamics in the process of credit intermediation. In fact, since the bank lending policy influences the credit provision over time, or simply because there is some inertia, we can reasonably argue that the growth rate of loans in the previous period might also affect the growth rate of loans in the following periods: for this reason, it would be interesting to add also the lagged value of the loan growth rate. However, this can create problems of inconsistency for the fixed effects estimator, due to the correlation between the individual fixed component in the lagged dependent variable and the error term in the regression equation. Then, the Within estimator would be biased and inconsistent. Indeed, since the estimation bias is O (1/T), we can argue that the bias would decrease and then the fixed effects estimator would become consistent only when T gets large.[10] But in our case, we have N=39 and T=44, so the amount of T is not large enough to claim that the fixed

[10] For more details on that, see the discussion on dynamic panel data models by Baltagi (2008)

effects estimator may be consistent. This is the reason why a panel VAR estimation should be considered as highly appropriate for such analysis.

Indeed, the Panel VAR methodology (Holtz Eakin, Newey and Rose, 1988) has been already implemented in some empirical papers on the bank capital channel (Hancock, Laing and Wilcox, 1995; Mora and Logan, 2010). In particular, in the estimation of the Panel VAR model, I apply the program developed for Stata by Love and Zicchino (2006). In order to solve the issue of the correlation between the lagged dependent variable and the error term, the model is estimated by using a GMM procedure, as proposed for dynamic panel data by Arellano and Bover (1995): this method produces efficient IV estimators by using lagged regressors as instruments.

However, before applying the GMM estimation method, I need to apply two transformation procedure on the data. Firstly, in order to remove possible non-stationarity in the data, I have to time-demean the data for the relevant variables. Then, in order to eliminate the individual fixed effects, I also apply the Helmert transformation to the time-demeaned data. At this point, I can implement the GMM procedure on Helmert- transformed data. In particular, for the purpose of the estimation, I consider the following order for the variables: off-balance credit exposure, securities market value and then bank lending (in logs or in growth rates). The choice of this order can be explained, on the basis of the hypotheses outlined in section 4, because the shocks to the credit derivative exposure show a higher degree of exogeneity compared to the other variables. Indeed, in most of the cases, such shocks are related to the probability of default of a counterparty, which is a different financial intermediary. Then, after the GMM estimation of the coefficients, I can compute and represent the impulse response functions for the shocks to off-balance credit exposure and securities market value.

As above explained, the use of a Panel VAR analysis, based on time-demeaned data, removes eventual non-stationarity problems: in this way, I can examine the effects on bank lending, by considering two variables, both the amount of loans (in logs) and the growth rate of loans. The reason why I include both specifications (rather than just the amount of lending) is due to the empirical facts observed in the data about bank lending: indeed, even after the beginning of the financial crisis, we observe for some quarters a reduction in the growth rate of loans but not also a contraction in the level of bank lending, at least until mid-2009. For this reason, an analysis focused also on the growth rate of loans could provide some other insights, in addition to the results of the study based on the amount of loans (in logs).

7. The Results of the Panel Fixed Effects Estimation

As a first step in the empirical analysis, we consider y about the impact of off-balance sheet credit exposure and of securities market value on the growth rate of loans (total loans or

specific categories of loans). Then, in the following section, we will analyze the outcomes obtained from the Panel VAR analysis.

Let us focus firstly on the regression with the growth rate of total loans as a dependent variable. Just for this part of the analysis, as anticipated in the previous section, I will compare the outcomes obtained from two different specifications of the panel regression, i.e. the one using a fixed effects estimator and the one adopting a random effects estimator, also on the basis of the results of the Hausman test. We can observe such results in table 1.

The specifications 1-4 describe the results for the static panel: in the fixed effects estimation, only the coefficient for credit derivative exposure is significant and negative. This means that a 1-percent increase in off-balance credit exposure reduces the growth rate of total loans by 0.034% (col.1) or 0.036% (col.3). These figures are quite relevant if we consider the

Table 1. The Impact on the Growth Rate of Total Loans

	GROWTH RATE OF TOTAL LOANS							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnCRE_EXP_DER	-0.0344** (0.0135)	-0.0121* (0.0064)	-0.0361** (0.0142)	-0.0156* (0.0086)				
lnMARKET_SECUR	0.0167 (0.0224)	0.0217* 0.0128	0.0146 (0.0230)	0.0169 (0.0152)				
ln_EQUITY_CAPIT			0.0179 (0.0453)	0.0129 (0.0214)				
lnCRE_EXP_DER_1					-0.0174* (0.0097)	-0.0020 (0.0034)		
lnMARKET_SECUR_1					-0.0198 (0.0131)	0.0015 (0.0068)		
lnCRE_EXP_DER_2							-0.0052 (0.0103)	-0.0018 (0.0027)
lnMARKET_SECUR_2							-0.0046 (0.0135)	0.0062 (0.0055)
CONS.	0.2348 (0.4191)	-0.1582 (0.1583)	0.0006 (0.7259)	-0.2407 (0.2094)	0.6004** (0.2690)	0.0247 (0.0832)	0.1708 (0.2834)	-0.0593 (0.0659)
Bank Fixed Effect	YES	NO	YES	NO	YES	NO	YES	NO
Hausman Test	3.59 (0.1663)		10.87** (0.0124)		5.07* (0.0793)		0.80 (0.6706)	
No. Observations	342	342	342	342	309	309	290	290

*, **, *** indicate respectively statistical significance at 10%, 5% and 1% level

effective growth rates for total loans and for credit derivative exposure, as registered in the last few years. At this regard, let consider some descriptive statistics for the last two years of our sample (2007- 2008): during that period, the average quarterly growth rate of total loans was equal to 2.39%, while the average quarterly growth rate of credit derivative exposure was equal to 22.98%. As a consequence of that, a sudden increase in off-balance credit exposure by 25% (or by 50%) - absolutely normal or quite common for that period – would determine a decrease in the growth rate of loans by 0.9% (or by 1.8%) and then it would reduce the

growth rate to 1.5% (or to 0.6%). In a similar way, we can also argue that the growth rate of loans may become negative, after a 65% increase to credit derivative exposure. This immediate and negative impact of off-balance credit exposure on the growth rate of loans could display – as discussed in section 4 – a contagion risk effect: indeed a rise in credit exposure, implying an increase in the potential losses from off-balance sheet items, and in particular from securitisation activities, may induce banks to contract lending, by reducing the growth rate of loans.

