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I dedicate this to my Mother and Father.

Thanks for always being there for me.

Contents

List of Figures

List of Tables

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Publications

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Abstract

A large body of the literature on finance and economic growth has been devoted to the impact of financial shocks and credit market imperfections on the real economy. On the one hand, financial frictions facilitate the propagation of business cycles, amplifying the effect of shocks that originate in the real economy. On the other hand, exogenous financial shocks may be also the primitive trigger of wide fluctuations in relevant real variables.

Whatever the channel, access to bank credit constitutes for sure an essential source through which finance supports a sustainable growth. Accordingly, we should expect that national GDP and bank credit to the private sector move always in the same direction, even in cases of short term fluctuations of the business cycle. However, empirical evidence shows that this is not always true. Many cases exist in which recessions were followed by a recovery in national GDP without a corresponding recovery in domestic and external credit to the private sector. These episodes have been treated in the literature under the name of *creditless recoveries*. The dissertation takes both a theoretical and an empirical approach to investigate the determinants and consequences of these puzzling phenomena.

Chapter 2

In chapter 2 we introduce the seminal work of Calvo et al (2006a,b) on creditless recoveries. We also present the different view of Biggs et al (2009, 2010), according to which these phenomena are only observable when considering changes

in the annual *stocks* of private credit rather than changes in its *flows*. Recurring to macro level data, we find that both the two approaches can actually lead to the evidence of creditless recoveries and that this even occurred in several European countries after the global financial crisis. Therefore, creditless recoveries in the Calvo and the Biggs sense should be considered as complementary rather than contradictory.

After the global financial crisis, creditless recoveries have been mainly characterized by a significant rebound in *measured* TFP, which captures not only technological changes but also sudden reversals in capacity utilization. In addition, firm level data show that different trends in bank credit and national GDP are due to both a *behavioral effect* and a *composition effect*. The latter reveals redistributive effects among firms, according to the degree of their indebtedness before the crisis. The former implies a generalized deleveraging at the enterprise level.

Chapter 3

In chapter 3 we set up a theoretical framework to justify the relevance of financial markets for the real economy and, at the same time, to better comprehend the mechanisms behind the occurrence of creditless recoveries. In this conceptual background, it is of primary importance the interaction between one exogenous factor, representing the health of the financial sector, and one endogenous component, which is the value of capital goods that can be used as collateral. Two different kinds of collateral constraints are considered. Constraints on short-term credit limit the available working capital, i.e. the firms' ability to sustain current expenditures for their activity. By contrast, collateral constraints on long-term credit mainly affect the new investments in tangible and intangible fixed assets, which are relevant for both current aggregate demand

and future potential growth.

In the same chapter we also introduce an accounting approach to analyse firm-level data, creating a bridge with the model presented. Such an approach shows several channels through which creditless recoveries may be possible at the enterprise level. In this context, the notion of production capacity is referred not only to fixed assets, but also to the gross working capital which is available to finance operating expenditures within a certain period. In a recession phase, the underutilization of production capacity not only implies that the fixed capital is partially unused, but also that the turnover of current assets is particularly slow. Therefore, at the beginning of the recovery phase, companies can increase their output levels by taking advantage of unused plants and equipment and by increasing the gross working capital turnover. Consequently, this early stage of the recovery does not require new bank credit neither for capital expenditure nor for increasing working capital.

Chapter 4

In chapter 4, we test empirically the hypothesis that creditless recoveries imply redistributional effects among industries with a different dependence on external finance for their capital expenditures. This analysis is useful to better examine the cause-effect relationship between credit and output during creditless recoveries. Indeed, if creditless recoveries are the result of impaired financial intermediation, the more the recovery is creditless the worse is the performance of industries that are heavily reliant on bank credit. Chapter 4 is composed by two main parts.

Part I (section 4.2, co-authored with Fabrizio Coricelli) focuses on industry-level data for a large sample of peak-to-recovery episodes at the country level between 1963 and 2003.

Based on this data, we actually find that industries more dependent on external finance recover more slowly when recoveries are classified as creditless, although this result is noticeable in emerging markets only and, especially, during creditless recoveries in the Biggs sense.

Tangibility and *Capital Intensity* are also relevant characteristics that induce a reallocation of growth among different sectors during creditless recoveries, signaling the importance of intrinsic collateral to face impaired financial markets. Finally, industries more dependent on trade credit relative to bank credit are less vulnerable during the peak-to-recovery episode (*substitution effect*). By contrast, at the country level, a lower relative dependence on trade credit leads to more robust recoveries (*contagion effect*). This suggests the existence of a propagation of financial distress and bankruptcy through trade credit chains during crisis episodes.

In part II (section 4.3), we analyze data available at the enterprise level for the European countries during the period 2003-2011, so capturing the global financial crisis. This study confirms that dependence on external finance is not the only characteristic that induces a reallocation of growth during creditless recoveries. In this context, in particular, we highlights that firms' reliance on credit can be of two types. On the one hand, reliance on bank credit is due to technological characteristics that make some firms more vulnerable in their productive capacity when credit is not available (*supply channel of transmission*). On the other hand, this reliance is due to lower demand of goods that are typically purchased with the help of external financing, such as investment or intermediate goods (*demand channel of transmission*). Finally, it is further demonstrated that both a substitution and a contagion effect descend from firms' dependence on trade credit as opposed to bank credit during the last crisis, especially in CEE countries.

Appendix A

The Appendix is a concise methodological note on the AMADEUS database that is used for our analyses at the enterprise level. AMADEUS is a dataset collected via national sources by Bureau van Dijk (BvD), providing a collection of accounts from companies balance sheets and income statements across 41 countries in both Western and Eastern Europe. The chapter describes the sample selection and the essential cleansing procedures to be adopted in order to improve data quality.

Chapter 1

Introduction

The global financial crisis that started in 2007 has generated renewed interest in the role of credit in shaping economic recoveries and in particular on creditless recoveries. The current dissertation tries to uncover the main channels at work during creditless recoveries, through original work on three dimensions: macro, sectoral and firm-level.

Content of the dissertation

Chapter 2 is an introductory chapter presenting two main arguments suggested in the literature on creditless recoveries, respectively referring to Calvo et al (2006a,b) and Biggs et al (2009, 2010). By offering a thorough analysis of the macro data, the chapter discusses the role of *composition* effects, associated to the reallocation of resources to activities less intensive in the use of credit, and the *deleveraging* effect, associated to a reduction in the use of credit per unit of output. The latter is related to the dynamics of capacity utilization during the various phases of a recession-recovery cycle.

Chapter 3 lays out a theoretical model extending a model by Quadrini (2011). Two main channels are identified through which credit affects the operation of a firm: an *investment* and a *working capital* channel. The investment channel is the one that dominates the analysis on the relation-

ship between credit and growth. The working capital channel is gaining importance in the recent literature on credit shocks and business cycle. The chapter is supplemented by some useful firm-level evidence documenting the theoretical arguments.

Finally, in chapter 4 we extend the well-known identification scheme of Rajan and Zingales (1998) and use both sectoral and firm-level data to document the role of alternative sources of financing as an explanation of creditless recoveries. In addition, we introduce an interesting and relevant distinction between a *supply* and a *demand* channel underlying creditless recoveries. The supply channel works through the effect that the contraction of credit exerts on firms that are more dependent on credit for their operations. The demand channel works through the reduction in demand of goods that are typically purchased with the help of external financing. The interesting aspect is that both supply and demand channels are linked to the credit shock.

Research questions

To summarize, the current dissertation aims at dealing with the following research questions:

1. Is it possible to observe any kind of creditless recovery in Europe after the Great Recession? (Chapter 2)

2. Is the approach of Biggs et al (2009, 2010) really in contradiction with the existence of creditless recoveries? (Chapter 2)

3. Which different mechanisms play an essential role in the occurrence of creditless recoveries? (Chapter 3)

4. What is the role of working capital in the occurrence of recoveries without credit? (Chapter 3)

5. Are creditless recoveries a consequence of credit impairment? What are the effects on productive reallocation among industries? (Chapter 4)

6. What is the role of trade credit during creditless recoveries? (Chapter 4)

Main results

The main results related to the set of research questions above can be summarized as follows.

Chapter 2

The chapter provides some important descriptive statistics. It concentrates on macro data to identify episodes of creditless recovery and actually observes that many European countries have experienced negative (or weak) credit growth during the recovery phase. By recurring to enterprise-level it also disentangles two types of creditless recoveries. The first one (in the Calvo sense) is characterized as the output recovery without an increase in the *stock* of bank credit, while the second one (in the Biggs sense) is characterized as the output recovery without an increase in the *flows* of bank credit. Evidences show that the two approaches should be considered as complementary rather than contradictory.

Chapter 3

In chapter 3 it is shown through an original theoretical framework that, during the recovery from a credit shock, firms can recover without credit for two reasons. First, they increase capacity utilization that typically drops in the downturn of economic activity. Second, firms increase the rotation of working capital, which allows them to save on the use of external funds. Therefore, output recovers without an increase in credit both for financing investment and working capital. The main ambition of this chapter is to pinpoint the mechanisms of how various financial constraints translate into weak economic activity and how they can be circumvented during creditless recoveries. To do this, we also introduce an innovative accounting approach to analyse firm-level data.

Chapter 4

During creditless recoveries, we find significant productive reallocation away from sectors more dependent on external finance. But this is so only in emerging markets. We also find evidence of the relevance of collateral constraints, as sectors with higher asset tangibility and more capital intensive production fares better in terms of output growth during creditless recoveries. Finally, we find a significant role of trade credit. At the industry level, indeed, a lower dependence on bank credit relative to trade credit is associated with a better output performance of firms during the peak-to-recovery episode, especially when the recovery is creditless (*substitution effect*). At the country level, by contrast, a lower dependence on bank credit relative to trade credit appears to have a negative impact on growth during recoveries. This suggests the existence of a propagation of financial distress through trade credit chains during crisis episodes (*contagion effect*). In our opinion, Chapter 4 represents a very useful empirical contribution, starting from a relevant job in creating large datasets at the sectoral and firm-levels.

Chapter 2

Creditless Recoveries After the Great Recession: A European Perspective

2.1 Introduction

A large body of the literature on finance and economic growth has been devoted to the impact of financial shocks and credit market imperfections on the real economy. On the one hand, financial frictions have an important role in the propagation of business cycles, amplifying the effect of shocks that originate in the real economy. On the other hand, financial shocks may also be the primitive trigger of wide fluctuations in relevant real variables. This is the case, for example, of high borrowing costs and low availability of credit unleashed by the initial deterioration of bank capital. Whatever the channel, access to bank credit constitutes for sure an essential source through which finance supports a sustainable growth. Accordingly, we should expect that national GDP and bank credit to the private sector move always in the same direction, even in cases of short term fluctuations of the business cycle. However, empirical evidence shows that this is not always true. Many cases exist in which recessions were followed by a recovery in national output without a cor-

responding recovery in bank credit.

The phenomenon of *creditless recoveries* has been recognized for the first time in Calvo, Izquierdo, and Talvi (2006a,b), henceforth cited as CIT. According to the authors, these episodes manifest themselves just as periods in which national GDP comes back to positive growth after systemic output collapses, while domestic and external credit to the private sector remains weaker than in pre-crisis years. Following CIT, several other papers focused on the existence and the characteristics of these episodes. In this chapter, in particular, we compare the seminal work of CIT and an analysis made in Biggs, Mayer, and Pick (2009, 2010), henceforth cited as BMP. As we will see, the approach followed by BMP conflicts with the idea of creditless recoveries. Indeed, according to the authors' view, the identification of these phenomena would be only due to an incorrect measurement of credit developments, i.e. considering changes in the annual *stocks* of private credit rather than changes in its *flows*. However, in our opinion, the CIT and the BMP approaches should be possibly considered as complementary. Indeed, we highlight in this chapter that creditless recoveries can actually occur according to both the CIT and the BMP assumptions on credit.

After introducing these topics, we want to test whether creditless recoveries occurred in the aftermath of the global financial crisis of 2008 and 2009. In particular, we concentrate our analysis on a large number on European countries, for which we have data not only at the macro level but also at the firm level, thanks to the AMADEUS database. AMADEUS is a dataset collected via national sources by Bureau van Dijk (BvD), an electronic publishing firm providing company information. Based on this data, we can make a useful comparison between what happened at the macro level and what happened at the enterprise level during and after the crisis in a panel of heterogeneous countries.

According to the macro level, we actually prove that creditless recoveries characterized several European countries in the aftermath of the global financial crisis. Moreover, we show that the components of aggregate demand that are potentially more dependent on external financing, and in particular investments in gross fixed capital formation, are those

suffering the most during the crisis. On the supply side, the recovery phase 2009-2011 is characterized by weak growth in capital formation, a negative contribution of employment and a relatively faster rebound in total factor productivity (TFP). As in CIT, changes in measured TFP explain the most part of variations in national GDP during both the recession and the recovery period. In short run fluctuations, this is likely to be due to sudden reversals in capacity utilization at the firm level rather than to technological changes. This draws attention on the importance of distinguishing among *true* TFP and *measured* TFP, since the last is strongly affected by liquidity crunches and the consequent movements in working capital at the micro level.

At the same time, analyses on the AMADEUS dataset show that the different trends in credit and GDP observed at the aggregate level are due to both a *behavioral effect* and a *composition effect*. The former implies a generalized reduction in the debt-to-output ratios at the enterprise level. By contrast, the composition effect is due to redistributive effects among firms, according to the degree of their indebtedness before the crisis. We also reveal that the composition effect, in turn, may have different motivations when moving from one country to the other. In some regions, a negative composition effect may be due to difficulties of high-leveraged firms in further increasing their long-term debt and, consequently, their physical capital and their productive capacity. In other regions, it may rather signal cases of liquidity crunch in the CIT sense, mainly affecting firms with higher dependence on short-term financing.

The chapter is organized as follows. In section 2.2, we briefly introduce the existing literature on the relationship between finance and the real economy and, in particular, we present the main mechanisms through which bank credit may generate or amplify fluctuations in national GDP. In section 2.3, we introduce the puzzling phenomenon of creditless recoveries, by focusing on the contrasting approaches of CIT and BMP. Section 2.4 shows that some European countries actually constitute valid examples of creditless recoveries in the aftermath of the last global financial crisis. In light of this, section 2.5 looks at demand and factor input contributions to GDP growth in order to understand which

components suffer the most in front of persisting financial frictions. Sections 2.6 and 2.7 are dedicated to the analysis of data at the firm level. The former introduces the differences between behavioral and composition effects, while the latter deepens our knowledge of changes in balance sheet items of the private non-financial sector during the global financial crisis and, in particular, in cases of creditless recoveries.[1] Finally, in section 2.8 we state the conclusions.

2.2 Relevant literature on the importance of the financial channel and of bank credit for the real economy

Bank credit to the private sector plays a crucial role in supporting productive activities. It is needed for investment and working capital, and also for specific consumption purposes. Actually, the level of financial development and the stability of bank credit matter both from a long-term structural perspective (i.e. ten or more years) and a short-term business cycle perspective.

From the long-run perspective, abundant academic research has been devoted to modeling credit market imperfections and explaining the impact of financial development on potential growth. The basic argument is that the information asymmetries that typically characterize financial relations may severely limit the access of the private sector (households and enterprises) to bank credit. In this sense, financial development just measures how much the credit market in a country is imperfect. By reducing financial market imperfections, financial development cuts down the cost of raising funds and the reliance of credit supply on firms' and households' net worth and collateral, thus enabling them to obtain the desired amounts of external funds, in line with their specific technological needs and preferences. The lower the imperfections are, the better are the solutions and the alternatives in the hands of potential borrowers to get external financing.

[1] Such an accounting approach will be further developed in chapter 3.

Financial development has also a beneficial impact on the selection of promising investment projects to the detriment of unproductive activities, thus promoting technological innovation and affecting the market structure. According to Schumpeter (1934), for example, banks promote growth by identifying entrepreneurs with innovative projects and reallocating capital to high return uses, thus accompanying the process of creative destruction. Abundant academic research introduces models where financial development directly influences the goodness of investment made within a country or the costs incurred by potential borrowers to raise external fund.[2] Other papers empirically analyze industry-level and firm-level data in order to demonstrate that causality effectively goes from financial development to long-run output growth. Rajan and Zingales (1998), in particular, do this by evidencing how the comparative advantage of sectors that are more dependent on external finance increases with the level of financial development.[3]

However, just as financial development significantly contributes to growth, so in crisis years the fragility of the financial sector contributes to instability. From a short-run perspective, there is a long tradition in macroeconomics, dating back at least to the *debt deflation* formulation presented in Fisher (1933), to model the impact of financial shocks and credit market imperfections on the real economy and, also, to explain how they may amplify and prolong the fluctuations within business cycle frequencies. The existing literature on these topics[4] typically brings them under the heading of *financial accelerator*.

Moreover, a large body of literature also described how frictions in the credit markets may amplify the effects of monetary policy on the real economy, a mechanism known as the *credit channel* of monetary policy transmission.[5] Quadrini (2011) clearly shows that the assumption

[2]See, for example, Greenwood and Jovanovic (1990).

