The financial accelerator effect: concept and challenges

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Abstract

This review concentrates on the role of information asymmetry in financial markets in the amplification and propagation of short-run output fluctuations. We find that the financial accelerator effect, as it is known, provides a consistent, first principle based, theoretical framework for the analysis of the relationship between financial markets and short-run output fluctuations. It also provides a plausible explanation of the proximate causes of the recent crisis, and first principle-based theoretical background for the credit policy measures taken during this crisis by many central banks and fiscal authorities. Despite the theoretical plausibility, the empirical evidence about the economic importance of the financial accelerator effect is still relatively weak. We also suggest two new aspects to expand existing concept of the financial accelerator effect, which call for further research.

Keywords: asymmetric information, financial markets imperfections, financial accelerator, business cycles

1 introduction

In 1988 Mark Gertler summarized the stance of macroeconomic literature in the following sentence; Most of macroeconomic theory presumes that the financial system functions smoothly – and smoothly enough to justify abstracting from financial considerations (Gertler, 1988:559). Twenty years after, the severe consequences of the worst financial crisis since the Great Depression have drawn attention of a broader economic community to the idea that episodes of deteriorating credit market conditions, growing debt burdens and falling asset prices in financial markets are not just passive reflections of a declining economy, but can themselves be a major factor depressing real economic activity. The potential for the active role of financial markets in real economic activity was recognized and extensively investigated in the macroeconomic literature over the last two decades. Most of these researches have focused on the financial accelerator effect.

This literature essentially incorporates the partial equilibrium analyses about information-based imperfections on financial markets into a general equilibrium framework. The idea that the asymmetric information-based imperfections in financial markets can influence short-run aggregate economic activity was suggested by Bernanke (1983). In particular, Bernanke (1983) argued that the credit squeeze during the great depression arose mainly from the autonomous reaction of the banking sector to increased real costs of intermediation caused by worsening asymmetric information problems in the financial markets during this period. In other words, the credit squeeze was not just the passive response of decreasing demand for loans due to the decline in economic activity. Despite this early work, it was only after Bernanke and Gertler (1989) formalized this idea in a general equilibrium framework that it attracted the broader attention of the economic audience. Bernanke and Gertler (1989) constructed a general equilibrium model with incomplete financial markets, where the actions of all economic agents pro-

ceed from first principles, and in which short-run output fluctuations are amplified and propagated due to information-based credit market frictions.

This study reviews and discusses a growing literature on the financial accelerator effect. The review is organized in five sections. Section two presents the theoretical rationale for the financial accelerator effect. Section three discusses different ways to model this effect. The fourth section deals with the role of the financial accelerator in the monetary transmission mechanism. The fifth section discusses the findings and challenges this literature faces. The last section concludes.

2 THE FINANCIAL ACCELERATOR EFFECT

Short-run output fluctuations have usually been considered a result of various economic shocks, which are further transmitted by different propagation mechanisms. One of the common ways of thinking about the generation of output movements over a short-run period is an autoregressive (AR) process (see for example: Blanchard and Simon, 2001),[1]

$$\Delta y_t = \mu + \phi \Delta y_{t-1} + u_t,\ u_t \sim N(0,\sigma^2),\ |\phi| < 1 \qquad (1)$$

where Δy_t stands for growth rates of output. ϕ is the autoregression coefficient whose value measures the persistence of the effects of economic disturbances on output. The error term u_t symbolizes economic shocks. Under the assumption that the regression error term follows a normal distribution and that the absolute value of the autoregression coefficient is less than one[2], output variance is,

$$Var(\Delta y_t) = \sigma_y^2 = \frac{\sigma_u^2}{1-\phi^2} \qquad (2)$$

Consequently, the size of short-run output volatility depends on the size of economic shocks (size of economic shocks standard deviation, σ_u^2) and strength of the propagation mechanism (size of autoregression coefficient, ϕ).

Identification of economic shocks and propagation mechanisms sufficiently large to explain short-run volatility observed in macroeconomic time series has been the main issue of business cycle literature. The term financial accelerator is used for the economic shocks amplification and propagation mechanism, which aims to

[1] There are number of different univariate models that strive to find the best statistical representation for short-run properties of output time series. The AR(1) model is chosen in order to make the exposition simple and because it has become a standard reference point for these models. Furthermore, Hess and Iwata (1997) found that an AR(1) process is at least as good as, if not better than, other widely used nonlinear models at replicating business-cycle features of the US GDP.

[2] The assumption that $|\phi| < 1$ is necessary to keep the variance of time series generated by an AR(1) process positive and finite. This assumption should not be considered as restrictive since that kind of variance and the size of the autoregressive coefficient is commonly observed in output data across countries (see, for example, Ćorić, 2011). Namely, autoregression coefficient $|\phi| = 1$ will result in infinitely large variance, which is not observed in the output data.

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explain how relatively small economic shocks can have large and persistent effects on aggregate economic activity due to financial market imperfections. In the original Bernanke and Gertler (1989) formulation, it relies on the interplay between *economic agents' net worth* and the *external finance premium* that arises due to asymmetric information between lenders and borrowers.[3] Where economic agents' net worth is defined as: the sum of liquid assets plus collateral value of illiquid assets less outstanding obligations; and the external finance premium is defined as: the difference between the cost of funds raised externally and opportunity costs internal to the firm (Bernanke, Gertler and Gilchrist, 1999:1345). The relationship between the external finance premium and agents' net worth is commonly acknowledged as the keystone of the financial accelerator. This relation rests on two presumptions (Bernanke and Gertler, 1990).