This contagion risk effect, as it is based just on the concern for the potential losses coming from a counterparty's default and so it doesn't involve any actual variation in bank capital, would work immediately after the shock to credit exposure: for this reason, the magnitude of the negative effect should be larger in the same period of the shock and then it should decrease in the specifications including the lagged values of the explanatory variables. Indeed, as we can notice from columns 5-8, the coefficient for credit exposure is still significant in the specification with one quarter lag, but it is not anymore in the regression with two lags.

Moreover, as we can notice from the observation of the results, the coefficient for the market value of on-balance securities is never significant in the specifications including a small number of lags, while the coefficient for off-balance credit exposure is significant at least for one quarter lag. This could support the argument that the contagion risk effect not only operates in the very short-run, but it is more relevant for off-balance sheet activities than for on-balance sheet securities: indeed, in many cases - also for regulatory arbitrage purposes related to the different weighted risk for on and off-balance sheet activities - the derivative contracts registered off-balance sheet display higher credit risk than the on-balance sheet securities. For this reason, if there is a concern about a potential counterparty default, in the very short-run a shock to credit derivative exposure can produce a larger impact than a shock to on-balance sheet securities.

Then we can consider the impact of the same explanatory variables on the growth rate of some specific categories of loans. In table 2, I present the results of the regression for the growth rate of residential mortgages and real estate loans: as we have observed for total loans, an increase of credit derivative exposure can determine in the same time period a decrease in the growth rate of loans, for both categories of bank lending. The magnitude of the effect is almost identical for both, as a 1-percent increase in off-balance credit exposure reduces the growth rate of residential mortgages (col.2) and of real estate loans (col.4) by around 0.041%. As before, the size of these coefficients has to be evaluated by taking into account the quarterly growth rate of credit derivative exposure, in particular for the last period (2007-2008): indeed, an increase in credit derivative exposure by 25% (or by 50%) – the first one absolutely normal and the second one quite common for that period – would determine a decrease in the growth rate of loans by 1.025% (or by 2.05%), while the average quarterly growth rate of residential mortgages during those years was equal to 2.73% and the average quarterly growth rate of real estate loans was equal to 2.76%.

Table 2. The Impact on the Growth Rate of Residential Mortgages and of Real Estate Loans

	GROWTH RATE OF RESIDENTIAL MORTGAGES				GROWTH RATE OF REAL ESTATE LOANS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnCRE_EXP_DER	-0.0393** (0.0179)	-0.0408** (0.0188)			.-0.0389** (0.0157)	-0.0413** (0.0165)		
lnMARKET_SECUR	0.0375 (0.0297)	0.0355 (0.0305)			0.0372 (0.0261)	0.0342 (0.0269)		
ln_EQUITY_CAPIT		0.0166 (0.0601)				0.0254 (0.0529)		
lnCRE_EXP_DER_1			-0.0329* (0.0196)				-0.0287* (0.0156)	
lnMARKET_SECUR_1			-0.0138 (0.0265)				-0.0087 (0.0211)	
lnCRE_EXP_DER_2				-0.0151 (0.0225)				-0.0131 (0.0181)
lnMARKET_SECUR_2				-0.0132 (0.0294)				-0.0097 (0.0237)
CONS.	-0.0391 (0.5553)	-0.2563 (0.9618)	0.7239 (0.5420)	0.4578 (0.6150)	-0.0384 (0.4887)	-0.3705 (0.8462)	0.5801 (0.4321)	0.3724 (0.4961)
Bank Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES
No. Observations	342	342	309	290	342	342	309	290

*, **, *** indicate respectively statistical significance at 10%, 5% and 1% level

Also in this case, we can observe the negative impact of contagion risk, which is even accentuated in terms of magnitude because both residential mortgages and real estate loans are long-term loans and then very illiquid assets, so banks are not interested in keeping them especially in a period characterized by an increase in off-balance credit exposure. Moreover, as we have noticed for total loans, the coefficient for credit exposure is still significant in the specification with one quarter lag (col.3 and 7), but it is not anymore in the regression with two lags (col.4 and 8).

Finally, we can examine the impact on the growth rate of commercial and industrial loans and of agricultural loans, as presented in table 3. Here the effect of an increase in off-balance credit exposure is completely opposite. Indeed, in the specification with simultaneous explanatory variables (col.1-2 and 5-6), there is no significant coefficient, while in the regressions with 1 or 2 quarter lags (col. 3-4 and 7-8) I find significant and positive coefficients. So this means that, for such categories of loans, a rise in credit derivative exposure doesn't produce any effect on the growth rate of loans in the same time period, while it has a positive impact on the growth rate with one or two lags. We can provide a possible explanation for these outcomes.