[3]See Levine (1997) for a general review of the topic. Interesting contributions are also to be found, among the others, in Demirguc-Kunt and Maksimovic (1998), Jayaratne and Strahan (1996), Levine and Zervos (1998).

[4]See, for instance, Bernanke and Blinder (1988), Bernanke and Gertler (1989, 1990), Kiyotaki and Moore (1997), Holmstrom and Tirole (1997), Bernanke et al (1999).

[5]As shown in Bernanke and Gertler (1995), the credit channel, in turn, can be broken down into two mechanisms that explain the link between monetary policy and the cost

that financial markets are imperfect is central to explain the mechanisms mentioned above. Indeed, accepting the existence of information asymmetries implies recognizing issues (such as moral hazard or contract design problems) that are not considered in standard neoclassical economic models. First of all, because of limited enforceability of debt contracts, potential borrowers are subject to collateral constraints (Kiyotaki and Moore, 1997). In this framework, durable assets not only serve as productive inputs, but also to secure loans from banks. Second, because of imperfect information, financial arrangements between borrowers and lenders involve significant agency costs (Bernanke and Gertler, 1989) as also shown in the *costly state verification* problem of Townsend (1979).

The interaction between financial factors and the real economy is just based on the fact that both collateral constraints and agency costs depend on the borrower's liquidity and net worth, i.e. on the quality of its balance sheet. By altering the net worth of potential borrowers, current and future sales as well as asset prices may thus increase (or decrease) the cost of external funds and, consequently, reduce (or enhance) their ability to borrow, invest and consume. Therefore, in a general equilibrium framework, this mechanisms ultimately contribute to amplify (and, possibly, even generate) output fluctuations at business cycle frequencies. This process is self-reinforcing and, in favorable periods, may even increase vulnerabilities in the financial system and lead to bubbles where assets prices are no more in line with economic fundamentals.

However, several events can intervene to interrupt the cyclical persistence induced by financial accelerator mechanisms and reverse the trend of economic expansion. On the one hand, bank credit may initially decrease because of primitive negative shocks (e.g. bank runs) directly affecting financial intermediaries, which consequently constrain lending to protect their liquidity. On the other hand, bank credit may decrease because of declining ability of borrowers to post collateral. This can be motivated alternatively by falling asset prices, failed investments, bankruptcies, primitive shocks in demand or productivity. All of them,

faced by the private sector to raise funds externally: the *balance-sheet channel* and the *bank-lending channel*.

indeed, may affect the balance sheets of households and firms, thus inducing an initial deterioration of their financial position. This, in turn, increases the cost of credit and the amount of collateral required by banks and, consequently, reduces the resources for investment in fixed assets and the provision of liquidity, with a potentially adverse impact on the real economy. Indeed, since external and internal funds are not perfectly substitutable, as well as bank credit and alternative forms of external financing (e.g. many firms do not have access to equity capital), then impaired credit markets often constitute an impressive constraint on output growth. Finally, output collapses at the firm level imply further deterioration of net worth and additional reduction in the access to financial services, thus perpetuating the consequences of the initial shocks, as actually happened after the global financial crisis of 2008.

It is relevant to notice that a large body of academic research recurs to the Rajan and Zingales (1998) measure of *external finance dependence* as the relevant industry characteristic to explain not only the heterogeneous effects of financial development on long-run output growth, but also the effects of financial shocks on short-run fluctuations.[6] However, we stress the fact that additional industry characteristics may potentially give similar, or even superior results, especially when considering business cycle frequencies. This is the case, for example, of *liquidity needs*, which is the amount of working capital that is necessary to finance firms' day-by-day operations.

In fact, while the Rajan and Zingales (1998) measure of external dependence is designed to quantify how much external funds are needed to invest in fixed capital assets, liquidity needs are more likely to capture the reliance of each sector on supportive financial conditions in the short run. Actually, since physical capital investment is discontinuous and lumpy at the microeconomic level,[7] working capital investment is possibly more relevant for the short-term productive capacity. Raddatz (2006), for example, shows that the role of financial markets in providing liquidity is essential for reducing output volatility of industries that use

[6] See, for example, Braun and Larrain (2005).

[7] See Caballero et al (1995).

large amounts of working capital. Furthermore, it also provides evidence that banks play an even more essential role in liquidity provision than equity markets, especially in developing countries, where bank overdrafts are much more important than alternative sources of funds, such as commercial papers.[8]

2.3 Open questions in the literature on creditless recoveries

In this section, we focus our attention on the phenomenon of *creditless recoveries*. According to what we outlined in the previous section, we should expect that national GDP and private credit tend to go hand in hand even in cases of short term fluctuations of the business cycle. Episodes of creditless recoveries show that it is not always so. The puzzling occurrence of recoveries without credit has been documented for the first time by CIT, although with a specific reference to emerging markets only. Indeed, CIT identifies two stylized facts that characterize several crisis episodes in developing countries, i.e. *sudden stops* and *creditless recoveries*. Systemic sudden stops are defined as severe drops in capital inflows, accompanied by unusually large bond spreads and also, typically, by severe output collapses. Creditless recoveries, instead, are defined as episodes in which output returns to pre-crisis levels after recession phases while no resumption occurs in external or domestic credit. Although CIT concentrate their analysis on creditless recoveries that follow systemic sudden stops, these phenomena are not necessarily a specific feature of these collapses. Indeed, while sudden stops tend to be concentrated in short periods of time and are generally limited to emerging economies, creditless recoveries take place also in developed countries, as clearly shown in Claessens et al (2009). It is nevertheless true, as also stated in Darvas (2014), that the frequency of these phenomena is higher in emerging markets, which are in their financial early life, than in countries with more developed financial systems.

[8] See also Levine and Zervos (1998) and Beck et al (2000).

CIT also define creditless recoveries as Phoenix Miracles, just referring to the bird of Greek mythology that obtains new life by arising from the ashes of its predecessor:

> "*The existence of phoenix-like recoveries suggests that financial frictions play a key role in pushing economies to the abyss from which, in some way or another, they can crawl back to safe ground by means less than apparent to the conventional observer looking for standard 'fundamentals' and, thus, may appear miraculous*".

According to CIT this apparent paradox may be explained by the fact that, following systemic sudden stops (and in the face of financial frictions that continue to affect the economy), firms may finance their working capital and get back to their pre-crisis production by finding alternative sources to support their short-term needs and by cutting back on long-term investments in physical capital. However, further investigations are needed to better comprehend the determinants and consequences of creditless recoveries. This is just the main objective of analyses that will be developed later, in chapters 3 and 4. For the moment, we just want to dwell on which are the essential aspects to be taken in consideration to better examine the phenomenon of creditless recoveries.

The first aspect to consider is what *creditless* exactly means. In particular, we wonder whether we should refer to the outstanding stocks of credit or to the flows of credit itself when examining the credit changes during recovery years. Should we compare the GDP level with the amount of bank credit to the private sector or with its annual variation? These questions prompt us to compare two essential research works on creditless recoveries, which are just CIT and BMP. The two works follow two contrasting approaches to describe these phenomena but, in our opinion, they should be possibly considered as complementary. In the following paragraphs, we just provide a brief explanation of the two different perspectives of CIT and BMP as regards the existence of creditless recoveries.

In the partial equilibrium model presented by CIT, bank credit is identified with *intra-period loans* that are only used to maintain the work-

ing capital, i.e. to sustain cash or liquid assets typically needed for day-by-day operations (e.g. inventory accumulation and salaries). Since bank credit is entirely repaid within one single year, from this perspective it makes sense to base the definition of creditless recovery on the annual change of credit stocks rather than of credit flows. In CIT, the collapse of bank credit is the equivalent of a liquidity crunch. Investments in fixed assets do not rely on external financing, since they are self-financed through retained earnings as it typically happens in emerging countries. However, during episodes of creditless recovery, the most part of available funds is not devoted to physical capital and, consequently, investments remain very weak. A large part of retained earnings, indeed, is dedicated to working capital, thus substituting the impaired bank credit. This also explains the behavior of *Total Factor Productivity* (hereafter TFP) that, in the episodes analyzed by CIT, accounts for the most part of the changes in aggregate production during both the recession and the recovery periods. According to the authors, fluctuations in TFP are due to the fact that in growth accounting the *measured* TFP growth is obtained as a residual and may diverge significantly from the *true* TFP. Indeed, true TFP is assumed to be closely linked to technological progress and not highly volatile in the short term. By contrast, measured TFP is affected in the short term by additional factors, that are likely to comprehend the impact of significant financial constraints. This is the case, for example, of a temporary underutilization of production capacity, which has nothing to do with the true TFP but negatively affects the measured TFP. We point out that the reason for capacity underutilization in CIT is not low aggregate demand, but the credit and working capital constraints. As such, capacity underutilization is the result of a liquidity crunch. From this perspective, firms do not fully use their productive capacity during recessions because significant disruptions in the credit market impose a constraint on the optimum level of day-by-day operations.

BMP, on the contrary, present a closed-economy model where credit is mainly needed to buy investment goods, since they cannot be financed through retained earnings. This implies the existence of a very strong link between credit and real domestic demand. However, in BMP mo-

del the accumulated stock of bank credit is not entirely repaid within one single year. On the contrary, it manifests itself in the form of *inter-temporal loans*, so that only its annual increase can be associated with the financing of new investments in the current period. Thus, what matters for aggregate demand (and GDP growth) are mainly the flows of new credit. If credit flows are constant, their contribution to investment growth is zero. If they have a steady growth, then the same occurs to the gross fixed capital formation. Therefore, from this perspective, it is reasonable to base the definition of creditless recovery on the annual change in credit flows, dubbed *credit impulse* in BMP, rather than on growth of the outstanding credit stocks. However, in BMP there is no investment without new credit and there is a very low probability of real growth without investment. This leads the authors to state that the puzzle of creditless recoveries does not exist or it is very unlikely to occur once we refer to the credit impulse as a measure of weakness in bank lending.

As we shall see, the reasoning of BMP has both merits and shortcomings. Actually, behind the choice to take in account the flows of new credit there is a shareable justification. The debt incurred for capital expenditures cannot be repaid within a single accounting period. Therefore, the new credit financing any investment in fixed assets adds up to the outstanding amount of debt. So it makes sense to assume that investments in the current year are more correlated with annual changes in debt than with the stock of debt accumulated over time.

However, borrowing can provide funds not only for capital investment but also for day-by-day financial operations and ongoing expenses, such as labor costs and the purchase of intermediate goods, which are necessary to support production cycles. A company, for example, may need to resort to intra-period loans for the sustenance of current expenses just because the produced goods are sold with a certain delay compared to the time when firms have to bear the costs of production. These credit lines do not involve an increase in the stock of debt, because they are renewed from period to period and entirely repaid at the end of each production cycle by recurring to the corresponding cash flows. If production remains stable over time, amounts due to banks are renewed perpetu-

ally at each production cycle, so that the flows of new intra-period credit perfectly overlap with the outstanding stock. From this perspective, the variable we are most interested in is just the stock of credit, as indicated by CIT.

To highlight the inconsistencies in the reasoning of BMP, it is necessary to point out that in their model there cannot be capacity underutilization due to a liquidity crunch as in CIT. Thus, we reasonably suspect that the puzzle of creditless recoveries is negated by BMP simply because they deny one of the most likely drivers of creditless recovery, i.e. the return to a full utilization of the existing production capacity after a financial crisis. In BMP, output is only affected by shocks to aggregate demand and, at the same time, there are no alternatives to credit in order to stimulate the demand itself. By contrast, according to CIT view, investments give an insignificant contribution to recovery during phoenix miracles and, then, it is still perfectly possible to justify a situation where credit flows and GDP move in opposite directions.

Actually, both approaches are useful and offer complementary insights into the determinants of output growth. Moreover, they also help to make clear that even the definition of *recovery* is absolutely not trivial and, indeed, makes the difference. Actually, a *full recovery* would necessarily require (i) the return to the pre-crisis peak or, according to an even narrower view, (ii) the return to the pre-crisis trend. The former is more easily observable and, as we will see, it is what actually occurred in several European countries in the period 2009-2011. In a peak-to-recovery approach *à la* CIT, the recovery is evaluated by comparing GDP levels with their pre-crisis peak, as in definition (i). As mentioned above, for a *full* recovery of this type it may be sufficient a rebound in the financing of working capital while investments remain flat and the capital stock remains constant. By contrast, a resumption of type (ii), i.e. a reversion to pre-crisis trend, would require that the stock of capital and the investment growth return in line with the trend. The same goes for the role of TFP, which typically tends to explain most of the long-run growth in output. Therefore, a recovery in the utilization of existing production capacity without a parallel recovery in investments is not enough to pursue

full recovery according to definition (ii).

Empirical evidences confirm that financial crises and creditless recoveries are generally characterized by an output resumption of type (i). Cerra and Saxena (2008), for example, show that after financial crises we have a permanent loss in output with respect to its pre-crisis trend and lower growth in the long-run. GDP restarts, though at lower levels, with accumulated gaps resulting impossible to fill. As stated above, one possible reason for this permanent loss is the significant drop in investments during the financial crisis. Even if the financial market wakes up, it is often impossible to fill the gap in the stock of capital accumulated during the crisis. To make things worse, if credit supply remains weak, firms even struggle to get back to the pre-crisis growth rate of investments and the permanent loss becomes even more pronounced. One additional reason for the lower long-run growth is a stagnation of true TFP after financial crises, which is not an implausible occurrence. Indeed, as also noted in CIT, in the face of financial frictions that persist after the crisis, firms necessarily focus on working capital management and are likely to assign a lower priority to increasing their long-term productivity. However, the extent to which the true TFP growth is actually influenced by the availability of bank credit remains to be better clarified and would be an interesting avenue for further research.

One final aspect to consider when examining creditless recoveries is the necessity to distinguish among demand- and supply-side explanations for the weakness of bank lending. Low credit can be due to low demand of external financing or, on the contrary, to constraints on the supply-side of bank credit markets. Only the latter would require policy actions aimed to solve problems at the banking system level. Indeed, tight credit constraints may induce the private non-financial sector to delay their capital and current expenditures or, alternatively, to recur to more expensive financing sources. The lack of bank credit may also negatively affect the quality of the market structure, by favoring industries that are less dependent on external finance because they contribute less to the capital endowment and the technological innovation of a country. By contrast, policy actions should not concern the banking system

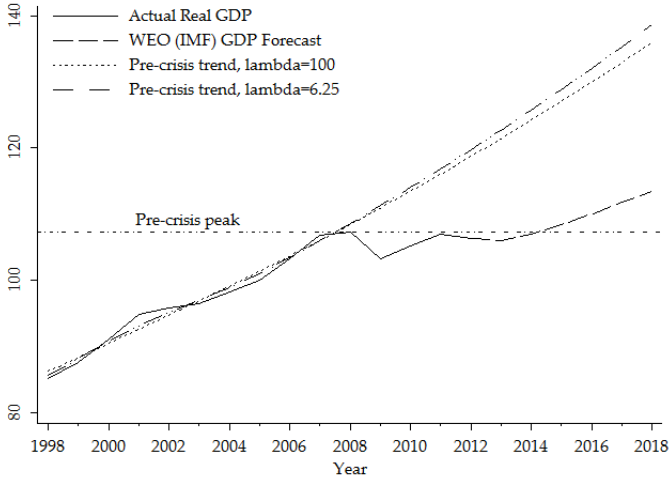
if credit weakness descends by the fact that firms are obtaining cheap financing by other means, or banks are reducing the credit granted to obsolete industries in favor of more productive and less credit-dependent sectors. In these cases, output recovery without a pick-up in bank credit would be not a major source of concern.

2.4 The recovery of the European economies after the global financial crisis: credit-less or credit-with?

The global financial and economic crisis of 2008 and 2009 resulted in severe declines in economic activity among the European countries. This global episode provides a unique case study to explore the impact of financial constraints on the macroeconomy. The initial shock takes root in global capital markets and dramatically erodes liquidity from banks. Therefore, output collapses all around the global economy at the about the same time. However, even if the credit crunch seems to have a major impact on the crisis, some economies are able to recover without a resumption in bank lending.