First, the less the amount of his own wealth the borrower contributes to the project, the more his interests will diverge from the interests of the supplier of the external funds. There are two basic explanations for this presumption. The first one is related to the theory of credit rationing and the role of collateral in loan agreements. In brief, in the case of debt financing, borrowers will be more eager to undertake riskier projects. That is, projects that have a high probability of large return, but also those offering low returns. From the borrower's perspective these projects are preferred since the firms' losses in the cases when the project's return is low are limited to zero by legal regulation (limited liability assumption). From the lenders' point of view, these projects are unfavourable since they bear all, or most of, the costs in the case of low project returns. Implicit[4] or explicit collateral requirements reduce this divergence of interest between lenders and borrowers; collateral, or the level of own funds with which the borrower participates in the project, increases the costs the borrower will face in the case of low project returns. This way they will make borrowers less eager to undertake riskier projects that are seen as unfavourable from the lenders' point of view. So, as the borrowers' net worth grows, the costs they have in the case of low returns increase and, hence, the divergence of the interest between borrowers and lender should decrease (for details on the theory of credit rationing and the role of collateral in loan agreements see for example: Stiglitz and Weiss, 1981; Bester, 1985; and Besanko and Thakor, 1987). According to another explanation, if firms take too much debt in relation to equity they will not have a sufficient stake in the financial outcome and might therefore not behave diligently. The higher the agents' net worth in relation to the debt, the higher their stake in the financial outcome and the greater their incentive to behave diligently, hence, lower the divergence of the interest between borrowers and lenders (Holmstrom and Tirole, 1997).

[3] Although the formulation with external finance premium is most frequently used it is not the only possible approach, see below.

[4] An implicit collateral requirement presumes borrower's assets which are not explicitly assigned as collateral to a lender but which the borrower will lose in the case of default. For example, the lender's restriction that the maximal amount of a loan provided to a firm cannot exceed some percentage of its value, or some percentage of its asset value.

Second, in cases when the borrowers have superior information about projects' characteristics (value, riskiness, etc.), or abilities to take unobserved actions that can affect projects' return distribution, a greater incompatibility of interests between borrowers and lenders increases agency costs.[5] What types of costs agency costs would include depends on the way the information asymmetry in the credit market is modelled (see below). In brief, if a model is built on the assumption that information problems are solvable, then the agency costs will include costs of all real resources that the lender would be "forced" to spend to overcome these problems. On the other hand, if the underlying assumption is that those problems are not solvable, or at least not completely solvable, and credits are rationed in equilibrium, then agency costs will include the costs of suboptimal allocation of funds in the economy. So, the greater the incompatibility of interests between lenders and borrowers, the greater the extent of real resources spent on monitoring, selecting, etc., and/or the greater the extent of credit rationing in the economy. Consequently, the greater the incompatibility of interests, the higher the interest rate and/or the lower availability of credits.

The financial accelerator effect can be described as follows (figure 1). A change in aggregate economic activity causes a change in economic agents' net worth because of a positive correlation between them. Due to imperfect information, the terms under which economic agents are able to raise external finance, hence also the external finance premium, are inversely related to their net worth. In so far as the external finance premium is inversely related to economic agents' net worth, the procyclical behaviour of economic agents' net worth over business cycles implies countercyclical behaviour of the external finance premium. This inverse relation between output changes and the external finance premium makes borrowing more difficult and/or expensive during recession than during the expansionary phase. This in turn exaggerates swings in investment, spending and production over business cycles. For example, any negative economic shock that might lead to a decrease in economic agents' net worth would also increase the external finance premium. Consequently, due to higher costs, and/or reduced ability to borrow, the overall level of agents' investments, spending and production will decrease. In turn, that will depress the economy even further.

Economic disturbances that can be amplified and propagated by the financial accelerator mechanism include all shocks that cause: changes in the value of economic agents' liquid assets (change in cash position, short-term financial asset, etc.), such as, a change in productivity, a change in aggregate demand caused by a decrease in money supply, a decrease in foreign demand, etc.; changes in the value

[5] Agency costs are a broad range of different costs that arise in all economic transactions where the parties involved in those relations have different interests and where their actions are not observable, or at least not costlessly observable by all transaction participants. They are the wedge between the so-called first best and the second best solution. That is, the difference between costs of the transaction that takes place between two parties in situations in which the information is equally shared and costless, and the costs of the same transaction in the situation where information is not equally distributed between parties.

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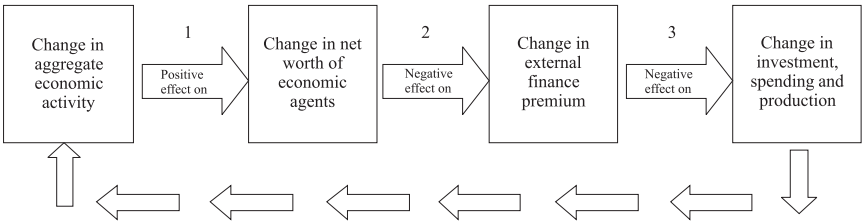
of economic agents' illiquid assets, that can arise due to either a change in interest rate or a change in the asset prices both of which can be caused by actions of economic policy makers or by changes in the expectations about future economic performance, etc.; change in economic agents' outstanding obligations can also be caused by a change in the interest rate, under the assumption that outstanding loans are subject to variable interest rates.

FIGURE 1
The financial accelerator effect



The arrows symbolize the mechanisms (channels) through which the financial accelerator operates, and the boxes represent events and their consequences for the economy. Arrow 1 represents a positive relationship between changes in aggregate economic activity and agents' net worth. In turn, Arrow 2 represents an inverse relationship between net worth and the size of the external finance premium. Arrow 3 represents an inverse relationship between the external financial premium and investment, spending and production. Finally, the return arrows represent pro-cyclical feedback into aggregate economic activity.

3 MODELLING STRATEGIES

The different modelling approaches to the financial accelerator effect reflect: the variety of different situations in which the asymmetric information problem between borrowers and lenders may emerge; different financial markets in which this problem can appear; different attitudes toward the question whether participants in financial markets can overcome the problem of asymmetrically distributed information or not; and different types of borrowers whose economic activities can be influenced by financial market imperfections.

3.1 DIFFERENCES IN MODELLING INFORMATIONAL ASYMMETRY

In general, it is possible to distinguish three major types of modelling strategies used by researchers to incorporate the financial accelerator effect into general equilibrium models (the main differences among these approaches are summarised at the end of this section in the table 1). The first two approaches, established by Bernanke and Gertler (1989) and Kiyotaki and Moor (1997), consider informational asymmetry on credit markets as the cause of the financial accelerator effect. The third approach, established by Greenwald and Stiglitz (1993) considers informational asymmetry on equity markets and managers' risk aversion as the cause of this effect.