Both commercial and industrial loans, and agricultural loans can be considered, compared to residential mortgages and real estate loans, as short-term loans. Then, as explained in section 4, an increase in securitisation activities may have a positive impact on such classes of loans, because of the discussed liquidity and maturity transformation

Table 3. The Impact on the Growth Rate of Commercial & Industrial Loans and of Agricultural Loans

	GROWTH RATE OF COMMERCIAL & INDUSTRIAL LOANS				GROWTH RATE OF AGRICULTURAL LOANS			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnCRE_EXP_DER	-0.0219 (0.0162)	-0.0233 (0.0170)			0.0063 (0.0366)	0.0208 (0.0390)		
lnMARKET_SECUR	0.0044 (0.0268)	0.0027 (0.0276)			0.0048 (0.0565)	0.0196 (0.0581)		
ln_EQUITY_CAPIT		0.0146 (0.0544)				-0.1248 (0.1163)		
lnCRE_EXP_DER_1			0.0256*** (0.0094)				0.0755* (0.0434)	
lnMARKET_SECUR_1			-0.0076 (0.0125)				0.0305 (0.0531)	
ln_EQUITY_CAPIT_1			-0.1338*** (0.0242)				-0.1972* (0.1045)	
lnCRE_EXP_DER_2				0.0199* (0.0103)				0.1178** (0.0461)
lnMARKET_SECUR_2				-0.0024 (0.0133)				0.0057 (0.0555)
ln_EQUITY_CAPIT_2				-0.0956*** (0.0260)				-0.1916* 0.1094
CONS.	0.2722 (0.5024)	0.0816 (0.8702)	1.9887*** (0.3946)	1.3526*** (0.4280)	-0.1544 (1.0867)	1.4464 (1.8452)	1.6574 (1.6805)	1.3790 (1.7993)
Bank Fixed Effect	YES	YES	YES	YES	YES	YES	YES	YES
No. Observations	342	342	309	290	307	307	280	262

*, **, *** indicate respectively statistical significance at 10%, 5% and 1% level

function. However, this positive effect - working over time – can be offset by the negative impact of contagion risk, which produces its largest effect at the same time of the change in off-balance activities. Then, the results for these short-term loans, mainly aimed to finance entrepreneurial activities can be explained in this way: at the time of the increase in off-balance exposure, the negative effect due to the contagion risk would prevail, while in the following quarters the positive impact due to the maturity transformation function would be stronger.

8. The Results of the Panel VAR Analysis

The possible inconsistency of the fixed effects estimator in a dynamic panel including a lagged dependent variable among the regressors, as well as the need to analyze the complete dynamics of the variables over time, suggest us to run a Panel VAR analysis in order to study the effects of shocks to the market value of on-balance sheet securities and to the off-balance sheet credit exposure to derivatives. For the purpose of this analysis, I don't

include the equity capital because, in the framework outlined in section 4, the shocks affecting the equity capital can be considered as consequences of the losses, and then of the shocks regarding the market value of securities and the off-balance sheet credit exposure. Moreover, an increase in credit exposure (so in the potential amount of losses in the case of default of a counterparty) could negatively affect bank lending even without producing effective losses and then consequent reductions in bank capital.

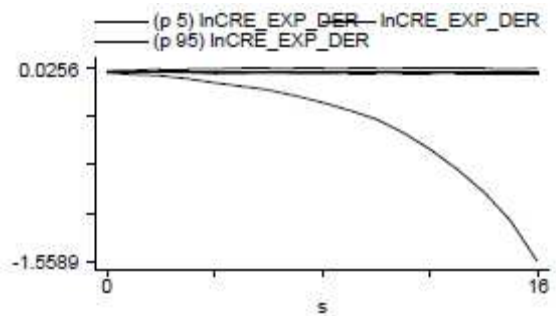
Another relevant issue arising in the specification of the Panel VAR regards the choice of the lags to be included in the analysis. A consideration of the hypotheses presented in section 4 could lead to opposite choices: indeed, the effective losses registered for on-balance sheet securities or for off-balance sheet activities can take some time before producing an impact on bank lending (after inducing a reduction in capital reserves), then this would require the introduction of many time lags (up to 8 quarters); on the other side, the reduction in bank lending simply due to the diffusion of contagion risk, after a given increase in off-balance sheet credit exposure, could require a shorter period of time, so implying the need for relatively few time lags. Then, the evolution of bank lending in the last few years, as described in figure 3, could give an idea about the time persistency of shocks to the banking system. For example, if we consider the impact of Lehman's bankruptcy, we notice that the propagation process from the time of the shock (September 2008) to the time of the lowest (and negative) growth rate of loans took around 4 quarters (until September 2009) for the largest bank holdings and about 6-7 quarters (until March-June 2010) for the other commercial banks. For this reason, in the Panel VAR analysis of this paper I introduce a time lag of 6 quarters for the variables considered in the estimation, but I present in the appendix the results for the specification of the Panel VAR model with a 4-quarter lag.

8.1 The Impact of Shocks on the Amount of Loans

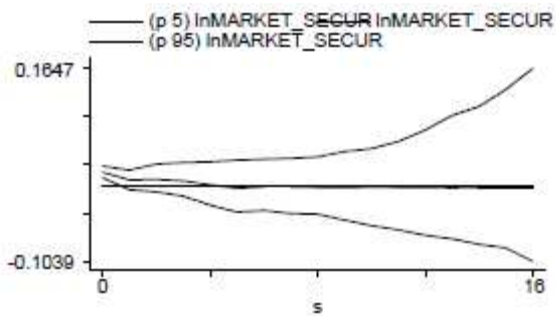
In order to discuss the results of the analysis, I will present the graphs of the impulse response-functions obtained for shocks to the off-balance sheet credit derivative exposure and to the market value of on-balance sheet securities. Firstly, I will consider the impact of such shocks on the amount of bank loans (total loans and specific categories of loans). The lines above and under the central one define the intervals for the errors, as generated by a Monte-Carlo process with 500 repetitions.

Let us consider the impact on the total amount of loans, without any distinction among specific categories. An increase in the credit exposure doesn't imply a significant effect on the amount of total loans (graph 1), probably because of the off-setting between effects of opposite sign. Moreover, also a rise in securities market value doesn't determines a significant effect on bank loans (graph 2).