In the next paragraphs we identify concrete examples of creditless recoveries among the European countries in this period. In addition, the availability of data at both the macro and firm level for the European region enables us to analyze these episodes from different angles. Indeed, as clearly evidenced in Sugawara and Zalduendo (2013), the distinction among creditless and credit-with recoveries can be tested on three different levels: country-level, industry-level and firm-level data. In this section we start from country-level data to examine the early years of recovery in the aftermath of the global financial crisis. On the one side, we have to analyze the fluctuations in real macro variables during the financial crisis and the following recovery period 2009-2011. On the other hand, we have to explore the evolution of credit during the same periods, by testing both the two approaches of BMP and CIT, just to establish whether some recovery episodes that took place in Europe can be char-

Figure 1: Output gaps in the Eurozone

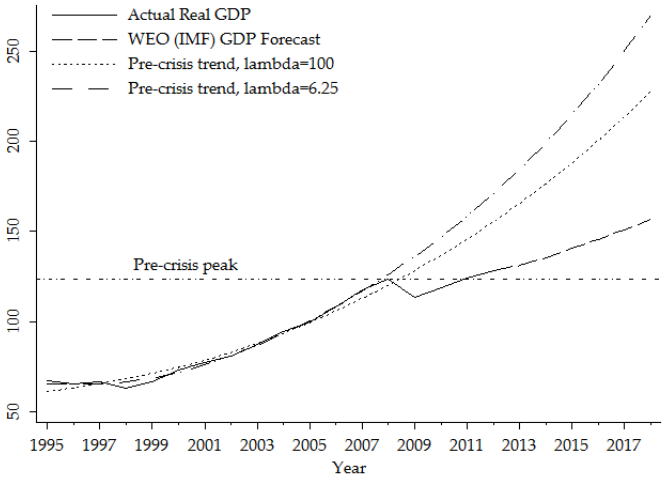


acterized as creditless recoveries and, if so, in which countries they did effectively occur.

First and foremost, within each country of our dataset we identify the years and the magnitude of the recession phase, together with the years and the extent of the subsequent recovery. We do this by measuring the lost ground with respect to the pre-crisis peak in real GDP[9] and with respect to its trend. Trend (smoothed) GDP is computed by using the Hodrick and Prescott (1997) filter, hereinafter HP filter. We set the smoothing parameter λ to 6.25, the value suggested by Ravn and Uhlig (2002). Higher values of λ (e.g. the standard 100 value for annual data) attach larger weight to smoothing rates of change in the trend and therefore produce smaller fluctuations in estimates of potential growth. In particular, the trend real GDP that we consider is obtained by applying the HP filter until year 2007 and then by extending the 2007 trend growth

[9]The real Gross Domestic Product, expressed in constant local currency units, is obtained from International Financial Statistics (IFS) published by the International Monetary Fund. Some missing data and forecasts until 2014 are obtained from the IMF's October 2013 World Economic Outlook (WEO). The time span ranges from 1965 to 2014, although data availability reduces it for many countries.

Figure 2: Output gaps in Commonwealth of Independent States (CIS)



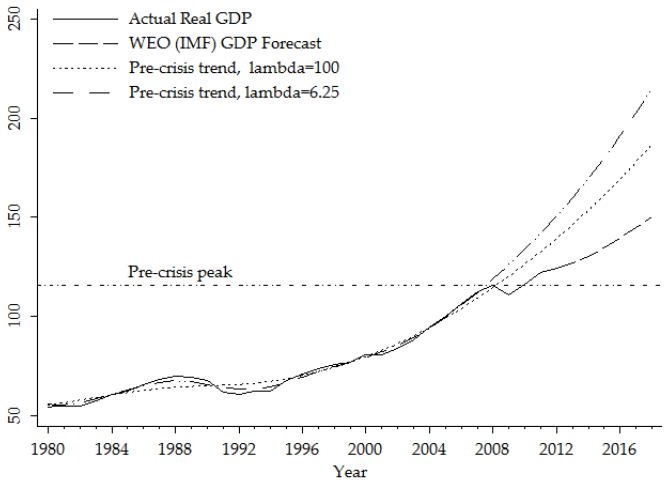
rate to the remaining years.[10] Figures 1-3 provide an overview of the actual real GDP and its pre-crisis trend in three country groups that are relevant for our later analysis: the Eurozone (figure 1); the Commonwealth of Independent States (CIS) (figure 2); the Central Eastern Europe (CEE) (figure 3).[11] Trends obtained with the alternative standard 100 value of λ are also shown in the graphs. Real GDP in 2005 is set equal to 100.

European economies have enjoyed a period of solid growth before the financial crisis, which hit the region during the second half of 2008. Most of them experienced large losses in their output in 2008-2009, and for

[10] Indeed, if we applied the HP filter until 2014, by considering current data and WEO forecasts, we would obtain a much lower level of trend real GDP, since large shocks tend to distort the estimates of the underlying trends, both before and after the shock.

[11] According to IMF definitions, the Euro area is composed of 17 countries: Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovak Republic, Slovenia, and Spain. The CIS is composed of 12 countries: Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. Georgia, which is not a member of the Commonwealth of Independent States, is included in this group for reasons of geography and similarities in economic structure. The CEE is composed of 14 countries: Albania, Bosnia and Herzegovina, Bulgaria, Croatia, Hungary, Kosovo, Latvia, Lithuania, FYR Macedonia, Montenegro, Poland, Romania, Serbia, and Turkey.

Figure 3: Output gaps in Central Eastern Europe (CEE)



some, losses are still continuing in 2013. On average, economic activity in the three regions started to grow again from 2010. However, as we can see in the figures, there appears to be a permanent and considerable loss of potential output. Notwithstanding the recovery, in 2011 there was still a difference of about 8 percent between the trend fitted before the crisis and the level of actual GDP in both the Eurozone and the CEE, and about 16 percent in the CIS. In addition, according to IMF forecasts, the sharp fall in the output level seems also to be accompanied by a significant flattening in the post-crisis growth trend.

In our following analysis, post-crisis troughs are identified as years with the lowest level of real GDP starting from 2008, while the recession period starts from the first year which follows the previous peak of real GDP. Therefore, the natural way to gauge the following recovery is to measure, country by country, how much of the lost ground has been regained, comparing real GDP to both its pre-crisis peak and pre-crisis trend. The 39 countries analyzed (see table 1) are the same as those available in the AMADEUS database, for consistency with the subsequent analysis at the micro level. We focus on 2011 as the last year of our anal-

Table 1: Pre-Crisis Peaks, Post-Crisis Troughs and 'lost ground' in Real GDP

Country	Pre-Crisis Peak Year	Trough Year before 2011	Gap (%) with respect to Peak Year in: Trough Year	Gap (%) with respect to Peak Year in: 2011	Lost ground regained (%) up to 2011	Gap (%) with respect to Pre-crisis Trend in: Trough Year	Gap (%) with respect to Pre-crisis Trend in: 2011
Austria	2008	2009	-3.8	0.8	122.2	-7.4	-8.6
Belgium	2008	2009	-2.7	1.4	151.4	-6.1	-6.7
Bosnia	2008	2009	-2.9	-1.0	66.6	-7.3	-15.7
Bulgaria	2008	2009	-5.5	-3.4	38.7	-12.2	-22.7
Croatia (*)	2008	...	...	-8.3	...	...	-25.1
Cyprus	2008	2009	-1.9	0.0	97.8	-6.0	-11.8
Czech Republic	2008	2009	-4.5	-0.4	91.8	-12.7	-20.2
Denmark	2007	2009	-6.4	-3.9	39.4	-10.9	-12.6
Estonia	2007	2009	-17.4	-7.8	54.9	-35.9	-41.7
Finland	2008	2009	-8.5	-2.9	65.9	-15.3	-17.1
France	2007	2009	-3.2	0.0	98.5	-7.2	-8.1
Germany	2008	2009	-5.1	1.8	135.6	-7.4	-4.7
Greece (*)	2007	...	...	-14.6	...	...	-33.3
Hungary	2008	2009	-6.8	-4.0	41.1	-13.9	-17.0
Iceland	2008	2010	-10.3	-8.0	22.2	-26.0	-29.0
Ireland	2007	2010	-8.2	-6.8	16.1	-23.1	-26.6
Italy	2007	2009	-6.6	-4.6	30.9	-9.5	-10.2
Latvia	2007	2010	-21.2	-16.9	20.4	-51.7	-55.9
Lithuania	2008	2009	-14.8	-8.5	42.9	-28.9	-38.1
Luxembourg	2007	2009	-4.8	-0.4	91.6	-13.5	-18.7
Macedonia	2008	2009	-0.9	5.1	656.2	-4.1	-7.6
Malta	2008	2009	-2.4	2.1	186.8	-0.6	-1.3
Moldova	2008	2009	-6.0	7.5	225.5	-11.9	-9.8
Montenegro	2008	2009	-5.7	-0.3	95.2	-9.5	-17.4
Netherlands	2008	2009	-3.7	-1.2	66.1	-6.1	-8.9
Norway	2008	2009	-1.6	0.0	102.4	-6.4	-9.8
Poland (**)	...	...	...	...	...	...	-4.5
Portugal	2007	2009	-2.9	-2.6	11.7	-4.7	-6.8
Romania	2008	2010	-7.7	-5.7	25.9	-20.0	-24.4
Russian Fed.	2008	2009	-7.8	0.3	104.5	-17.4	-23.9
Serbia	2008	2009	-3.5	-1.0	71.3	-10.5	-18.5
Slovakia	2008	2009	-5.1	2.3	145.6	-12.0	-19.7
Slovenia	2008	2009	-7.9	-6.1	22.9	-13.8	-22.0
Spain	2008	2010	-4.1	-3.7	9.9	-13.6	-16.7
Sweden	2007	2009	-5.6	3.5	162.9	-12.6	-10.4
Switzerland	2008	2009	-1.9	2.8	242.8	-4.6	-5.8
Turkey	2008	2009	-4.8	13.0	369.4	-18.3	-14.7
Ukraine	2008	2009	-14.8	-6.6	55.2	-27.8	-32.5
United Kingdom	2007	2009	-4.9	-2.2	54.5	-10.7	-13.9

Source: own calculations on IFS (IMF) and WEO (IMF) data.
(*) No post-crisis recoveries (GDP still declining) in Croatia and Greece up to 2011
(**) No recession in Poland up to 2011

ysis for several reasons. First, this is the year up to which we have data at the enterprise level. Second, many economies experienced a double-dip recession starting from the end of 2011, thus complicating the identification of creditless recoveries after this year. As we can see in table 1, as a consequence of the 2008-2009 financial crisis, real GDP has contracted by more than 10 percent in Greece, Iceland and the Baltics, while Poland remained the only country to avoid a recession. Many economies already exhibit a positive growth rate as of 2010, while some of them have to wait until 2011. By contrast, Greece and Croatia are the only two countries with no hint of recovery in 2010-2011. In the years following the

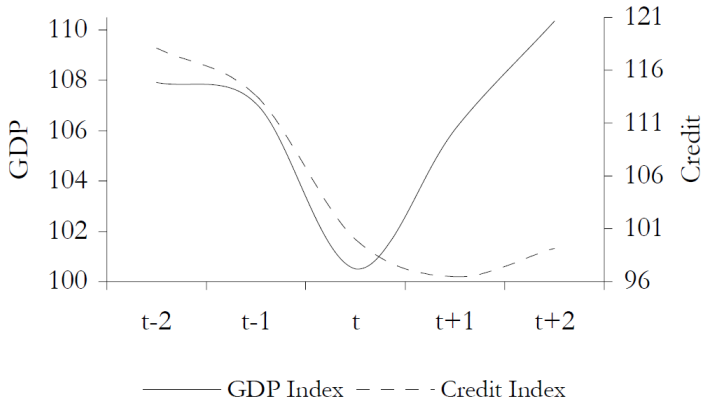
trough up to 2011, about half of the countries regained more than 90 percent of the ground lost, while eight regained less than 25 percent, thus highlighting a marked heterogeneity in the speed of recovery.

As expected, the picture is even less rosy if we look at gap compared to the pre-crisis trend. In this respect, there has been no sign of recovery in almost all countries of our sample since their average growth rate remained steadily below the pre-crisis growth trend. In 2011, this gap was higher than 25 percent in Ireland, Iceland, Croatia, Greece, Ukraine and the Baltics. It is important to note that for some of these economies the gap remained high notwithstanding positive GDP growth rates in 2011, even higher than 5 percent for Ukraine and the Baltics. We therefore need to specify which is the definition of recovery we want to stick to. For our purposes, we will consider *recovery* simply as a return to positive growth after the trough. This is a wider definition than the one of *full recovery*, which would necessarily require a return to the pre-crisis trend or, at least, to the pre-crisis peak. For the time being, however, we simply identify the years in which individual countries came back to positive growth after the crisis. This choice is justified by the fact that many European countries experienced double-dip recessions and had not yet fully recovered to pre-recession peaks by 2011.

Finally, we have to focus on the behavior of bank credit to the private non-financial sector during the global financial crisis and the early recovery years. Credit measures are obtained as the sum of domestic and cross-border bank credit. As for credit to private non-financial sectors by domestic banks, we focus on Claims on the Private Sector by Depository Corporations other than Central Banks from the IMF International Financial Statistics (IFS, line 22d). For countries where this item is not available we recur to the Claims on Other Sectors (IFS, line 22s),[12] which may sometimes include credit to state-owned or partially state-owned enterprises. Depository Corporations do not include non-bank financial intermediaries, but there are no alternatives that guarantee the

[12]For Norway, these items are not available, so we refer to the Outstanding Loans item published in the IMF Financial Access Survey (FAS). This item reports the amount of loans of resident nonfinancial (public and private) corporations and households with depository corporations other than monetary authorities.

Figure 4: GDP and credit stocks - 3S collapse episodes in Calvo et al (2006a)



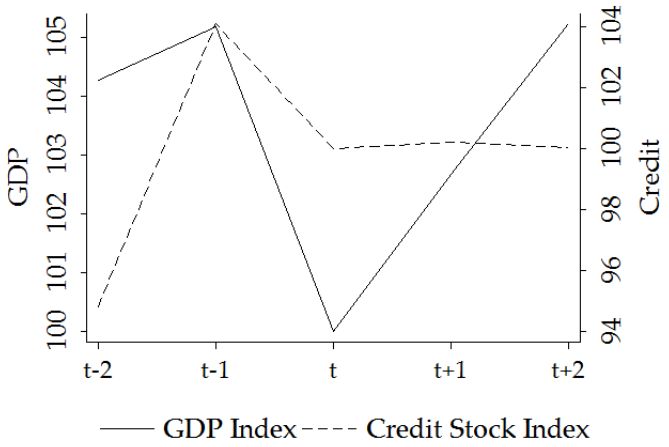
same cross-country coverage. Anyway, this should not be a major issue in our sample of countries. As for cross-border bank credit, on the other side, this measure captures credit extended by banks located abroad. We derive it from banking statistics collected by the Bank for International Settlement (BIS). The volume of cross-border bank credit to the private non-financial sector is obtained from both the locational and the consolidated statistics.[13]

We want to compare real GDP and real private credit (i.e., credit to the private sector divided by the GDP deflator[14]) in order to understand whether recoveries after 2008-2009 have some analogy with episodes described in CIT. Figure 4 reproduces the path of real GDP and real credit stocks presented in CIT, averaging data across 22 Systemic Sudden Stop

[13]We prefer *locational by residence* statistics, since creditors and debtors are allocated geographically according to their residence. However, the locational statistics only allow for a breakdown of banks' claims between banks and non-banks. Therefore, the share of the private non-financial sector in the latter category is obtained from the *consolidated* statistics. By doing so, cross-border credit to the non-financial sector may be partially overestimated because the non-banks sector includes non-bank financial corporations. Note also that all data are collected in national currency, although exchange rate movements may affect reported levels of credit since cross-border claims, at least in part, can be denominated in foreign currencies.

[14]For all countries, GDP deflator data are from the IMF IFS (line 99), with integrations from the IMF World Economic Outlook (WEO).

Figure 5: GDP and credit stocks - Global financial crisis in 36 European countries



episodes (3S collapses). The graph covers a five-year window centered on year t, which denotes the trough of each respective episode. As we can see, credit to the private sector falls down together with output, but fails to recover as output goes back to pre-crisis levels.

We similarly analyze the 2008-09 financial crisis looking at our sample of countries. Croatia and Greece are excluded because of the lack of recovery before 2011, while Poland is excluded for the lack of recession. GDP Index (YI) and Credit Stock Index (CSI) are constructed according to the following formulas:

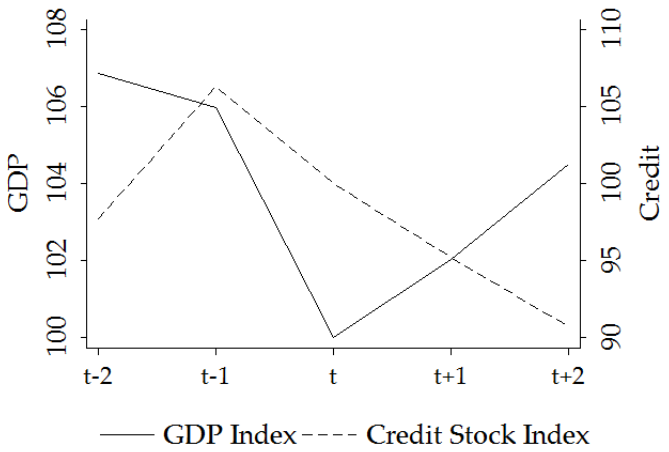
$$YI_s = \frac{1}{N} \sum_{i=1}^{N} \frac{Y^r_{i,s}}{Y^r_{i,t-3}} \tag{2.1}$$

and:

$$CSI_s = \frac{1}{N} \sum_{i=1}^{N} \frac{D^r_{i,s}}{D^r_{i,t-3}} \tag{2.2}$$

where $Y^r_{i,s}$ and $D^r_{i,s}$ are respectively real GDP and real private credit for country i at time s, with $s = t-2, t-1, ..., t+2$, and $i = 1, 2, ..., N$ for

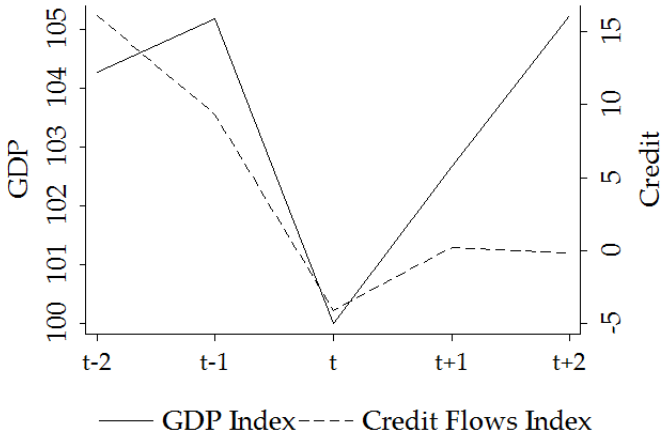
Figure 6: GDP and credit stocks - Global financial crisis in 20 European countries (creditless subsample)



$N = 36$ countries. YI and CSI are both set equal to 100 in the trough year t. Figure 5 shows that even in this case the stock of private credit falls down at the trough year and stays flat during the following two years of output recovery.