Differences between the first two approaches, which concentrate on credit markets, arise due to the variety of situations in which informational asymmetry between ultimate savers and investors on the credit markets may be evident, and differences in the underlying assumption taken by these authors with respect to the question whether participants in financial markets can overcome the problem of asymmetrically distributed information or not.

In particular, the asymmetric information problem can emerge because borrowers' intentions, or honesty, or project riskiness, or project quality, or any combination of these characteristics is not observable to lenders before transactions take place (ex-ante asymmetric information problems). Once the transaction has taken place, lenders may not be able to observe borrowers' actions, project return or duration, or to force borrowers to repay loans (ex-post asymmetric information problems) (Jaffe and Stiglitz, 1990). A model that would include all the possible scenarios in which an asymmetric information problem may arise as sources of the financial accelerator effect would be extremely complicated, very difficult to build and highly intractable. The strategy adopted by researchers has been to use one particular formulation of asymmetric information problems as representative of all scenarios and to assume a priori whether or not those problems are solvable. As a result, different models have different formulations of the agency costs and the external finance premium.

The assumption that asymmetric information problems between borrowers and lenders are solvable implies that the lenders would use various techniques to deal with this problem: for example, screening; selecting among borrowers; monitoring (inspection of borrowers' cash flows, balance sheet position, management, realized return, etc.); engaging in a long-term relationship with borrowers; and enforcement of restrictive covenants such as a minimum solvency ratio or a minimum cash balance, etc. The use of all these instruments requires lenders' real resources and entails real costs for which lenders have to be compensated in equilibrium. Therefore, even in the cases when these techniques are able to reveal all the hidden or unobservable borrower characteristics, their implementation makes external sources of finance expensive to the borrower compared to the use of internal finance, where these costs are not present. The difference between these two sources of funds will be expressed in the form of the higher interest rate borrowers will be asked to pay. The external finance premium will in this case take the form of the difference between the interest rate on the external source of finance that agents with low net worth would be charged compared to the interest rate those agents would be charged in the situation where their net worth is high.

On the other hand, the assumption that asymmetric information problems between borrowers and lenders are not solvable implies that the borrowers would not always be able to obtain credit, or at least not the amount considered optimal from their point of view. In particular, in circumstances when lenders are not able to overco-

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me asymmetric information problems by screening, monitoring and other techniques, they might ration credit not by price but by quantity (Stiglitz and Weiss, 1981). In these cases, some borrowers will not be able to obtain funds even though their investment projects have a positive net present value (NPV). Under this assumption, external funds will cost even less than the firms are willing to pay, but they will be unavailable. The marginal productivity of firms' internal funds will be higher than the marginal costs of external funds, but the firms will not be able to borrow enough funds to equalize this difference. Hence, firms, and the overall economy, will be forced to produce inefficiently, that is, below the level where marginal productivity meets marginal costs. In those cases the external finance premium will take the form of the difference between the marginal value of the firms' internal funds and the marginal costs of the external funds, and will contain the costs of all the wasted resources and missed production opportunities.

The majority of the literature has adopted Bernanke and Gertler's (1989) approach (see for example: Carlstrom and Fuerst, 1997; Bernanke et al., 1999; Aoki et al., 2004; Elekdag et al., 2006; Gertler et al., 2007; Christiansen and Dib, 2008; Portes and Ozenbas, 2009; von Heideken, 2009; Magud, 2010; Freedman et al., 2010; Calvalcanti, 2010). To model the financial accelerator effect, Bernanke and Gertler (1989) applied Townsend's (1979) costly state verification hypothesis. This hypothesis thesis states that the problems caused by asymmetric information between borrowers and lenders arise from the fact that lenders are not able to observe borrowers' project return realizations cost-free. The borrowers can report false project results (declare default) to mitigate debt obligations and retain the difference between reported and realized project returns. Due to this possibility lenders are forced to implement return verification in cases in which borrowers declare bankruptcy. Since the implementation of return verification procedure is costly, to minimize costs lenders implement a random verification procedure, which constitutes a realistic threat of being caught to cheaters. An inverse relationship between the external finance premium and net worth comes from the point that the low borrower's net worth means that the borrower has less to lose in the case of fraud. Namely, since lenders apply return verification procedures only to some of the firms that declare bankruptcy, borrowers have the incentive to report false project results. The costs borrowers will have when they declare bankruptcy are equal to the value of their net worth plus reported project return. On the other hand, the potential (expected) benefits of fraud are equal to the difference between realized and reported project returns multiplied by the probability they will not be caught. So, in a case in which borrowers' net worth decreases, the costs they will have if they report fake project returns will also decrease. Since the potential benefits of fraud stayed unchanged, borrowers' incentive to report false project results will rise. To prevent potential losses due to dishonest behaviour, lenders should reduce the benefits borrowers derive from fraud. The way lenders can reduce these benefits is to increase the proportion of borrowers in the group of borrowers who declare bankruptcy to which the returns verification procedure

will be applied. That is, to increase the probability that cheaters will be caught. Since auditing imposes real costs on lenders, they will require higher interest rates to compensate for those costs. So, in circumstances when an adverse economic shock decreases borrowers' net worth, the external source of finance will become more expensive. Consequently, investment, spending and production at the aggregate level will decline.

Another way of modelling the financial accelerator effect proceeds from formulations in which lenders are not able to overcome information asymmetry. In particular, Kiyotaki and Moor (1997) assumed that asymmetric information problems are unsolvable since lenders are not able to enforce debt repayment by any means. Hence, lenders are not willing to lend if the loan is not completely secured by the value of borrowers' durable assets (such as land, buildings, and machinery). In such an economy, credits will be rationed not just by price but by quantity as well, and firms' ability to obtain loans will be directly dependent on the value of the collateral they can offer. Any shift in firms' net worth, in these circumstances, influences significantly their ability to raise external funds. The level of credit rationing will be countercyclical due to the procyclical value of collateralised assets. This will exaggerate swings in investment, spending and production over business cycles. So, in circumstances when adverse economic shocks decrease borrowers' net worth, external sources of finance will become less available. Consequently, investment, spending and production at the aggregate level will decline. This approach is adopted and further developed by Kiyotaki (1998), Iacoviello (2005), Monacelli (2009), Gertler and Kiyotaki (2010), and Martin and Ventura (2010).