Graph 1. Response of lnTOTAL_LOANS to lnCRE_EXP_DER

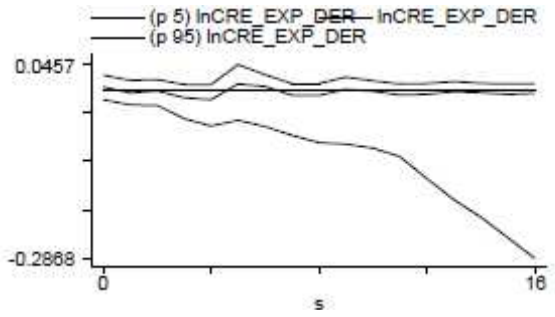


Graph 2. Response of lnTOTAL_LOANS to lnMARKET_SECUR

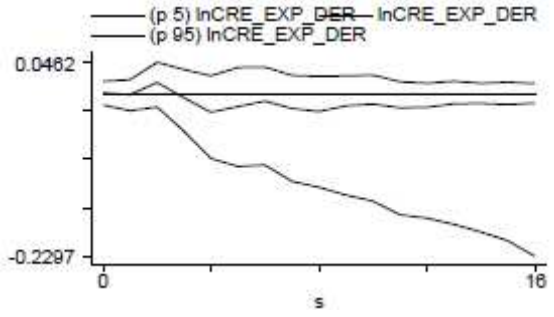


Since the impulse response functions for the amount of total loans don't provide any clear indication, in order to have a broader idea, it is worth analyzing the impact on specific categories of loans. To make the presentation shorter, I will focus on the effects of a shock to off-balance sheet credit exposure, given that such results can sensibly change depending on the type of loans. Then, let us examine in particular the impact on the amount of residential mortgages (graph 3) and of construction loans (graph 4). After the shock, both residential mortgages and construction loans show some tendency to a decrease, but in fact none of this effect is statistically significant.

Graph 3. Response of lnRESID_MORT to lnCRE_EXP_DER

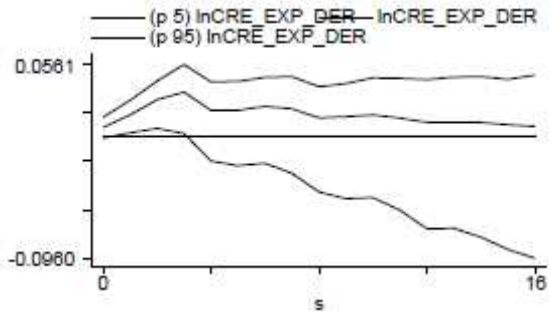


Graph 4. Response of lnCONSTR_LOAN to lnCRE_EXP_DER

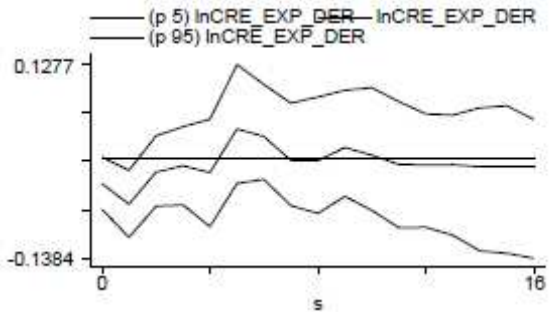


Then, we can observe the effects on other categories of loans, that is commercial and industrial loans (graph 5) and agricultural loans (graph 6). After a positive shock to credit derivative exposure, commercial and industrial loans increase and here the positive effect is significant at least until 3 quarters from the shock. Also agricultural loans – after a small decrease just in the 1st quarter – tend to show a similar growth, but here the impact is not significant. In both cases, an increase in off-balance sheet credit exposure seems to induce a positive impact on such categories of loans. Indeed, these are prevalently short-term loans, with shorter maturities than residential mortgages or construction loans. Then, this difference in the loan maturity can explain the different behaviour in bank lending, consistently with the logic previously explained.

Graph 5. Response of lnCOM_IND_LOAN to lnCRE_EXP_DER



Graph 6. Response of lnAGRIC_LOAN to lnCRE_EXP_DER

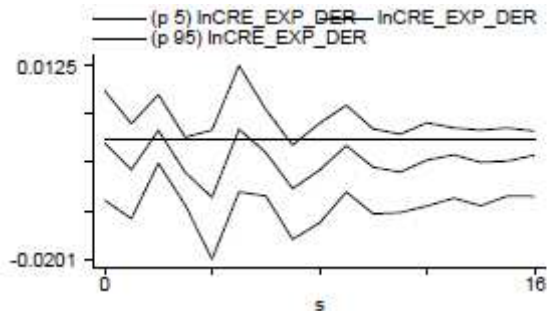


8.2 The Impact of Shocks on the Growth Rate of Loans

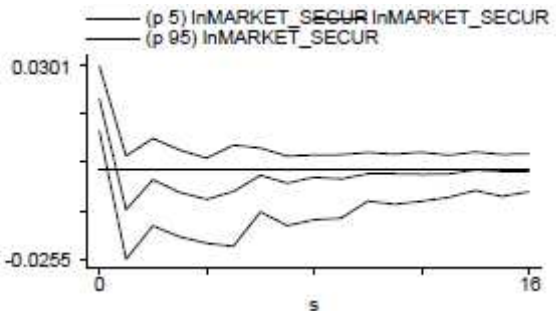
Now we want to examine the impact of shocks to off-balance sheet credit exposure and to securities market value on the growth rate of loans (total loans and specific categories of loans). In general, the results obtained from this specification are quite consistent with the outcomes of the panel fixed effects estimation, given that we still observe a negative impact of off-balance sheet credit exposure on the growth rate of total loans and we notice a different behaviour in bank lending depending on the category of loans.

As before, we start the analysis of the results observing the impact of shocks to the off-balance sheet credit derivative exposure (graph 7) and to the market value of on-balance sheet securities (graph 8) on the total amount of loans.