Moreover, we find high heterogeneity across countries during the global financial crisis. Indeed, by examining individual country episodes, we find that there are 13 countries with three consecutive years of negative annual real credit growth starting from t, i.e. including the trough year: United Kingdom, Ireland, Iceland, Norway, Belgium, Bulgaria, Romania, Hungary, Montenegro, Ukraine and the three Baltics. To these, we can also add one country, Spain, with two consecutive years of negative annual real credit growth starting from $t + 1$. In additional 5 countries (Austria, Germany, Denmark, Netherlands, Slovenia) the level of real credit is higher in the trough year t than in $t + 2$. Figure 6 clearly shows that in a subsample comprehensive of these 19 countries the recovery actually took place notwithstanding negative (and not simply flat) growth in private credit. Therefore, macro data confirm that credit-

Figure 7: GDP and credit flows - Global financial crisis in 36 European countries

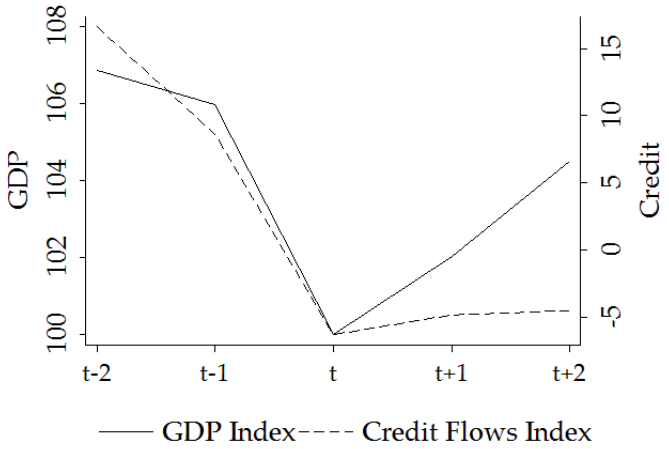


less recovery episodes actually characterized several European countries in the aftermath of the global financial crisis.

Even more interesting is the picture that emerges from figure 7, where we replicate the previous analysis looking at real private credit flows rather than stocks. The Credit Flows Index (CFI) is proxied here by changes in the Credit Stock Index between two following years, $CFI_s = CSI_s - CSI_{s-1}$. Indeed, once we look at credit flows, evidences are still consistent with the analysis presented in Calvo et al (2006a).

In particular, if we look at the previous sub-sample of 19 countries, (figure 8), average credit flows turn negative in t (i.e., repayments are higher than new credit) and give no sign of significant pick up in the following years. Therefore, while output and credit flows collapse together, output recovers to pre-crisis levels without a similar recovery in credit. This gives rise to what we could call a flow-based creditless recovery, since here the evidence regards credit flows instead of credit stocks. We can define them as Phoenix Miracles *à la* BMP, although we need to recall that, according to the BMP model, credit flows would be supposed

Figure 8: GDP and credit flows - Global financial crisis in 20 European countries (creditless subsample)



to pick-up when output recovers. Indeed, these figures clearly contrast with the BMP thesis that there would be no evidence of creditless recoveries once we refer to the credit impulse rather than to the credit stock. BMP consider a situation where the credit stock falls down during the crisis and then stabilizes during the recovery phase. As a consequence, credit flows are negative in the first period and null in the second period. In the transition from negative to null values, flows are increasing and, therefore, consistent with a GDP recovery. By contrast, our data reveal that in many countries the flows of bank credit continue to decline even after the trough in real GDP and do not accompany the output recovery.

We must be careful in interpreting the path of credit flows. Changes in stock data provide only approximate measures of credit transactions (i.e. the amount of new credit less credit repayments). Indeed, some annual changes in the stock of credit could be not a result of transactions, but the effect of revaluations or of other changes in the volume of assets/liabilities (e.g. write off of debts by the creditors or accumulation

of bad loans).[15] However, alternative data sources suggest that we can be quite comfortable with results shown above. Actual transactions in domestic loans of Monetary Financial Institutions (MFIs) toward the rest of the economy are available in the European sector accounts provided by the ECB. Although these data are available for only 21 countries of our sample and do not include cross-border claims, they lead to results fully in line with our previous findings. On average, credit transactions remain very weak after the trough, resulting nearly ten times lower in $t+2$ than in $t-2$, notwithstanding the output recovery. As stated above, this evidence seriously questions the absence of miracles *à la* BMP.

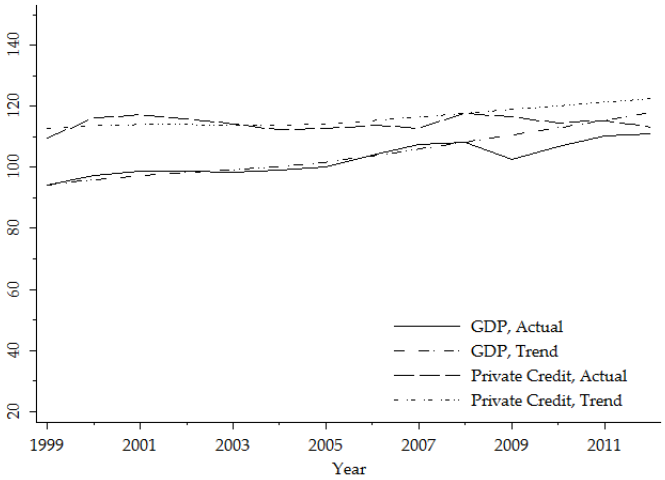
In section 2.3 we showed that a narrow definition of *recovery* may also require a return to the pre-crisis trend. Therefore, it is also useful to compare respectively the deviations of real GDP and real credit stock from their respective trends, before and after the recent crisis. We get the trend of private domestic credit in an indirect way, by estimating first the trend of the credit-to-GDP ratio. This approach specification has a number of advantages. Being expressed as a ratio to GDP, the indicator variable is normalized by the size of the economy. This means it is not influenced by the normal cyclical patterns of credit demand. Moreover, being measured as a deviation from its long-term trend, the credit-to-GDP gap allows for the secular financial deepening trend. Therefore, the credit-to-GDP trend can be seen as a sustainable path of the credit-to-GDP ratio based on the historical experience of a given economy.[16]

To establish the long-term trend of the credit-to-GDP ratio, we adopt the HP filter with a high smoothing parameter, since fluctuations in financial cycles have a lower frequency than those of output. Episodes of financial distress, in particular, are quite rare and reflect longer and

[15] Bank credit series can also be affected by securitisation. Under traditional accounting rules, derecognised securitised loans did not sit on banks balance sheets and they were not reported in monetary statistics, even though banks often support their securitised loan portfolios with off-balance sheet commitments. However, under the International Financial Reporting Standards (IFRS), traditional securitisations are being progressively included in banks balance sheets.

[16] Indeed, the credit-to-GDP gap is just the countercyclical capital buffer guide set out by the Basel Committee on Banking Supervision as a useful reference point for the build-up of system-wide risk. See BIS (2010).

Figure 9: GDP and private credit gaps in Germany

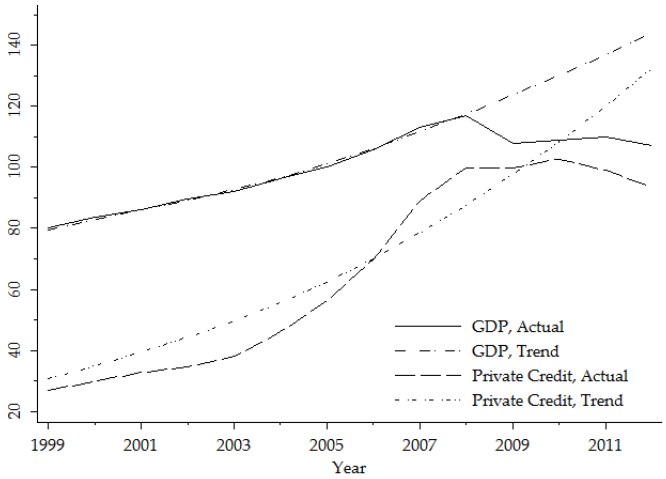


larger cycles in credit and asset prices. Since the technical literature suggests that λ is set according to the expected duration of the average cycle and the frequency of observation, we set it to 1600, which is in line with the assumption in Drehmann et al (2010) that credit cycles are four times as long as business cycles.[17] We consider only the domestic component of private credit because the time series of cross-border claims are not long enough. Once we obtain the credit-to-GDP trend, it is sufficient to multiply it by the pre-crisis trend of real GDP previously estimated in order to get the trend of real private credit that we could expect with no financial crisis. Figures 9 and 10 show two examples at the country level.

In Germany (figure 9) the trend of the credit-to-GDP ratio gradually decreases from 119.6 percent in 1999 to 104 percent in 2012. Therefore,

[17] $\lambda = 1600$ is the standard value for quarterly data in business cycle analysis. Ravn and Uhlig (2002) analyze how this standard value has to be adjusted if data frequency changes. They show that it is optimal to multiply this value by the forth power of the observation frequency ratio, p, so that $\lambda = 1600 \times (p^4)$. Since we assume that credit cycles are four times as long as business cycles, but at the same time we use annual data instead of quarterly data, then $p = 1$ and $\lambda = 1600$. Alternatively, we also tried to use the Baxter and King (1999) band pass filter instead of HP filtering. Since our main conclusions are insensitive to the chosen approach, then we can safely use the HP filter.

Figure 10: GDP and private credit gaps in Slovenia

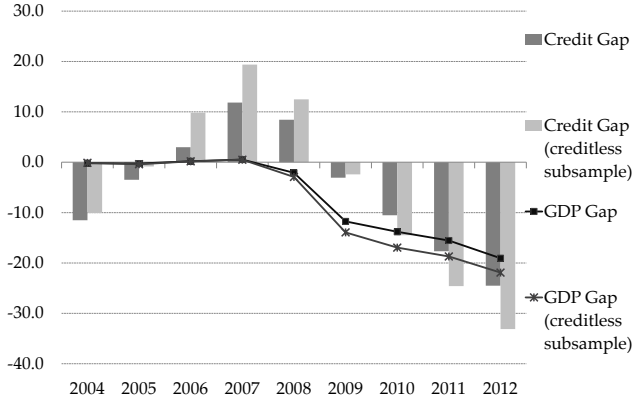


the line representing the trend of private credit stands above the line representing the trend of GDP, but the two trends come close over the years.

In many other cases, and especially in the emerging markets of Central-Eastern Europe, the trend of the credit-to-GDP ratio has been growing strongly in recent decades, although generally starting from much smaller values. In Slovenia (figure 10), for example, the trend of the ratio increases from 38.6 percent in 1999 to 92 percent in 2012. Even in this case the two trends tend to approach over the years, but now it is private credit to start from levels well below the GDP, the ratio being less than 100 percent. Despite different evolutions in the credit-to-GDP ratios, the European countries share a positive cyclical component of credit in the years preceding the crisis, followed by a strongly negative gap that resembles the permanent loss in output after the crisis itself. Germany and Slovenia are no exception to this evidence.

Figure 11 shows the average values of the cyclical components of credit (histograms in the figure) and GDP (lines in the figure), both in the whole sample of 36 countries considered above and in the sub-sample of

Figure 11: Cyclical components of GDP and credit



19 countries where it has been found some evidence of a creditless recovery. In the whole sample, average credit gap is strongly positive (+10.6 percent) until 2008 and then turns increasingly negative up to -21.2 percent in 2012. Output gap has a similar trend, though characterized by lower positive values before the crisis and more pronounced negative values starting from 2008. These evidences are even more pronounced in the subsample of creditless recoveries. Here, the average credit gap is even more positive before the crisis, but also more negative following it. Even the fall of the average output gap is greater than in the whole sample.

In summary, the comovements of credit stock and GDP are relatively more evident when considering their cyclical components, i.e. their deviations with respect to the long-term trend. However, we cannot ignore that creditless recoveries in both the CIT and the BMP sense have their own importance even in the context of the recent global crisis. Therefore, we believe that a better comprehension of the determinants and consequences of creditless recoveries is also useful to broaden our understand-

ing of the financial crisis and also of the negative repercussions that still plague many European countries.

2.5 Demand and Factor Input Contributions to GDP growth

Before proceeding with the analysis at the firm level, we can further study available macro data, by looking at *demand* and *factor input* contributions to GDP growth within European countries in connection with the recent financial crisis. Empirical evidence will help us to better discern the weight of the various factor inputs on the fall and subsequent recovery of GDP, as well as the potential link between each of these factors and the current credit growth. The source of data used in tables 2-3 is the Penn World Table, version 8.0 (PWT 8.0), a database with information of output, inputs and productivity, covering a large number of countries until 2011.

In table 2, we decompose aggregate growth in its demand components. Contributions of changes in inventories are derived as a residual to GDP growth and include a statistical discrepancy.[18] In the collapse phase 2007-2009, the components of aggregate demand that are potentially more dependent on credit contribute the most to the drop of real GDP. This is especially true in countries with subsequent creditless recoveries. Based on simple averages over countries in the sample, the contributions of gross fixed capital formation ($GFCF$) and of changes in inventories (Z) are respectively -4.7 percent and -2.5 percent (-6.4 and -2.6 in the creditless sample). The contribution of consumption is -1.5 percent (-3.9 in the creditless subsample). Net exports contribute positively to output, but only thanks to the collapse of imports. In the recovery phase 2009-2011, GDP grows back thanks to consumption, changes in inventories and net exports while investments remain flat, or even negative in the creditless subsample. Since investment is assumed to be a credit-

[18] When the volume series are not expressed at constant prices of a fixed base year, but are derived from chain-linking data at previous year's prices, components may not add up exactly to GDP growth and contributions can only be considered as approximations.

Table 2: Average Demand contributions to GDP growth during the global financial crisis

			Growth of:						Contributions of:					
		GDP				of which:								
		Growth	C	G	I	GFCF	EXP	IMP	C	G	GFCF	Z	EXP	IMP
Whole sample (39 countries)	2007-2009	-3.6	-2.2	4.1	-25.3	-17.6	-9.4	-15.3	-1.5	0.8	-4.7	-2.5	-5.0	9.3
	2009-2011	4.3	3.1	-0.9	11.1	1.3	18.7	16.8	2.1	-0.2	0.0	1.6	9.5	-8.8
Excl. Poland, Greece and Croatia (36 countries)	2007-2009	-3.9	-2.5	4.1	-25.9	-18.6	-9.3	-15.4	-1.7	0.8	-5.0	-2.5	-5.2	9.6
	2009-2011	4.8	3.5	-0.5	12.5	2.7	19.4	18.0	2.4	-0.1	0.3	1.6	10.0	-9.5
Creditless sub-sample (19 countries)	2007-2009	-5.9	-6.0	2.9	-30.4	-22.7	-8.5	-17.8	-3.9	0.6	-6.4	-2.6	-4.9	11.3
	2009-2011	3.7	2.7	-1.8	10.2	-2.5	19.2	17.8	1.9	-0.4	-0.9	2.2	10.7	-9.7

Data expressed as percentages.