The third modelling strategy, which is somewhat different, but can still be considered a way of incorporating the financial accelerator effect into the general equilibrium framework, was established by Greenwald and Stiglitz (1993). Although this formulation does not rely on the existence of the external financial premium, it still produces amplification of aggregate economic fluctuations due to informational asymmetry in financial markets and the procyclicality of firms' net worth. Namely, in Greenwald and Stiglitz (1993) firms are allowed to raise funds on a frictionless credit market, but are precluded from accessing the equity market. Limited access to the equity market is based on the asymmetric information considerations discussed by Greenwald et al. (1984), and Myers and Majluf (1984). In brief, in circumstances in which the firms' managements have "better" information about the true value of the firms' existing assets and/or investment projects, the firms' decisions to issue shares signals "bad news" to investors. Conversely, the firms' decisions not to issue shares signals "good news" to investors. In particular, investors consider equity issue as a signal that the firms' managements consider existing share prices to be overvalued. Since investors do not have full information about the firms' true value, they consider every equity issue in the same way. The consequence is that equity issue typically decreases the firm's share price, independently of the fact whether or not it is truly overvalued. Hence, even in the cases

when a project's NPV is positive, firms will often be reluctant to issue new shares and invest, because the decrease in share prices can outweigh increase in value arising from the project's positive NPV. Further, Greenwald and Stiglitz (1993) also assume that firms behave in such a manner as to minimize the probability of bankruptcy, since bankruptcy is costly for stockholders and especially for managers, due to loss of reputation. These costs induce firms to act in a risk-averse manner. Finally, firms operate in a stochastic environment where the outcome of every production and investment decision is uncertain. In an environment which is intrinsically stochastic and in which firms are risk-averse, changes in firms' net worth position can have potentially large effects on their willingness to produce. For example, economic shocks that reduce firms' net worth also reduce the level of their own funds with which the firm may contribute to investment in production. Consequently, if firms want to maintain the same level of investment in production, they have to increase borrowing. Insofar as debt obligations are in the form of state-independent claims, a rise in the share of fixed obligations in financial sources, in a stochastic world, increases the probability of bankruptcy. Since firms are risk averse they will be reluctant to increase borrowing, but will rather decrease investment in production. Decreases in firms' production get translated into decreases in the demand facing other firms, and through this mechanism shocks get transmitted further. Overall, similar to the previous models, financial market imperfections will, due to net worth procyclicality, amplify changes in economic activity over the business cycle. So far, this approach to modelling the financial accelerator effect has been adopted by Arnold (2002) and Gatti et al. (2007).

Table 1

Different approaches to modelling the financial accelerator effect

	Bernanke and Gertler's (1989)	**Kiyotaki and Moor's (1997)**	**Greenwald and Stiglitz's (1993)**
Cause of the financial accelerator effect	informational asymmetry on credit markets	informational asymmetry on credit markets	informational asymmetry on equity markets and risk aversion of firms' managers
Ability of financial markets participants to overcome informational asymmetry	problem can be solved	problem cannot be solved	problem cannot be solved
Change in net worth induce change in	cost of credits	availability of credits	willingness to borrow

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3.2 DIFFERENT TYPES OF BORROWERS

Another feature of the financial accelerator literature is that almost all studies in this field concentrate on one group of economic agents.[6] Following Bernanke and Gertler (1989), Greenwald and Stiglitz (1993) and Kiyotaki and Moore's (1997) seminal contributions, the large majority of general equilibrium models in this field concentrate on firms' borrowing in the formulation of interactions between imperfect financial markets and short-run economic fluctuations. The general orientation of the literature toward explanation of the financial accelerator effect through the behaviour of one group of economic agents (usually firms) is based on the intention to reduce technical concerns and keep models relatively simple to maintain tractability. This strategy is not a product of beliefs that the activity of other economic agents is not influenced by the same kind of financial market imperfections. On the contrary, as Bernanke et al. (1999) emphasized, a complete description of the financial accelerator mechanism will likely include a significant role for non-firm borrowers such as households and banks.

The financial accelerator effect on household spending occurs because households, as well as firms, finance some of their expenditures by borrowing. In particular, households usually finance investments in housing and purchases of other durable goods by raising funds in credit markets. These finance transactions are also characterized by asymmetric information problems between the borrowers (households) and the lenders (banks). Therefore, households' ability and/or terms under which they are able to obtain funds, hence their spending, are also influenced by their net worth. Since empirically a large proportion of households' borrowings are secured by real estate, the literature has focused primarily on the effect of changes in house values (seminal contributions include: Aoki et al., 2002, 2004; and Iacoviello, 2005). Aoki et al. (2004) described the financial accelerator effect on household spending as follows. A positive shock to economic activity causes a rise in house prices, which leads to an increase in homeowners' net worth. This decreases the external finance premium, which leads to a rise in housing investments and also spills over into consumption demand (spending on durables). Consequently, the same mechanism that propagates economic shocks through firms' investments should also work through households' spending and investments decisions. It does not seem unreasonable to assume that the effect of the net worth changes on households' investments should be even more pronounced than on the firms', since households are unable to raise alternative sources of finance through equity or bond issues, but are exclusively oriented towards banks as the sources of external funds.

Recently Gertler and Kiyotaki (2010) developed a general equilibrium model in which the financial accelerator effect emerges due to an asymmetric information

[6] For a model which simultaneously combines the financial accelerator effect on firms' and banks' economic activity in a partial equilibrium environment see Holmstrom and Tirole (1997). Iacoviello (2005) combines the financial accelerator effect on firms' and households' activity in a general equilibrium model.