Graph 7. Response of G_TOTAL_LOANS to lnCRE_EXP_DER



Graph 8. Response of G_TOTAL_LOANS to lnMARKET_SECUR



An increase in the off-balance credit exposure may imply a decrease in the growth rate of loans: this effect is statistically significant only for some time periods, but it is particularly accentuated after a time lag of 4 quarters. Also a rise in the securities market value may be associated with a decrease in the growth rate of loans, but such drop is not significant and concerns mainly the first quarter after the shock.

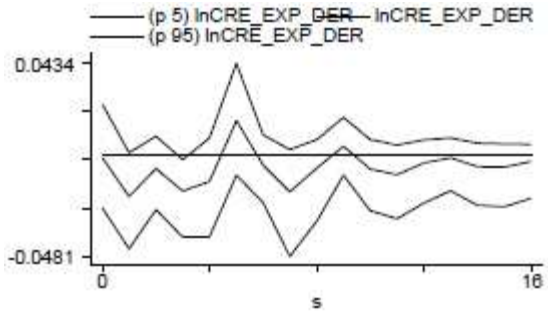
The analysis of the impact of shocks on the growth rate of loans is complementary to the study of the effects of the same shocks on the amount of loans: indeed, in this case, we can observe a negative impact of off-balance sheet credit exposure on the growth rate of loans, while this effect was not clear in the specification considering the amount of bank lending (in logs). In any case, this evidence is consistent with the observed trend in bank lending over the last decade: indeed, apart from the quarters immediately following

Lehman's bankruptcy, we notice a decreasing but still positive growth rate in total loans. For this reason, it is reasonable to argue that an increase in off-balance sheet exposure may produce a reduction in the growth rate of loans, but can induce a negative growth rate only under particular conditions of financial stress in the banking system.

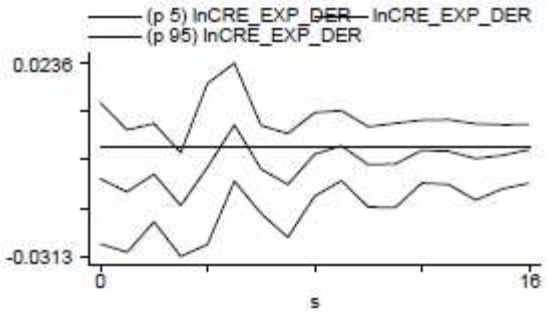
Then we can discuss the results of the analysis for specific categories of loans. Indeed, we obtain different results depending on loan maturity: indeed, a positive shock to off-balance credit exposure has usually a negative impact on bank lending for long-term loans and mortgages while it shows a positive effect on bank lending for short-term loans, aimed at financing entrepreneurial activities.

Let us consider the results for residential (graph 9) and non-residential (graph 10) mortgages. In both cases, we generally observe some decrease in the growth rate of

Graph 9. Response of G_RESID_MORT to lnCRE_EXP_DER



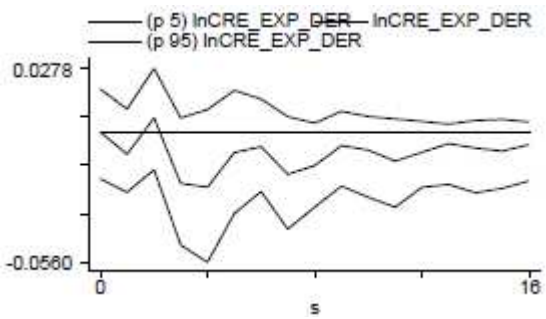
Graph 10. Response of G_NONRES_MORT to lnCRE_EXP_DER



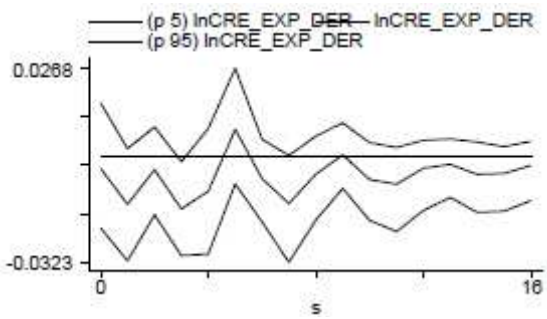
mortgages and in particular this effect is statistically significant after 3 quarters following the time of the shock.

Similar results concern the impact of off-balance sheet credit exposure on the growth rate of construction loans (graph 11) and of real estate loans (graph 12). Indeed, after the shock, the growth rate of real estate loans decreases and the negative effect is significant after 3 and 7 quarters. Also the growth rate of construction loans seems to be lower after the shock, but in this case the impact is not significant (at least given a 5% confidence interval).

Graph 11. Response of G_CONSTR_LOAN to lnCRE_EXP_DER



Graph 12 Response of G_REAL_EST_LOAN to lnCRE_EXP_DER

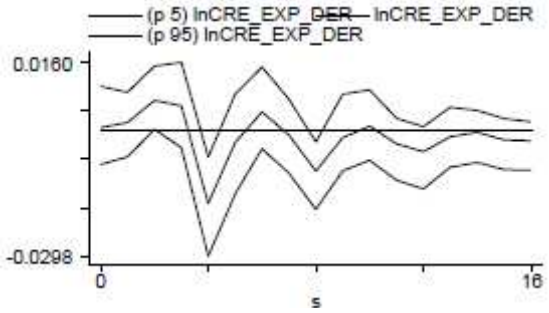


The conclusions for these long-term mortgages and loans are then consistent with our hypothesis: indeed, in such cases, the negative effect due to the potential and actual losses from the off-balance sheet credit exposure prevails, given that we cannot observe for such

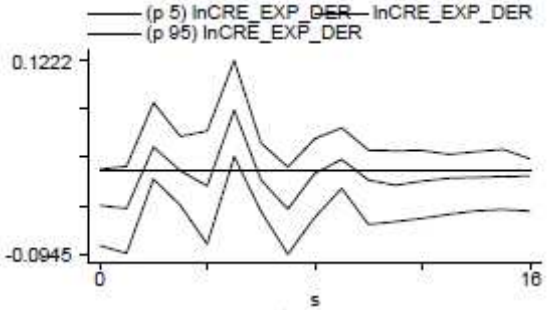
long-term loans the positive impact due to the maturity transformation function of securitisation.