Table 3: Average Factor Input contributions to GDP growth during the global financial crisis

		GDP	Growth of:				Contributions of:			
		Growth	E	HC	K	TFP	E	HC	K	TFP
Whole sample (36 countries) (*)	2007-2009	-4.4	-0.8	0.8	5.8	-6.8	-0.5	0.4	2.5	-6.8
	2009-2011	4.1	-0.8	0.4	3.7	2.9	-0.6	0.2	1.6	2.9
Excl. Poland, Greece and Croatia (33 countries) (*)	2007-2009	-4.7	-1.0	0.7	5.6	-6.9	-0.6	0.4	2.4	-6.9
	2009-2011	4.6	-0.4	0.4	3.6	3.2	-0.3	0.2	1.6	3.2
Creditless sub-sample (18 countries) (*)	2007-2009	-6.6	-2.2	0.7	6.3	-8.2	-1.7	0.4	2.6	-8.0
	2009-2011	3.6	-1.0	0.3	3.3	2.5	-0.8	0.2	1.3	2.8

Data expressed as percentages; growth rates in log differences.
(*) Data for Factor Input Contributions are not available for three countries of our whole sample: Bosnia, Montenegro and Macedonia.

intensive activity, lack of investment during the recovery may partially explain why the recovery appears creditless. However, it is still unclear whether the failure of investment to recover in tandem with GDP is due to demand factors (low investment demand results in low demand for credit) or supply factors (prolonged credit market disruptions constrain firms' access to external finance).

In addition, growth accounting can be used to decompose differences in growth of GDP into the contribution from growth of physical capital, human capital, employment and TFP. This type of analysis goes back longer to Solow (1957) and Jorgenson and Griliches (1967) for the US, and Jorgenson and Vu (2010) covering a global sample. These studies estimate the contribution of each input factor to changes in real GDP at constant national prices, by making use of a general production function combining capital (K) and labor input (L) with a determined level of TFP (A) to produce output (Y):

$$Y = A \cdot K^{\alpha} \cdot L^{1-\alpha} \tag{2.3}$$

where labor input is defined as the product of the number of workers in the economy (E) times their average human capital (H). The measure K of capital input takes into account the differences in investment composition across countries and over time, which gives more accurate comparative capital levels. Accordingly, the depreciation rate is not constant over time and across countries, but varies with asset composition (buildings, transport equipment, machinery, computers, etc.).

The production function imposes constant returns to scale and introduces α as the output elasticity of capital. To approximate output elasticities, α is obtained from national accounts data as the share of GDP that is not earned by labor, an assumption that imposes perfect competition in factors and goods markets.[19]

After log-transformation, GDP growth can be decomposed into the

[19]The exact calculation of the share of labor income in GDP as well as the measurement of capital stock, labor input, human capital and TFP is given in Inklaar and Timmer (2013) and in Feenstra et al (2013).

following sources of growth:

$$\Delta lnY = (1 - \bar{\alpha}) \cdot \Delta lnE + (1 - \bar{\alpha}) \cdot \Delta lnH + \bar{\alpha} \cdot \Delta lnK + \Delta lnA \quad (2.4)$$

where $\bar{\alpha}$ is the arithmetic average of α for the period considered. As usual, TFP is estimated as the residual.

To illustrate the results from our sample of countries (excluding Bosnia, Macedonia and Montenegro, whose data are not available in PWT 8.0) we compute a simple average for each element in the equation over each of the sub-periods considered.

In table 3, growth rates are represented using log-differences to ensure adding up. The table shows that growth in capital stock results weaker in the recovery phase 2009-2011 then in the collapse phase 2007-2009, consistently with growth in investment remaining low or even negative by the time output starts to recover. In addition, despite a significant negative contribution of employment (-1.7 percent) detected during the crisis in the creditless subsample, employment and human capital are more stable than other inputs during both the collapse and the recovery phase. As in demand decomposition, this result is consistent with the statement that more credit dependent components are those suffering the most during financial crises. Finally, average measured TFP mimics the behavior of output throughout the collapse-recovery process. Indeed, about 70 percent of the increase in output from trough to recovery is explained by increases in measured TFP. TFP falls sharply by 6.8 percent from 2007 to 2009 and then recovers quite swiftly in the following two years, filling only about 40 percent of the initial gap.

Recall that the revival in measured TFP growth does not necessarily mean that output recovery is due to technological change. It may also signal a partial recovery in capacity utilization at the firm level. Indeed, the measure K comprehends fixed tangible assets only, so that changes in working capital may enhance the measured TFP contribution. This would be consistent with the CIT thesis according to which firms may partially recover after a liquidity crunch thanks to a partial revival in working capital. However, there is a large scope for further research on how to improve this kind of growth-accounting framework, giving more

emphasis to the distinction among *true* TFP and *measured* TFP and implementing adjustments for variations in factor utilization. A good starting point is the analysis made by Fernald (2012), which describes a new real-time, quarterly growth-accounting database for the U.S. business sector.

2.6 Evolution of the Debt-to-GDP ratio: behavioral effect vs. composition effect

As outlined in previous sections, evidences and stylized facts from data at the macro-aggregate level (and in particular the occurrence of creditless recoveries) may have several explanations once we look at industry-level and firm-level data. We will recur to industry-level data for some empirical regressions introduced in chapter 4. In this section, instead, we want to extract some useful information from data at the enterprise level. Let's start by identifying the different channels that may imply a reduction of the debt-to-GDP ratio, i.e. the ratio between credit extended to the private non-financial sector and GDP at the country level. A reduction of the ratio signals a more than proportional GDP growth with respect to the total stock of debt, which is a necessary but not sufficient condition for the occurrence of creditless recoveries. These latter, in fact, are more precisely characterized by a positive GDP growth and a negative growth of debt. We start, however, from a more general analysis of the debt-to-GDP ratio to explain some evidences that go beyond the actual occurrence of creditless recoveries.

A reduction of the ratio at the aggregate country-level may reflect two types of changes at the firm level. First, it can be the result of a *behavioral effect*, a generalized reduction that characterizes a large number of companies, involved in a deleveraging process. In this sense, a lower debt-to-GDP level reflects a generalized lower degree of indebtedness at the enterprise level, captured via the ratio of firms' debt to value added. Secondly, the ratio reduction can result from a *composition effect*. In this case, the different trends in credit and GDP observed at the aggregate level are not due to a behavior that involves different groups of firms, but to redistributive effects among them.

In particular, if firms with a low degree of indebtedness before the crisis grow more (or drop less) than others during the peak-to-recovery period, then their weight in the entire population grows in terms of value added, contributing to reduce the debt-to-GDP ratio. In principle, relevance of the composition effect would be somehow in line with a reasoning *à la* Rajan and Zingales (1998) (RZ), reflecting heterogeneous effects of the crisis with respect to specific characteristics of industries and firms. For example, in the pre-crisis period, industries with high external finance dependence and liquidity needs are likely to be characterized by higher ratios of debt to value added. If these industries are really the most affected by the credit crunch, then they end up constituting a smaller fraction of national GDP. By contrast, the behavioral effect reveals changes affecting firms' balance sheets rather than different growth rates.

Let's analyze observations at the firm level listed by AMADEUS in order to figure out the importance of these different channels in Europe during the global financial crisis.[20] In fact, aggregate data do not reveal which one contributes more to regularities highlighted at the country level. Since value added is available for only a small number of firms, we use *Total Operating Revenues (Turnover)* as our proxy for firms' output. As a proxy of bank debt we build a specific measure of Total Financial Debt (TFD), which is obtained as the sum of *Current Liabilities: Loans* and *Non Current Liabilities: Long Term Debt*, available in the dataset. Hereinafter, we will dub these two terms respectively Short Term Financial Debts ($STFD$) and Long Term Financial Debts ($LTFD$). We consider only firms with available data in the whole five-year window 2007-2011, i.e. two years preceding the trough of the global output collapse to two years after the trough. The sample that we obtain consists of nearly one million (986,377) firms in 39 European countries.

We split the sample in groups based on percentiles of our measure of indebtedness at the firm level. Percentiles are obtained at the end of the pre-crisis year 2007. Then, we can measure the debt-to-turnover ra-

[20] Refer to the Appendix A for further details on the AMADEUS dataset and on available firm-level data.

tios within both the individual groups and the aggregate sample. The aggregated debt-to-turnover ratio can be represented as follows:

$$\frac{D}{Y} = \sum_i \frac{d_i}{Y} = \sum_i \frac{d_i}{y_i}\frac{y_i}{Y} = \sum_i r_i w_i \tag{2.5}$$

where i identifies the groups based on percentiles, while d_i and y_i are respectively the *TFD* and the output of each group. D and Y represent the same aggregates in the whole sample. Finally, $r_i = d_i/y_i$ and $w_i = y_i/Y$ are the debt-to-turnover ratio and the weight in total turnover of each group i.

Therefore, by first-order Taylor-series approximation, we have that :

$$\Delta\left(\frac{D}{Y}\right) = \Delta\left(\sum_i r_i w_i\right) \approx \sum_i r_i \Delta w_i + \sum_i w_i \Delta r_i \tag{2.6}$$

where the first term on the right-hand side represents the composition effect and the second term the behavioral effect, i.e. the effect of changes in ratios within percentiles. We may apply the same computations directly to individual firms, without recurring to percentiles. However, indebtedness at the firm level presents very large fluctuations, generating too high residuals with respect to our approximations.

We then start from analyzing the period 2007-2009. All data are converted into dollars based on exchange rates at 2007 and deflated by GDP deflator. This is strictly necessary to prevent disturbing elements in our following computation of the composition and the behavioral effect, since changes in exchange rates or different rates of inflation would entail variations that are not due to firm characteristics. In our sample, the aggregated ratio of Total Financial Debt over Total Operating Revenues shows an increase of 4.7 percentage points, from 30.6 percent in 2007 to 35.3 percent in 2009. According to the approximations reported above, about 52.2 percent of this increase can be attributed to a behavioral effect, while the remaining part is due to a composition effect. Therefore, the two components are equally important for the increase of aggregate indebtedness during the recession years.

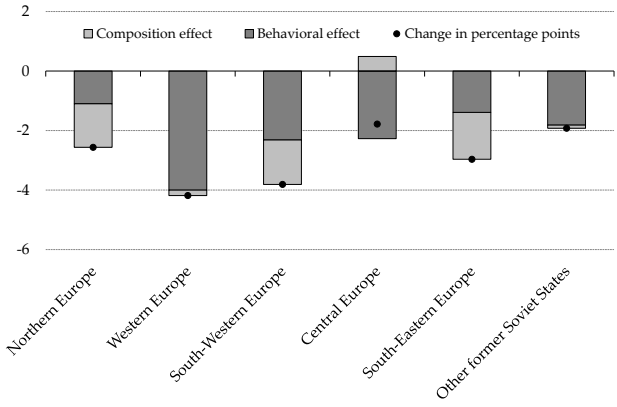
The composition effect is positive because low leveraged firms grow less then high leveraged firms during the peak-to-trough period. This

may seem counter-intuitive, but low percentiles are likely to include small and young firms that have less access to external finance and are even more constrained by financial frictions during the crisis, thus reporting the larger drops. However, the behavioral effect is equally important, indicating that a general increase of the ratio characterizes all the enterprises, independently from their pre-crisis indebtedness. The large fall in real output (-7.2 percentage points at the aggregate level within the period 2007-2009), which is the denominator of the ratio, have a major impact on the increase of the ratio itself. Interestingly, the composition effect is almost zero (+0.31 percentage points) once we consider the *short-term* financial debt only. Therefore, high-leveraged firms are relatively more resilient to the crisis only when considering long-term debt, i.e. debt that does not need to be repaid within the current fiscal year.

We then proceed with exactly the same analysis for the period 2009-2011, though percentiles are still based on the firms' indebtedness in 2007. Interestingly, in the 2009-2011 period, turnover aggregated over the whole sample grows by around 12 percent in real terms, while real aggregate borrowing remains broadly constant (+0.3 percent), thus suggesting some evidence of a 'phoenix miracle' at the micro level. The aggregated ratio returns to decline by about 3.7 percentage points from 2009 to 2011. According to our computations, only a 30 percent of this decline is due to the composition effect during this period. Therefore, the most part of the correction in the debt-to-output ratio is due to deleveraging at the firm level. The contribution of the composition effect is negative because low-leveraged firms that dropped the most during the recession years have also a partially greater rebound in the early recovery years. As in the recession period, even after the trough the composition effect is almost zero (-0.17 percentage points) when we limit our analysis to the short-term financial debt, excluding inter-temporal financing.

One potential shortfall of this technique concerns the lower weight of small and poorer countries in terms of total output, once we aggregate data within the whole sample. The same analysis repeated by *macroregions* (see the Appendix A for countries within each group) shows that some cross-country heterogeneity actually exists. Indeed, there are a cou-

Figure 12: Behavioral and composition effects in the decline of the debt-to-turnover ratio during the recovery phase



ple of regions where the contribution of the composition effect to variations of the debt-to-output ratio during the crisis prevails on the behavioral effect. This is the case of Northern and South-Eastern Europe as we can observe in figure 12, which refers to the recovery period 2009-2011. In these country groups the composition effects account respectively for about 57 and 53 percent of the reduction in the leverage ratio.

However, if we separate short-term debt from long-term debt, we realize that these results have different motivations. In Northern Europe, the composition effect is more negative than the behavioral effect only when considering long-term financial debt. In South-Eastern Europe it is more negative when considering short-term financial debt. This difference suggests that growth reallocation among high-leveraged and low-leveraged firms is not necessarily due to the same reasons when moving from one country to the other. Intuitively, long-term debt is more important for investments in fixed asset, while short-term debt is needed for liquidity purposes and day-by-day operations. In the first case, the

negative composition effect may be due to difficulties of high-leveraged firms in further increasing their productive capacity. In the second case, it may rather signal cases of liquidity crunch in the CIT sense.

These evidences leave a large scope for further research on the different channels through which deleveraging may take place in different countries during recovery periods. In the next paragraph and in the second part of chapter 3 we especially concentrate on the behavioral effect, i.e. on the possible explanations for deleveraging at the firm level. However, in chapter 4 we also introduce econometric analyses regarding the redistributional effects of creditless recoveries. By looking at the heterogeneous effects of low bank credit on output fluctuations at the industry level, these analyses not only reveal the existence of disruptions on the supply-side of the credit market, but they also provide possible explanations for the relevance of the composition effect.

2.7 Evolution of balance-sheet items during creditless recoveries

In this section we further deepen our analysis of the AMADEUS dataset in order to figure out which changes characterized balance sheet items in the private non-financial sector during the global financial crisis and, in particular, in cases of creditless recoveries at the firm level. This section focuses on three groups of companies, which are subsets one of the other. The first group comprehends the whole sample of firms, independently from their annual performances. The second group includes only firms characterized by falls and subsequent recoveries in their output as a consequence of the crisis. To this end, we select only those companies that have seen their *Total Operating Revenues (Turnover)* falling down in 2007-2009 and growing again in 2009-2011. Finally, in the third group we consider cases of creditless recoveries at the firm level, by selecting those firms in the second group who have seen their financial exposure (the *TFD* measure of section 2.6) declining in both the two periods. By analyzing changes in the balance sheet items of companies within these groups we can get an idea of their general behavior during the crisis

period, as well as in the puzzling cases of creditless recoveries at the enterprise level. As we will see, there are relatively few cases (around 15 percent of the total) which fall in the third group of creditless recoveries at the firm level, but they are very interesting to consider, since they give a clear and extreme idea of behavioral metamorphoses that may contribute to the occurrence of creditless recoveries at the macro level.

First of all, we focus on the variations of Operating Capital (OC) and of its main sub-components, the Operating Fixed Assets (OFA) and the Gross Operating Working Capital ($GOWC$). We define OFA as the sum of *Tangible Fixed Assets* and *Intangible Fixed Assets* in AMADEUS dataset, thus including research and formation expenses, plants, land, machinery and all other operational assets with a long term effect. $GOWC$, on the contrary, measures the operational liquidity of a firm, i.e. the amount of funds that an organization has at hand to finance the components of a day-by-day operating cycle (e.g. compensations of employees and intermediate goods purchased), as well as to ensure its smooth functioning and the optimum use of productive capacity. As production grows, firms generally need larger investments in working capital. From a financing perspective, working capital refers to the firms' investment in short-term assets needed to operate over a normal business cycle. Therefore, in this definition, $GOWC$ equals to current assets and it can be decomposed into inventories, accounts receivable, cash and other current assets (respectively named *Stocks*, *Debtors* and *Other Current Assets* in AMADEUS dataset).

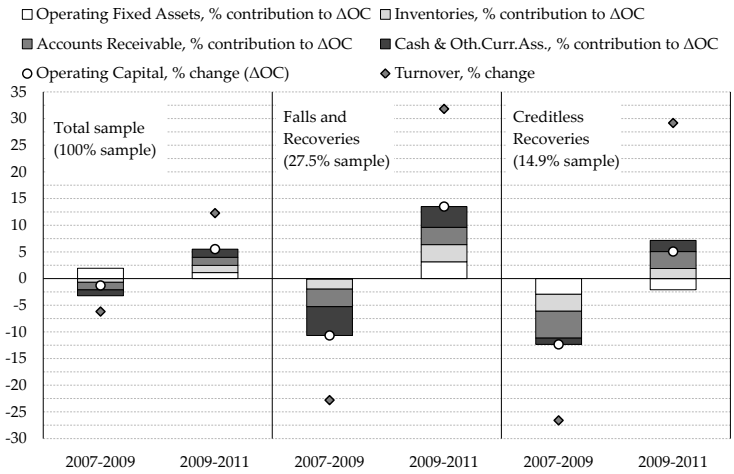
Secondly, we focus on the potential sources of financing for the variations in operating capital. Sources of financing include not only the already mentioned Short Term Financial Debts ($STFD$) and Long Term Financial Debts ($LTFD$) but also Shareholders' Funds, Accounts Payable (*Creditors* in AMADEUS dataset) and Other Net Liabilities. The latter incorporate all current and non-current liabilities not included in items above, net of all other non-operating (financial) assets.