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problem that constrains the ability of banks to obtain funds from depositors in retail as well as in wholesale ("inter-bank") financial markets. Since banks enter the deposit market as borrowers and given that they can go bankrupt as well as firms, there is no reason to assume that banks' ability to collect funds and/or the costs of the funds will not be influenced by their net worth (bank capital). To the extent that the economic shocks affect banks' net worth[7] it might also affect banks' ability to attract funds. Why does banks' net worth matter for attracting funds? The reason is the same as before – information asymmetry. Depositors cannot observe how much risk banks are taking while investing their money. However, they know that bankruptcy is costly. Higher bank net worth implies larger costs of bankruptcy and, hence, lower incentive to take risk. Additionally, higher bank net worth means a more liquid bank, that is, a better ability to compensate unanticipated losses and again a lower probability of bankruptcy. In sum, depositors will be more willing and/or will request a lower deposit interest rate to put their money in bank with high net worth. They will also be more willing to "contribute" to bank capitalization by investing in bank's issue of new shares if that bank has higher net worth. This is important because a negative effect of a reduction in banks' net worth on loans supply can also be caused by banks' intention to maintain a desired or imposed capital adequacy ratio (see below). Unlike that of firms and households, the economic activity of the banks does not consist of spending on durables and houses, or of production and investment. Yet, since banks finance these activities to a large extent, a change in their net worth can have an effect on aggregate spending, investment and production. The terms and amounts of the funds the banks collect directly determine the terms under which they lend, and the amounts they are able to offer to potential borrowers. Therefore, adverse changes in their net worth can cause credit tightening and negatively affect households' and firms' expenditure and overall economic activity.

4 MONETARY TRANSMISSION MECHANISM

The financial accelerator effect has recently been used in many different areas of research, for example: Cepedes et al. (2004), Gertler et al. (2007) and Magud (2010), among others, analysed properties of different exchange rate regimes using the financial accelerator framework; Olivero (2010) explored the relationship between the financial accelerator and international transmission of business cycles; Aghion et al. (2005) incorporated this effect in the analysis of the relationship between output volatility and growth. Assuming that entrepreneurs raise funds on imperfect credit markets, Wasmer and Weil (2004) developed a theory of job creation and job destruction that suggests the existence of a financial accelerator effect based on the general-equilibrium feedback between credit and labour market; Portes (2007), Portes and Ozenbas (2009), and Ćorić and Pugh (2011) explore the role of the financial accelerator effect in the so-called great modera-

[7] For example, negative economic shock can increase the non-performing loans rate and/or decrease the value of banks' securities. In the case of the exogenously induced increase in interest rate banks can also suffer capital erosion due to a maturity mismatch between banks' assets and liabilities.

tion. Hirose (2008) investigated sources of asset price fluctuation in Japan using this model. Using the general equilibrium model with financial accelerator, Freedman et al. (2010) estimated the effects of fiscal stimuli during the crises.

For example, in the monetary policy literature, the financial accelerator effect has been particularly intensively used. Almost in parallel with the financial accelerator theory there has been a development of literature that considers information-based financial market imperfections as a channel through which monetary policy measures influence aggregate economic activity, the so-called credit channel of monetary policy (groundbreaking contributions include: Bernanke and Blinder, 1988, 1992; Bernanke and Lown, 1991; Gertler and Gilchrist, 1993; Hubbard, 1995; Kashyap and Stein, 1995; and Bernanke and Gertler, 1995; more recent papers include: Iacovielo, 2005; Gertler et al., 2007; Monacelli, 2009; Van den Heuvel, 2009; Gertler and Kiyotaki, 2010). The financial accelerator effect has been considered one of the main mechanisms on which the credit channel is based (this channel consists of the bank lending channel and the balance sheet channel).

That is, the financial accelerator effect forms the theoretical background for the balance sheet channel. According to the balance sheet channel, a change in monetary policy impacts on the balance sheet (net worth) of firms.[8] A change in balance sheet affects their borrowing and, consequently, the overall aggregate economic activity. In particular, if changes in monetary policy are defined as exogenously induced changes in the interest rate (Bernanke and Mihov, 1998), then monetary policy changes can have effect on all three components of firms' net worth. For example, an increase in interest rate should induce a decrease in the market value of firms' illiquid assets simply because the market will discount future returns from those kinds of asset by a higher interest rate. Further, an increase in the interest rate may increase firms' indebtedness to the extent that corporate loans have variable interest rates. Finally, since the policy-induced increase in interest rate depresses the aggregate demand, firms' liquid asset flows, that is, flows from existing economic activity, can also decrease due to a decline in demand for products. Thus, the monetary policy-induced increase in interest rate pushes all three components of net worth in the "same", unfavourable direction. That increases the external finance premium and, consequently, depresses the aggregate economic activity. For the same reasons the borrowing, hence also the investment and spending of households, should be affected in the same manner.

The financial accelerator effect has recently been used to explain the bank lending channel as well. According to the bank lending channel, monetary policy can influence aggregate economic activity through policy-induced changes in loan supply. In short, the tightening of monetary policy reduces banks' lending capacity which, in turn, causes a decline in loan supply and/or tightening of the lending

[8] In the monetary literature the financial accelerator effect and the term net worth are also known as the balance sheet effect and balance sheet.