Finally, we can observe the effects on the growth rate of commercial and industrial loans (graph 13) and of agricultural loans (graph 14). For commercial and industrial loans, an increase in off-balance sheet credit exposure implies a rise in the growth rate of loans, at least after 2 quarters; then, we can notice some different credit cycles, due to the existence of effects of different sign. For agricultural loans, we also notice an increasing trend, at least until the 5th quarter after the shock. Then, apart from the drop of the growth rate in the 4th quarter, the impact of the shocks on the growth rate of loans to entrepreneurial activities should confirm the argument that credit securitisations may have a positive impact on short-term bank lending. Indeed, in this case, the positive effect due to the maturity transformation function is stronger than the negative one due to the potential and actual losses from credit exposure.

Graph 13 Response of G_COM_IND_LOAN to lnCRE_EXP_DER



Graph 14 Response of G_AGRIC_LOAN to lnCRE_EXP_DER



In conclusion, we can summarize the results obtained from the Panel VAR analysis as follows:

1) An increase in off-balance sheet credit exposure may have a negative impact on the growth rate of total loans and of several categories of loans, due to the potential and actual losses related to the off-balance sheet activities.

2) The effects on the single categories of loans depend on their maturity: the positive impact of credit securitisation on bank lending prevails for short-term loans, such as commercial and industrial loans, while the negative effect is stronger for long-term loans, such as mortgages or real estate loans.

3) There is evidence – in the very short run - of a contagion risk effect due to an increase in off-balance sheet credit exposure. This effect concerns more the off-balance sheet activities than the on-balance sheet securities because the former ones usually imply a higher credit risk for the bank.

8.3 Robustness and diagnostics of the results

After presenting the key results of the panel VAR analysis, we have to discuss some aspects concerning the robustness of the observed effects as well as about the use of diagnostic tests in this framework.

Firstly, I have checked the robustness of the results, as far it concerns the choice of the appropriate order for the time lags. Indeed, I have run the panel VAR analysis also for other specifications including different number of lags. Apart from the main analysis, based on the introduction of 6 quarter lags, I have also estimated the model for 2, 4 and 8 lags. In particular, in the appendix A1, I present the results of the analysis for the estimation of the model with 4 lags. As we can notice from a comparison of the graphs for the impulse response functions, the change of specification doesn't affect significantly the results. Nevertheless, the model with 6 quarter lags is to be preferred, because more results are significant under this specification and then the discussed effects can be better observed. On the other hand, the specifications for 2 and 8 lags are not appropriate, the first one because it doesn't take into account the complete dynamics of the lagged effects, the second one because the lagged impact after 8 quarters is almost irrelevant.

Moreover, we have to consider some issues about the diagnostics of the results obtained from the panel VAR model. In fact, the diagnostics is a shortcoming of the current empirical analyses using this estimation framework, because of the specific nature of the model. Indeed, in a pure time-series framework, after estimating a VAR model, we can usually perform some tests to check for residual autocorrelation, for normally distributed residuals or for the stability conditions of the VAR estimates, as well as to obtain lag-order selection statistics for VARs. But these tests, constructed for a pure time-series framework, cannot be directly implemented in a panel VAR framework, where we also have to consider a panel dimension. In particular, Banerjee, Eberhardt and Reade (2010) examine the issue in the context of non-stationary panels and employ Monte Carlo simulations to study the distributions and rejection frequencies for standard time-series diagnostic procedures, such as tests for residual autocorrelation, normality, functional form. Then they show that, notwithstanding the difficulties in extending misspecification tests to a panel setting, proper estimators have sound residual properties and then diagnostic tests based on such estimators have power in detecting misspecification. But the tests to be used are different: indeed, we have to implement – also in terms of software programming – some tests specific to dynamic panels, such as the m-statistics proposed by Arellano and Bond (1991) for residual serial correlation, or the test for the specification of lag lengths suggested by Holtz Eakin, Newey and Rose (1988). For this reason, the lack of diagnostic testing procedures in panel econometrics, if compared to their diffusion in the time-series domain, cannot be solved simply by the application of the time-series procedure, but requires an autonomous implementation of some specific tests for the panel VAR model. Then, this will be an aspect to be developed in the future research.

9. Conclusions

The empirical analysis presented in this paper has shown that the banking system may play a key role in the amplification of the financial shocks to the real economy: an excessive recourse to credit securitisation and to off-balance sheet activities in the management of bank assets and liabilities may particularly increase the size of the mechanism, by which financial shocks may produce a negative impact on bank lending. Indeed, the systematic use of the above mentioned practices, by augmenting the leverage of financial intermediaries, sensibly increases the credit risks born by banks and this may affect the financial stability of the banking system, in situations of contagion risk. Indeed, in such cases, the banks which are more concerned about a potential default of their counterparties, are not willing to expand the credit provision to the private sector and, actually, they can be interested in reducing the amount of available credit.

The paper examines this topic by proposing a Panel VAR analysis, which studies the impact of the shocks affecting bank off-balance credit derivative exposure and on-balance securities, in order to observe the effects on the amount and on the growth rate of bank lending. The results of the analysis illustrate that an increase in off-balance credit exposure, mainly determined by a rise in securitisation activities, may produce a sensible reduction in the growth rate of bank lending, especially for some categories of loans characterized by long-term maturity, such as residential and non-residential mortgages, real estate loans. For other classes of loans, such as commercial and industrial loans, an increase in asset securitisation may induce an increase in the growth rate, but we still observe in some periods a negative effect due to the losses born by banks because of the enormous rise in off-balance activities.