All the balance sheet figures so reclassified are converted into dollars and deflated by GDP deflator. Finally, each item is summed over all firms within the three groups identified above. The first group, i.e.

the whole sample, is a balanced panel of 742,530 firms whose balance sheet figures are available for all these items in the three years 2007, 2009 and 2011, representing respectively the pre-crisis peak, the trough and the last available year for the recovery period. The second group and the third group contain respectively 204,309 and 110,359 firms, i.e. about 27.5 percent and 14.9 percent of the whole sample. Figures 13 and 14 show which major changes affected firms according respectively to an *asset approach* and a *sources of financing approach*. The former looks at the components of operating capital, while the latter looks at the sources financing it. In figure 13, changes in Operating Capital (ΔOC) in both the crisis period 2007-2009 and the recovery period 2009-2011 are broken down into the sum of contributions from its various components. In figure 14 the same changes in Operating Capital are broken down into the sum of contributions from its sources of financing. The two figures also show the rate of real growth of *Total Operating Revenues (Turnover)*, for a comparison with the simultaneous trend of operating capital.

In the first group on the left of figures 13 and 14, which represents the whole sample, the aggregate output drops by 6.2 percent during the recession period 2007-2009, while Operating Capital falls by only 1.3 percent. The OC decline is due to a negative contribution of all the components of the Gross Operating Working Capital, while the permanent component (Operating Fixed Assets) continues to grow notwithstanding the recession. The negative change in working capital means that fewer financial resources are tied up to finance current operations in the productive process. We should expect that the more permanent needs (fixed assets) are financed by fairly permanent sources (e.g. equity and long-term debt) while the operating working capital is mainly supported by short-term sources, which have to be repaid at short notice. In fact, figure 14 shows that banking debt (and in particular $LTFD$) remains on a positive path and that the OC decrease in 2007-2009 is mainly related to a decline in trade debt and in other net liabilities. The latter can be partly attributed, among the other things, to the utilization of provisions for risks and charges and of provisions for employee severance indemnities and pensions. During the following upturn in 2009-2011, output

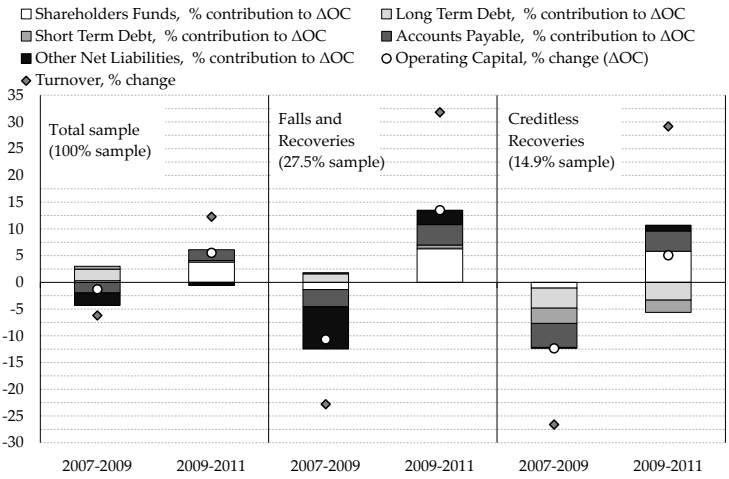
Figure 13: Decomposition of Operating Capital growth - Asset approach



increases by 12.3 percent and the Operating Capital also returns to a positive trend (+5.5 percent), which is driven by a revival in the components of the Gross Operating Working Capital. This recovery is mainly financed by positive growth in trade debt and by a significant increase of shareholders' funds, which may have been achieved through either retained earnings or recapitalizations. Total Financial Debt, on the contrary, remains flat after the trough year 2009. This actually constitutes a potential signal of financial frictions still affecting the economy and of creditless recoveries characterizing some European countries.

The whole sample includes firms with very heterogeneous behavior and resilience with respect to the crisis. In the second group (the one to the center of figures 13 and 14), we limit our attention to firms with a negative output growth in 2007-2009 and a resumption in 2009-2011. Here, real output falls by 22.8 percent and then recovers by 31.8 percent, with fluctuations that are necessarily wider than in the whole sample. Even

Figure 14: Decomposition of Operating Capital growth - Sources of financing approach



the initial drop of Operating Capital (-10.7 percent) is greater than in the whole sample, as well as its subsequent rebound (+13.5 percent), while the contributions of the individual components remain proportionally similar according to both the two approaches. In particular, the components of Gross Operating Working Capital return to positive growth in the recovery phase thanks to a sharp increase of Shareholders' Funds and Accounts Payable, while bank credit (*STFD* and *LTFD*) still seems to have a weaker relationship with working capital movements. However, the revival in financing resources appear sufficient to stimulate also a partial revival in Operating Fixed Assets.

Finally, in the third group of companies (those to the right of figures 13 and 14) we further restrict the focus on cases of creditless recoveries at the firm level. The initial drop in turnover is even greater (-26.6 percent) than in previous cases and the resumption is weaker (+29.2 per-

cent). A distinctive feature of this subsample is that variations of fixed assets are negative in both the two periods, thus suggesting a major correlation with the trend of bank credit. The negative change of Operating Capital in 2007-2009 (-12.3 percent) is followed by only a partial recovery in the following period (+5.1 percent), which is made possible again by Shareholders' Funds and Accounts Payable. With decreasing bank credit, these funding resources are devoted to foster a rebound in working capital, while Operating Fixed Assets remain on a negative path. The positive growth of Net Other Liabilities in 2009-2011 and their greater resilience in 2007-2009 could also signal an attempt by companies to replace at least part of the traditional forms of credit with alternative channels of funding or even with a reduction in non-operating activities, such as financial assets and available-for-sale investments.

To sum up, data show that after the crisis the Gross Operating Working Capital comes back to growth together with output even in cases of creditless recoveries at the firm level. After all, the only possible explanation for a different evidence would be that firms have been able to change their production processes in a relatively short time, producing greater quantities of goods (or providing more services) while using less working capital. In theory, for example, some firms could adopt a just-in-time production strategy, reducing the inventory of raw materials and semi-finished goods and minimizing the relative carrying costs. Efficiency improvements in production processes and a better management of working capital would thus reduce the financial requirements of a company while still allowing uninterrupted production.

However, available data show that working capital and turnover move exactly in the same direction, both in the recession and the recovery period. This suggests that when the bank credit remains weak, then the revival in economic activity is just made possible by a different structure of operating capital (i.e. a resurgence of working capital at the expenses of fixed assets) or by alternative sources of financing. Indeed, lower bank credit tends to be replaced by an increasing contribution of accounts payable and shareholders' funds, which in turn can be due to either recapitalizations or retained earnings within the company.

Finally, we devote a separate discussion to the behavior of Net Trade Credit, which is given by the difference between Accounts Receivable and Accounts Payable. In all the groups of firms identified above, the difference between receivables and payables tends to remain roughly unchanged in both the recession and the recovery phase, since trade credit and debt always move in the same direction. Interestingly, in creditless recoveries, Net Trade Credit shows a slight negative variation in both the two periods due to a lower drop and a stronger revival of accounts payables with respect to accounts receivables. Recall that in our definitions we consider receivables as a component of operating capital and payables as a component of external financing. However, we could also adopt alternative approaches. In Rajan and Zingales (1998), for example, inter-firms trade debt is entirely treated as part of operations, assuming it as mainly used to reduce transactions costs rather than for financing. In this sense, the slight fall in net trade credit should be interpreted as a lower absorption of financial resources for investments in working capital. On the contrary, if we wanted to treat the trade credit entirely as an alternative source of finance, then we should read the fall in net trade credit as a larger use of debt to suppliers (and a smaller use of credit to customers) to compensate for the reduction of bank credit. Firms could pay bills slowly and collect receivables quickly just to help the recovery in production without the help of banks. Whatever the interpretative approach that we adopt, changes in net trade credit do not seem sufficient by themselves to justify a revival of economic activity in the absence of bank credit, but for sure they still result in a positive contribution to output growth.

2.8 Concluding remarks

This chapter has been dedicated to the puzzling phenomenon of creditless recoveries, where national GDP comes back to positive growth after systemic output collapses, while domestic and external credit to the private sector remains weaker than in pre-crisis years. Following the seminal paper of Calvo et al (2006a,b), several other papers focused on

the existence and the characteristics of these episodes. The stagnation of bank credit is not without consequences for the long-run resilience of the economy. Indeed, countries where private lending remains sluggish are typically characterized by a less sustained resumption in terms of real GDP on the long term. Therefore, if recoveries are weak because of disruptions in the credit market, then economic activity may significantly benefit from policy actions aimed at supporting a revival of bank lending. The weakness of bank credit can be originated by stress on the capitalization of banks, but also by the low quality of balance sheets of non-financial players in the private sector. On the one hand, banks facing a deteriorating loan portfolio or pressing requirements for higher capital ratios struggle to generate new credit supply. On the other hand, firms and households continue to have limited access to finance until the quality of their balance sheets remain poor. Distinguishing the different constraints on credit is essential in order to identify the best rescue measures that the authorities should adopt to sustain faster recoveries. This is particularly true in most European countries where firms, and in particular small ones, still heavily depend on bank loans for their survival and their sustainable growth.

In this chapter we just highlight the occurrence of creditless recoveries in Europe in the aftermath of the global financial crisis. We also show that many of these episodes can be actually defined as creditless not only when considering the outstanding stock of bank credit at the national level, but also when considering its flows over time. This result contradicts the results in Biggs et al (2009, 2010), according to which the identification of recoveries without credit would be only due to an incorrect measure of credit developments. Growth accounting at the macro level reveals that changes in measured TFP explains the most part of fluctuations in national GDP during both the recession and the recovery period. The large variations of measured TFP in the short run are likely to be due to sudden reversals in capacity utilization at the firm level. This, in turn, is the result not only of swings in aggregate demand but also of the working capital management of firms that are dealing with liquidity crunches.

Different trends in credit and GDP observed at the aggregate level can be partly attributed to higher growth of low-leveraged firms in the recovery period. However, an important finding of this chapter is the evidence that this composition effect is not sufficient to explain the diverging trends. For the most part, in fact, creditless recoveries are just the consequence of deleveraging, i.e. of a generalized reduction in the debt-to-output ratios at the firm level. This result is relevant in itself, but it also suggests and outlines future work. In this chapter we already introduce a preliminary analysis of firms' balance sheets in Europe during the global financial crisis. This analysis show the importance of shareholders' funds and trade credit for the management of working capital within the companies, when bank credit remains weak. As expected, creditless recoveries are characterized by a rebound in working capital, while the growth of operating fixed assets remain negative. In our opinion, this accounting approach is particularly promising to explain the mechanisms through which financial frictions can affect the real economy and, consequently, it will be further developed in the second part of chapter 3.

Chapter 3

Financial Constraints and the Shape of Recovery: Demand and Supply Channels

3.1 Introduction

In chapter 2, we highlighted to ways in which finance interacts with economic fluctuations. On the one hand, *financial frictions* facilitate the propagation of real shocks that do not originate in the financial sector, amplifying their impact. On the other hand, exogenous *financial shocks* can directly affect the economy, even in the absence of additional perturbations in other sectors of the economy. Once we support the thesis that financial markets significantly affect the real aggregate output, it is necessary to explore how it is possible that creditless recoveries take place. Therefore, beyond the empirical analysis, we also need a theoretical background and a set of assumptions for justifying both the relevance of financial markets and the occurrence of creditless recoveries. In this chapter we just set up a stylized model that can serve as a conceptual framework for identifying the mechanisms behind these stylized facts.

We start by developing a model with standard neo-classical features and then, in a second step, we introduce financial frictions due to limited enforcement of debt repayment. In our setting, it is of primary importance the interaction between one exogenous factor, representing the health of the financial sector, and one endogenous component, which is the value of capital goods that can be used as collateral. The model considers two different kinds of collateral constraints. Collateral constraints insisting on intertemporal (long-term) credit directly affect the new investments in fixed tangible assets and in R&D. By contrast, collateral constraints insisting on intra-period (short-term) credit limit the working capital and, consequently, the firms' ability to sustain their current operating expenses.

This framework makes direct reference to the standard models of output fluctuations under financial constraints presented in Quadrini (2011).[1] However, we add complexity to these models in order to consider the effects of financial frictions on the different sectors of the economy. In particular, in the model that we are going to present, goods (and the corresponding industries) are categorized according to their end use: *consumption*, *intermediate* and *investment* goods. By incorporating a categorization of sectors in the model, we are able to identify the channels through which financial frictions affect production, not only at the aggregate level, but also at the industry level. Even more important, this setting also emphasizes that capital expenditures affect the economy in two ways. On the one hand, investments impact the productive capacity of companies by changing their stock of fixed capital. On the other hand, they have an immediate influence on the current production levels of companies that manufacture investment goods and, consequently, on satellite activities. A similar reasoning concerns the purchase of intermediate goods and the accumulation of current assets. We believe that this approach has a very important role when exploring the potential determinants of creditless recoveries.

Indeed, the theoretical model introduced in this chapter facilitates

[1] Additional references are also given in Jermann and Quadrini (2012) and Kocherlakota (2000).

better comprehension of the empirical evidences that typically characterize the puzzling phenomenon of creditless recoveries. In the second part of this chapter we just introduce an accounting approach to analyse data at the enterprise level and to create a bridge with the models presented in the first part. This expedient allows to analyze output fluctuations concurrently with changes in firms' balance sheet items. We believe that such an analysis may provide a useful tool, on the one hand, to explore the importance of the financial channel for output growth and, on the other hand, to identify the potential determinants for the occurrence of creditless recoveries. It will be shown that these determinants are not necessarily the same across different crisis episodes and they can also depend on country characteristics. Therefore, the innovative approach adopted in this chapter could be functional to exciting future research on the characteristics of individual financial crises and on the specific evolution of recoveries at the firm level.

The chapter is structured as follows. In section 3.2, we introduce a two-period economic model with standard neo-classical features, presenting similarities and differences with respect to the model of Quadrini (2011). Section 3.3 characterizes the competitive market equilibria for this frictionless economy. Then restrictions are introduced on the lender's ability to enforce the contractual obligations. Section 3.4 presents a collateral enforcement model where entrepreneurs cannot borrow on the long term to the desired levels, while section 3.5 extends the analysis to a collateral constraint on working capital. In section 3.6 we state that the equilibrium configuration derived from the collateral enforcement model has important implications for outlining the potential determinants of a creditless recovery. These implications will be also useful for developing an appropriate empirical analysis of creditless recoveries based on firm level data. In light of this, we dedicate section 3.7 to explaining how accounts and ratios within the financial statement of a company can interact with output fluctuations at the enterprise level. Section 3.8 is just dedicated to the analysis of firm level data of European countries during the global financial crisis. We base our firm-level analyses on the same AMADEUS dataset introduced in chapter 2. Finally, in section 3.9 we

state the conclusions and discuss avenues for further research.

3.2 A model of general economic equilibrium

Quadrini (2011) introduces a formal model that helps to explain how financial shocks may generate output fluctuations and how financial frictions may amplify real shocks. In this model, firms have to face a binding constraint on their ability to raise external financing (e.g. borrowing from banks), because of market incompleteness. Through this constraint, financial markets affect the firms' capability to support current and capital expenditures and, consequently, play an essential role in business cycle fluctuations. As in the model proposed by Quadrini (2011), in our setting we have only two periods, period 1 and period 2. Similarly, we assume the existence of a unit mass of workers, who also act as lenders for the entrepreneurs in period 1. *Workers-Lenders* are denoted by subscript l. Differently from the original framework, however, representative entrepreneurs will be divided in three different sectors: the *Consumption Goods* sector, denoted by subscript c, the *Intermediate Goods* sector, z, and the *Investment Goods* sector, i. The behavior of the four types of agents is briefly described in the following paragraphs.

Intermediate Goods sector. Entrepreneurs z enter the system with a given level K of capital and with a given amount B of debt owed to workers-lenders l. Intermediate goods are produced with available capital K and inputs h of labor hired from workers, according to the following production function:

$$Z = AK^{\theta}h^{1-\theta} \tag{3.1}$$

where A is the aggregate level of productivity.

The amount of capital available in period 2 depends on investment in period 1, so that:

$$K'_z = K + i_z \tag{3.2}$$

where, from now on, the prime superscript indicates variables referring to period 2. We are implicitly assuming complete capital irreversibility,

i.e. the impossibility of negative investments, and the absence of depreciation. In period 2, entrepreneurs z utilize available capital for directly producing consumption goods, based on the following production function:

$$C'_z = A'K'_z = A'(K + i_z) \tag{3.3}$$

There is no aggregate uncertainty, so we assume A' is perfectly anticipated in period 1.