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conditions, and the reduction in overall economic activity. Opinions differ about what kind of monetary policy changes credit supply, and for what reasons. The "traditional" view focuses on the effects of reserve requirements and the central bank's open market operations.[9] The recent literature, however, has focused on the potential effect of monetary policy changes on banks' net worth (capital), and resulting change in loan supply due to the financial accelerator effect[10] (see for example: Kishan and Opiela, 2000; Hubbard, Kuttner and Palia, 2002; Aikman and Vileghe, 2004; Gambacorta and Mistrulli, 2004; Van den Heuvel, 2002, 2009). Namely, to the extent that changes in the short-term interest rate affect banks' capital they might also, due to information asymmetry, affect banks' ability to attract funds and, hence, their loans supply. This literature suggests that an increase in the interest rate might reduce banks' capital through two channels. The first channel is recognised by Bernanke and Gertler (1995), who note an increase in banks' holdings of volatile securities and derivative instruments. This might increase the sensitivity of bank lending to changes in the interest rate. For example, a rise in interest rate lowers the value of securities. That reduces banks' capital and negatively affects their ability to attract funds. The second channel is proposed by Van den Heuvel (2002, 2009). It arises due to a maturity mismatch between banks' assets and liabilities. Namely, deposits usually have a shorter time duration than bank loans. This means that interest rates on bank loans are slower to adjust to changes in the interest rates than the interest rates on their liabilities, simply because loans, on average, are less frequently (re)negotiated. Hence, this mismatch should decrease banks' profitability and reduce their capital. Taken together, when the central bank increases the short-term interest rate both effects should have a decrease in banks' capital as a consequence. Reduction in banks' capital will increase the agency costs of collecting funds and, in turn, negatively affect banks' ability to attract funds. The limitations in banks' deposit collection will then cause decline in loan supply and the reduction in overall economic activity.

5 DISCUSSION

The literature reviewed offers a coherent theoretical framework in which economic shocks are amplified and propagated due to information-based financial market frictions. The financial accelerator effect demonstrates that irrationalities such as herd behaviour, animal spirit or myopia, are not necessary to explain the active role of financial markets in real economic activity, and that financial markets can have an active role in short-run output fluctuations even when all economic agents conform to the postulates of rational expectations and optimising behaviour.

[9] According to this point of view, an increase in the reserve requirement level or/and the central bank's open market sales will contract the funds banks have at their disposal for lending and so reduce loan supply. The underlying assumptions are that banks are not able to easily compensate for lost deposits and that borrowers are unable to frictionlessly substitute bank loans with other sources of finance.

[10] This potential effect is also known as the bank capital channel.

The financial accelerator literature also offers a plausible first principle based explanation of the proximate causes of the recent crisis. If we consider the collapse of the subprime mortgages market in September of 2007 as the initial economic shock, then this shock can hardly be categorised as large. Although the size of subprime mortgages market was large in absolute terms ($0.7 trillion) it was less than 0.5 percent of the size of US financial markets (Bank of England, 2007). Hence, it is puzzling how default on these loans could become the source of the most severe crisis of this era. A possible explanation can be summarised as follows. The collapse of the US subprime mortgage market forced financial intermediaries to write off hundreds billion dollars in bad loans and caused an erosion of their capitalization. Deterioration of intermediaries' balance sheets harmed their ability to raise funds, which reduced their lending capacity. Consequently, lending standards that non-financial borrowers face tightened and loan supply declined. The credit crunch adversely affected investment, consumption and property prices that are sensitive to the free flow of credits and lending standards. Decline in house and real estate prices caused erosion of households' and firms' net worth and accordingly a decline in their debt capacity. Weakening of non-financial borrowers' debt capacity further increased external financial premium and amplified existing decline of investment, consumption and output. Decline of the aggregate economic activity, the ensuing rise in unemployment and reduction in housing prices increased the amount of nonperforming loans. This reduced intermediaries' profitability and further deteriorated their net worth with another pro-cyclical feedback into the aggregate economic activity. Overall, the initial shock to the financial sector itself seems to have caused and/or intensified the deterioration of the net worth of all three groups of economic agents and through the financial accelerator effect generated a severe crisis.[11]

The financial accelerator can also provide a theoretical background for the credit policy measures taken during this crisis by the Fed and many other central banks and fiscal authorities, which are often seen as old-fashioned and contradictory of modern economic theory. In particular, the Fed reacted to the current crisis using three types of credit policy measures: by making imperfectly secured loans to financial institutions; by lending directly to high grade non-financial borrowers; and by equity injection and debt guarantees to large financial institutions (Gertler and Kiyotaki, 2010). The same or similar measures to facilitate credit flows and boost financial institutions' net worth were taken by monetary and fiscal authorities of many other countries as well. Using the dynamic general equilibrium mo-

[11] It is important to stress that this is just one of the possible explanations of proximate causes. The ultimate causes of the recent financial crisis are still a matter of debate and intensive research. At the moment a few questions seem to be crucial with respect to the ultimate causes of recent financial crisis. What was the source of excessive liquidity on the financial markets of the US and other industrialized countries in the years before outbreak of recent financial crisis? To what extent did financial innovations and financial derivatives, which had been supposed to make the financial system more stable by diversifying risk and rising liquidity, amplify the problem of information asymmetry? Why did financial institutions engage in excessive risk taking? To what extent might the principal-agent problem between the owners and managers of financial institutions contribute to excessive risk taking?

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del in which the financial accelerator effect emerges due to changes in banks' net worth Gertler and Kiyotaki (2010) demonstrated that implementation of this kind of measures can have beneficial effect on the aggregate economic activity during the crisis by reducing the rise in the external finance premium. The results of Gertler and Kiyotaki's (2010) model simulations also demonstrated that the net benefits from these credit market measures increase with the severity of the crises, which helps to account for why it makes sense to employ them only in the cases of severe recession. These results are important because they demonstrate that these measures are in line with modern, first-principle based macroeconomic theory.

Theoretical consistency and the ability to offer a plausible explanation of the recent crisis has drawn attention of a broader economic community toward the idea of the financial accelerator. However, despite its recent popularity in the broader economic community, the empirical evidence on the economic significance of this effect is still relatively weak. The empirical estimates of the financial accelerator effect face three main difficulties. Problems that are commonly acknowledged are: potential endogeneity that hampers any evaluation of aggregate data, and inability directly to observe and measure the external finance premium.

A problem that has not been recognised, and that makes an empirical assessment of the financial accelerator effect even more difficult is that the existence of a procyclical external finance premium is a sufficient but not a necessary condition for the existence of the financial accelerator effect.