The conclusions of the paper may have some relevant policy implications in terms of banking regulation, by emphasizing the need for specific rules limiting an excessive increase of off-balance sheet items, especially when the high credit risk related to such activities may determine some important losses for the bank balance sheet. In this perspective, it is certainly useful to increase the regulatory requirements for bank capital in order to raise the loss absorbency capacity of banks against potential shocks, but this solution might not be per se sufficient to preserve the financial stability of the banking system: indeed, it could be also important to reduce the potential causes of such losses, by focusing also on the numerous off-balance activities of the banking sector.

Finally, the preliminary results obtained in this empirical analysis may suggest some guidelines for future research: indeed, we have observed that an increase in off-balance credit derivative exposure, mainly due to loan securitisation, may determine both a positive and a negative effect on bank lending. Moreover, most of the insignificant results in the panel fixed effects estimation and in the panel VAR analysis are determined by the off-setting between effects of opposite signs, when none of them prevails on the other one. For this reason, given the importance of this outcome for the conclusions and for the policy implications of the analysis, future research plans should aim – both from the theoretical point of view and from the empirical one - to disentangle this puzzle due to the existence of heterogeneous and

opposite effects. Indeed, while the existing literature on securitisation and bank lending has focused the attention on the positive impact of securitisation – especially with regard to the originator banks – a key contribution of this paper has been to emphasize the existence of a negative impact due to the actual and potential losses from the off-balance credit exposure.

In particular, the paper formulates some hypotheses about the sources and the time dynamics of the effects - in order to understand the conditions under which the positive impact may dominate the negative one and vice versa – and then presents some results suggesting some plausibility of these hypotheses. Then, in the future research, it could be interesting to derive and to compare these opposite effects in a theoretical model of banking as well as to check the robustness of the discussed results by introducing a deeper empirical analysis, also based on a broader dataset. In particular, regarding the empirical study, some developments of the presented analysis can be achieved in the following directions: in the diagnostics of the results obtained from the panel VAR analysis, through the implementation of some specific tests for dynamic panels to this estimation framework; in the choice of the estimation framework to account for the role of contagion risk, eventually through the introduction of a non-linear switching model aimed to consider the impact of contagion risk on the behaviour of the lending variable.

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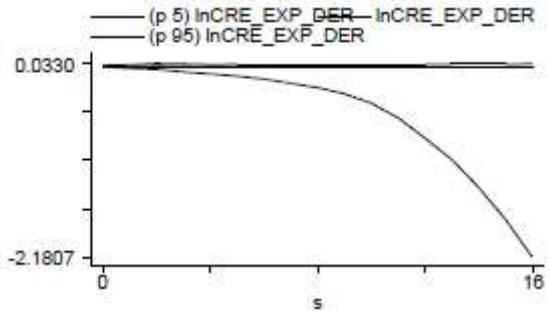
Appendix

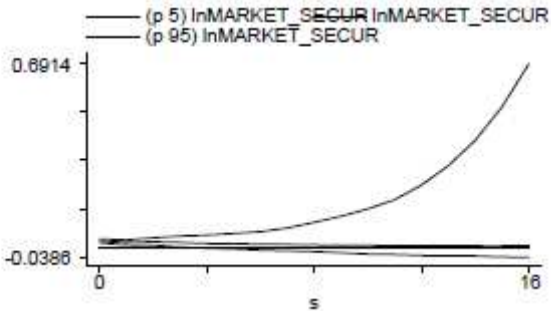
In this appendix I present the results of the Panel VAR analysis for the estimation of the model with 4 lags, in order to conduct a robustness check for the choice of the main specification, including 6 lags.

The Impact of Shocks on the Amount of Loans

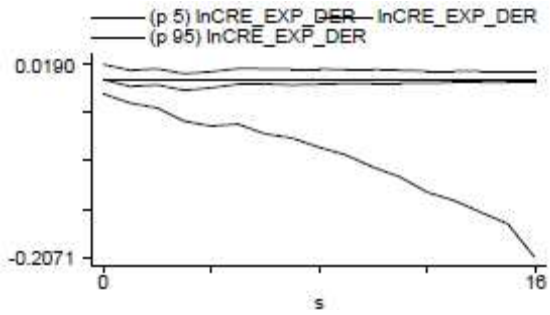
Graph 1. Response of lnTOTAL_LOANS to lnCRE_EXP_DER



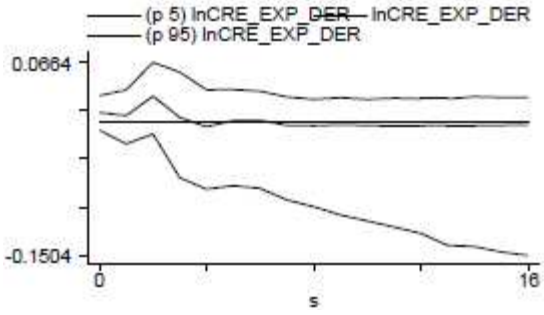
Graph 2. Response of lnTOTAL_LOANS to lnMARKET_SECUR



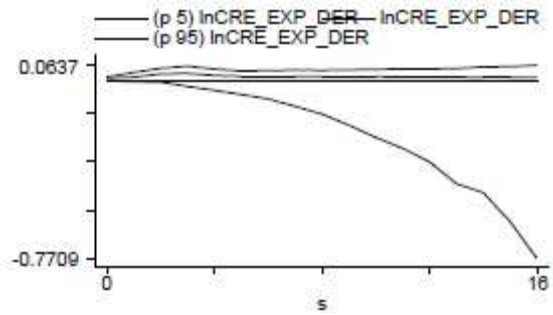
Graph 3. Response of lnRESID_MORT to lnCRE_EXP_DER