The net income from the first stage of production is available at end of period 1. In addition, within the same period, entrepreneurs z raise new external funds B'/R in the form of financial lending provided by workers-lenders[2] and, at the same time, repay the initial debt B. The residual resources have to be allocated between current consumption and the expenditure on investment goods. In the end, the representative entrepreneur z producing intermediate goods chooses c_z, c'_z, h, B', i_z to maximize its lifetime utility:

$$\max \{u[c_z] + \beta u[c'_z]\} \tag{3.4}$$

subject to:

$$pAK^{\theta}h^{1-\theta} - wh + \frac{B'}{R} - B = c_z + qi_z \tag{3.5}$$

$$A'(K + i_z) - B' = c'_z \tag{3.6}$$

where the price of consumption goods is normalized to unity, the price of intermediate goods is equal to p, the price of investment goods is equal to q and the cost of each unit of labor, i.e. the wage rate, is equal to w.

Differently from the model in Quadrini (2011), entrepreneurs' utility is not linear in consumption. Indeed, we assume the instantaneous utility function u to be increasing in c but concave ($u_c[.] > 0$ and $u_{cc}[.] < 0$), thus implying diminishing marginal utility of consumption. Moreover, we take for granted that $u[0] = 0$ and that Inada conditions are satisfied.

[2]Accordingly, B' is the amount of debt to be repaid in period 2, while R is the gross interest rate.

Workers-Lenders. In period 1, workers-lenders receive wages wh for their work, obtain back the amount B of money and provide the new financial lending B'/R. Apart from buying consumption goods, workers can decide to purchase investment goods i_l in order to operate as a residual productive sector in period 2. Capital available to them in the second stage is exactly equal to the investment made:

$$K'_l = i_l \tag{3.7}$$

If workers decide to operate as a residual productive sector, they will directly produce additional units of consumption goods, according to the following technology:

$$C'_l = A'H[K'_l] = A'H[i_l] \tag{3.8}$$

Function $H[.]$ is strictly increasing and concave and satisfies $H_K[0] = 1$. This implies $H_K[K'_l] < 1$ for $K'_l > 0$, so that residual sector l is less productive than the entrepreneurial sector for any positive level of capital. As we will see later, a direct implication of this assumption is that only the entrepreneur z will purchase investment goods, unless financial frictions restrict its ability to borrow.

The representative worker-lender l chooses c_l, c'_l, h, B', i_l to maximize its lifetime utility:

$$\max \left\{ v[c_l] - \frac{h_l^2}{2} + \beta v[c'_l] \right\} \tag{3.9}$$

subject to:

$$wh + B - \frac{B'}{R} = c_l + qi_l \tag{3.10}$$

$$A'H[i_l] + B' = c'_l \tag{3.11}$$

Consumption Goods and Investment Goods. Entrepreneurs in the remaining sectors produce their goods according to the following production functions:

$$C = F[z_c] \tag{3.12}$$

$$I = G[z_i] \tag{3.13}$$

where z_c and z_i are the amounts of intermediate goods that are used in the two sectors. Market clearing imposes that the total production of intermediate goods, Z, must be equal to the amount employed as factor of production, so that $Z = z_c + z_i$.

The production functions F and G are continuous and twice differentiable in their arguments. Marginal products are positive ($F_z[.] > 0$ and $G_z[.] > 0$) but diminishing ($F_{zz}[.] < 0$ and $G_{zz}[.] < 0$), so that more inputs of intermediate goods increase C and I by less and less. Again, we assume that $F[0] = 0$ and $G[0] = 0$ and that Inada conditions are satisfied, thus ensuring the existence of interior equilibria with positive and finite values of z_c and z_i.

We assume that entrepreneurs c and i limit their activity to period 1. Therefore, the representative entrepreneur c producing consumption goods chooses c_c and z_c to solve:

$$\max\{c_c\} \tag{3.14}$$

subject to:

$$F(z_c) - pz_c = c_c \tag{3.15}$$

while the representative entrepreneur i producing investment goods chooses c_i and z_i to solve:

$$\max\{c_i\} \tag{3.16}$$

subject to:

$$qG[z_i] - pz_i = c_i \tag{3.17}$$

Since their activity is limited to the first stage of production, entrepreneurs c and i simply maximize their instantaneous consumption without looking at the second stage.[3]

To sum up, in period 1 consumption goods are purchased by all the four representative agents, so that $C = c_c + c_z + c_i + c_l$, while investment goods are only purchased by agents z and l, so that $I = i_z + i_l$. As a result, by aggregating the four budget constraints that refer to the first stage of

[3]Note, however, that our model would lead to the same results even if we assumed that a single representative entrepreneur operates in all the three sectors (c, i and z) although requiring that sectors c and i separately maximize their current profits.

production [(3.5), (3.10), (3.15) and (3.17)], we obtain that *total output* in period 1 can be represented by $Y = C+qI$, i.e. the money value of all final goods produced in the economy. By contrast, in period 2 consumption goods are purchased only by agents z and l, so that $C' = c'_z + c'_l$. By aggregating the two budget constraints that refer to the second stage of production [(3.6) and (3.11)], we obtain that *total output* in period 2 can be simply represented by $Y' = C'$.

3.3 Frictionless equilibrium

Let's start from the maximization problem solved by workers-lenders l in a frictionless economy. Thanks to assumptions on $v[.]$, we do not need to impose non-negativity constraints on c and c'. Therefore, given w, q and R, first order necessary conditions for the representative lender's problem are given by:

$$w = \frac{h}{v_c[c_l]} = \frac{h}{v_c[wh + B - \frac{B'}{R} - qi_l]} \tag{3.18}$$

$$q = \frac{\beta v_c[c'_l]}{v_c[c_l]} \cdot A'H_K[i_l] = \frac{\beta v_c[A'H(i_l) + B']}{v_c[wh + B - \frac{B'}{R} - qi_l]} \cdot A'H_K[i_l] \tag{3.19}$$

$$R = \frac{v_c[c_l]}{\beta v_c[c'_l]} = \frac{v_c[wh + B - \frac{B'}{R} - qi_l]}{\beta v_c[A'H(i_l) + B']} \tag{3.20}$$

Our restrictions on preferences guarantee that equations (3.18) to (3.20) characterize a local optimum.

Equation (3.18) states that workers adjust their labor effort until marginal benefit in units of consumption goods, i.e. the real wage w, equals the marginal disutility in units of consumption goods, i.e. the marginal cost of labor effort, h, normalized by the marginal utility of consumption, $v_c[c_l]$. As we can see from the equation, wages affect labor supply in two ways. First, a rise in w increases the marginal benefit of working and, consequently, generates a positive substitution effect on labor supply, h^S. Second, it increases the marginal disutility of working by reducing the marginal utility of consumption and, consequently,

generates a negative income effect on h^S. We will assume preferences such that the substitution effect dominates.[4] Standard parametrizations of utility functions satisfy this assumption, thus implying that the labor supply curve slopes upward. Equation (3.19) states that workers, in their role of residual productive sector, adjust demand of investment goods until marginal cost of investment, q, equals the marginal benefit, i.e. the marginal product of fixed capital times the intertemporal marginal rate of substitution. Again, a shift in q generates both a wealth effect and a substitution effect on investment demand. However, in this case, both of them induce an inverse relationship between q and i_l, thus implying that the investment demand curve slopes downward. Finally, equation (3.20) is the standard consumption Euler equation, which equalizes benefits and costs from saving a unit of consumption today. Given the concavity of $v[.]$, this equation implies that individuals tend to smooth consumption over time. The saving supply curve slopes upward as usual.

According to our assumptions on preferences and parametrizations of utility functions, we outlined a framework where the supply and demand curves assume the following configurations:

$$h^s = h\left(w_{(+)}|q^s_{(-)}, q^m_{(+)}, R^s_{(+)}, R^m_{(-)}, A'_{(+)}\right) \tag{3.21}$$

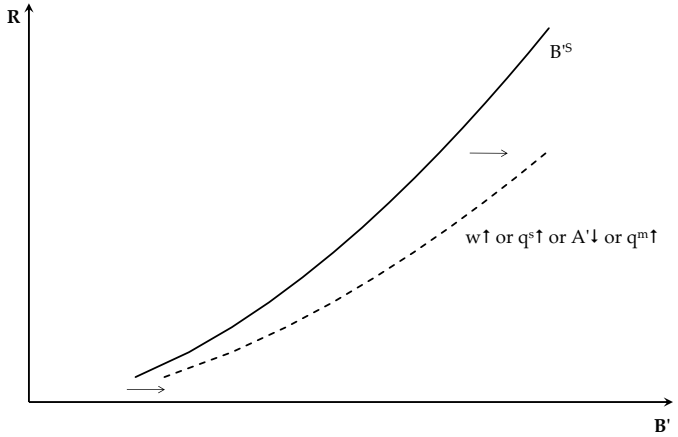
$$i^d_l = i\left(q_{(-)}|w_{(+)}, R^s_{(-)}, R^m_{(+)}, A'_{(+)}\right) \tag{3.22}$$

$$B'^s = B'\left(R_{(+)}|w_{(+)}, q^s_{(+)}, q^m_{(-)}, A'_{(-)}\right) \tag{3.23}$$

where the signs in parenthesis indicate the curve inclination [*upward* (+) vs. *downward* (-)] or the curve shift [*to the right* (+) or *to the left* (-)] relative to marginal increases of the corresponding variables, as shown in the example illustration of figure 15. Superscripts m and s in the equations above serve to distinguish income effects (m) from substitution effects (s). Indeed, cross effects due to changes in q and R are indeterminate and depend on whether income effects (q^m and R^m) offset substitution effects

[4]This comes down to limit the concavity of the utility function.

Figure 15: Savings Supply Curve



(q^s and R^s).[5] The reported effects of changes in A' are based on standard parametrizations such that in equation (3.19) the wealth effect, implied by changes of $v_c[c'_l]$, is always offset by the substitution effect, implied by changes in the marginal productivity of fixed capital. Therefore, workers increase their demand for investment goods when A' increases and, consequently, they also increase labor supply and decrease credit supply.

Similarly, taking as given w, q and R, the problem solved by the representative entrepreneur z, who produces intermediate goods, leads to the following first order conditions:

$$w = p(1-\theta)AK^{\theta}h^{-\theta} \tag{3.24}$$

$$q = \frac{\beta u_c[c'_z]}{u_c[c_z]} \cdot A' + \frac{\rho}{u_c[c_z]} = \frac{\beta A' u_c[A'(K+i_z) - B'] + \rho}{u_c[pAK^{\theta}h^{1-\theta} - wh + \frac{B'}{R} - B - qi_z]} \tag{3.25}$$

[5]Thinks, for example, of an increase in q that brings down i_l^d. When the income effect prevails, qi_l goes up, thus raising the marginal benefit of alternative sources of current consumption for workers. As a consequence, the raise in q affects labor supply h^s positively and savings b'^s negatively. Just the opposite happens when the substitution effect prevails and qi_l goes down.

$$R = \frac{u_c[c_z]}{\beta u_c[c'_z]} = \frac{u_c[pAK^{\theta}h^{1-\theta} - wh + \frac{B'}{R} - B - qi_z]}{\beta u_c[A'(K + i_z) - B']} \tag{3.26}$$

where ρ is the Lagrange multiplier associated with the non-negativity constraint on investment i_z. Equation (3.24) states that entrepreneur z adjusts labor demand to the point where the marginal cost, given by the real wage w, equals the marginal product of labour. Unless the non-negativity constraint on investment i_z is binding and $\rho > 0$, the interpretation of equation (3.25) is comparable with that of equation (3.19). Similarly, equation (3.26) has the same interpretation than the Euler equation (3.20) for agents l. Again, restrictions on the utility functions ensure that the first order conditions characterize an optimum.

Demand curves of entrepreneur z assume the following forms:

$$h^d = h\left(w_{(-)}|p_{(+)}, A_{(+)}\right) \tag{3.27}$$

$$i_z^d = i\left(q_{(-)}|w_{(-)}, R_{(-)}, p_{(+)}, A_{(+)}, A'_{(+)}\right) \tag{3.28}$$

$$B'^d = B'\left(R_{(-)}|w_{(+)}, q^s_{(-)}, q^m_{(+)}, p_{(-)}, A_{(-)}, A'_{(+)}\right) \tag{3.29}$$

An increase in the wage rate reduces the labor demand. Therefore, current production and resources available for current consumption go down. This also reduces demand for investment goods and increases lending demand. When current productivity A and the price p of intermediate goods increase, exactly the opposite happens. Positive shocks in future productivity A' raise demand for both lending and investment goods, while an increase in R tends to reduce both. Finally, an increase in price q of investment goods reduces the demand of investments but, again, will have indeterminate cross effects on the demand for lending.

In addition, since $Z = AK^{\theta}h^{1-\theta}$, the supply curve for the intermediate goods assumes the following form:

$$Z^s = Z\left(p_{(+)}|w_{(-)}, A_{(+)}\right) \tag{3.30}$$

while aggregate demand for investment goods I^d depends on both (3.22) and (3.28) since $I = i_z + i_l$.

Similar solutions to the problems of individual optimization imply that the representative entrepreneur c, who produces consumption

goods, adjusts demand for intermediate goods and supply of consumption goods to the point where the marginal cost of a unit of intermediate good, i.e. price p, equals the marginal product, i.e. $F_z[z_c]$:

$$p = F_z[z_c] \tag{3.31}$$

Since $F_z[.]$ is decreasing in z_c, then the demand curve slopes downward:

$$z_c^d = z\left(p_{(-)}\right) \tag{3.32}$$

Similarly, the representative entrepreneur i, who produces investment goods, adjusts demand for intermediate goods and supply of investment goods to the point where:

$$p = qG_z[z_i] \tag{3.33}$$

The demand curve slopes downward and is positively affected by q:

$$z_i^d = z\left(p_{(-)}|q_{(+)}\right) \tag{3.34}$$

Finally, since $I = G[z_i]$ and $Z = z_c + z_i$, we also have:

$$I^s = I\left(q_{(+)}|p_{(-)}\right) \tag{3.35}$$

$$Z^d = Z\left(p_{(-)}|q_{(+)}\right) \tag{3.36}$$

where (3.36) is derived by aggregating (3.32) and (3.34).

To sum up, from decision problems of workers-lenders and entrepreneurs-borrowers we obtained supply and demand curves for labor h, investment I, intermediate goods Z, and credit B'. Now we have to determine the competitive market equilibria for this frictionless economy, imposing market-clearing conditions.

Equations (3.20) and (3.26), combined with (3.19) and (3.25), imply the following condition:

$$q = \frac{A' H_K(i_l)}{R} = \frac{A'}{R} + \frac{\rho}{u_c[c_z]} \tag{3.37}$$

Now, recall that $H_K[i_l] \leq 1$ and that $H_K[i_l] = 1$ if and only if $i_l = 0$. In addition we know that $\rho \geq 0$ and $u_c[c_z] > 0$. Therefore, (3.37) is only

satisfied for $i_l = 0$ and $\rho = 0$, so that $q = A'/R$. As anticipated, in the frictionless equilibrium workers do not invest in fixed capital, renouncing to operate as a residual productive sector. By contrast, the null multiplier ρ guarantees that investment i_z from entrepreneur z is strictly positive.

The market clearing condition for investment goods implies:

$$q = \frac{A'}{R} = \frac{A'\beta u_c[c'_z]}{u_c[c_z]} = \frac{p}{G_z[z_i]} \tag{3.38}$$

$$I\left(q_{(+)}|p_{(-)}\right) = I\left(q_{(-)}|w_{(-)}, R_{(-)}, p_{(+)}, A_{(+)}, A'_{(+)}\right) \tag{3.39}$$

In turn, the market clearing condition for financial lending implies:

$$R = \frac{v_c[c_l]}{\beta v_c[c'_l]} = \frac{u_c[c_z]}{\beta u_c[c'_z]} \tag{3.40}$$

$$B'\left(R_{(+)}|w_{(+)}\right) = B'\left(R_{(-)}|w_{(+)}, q^s_{(-)}, q^m_{(+)}, p_{(-)}, A_{(-)}, A'_{(+)}\right) \tag{3.41}$$

where credit supply is very simplified with respect to (3.23) since workers-lenders do not invest in fixed capital.

Labor market supply simplifies for the same reason, so that the clearing condition for the labor market implies:

$$w = \frac{h}{v_c[c_l]} = p(1-\theta)AK^{\theta}h^{-\theta} \tag{3.42}$$

$$h\left(w_{(+)}|R^s_{(+)}, R^m_{(-)}\right) = h\left(w_{(-)}|p_{(+)}, A_{(+)}\right) \tag{3.43}$$

Moreover, from conditions (3.24), (3.31) and (3.33) we obtain:

$$p = \frac{w}{(1-\theta)AK^{\theta}h^{-\theta}} = F_z[z_c] = qG_z[z_i] \tag{3.44}$$

and the corresponding market clearing condition for intermediate goods:

$$Z\left(p_{(+)}|w_{(-)}, A_{(+)}\right) = Z\left(p_{(-)}|q_{(+)}\right) \tag{3.45}$$

Although we have not adopted specific forms for utility and production functions, from clearing conditions above we can explain output and employment fluctuations through variations of exogenous variables. The natural exogenous candidates in this framework are the technology parameters A and A'. In the next section, we will also introduce an exogenous parameter for financial frictions.