The financial accelerator effect suggests that adverse economic disturbances lead to a decrease in aggregate investment due to a shift in the credits supply curve caused by increases in asymmetric information costs. Hence, it seems that empirical tests can focus on the possible existence of procyclical movements in aggregate credit flows, that is, the existence of a positive correlation between aggregate credit and aggregate output movements. The strong positive correlation between these variables is, in general, observed in aggregate time series (see for example: Dell'Ariccia and Garibaldi, 2005). However, the joint test based on aggregate data is unlikely to be informative about the existence of financial accelerator (Bernanke et al., 1996). This testing procedure suffers from the so-called identification equivalence problem. The positive correlation between aggregate credit changes and GDP changes can be caused not just by movements in credit supply but by movements in credit (investment) demand as well. For example, King and Plosser (1984) demonstrated that procyclical movements of aggregate credit flows can be generated by a frictionless real business cycle model, in which changes in aggregate credits flows are caused solely by shifts in investment demand. The inability to distinguish between different sources of observed colinearity makes this testing procedure unsuitable. Hence, the empirical literature has followed alternative identification strategies. These empirical investigations consist of two groups of studies.

The first group of studies focuses on the relationship between variables that are meant to proxy the external finance premium and aggregate economic activity. That is, in the majority of models, the financial accelerator effect is based on a countercyclical external finance premium that is not directly observable. Gertler and Lown (1999) argued that the development of a high-yield debt market (the "junk bonds" market) in the early 1980s in the US can potentially resolve this problem. According to Gertler and Lown (1999) a high-yield bond spread[12] should provide a good overall indicator of the external finance premium since firms that raise funds by issuing high-yield bonds are the kind of firms that can be supposed to face frictions on credit markets. On the other hand, AAA rated firms are very unlikely to face asymmetric information problems on financial markets. During recession the cost of finance (bond rate), according to the financial accelerator effect, should increase more for firms that are more exposed to asymmetric information. Hence, the high-yield bond spread should rise. The reverse should be true over the economy expansionary phase. The results of their empirical tests confirmed this prediction of the financial accelerator theory. In particular, they found a strong inverse relationship between high-yield spread and output gap. The results of Gertler and Lown (1999) were confirmed by Mody and Taylor (2004), who recorded a high negative correlation between high-yield spread and annual percentage changes in real GDP. Recently, Aliaga-Diaz and Olivero (2010) found that price-cost margins for US banks are also consistently countercyclical, which can be an indicator of the financial accelerator effect in the banking sector. Although these results are consistent with the theory of the financial accelerator, a few issues challenge robustness and raise some concerns about this testing approach. First, whether high-yield bond spread is good proxy for external finance premium is a matter of debate; AAA rated firms are on average considerably larger than firms that raise funds on the high-yield bond market. The recent economic crisis has demonstrated that size (still) matters. Hence, the evidence that the bond rates of AAA rated firms increase less during recession than bond rates on the high-yield bond market can reflect investors belief in the "too big to fail" hypothesis. Furthermore, the large companies are usually more internationally diversified, which can make them less exposed to change in domestic GDP. Therefore, the negative correlation between high-yield spread and annual percentage changes in real GDP can also be the results of the larger international diversification of AAA rated firms. Second, identification of a countercyclical external finance premium does not necessary imply that this premium intensifies the effects of aggregate shocks. Third, the results of these studies are based only on US data, using a relatively short series, with only one significant recession in the cases of Gertler and Lown (1999) and Mody and Taylor (2004). Fourth, due to the short time period and lack of data for other countries, the potentials for further application of this approach are limited. Finally, the existence of external finance premium is not a necessary condition for the financial accelerator effect. In particular,

[12] The high-yield bond spread is the difference between high-yield bond rate and the corresponding rate for the bonds of AAA rated firms.

the information asymmetry on financial (equity) markets can amplify and propagate economic shocks because procyclical changes in economic agents' net worth produce countercyclical change in economic agents' exposure to risk (see Greenwald and Stigliz, 1993). In that respect, possible findings that external finance premium is not countercyclical or that a premium does not even exist (that credit markets are frictionless) would not imply that the financial accelerator effect is irrelevant.

As well as being a prediction about aggregate investment movements over time, the financial accelerator theory also has cross sectional implications. In particular, financial accelerator theory predicts that economic shocks should have a stronger influence on economic agents that face severe asymmetric information problems than on less exposed agents. The numerous panel data studies on the role of information asymmetry in determining real investment decisions can be considered as the second group of studies that provide empirical evidence in support of the financial accelerator effect. This literature employs the disaggregated (firm and bank level) data to test for the cross sectional difference in the effects of change in the internal source of finance on firms' investment and banks' lending. In brief, the literature was initiated by Fazzari, Hubbard and Petersen (1988) (FHP). FHP used Tobin's Q investment model to test for the effect of financial market imperfections on firms' investment. Underlying the FHP approach is the premise that firms' ability and/or the terms under which they are able to borrow, hence also their investment, are a function of their internal sources of finance (net worth)[13]. If this is the case then the estimated coefficient on the variable that measures firms' internal sources of finance (net worth) should be positive and statistically significant when it enters the investment regression equation. Moreover, its inclusion should increase the explanatory power of the standard investment specification. Finally, the estimated coefficient and increase of the explanatory power should be larger for the categories of firms more likely to face financial constraints, i.e. which are more exposed to the asymmetric information problem. The results of FHP empirical estimations were in line with these predictions supporting the hypothesis that internal sources of finance are an important determinant of firms' real investments. These findings have been confirmed by large number of empirical studies (for references and a recent review of this literature see Ćorić, 2010). Essentially the same approach, with similar results, has been used to test the role of information asymmetry in determining banks' lending decisions, that is, to test the credit channel of monetary policy (see for example: Kashyap and Stein, 1995, 2000; Kishan and Opiela, 2000; and Gambacorta and Mistrulli, 2004).[14] However, due to some serious shortcomings of this testing approach, these results cannot be considered robust evidence of the financial accelerator effect. For example, the financial accelerator effect is not in the primary focus of this literature, hence, this

[13] Firms' internal source of finance is usually proxied by cash flow.
[14] Empirical evidence consistent with some implications of the financial accelerator effect can also be found in: Peersman and Smets (2005), Almeida et al. (2006), Mody et al. (2007) and Cavalcati (2010).