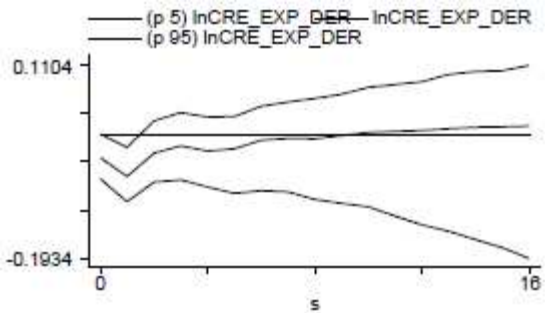
Graph 4. Response of lnCONSTR_LOAN to lnCRE_EXP_DER



Graph 5. Response of lnCOM_IND_LOAN to lnCRE_EXP_DER

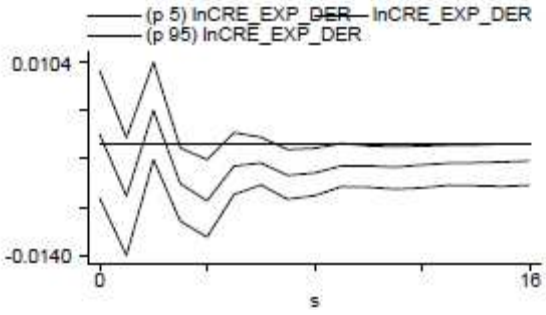


Graph 6. Response of lnAGRIC_LOAN to lnCRE_EXP_DER

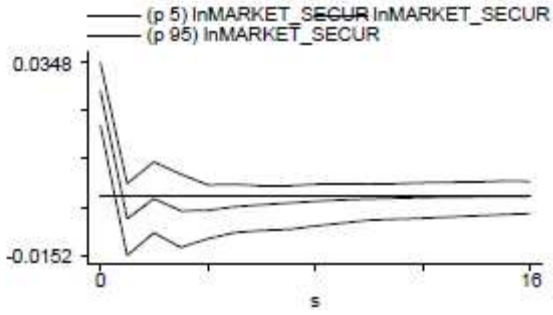


The Impact of Shocks on the Growth Rate of Loans

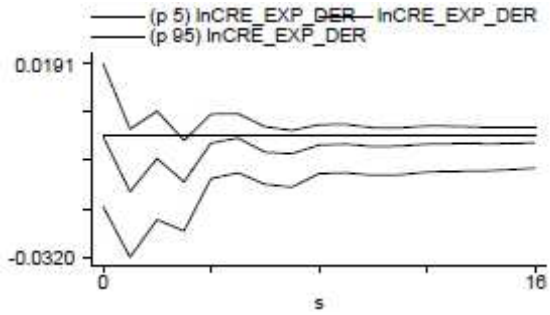
Graph 7. Response of G_TOTAL_LOANS to lnCRE_EXP_DER



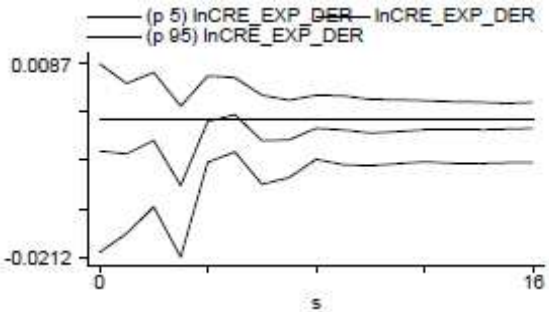
Graph 8. Response of G_TOTAL_LOANS to lnMARKET_SECUR



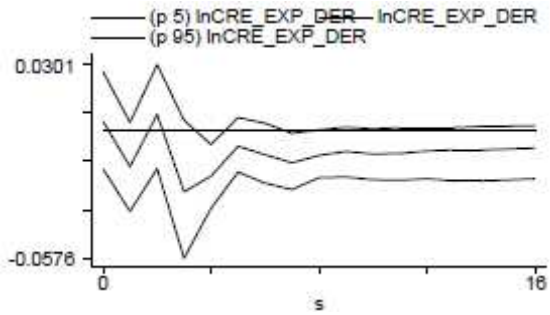
Graph 9. Response of G_RESID_MORT to lnCRE_EXP_DER



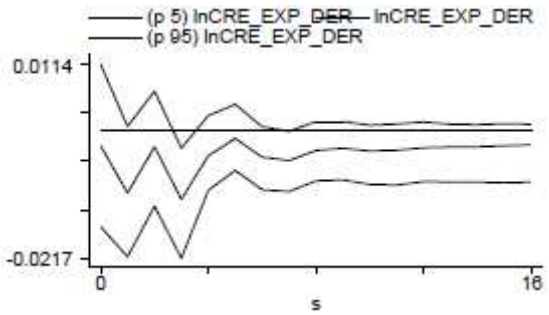
Graph 10. Response of G_NONRES_MORT to lnCRE_EXP_DER



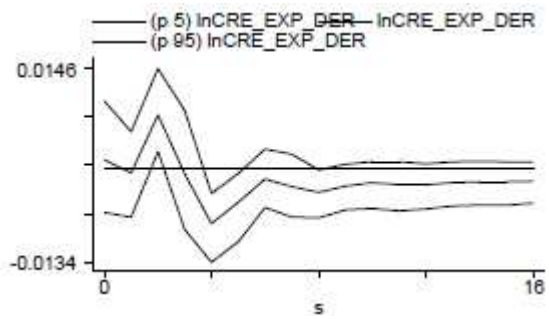
Graph 11. Response of G_CONSTR_LOAN to lnCRE_EXP_DER



Graph 12 Response of G_REAL_EST_LOAN to lnCRE_EXP_DER



Graph 13 Response of G_COM_IND_LOAN to lnCRE_EXP_DER



Graph 14 Response of G_AGRIC_LOAN to lnCRE_EXP_DER