literature does not assess to what extent the firms' net worth is procyclical and what the potential aggregate effects of these findings are. Furthermore, the recent research has produced three results that cast doubt on the evidence for financing constraints from the studies based on FHP methodology (Cummins, Hassett and Oliner, 2006). First, the cash-flow effect either disappears or becomes much smaller when one controls for the measurement error in Tobin's Q. Second, positive cash-flow coefficients can be generated without any financing constraints. Third, assuming that financing constraints exist, the size of the estimated cash-flow coefficient need not be positively related to the degree of the constraints, which undercuts the key identifying assumption of FHP methodology (for a detailed analysis of these researches see Ćorić, 2010). Although at the moment this literature does not provide robust results, this is a potentially promising line of research. First, the recent methodology for identification of financing constraints proposed by Hovakimian and Titman (2006) and Almeida and Campello (2007) is less subject to the above critiques. Second, since this estimation procedure does not test for the existence of external finance premium it is not subject to the critique that the external finance premium is not a necessary condition for the existence of the financial accelerator effect. Finally, data for this kind of empirical analysis are relatively available, at least for developed countries.

Overall, despite ample theoretical research based on the financial accelerator effect, more research is needed to assess the empirical significance of these models. The necessity of more empirical researches is especially urgent, for two reasons. The financial accelerator effect predicts that this effect should be stronger the deeper the recession is (due to the lower level of net worth). This implication seems to contradict common belief in the business and economic community (see for example, Chatterjeee, 2010), that in the deepest stages of recession the low credit level is caused by lack of credit demand caused by great uncertainty and low business confidence.[15] Second, the recent literature demonstrates that the financial accelerator effect theoretically can go in the opposite direction, "decelerating" economic shocks and reducing output volatility (see: Iacoviello, 2005; House, 2006; and Christiansen and Dib, 2008). Iacoviello (2005), for example, demonstrated that in a case in which debt contracts are written in the terms of the nominal interest rate, as is usually done, the additional possibility of Fisher's debt-deflation effect emerges. Whether the analysed effect is going to work as accelerator or rather as "decelerator" of economic fluctuations depends then on the nature of the economic shocks. In particular, in the case of a negative aggregate demand shock, decline in inflation amplifies any reduction in borrowers' net worth, due to an increase in the real value of borrowers' outstanding debt obligations, and hence, exaggerates the financial accelerator effect. Conversely, in the case of adverse aggregate supply shock a rise in inflation works in the opposite direction,

[15] The rationale for expansive short-run fiscal policy during recessions is also to a large extent based on the assumption that in recessions (especially deep recessions) government spending should act to substitute for lower demand for private investments (see for example, recommendations for fiscal policy during the recent crisis in Spilimbergo et al., 2009).

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reducing real value of borrowers' outstanding debt obligations. In that respect adverse supply shocks can be beneficial for the borrowers' net worth and consequently "decelerate" an economic shock.

With respect to possible further theoretical research, we suggest two new aspects to expand the existing concept of the financial accelerator effect.

Existing literature accounts for the problem of information asymmetry between economic agents, but not for the information asymmetry "within economic agents". In particular, in many firms, especially in banks, the owners are not the managers. Asymmetric information between owners and managers results in what is called the principal-agent problem. This problem is potentially important for the financial accelerator effect and its introduction in the financial accelerator framework can be informative. Namely, an economic agent's net worth is important for lenders because high net worth implies that an economic agent will behave more diligently and/or take less risk since its losses in the case of bankruptcy will be larger. However, in a case in which managers are not the owners of a firm or bank, their losses in the case of bankruptcy (loss of reputation) seem to be independent of the firm's or bank's net worth. Therefore when the principal-agent problem exists, an economic agent's net worth can lose its relevance for the lender. It is possible to speculate that the financial accelerator effect would still exist in this case since a higher economic agent net worth also implies a lower probability of bankruptcy, and also to speculate that in this case it is relative rather than absolute net worth that would be important to a lender. However, this should be investigated in more detail.

The literature also presumes that only an individual economic agent's net worth is important. The underlying premise is that a lender is able to observe a borrower's net worth. This assumption can be easily justified when banks are lenders. However, it seems less justified when banks are borrowers. Although banks are forced to release information on their capitalization on a regular basis it still remains doubtful how much firms, and especially households are informed about their net worth. For example, even if households do have information about these data releases it is very doubtful whether they have enough knowledge to understand them and compare capitalization among different banks. Consequently, it would be useful to analyse whether in the case of banks, information about soundness of the overall banking sector that can be communicated through the media or central banks' announcements; what the function of banks' aggregate net worth can be is also important. With respect to the results of existing financial accelerator models this would not make difference since their mathematical formulation is based on the representative agent approach. However, this might be important for the explanation and especially for the empirical assessment of the financial accelerator effect.

6 CONCLUSION

The severity of the recent economic crisis raises a question about the role of financial markets in modern market economies. This review concentrates on the relationship between information asymmetry on financial markets and short-run aggregate economic fluctuations, the so-called financial accelerator effect.

We found that the financial accelerator effect offers a consistent, first-principle based, explanation of the relationship between financial markets and short-run aggregate economic fluctuations based on informational asymmetry on financial markets. This effect also offers a plausible rationalization of the severe consequences of the subprime mortgages market's crash in September of 2007. Finally, this effect, or more precisely, the prevention of its even stronger manifestation, provides a theoretical background for the credit policy measures taken during the recent crisis by many central banks and fiscal authorities.

These features made the financial accelerator effect recently very popular in the broader economic community. Despite its popularity, and the recent financial crisis, which seems to confirm its significance, the empirical literature has faced serious challenges in the empirical identification of this effect. Overall, we found that existing empirical literature is still unable to provide robust assessments of the size and economic relevance of the financial accelerator effect. More empirical research is necessary especially because the recent literature demonstrates that this effect theoretically could go in the opposite direction and reduce output volatility as well. Finally, we made a case for two new lines of enquiry. In particular, we found that it might be informative to introduce the principal-agent problem between owners and managers into the financial accelerator framework; and also to consider the role of the aggregate net worth of banking sector in the financial accelerator effect and its empirical estimation.

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