Negative shock in A. Let's start from considering a negative shock in current productivity. Other variables being equal, decreasing current productivity induces entrepreneur z to reduce the demand of labor and the production of intermediate goods. Lower income during the first stage of production also induce the entrepreneurs z to find alternative sources of funds, by reducing the demand of investment goods and by increasing the demand of external financing. This behavior have a positive impact on the price p of intermediate goods and on the interest rate R, while negatively affecting the price q of investment goods and the wage rate w. Although these changes result in further adjustments of demand and supply curves, standard parametrizations can easily justify a scenario where the output of all the three sectors, I, Z and C fall down, as well as the aggregate output Y. By contrast, credit B' to be repaid may result higher than before the productivity shock, with workers accepting to reduce their consumption in period 1 in change of a higher payoff in period 2. In this way, the negative effects of lower current productivity in period 1 not only affect the representative entrepreneur z but they are shared by all agents. In return, entrepreneurs z undertake to return a greater share of their future production to lenders. However, despite the invariance of A', even future output and consumption (recall $Y' = C'$) result lower than before the shock, because of the lower investments made in period 1.

Negative shock in A'. A negative shock in future productivity generates a reduction in the investment demand, since we are assuming that the wealth effect in (3.25) is not so relevant to offset the lower incentives to buy investment goods. In turn, lower investments in period 1, together with lower production in period 2, generate relative abundance of resources in the first stage, thus reducing demand for external financing and the amount B' to be repaid in the next period, as shown in (3.41). The negative impact on q and R results in further adjustments of demand and supply curves. In particular, since q decreases, we can reasonably expect from (3.45) a reduction in demand for intermediate goods, which in turn generates a reduction in labor demand. If these effects prevail, the wage

rate w and the price p of intermediate goods tend to decrease, thus inducing an increase in current production of consumption goods C, through (3.31). On the demand side, higher C can be justified by producers of type z investing less and demanding for more consumption in period 1. Similarly, workers-lenders l may increase the resources available for consumption by providing lower credit to entrepreneurs. Therefore, the fall in aggregate output Y descending by lower A' could be mainly due to the lower demand of investment goods in period 1, while current production of consumption goods may partially offset the slowdown. However, forces acting in the opposite direction on consumption may also prevail. If the reduction in R is less than proportional to the reduction in B', workers provide a lower amount of new external funds B'/R to entrepreneurs in period 1. If this is the case, workers have larger resources available in period 1 and reduce their labor supply, as shown by equation (3.43) when $R^s_{(+)}$ prevails on $R^m_{(-)}$. This may induce an increase in the wage rate w and also, through (3.45), in price p. Through (3.31), this actually implies a decline in the current production of consumption goods C, thus amplifying the fall in aggregate output. Finally, lower A' and lower investments definitely lead to lower output and consumption in period 2.

3.4 Collateral constraint model

The model described in section 3.3 has the typical implications of a neoclassical business cycle model. However, the introduction of financial frictions in the model itself lead to different equilibria. As described in Quadrini (2011), models with financial frictions are typically characterized by two main features: (a) *market incompleteness*, such that some assets cannot be traded or cannot exceed certain limits; and (b) *heterogeneity*, such that agents in the economy are not identical in their preferences and technologies and they are also divided in surplus (lenders) and deficit (borrowers) units. Heterogeneity has been already introduced by considering that there are four types of agents, one of which is a borrower (entrepreneur z) and one of which is a lender (workers l). There-

fore, to incorporate financial frictions in our previous analysis, we just have to introduce endogenous market incompleteness, for example by including in the model a *limited enforcement* problem. This is the main idea of models with collateral constraints as the one studied in Kiyotaki and Moore (1997). Agency problems affect the lender's ability to enforce the contractual obligations and, in particular, the repayment of the intertemporal debt B'.[6] Then we need to impose the following collateral constraint on the representative entrepreneur z producing intermediate goods:

$$B' \leq \xi q' K'_z = \xi q'(K + i_z) \tag{3.46}$$

where q' is the theoretical price of fixed capital in period 2 and $\xi < 1$ captures potential losses incurred with the reallocation of capital.

Indeed, in the event of default, the lender can only recover a fraction ξ of the capital and resell it at price q'. This price is theoretical because period 2 is the last period in the model and, then, the actual price of capital should be zero. However, following Quadrini (2011), we simply assume that the fraction ξ of capital is reallocated to the residual sector l, which prices it according to its marginal productivity:

$$q' = A' H_K[i_l] \tag{3.47}$$

In the frictionless case, we obtained that $i_l = 0$, since workers do not operate as a residual productive sector and they do not invest in fixed capital. This result, derived from equation (3.37), depends on the ability of the representative entrepreneur z to purchase the optimum level i_z of investment goods. However, this could be not the case when the collateral constraint (3.46) is binding. Since only a fraction ξ of capital can be reallocated and $H_K[i_l] < 1$, condition (3.47) formalizes that capital has lower value for workers-lenders than for the entrepreneur z. This is the reason why entrepreneurs cannot borrow to the desired levels. An

[6] Quadrini (2011) also points out that the limited enforceability of debt contracts may be not a major problem if all firms can save enough resources over time and borrowing constraints become irrelevant. However, in this section we are assuming to live in a different world with respect to the one depicted in Modigliani and Miller (1958) and the financial structure of individual firms is not irrelevant for their values and their performances.

important consequence of (3.46) is that the lower is the net worth of borrowers and the lower is the financing that can be raised externally.

In accordance with the new assumptions, we add restriction (3.46) to conditions (3.5) and (3.6) in the maximization problem of the entrepreneur z. Accordingly, first order conditions (3.25) and (3.26) are substituted by the following conditions:

$$q = \frac{\beta u_c[c'_z]}{u_c[c_z]} \cdot A' + \frac{\rho + \mu \xi q'}{u_c[c_z]} = \frac{\beta A' u_c[A'(K + i_z) - B'] + \rho + \mu \xi q'}{u_c[pAK^{\theta} h^{1-\theta} - wh + \frac{B'}{R} - B - qi_z]} \quad (3.48)$$

$$R = \frac{u_c[c_z]}{\beta u_c[c'_z] + \mu} = \frac{u_c[pAK^{\theta} h^{1-\theta} - wh + \frac{B'}{R} - B - qi_z]}{\beta u_c[A'(K + i_z) - B'] + \mu} \quad (3.49)$$

where μ and ρ are the Lagrange multipliers associated respectively with the collateral constraint and the non-negativity constraint on investment.

Let's consider the equilibrium configuration where investment i_z is strictly positive but the constraint (3.46) is binding, i.e. $i_z > 0$ and $B' = \xi q'(K + i_z)$. This implies $\rho = 0$ and $\mu > 0$. Entrepreneur z cannot adjust its demand of credit to the frictionless optimum point. Indeed, according to (3.49), $\mu > 0$ implies that at the equilibrium point the marginal benefit from borrowing is still higher than the marginal cost R. When the collateral constraint (3.46) is binding, the budget constraint (3.5) can be rearranged as:

$$\left(q - \frac{\xi q'}{R}\right) i_z = \frac{\xi q'}{R} K + pAK^{\theta} h^{1-\theta} - wh - B - c_z \quad (3.50)$$

This expression formalizes the basic mechanism of the model. Each unit of new capital goods can be used as collateral to raise $\xi q'/R$ units of external financing. Therefore, the left hand side of (3.50) represents the actual payment for new capital goods in period 1. This amount is financed in two ways. On the one hand, the entrepreneur raises $\xi q' K/R$ units of external financing by using capital K already in hand as collateral. On the other hand, he uses the residual income of the first stage of production after debt repayment and consumption.

We can now impose the binding constraint (3.46) into conditions (3.48) and (3.49). Solving (3.49) for μ and substituting into (3.48) we de-

rive:

$$q - \frac{\xi q'}{R} = \frac{\beta(A' - \xi q') \cdot u_c[(A' - \xi q')(K + i_z)]}{u_c\left[pAK^{\theta}h^{1-\theta} - wh - B + \frac{\xi q' K}{R} - i_z\left(q - \frac{\xi q'}{R}\right)\right]} \tag{3.51}$$

Following the same approach than in section 3.3, we obtain the following configurations for the demand curves of entrepreneur z producing intermediate goods:

$$h^d = h\left(w_{(-)}|p_{(+)}, A_{(+)}\right) \tag{3.52}$$

$$i_z^d = i\left(q_{(-)}|w_{(-)}, R_{(-)}, q'_{(+)}, p_{(+)}, A_{(+)}, A'_{(+)}, \xi_{(+)}\right) \tag{3.53}$$

$$B'^d = B'\left(R_{(-)}|w_{(-)}, q_{(-)}, q'_{(+)}, p_{(+)}, A_{(+)}, A'_{(+)}, \xi_{(+)}\right) \tag{3.54}$$

By contrast to the frictionless case, investment demand of entrepreneur z is affected by changes in q' and ξ. Indeed, both increases in ξ and q' relax the collateral constraint (3.46), expanding the amount of resources available for investments in period 1.

In addition, equations (3.47)-(3.49) together with (3.19)-(3.20) lead to the following price for investment goods:

$$q = \frac{A' H_K[i_l]}{R} = \frac{A'}{R} - \frac{\mu A'(1 - \xi H_K[i_l])}{u_c[c_z]} \tag{3.55}$$

Conditions $H_K[i_l] \leq 1$, $\mu > 0$, $\xi < 1$ and $u_c[c_z] > 0$ must be respected. Therefore, (3.55) necessarily requires $H_K[i_l] < 1$ and $q < A'/R$. This implies $i_l > 0$, so that workers operate as a residual productive sector, differently from the frictionless case. Consequently, aggregate demand for investment goods depends on both (3.19) and (3.51) and market clearing conditions imply:

$$\begin{aligned} &I\left(q_{(+)}|p_{(-)}\right) \\ &\quad = i_z\left(q_{(-)}|w_{(-)}, R_{(-)}, q'_{(+)}, p_{(+)}, A_{(+)}, A'_{(+)}, \xi_{(+)}\right) \\ &\quad + i_l\left(q_{(-)}|w_{(+)}, R^s_{(-)}, R^m_{(+)}, A'_{(+)}\right) \end{aligned} \tag{3.56}$$

$$B'\left(R_{(+)}|w_{(+)}, q^s_{(+)}, q^m_{(-)}, A'_{(-)}\right)$$
$$= B'\left(R_{(-)}|w_{(-)}, q_{(-)}, q'_{(+)}, p_{(+)}, A_{(+)}, A'_{(+)}, \xi_{(+)}\right) \quad (3.57)$$

$$h\left(w_{(+)}|q^s_{(-)}, q^m_{(+)}, R^s_{(+)}, R^m_{(-)}, A'_{(+)}\right) = h\left(w_{(-)}|p_{(+)}, A_{(+)}\right) \quad (3.58)$$

$$Z\left(p_{(+)}|w_{(-)}, A_{(+)}\right) = Z\left(p_{(-)}|q_{(+)}\right) \quad (3.59)$$

Now output fluctuations can be explained through changes in A, A' and ξ.

Negative shock in A. Other variables being equal, a negative shock in current productivity reduces labor and investment demand and increases the supply of intermediate goods. These changes are now amplified by indirect effects that are induced by variations in price q of capital in the presence of financial frictions. Indeed, the lower aggregate demand of investment goods lowers q, thus increasing investments i_l of the residual sector, according to equation (3.19). As a consequence, equation (3.47) implies a reduction even in price q' . The corresponding tightening of the collateral constraint (3.46) reduces the ability to borrow of entrepreneur z and further hampers its investments. Further adjustments of demand and supply curves are not sufficient to offset this amplification mechanism of a shock in productivity. The output of all the three sectors, I, Z and C falls down, as well as the aggregate output $Y(= C + I)$. Similarly, credit B' to be repaid in period 2 decreases together with future production $Y'(= C')$.

Negative shock in A'. A negative shock in anticipated future productivity generates lower incentives to buy investment goods for both sectors z and l, inducing a decrease in aggregate demand of investment goods and in their price q. At the same time, interest rate R decreases since entrepreneurs z have lower incentives to borrow money and workers l have higher incentives to lend money. The final effect on investment demand i_l of the residual sector is indeterminate since the negative impact of the variation in A' may be counterbalanced by the positive impact

of the decrease in q. However, decreases in q and R imply for sure a decrease in q' too. Indeed, we can easily derive from equations (3.19)-(3.20) and (3.47) that in equilibrium $qR = q'$. The reduction in q' causes a tightening of the collateral constraint, so that the amplification mechanism takes place even in case of a negative news shock on future productivity. Since credit decreases and the cost of investment goods declines, workers have lower incentives to work in period 1, leading to an increase in w and a consequent lower supply of intermediate goods in sector z. Demand of intermediate goods also decrease as a consequence of the reduction in q and of the lower supply of investment goods. Therefore, production Z of intermediate goods decreases, while the sign of the change in p is indeterminate. If p is higher than before the shock, not only investments but also current consumption falls down. Finally, lower future productivity, together with lower investments, definitely leads to a decrease in production and consumption in period 2, amplified by the presence of financial frictions.

Negative shock in ξ. We finally arrive to describe the business cycle effects of shocks that directly arise into the financial sector. In our framework, these shocks can be represented by exogenous changes in the parameter ξ. The effect of a reduction in ξ is similar to that of a reduction in q' induced by negative shocks in productivity. In this case, however, the negative impact on the ability of entrepreneur z to borrow money from lenders l is more direct. By tightening the collateral constraint, the shock is reflected in a lower demand of credit B' and investment goods i_z. The corresponding reduction in price q affects positively the residual demand of investments i_l in the residual sector, thus exerting downward pressures on price q', according to equation (3.47). In turn, the reduction q' interacts with the exogenous change in ξ, so that the effects of the original financial shock are further amplified by the price mechanism described above. The reduction in price q of investment goods also induces lower demand of intermediate goods from the representative entrepreneur i producing investment goods. However, price p of intermediate goods will be not necessarily lower than before the shock. Lower levels of q and

R may potentially induce an expansion of resources available to workers in period 1, thus reducing their labor supply in the same period, consistently with condition (3.58). Therefore, rising wages w cut down the supply of intermediate goods, through (3.59), and create upward pressures on price p, notwithstanding the lower demand from entrepreneur i. This would finally imply, through (3.31), a lower production of consumption goods. In this way, we derived the important result that, even without additional shocks in real productivity, financial shocks can be sufficient to generate an output reduction in all the representative sectors of our economy and, consequently, the fall down of aggregate production in both period 1 (Y) and period 2 (Y').

3.5 Collateral model with working capital

In section 3.4 we proved that a financial shock can affect aggregate output even if there is no current or anticipated change in real productivity. In our setting, when financial conditions worsen, current output is affected through a *demand channel* of transmission and, in particular, through a lower demand of investment goods. However, financial shocks may also generate output fluctuations trough an alternative *supply channel*, involving working capital. By working capital we generally mean the amount of financial resources that have not been locked in fixed assets and that can be devoted to current operating expenditures. As noticed in Quadrini (2011), there are a few existing papers[7] that consider an explicit role for the interactions between working capital needs and the existence of a binding collateral constraint. However, availability of working capital is strictly necessary to deal with the mismatch between expenditures to be sustained at the beginning of a production stage and the subsequent realization of revenues. In this section we just analyze the consequences of lower resources available to finance liquidity needs.

For simplicity, in the formal model, we can assume that entrepreneur z producing intermediate goods uses working capital to hire labour from

[7]See, for example, Jermann and Quadrini (2006), Christiano et al (2007) and Mendoza and Quadrini (2010).

workers l.[8] In addition, the collateral constraint is not relative to intertemporal credit B' but only to intra-period loans that are necessary to pay wages before the realization of revenues. We assume, in particular, that entrepreneurs must borrow only a share α of the total payments wh to be made. Since intra-period loans are repaid at the end of the same period 1, they do not require interest payments. However, the working capital constraint imposes to entrepreneur z the following condition:

$$\alpha wh \leq \xi q' K \tag{3.60}$$

which substitutes condition (3.46). Investment goods i_z purchased in period 1 will be at firms' disposal only in period 2. Therefore, only K (and not K'_z) is available as collateral during the first stage of production. In the optimization problem of the representative entrepreneur z, first order conditions (3.25)-(3.26) remain exactly the same than in the frictionless case, while (3.24) becomes:

$$w = \frac{u_c[c_z] \cdot p(1-\theta) A K^{\theta} h^{-\theta}}{u_c[c_z] + \mu\alpha} \tag{3.61}$$

where μ is the Lagrange multiplier associated with the collateral constraint. Therefore, as already shown in condition (3.37), workers l do not invest in fixed capital ($i_l = 0$), while the investment of entrepreneur z is strictly positive ($i_z > 0$). However, (3.61) modifies the optimality condition for the demand of labor with respect to the frictionless case. Indeed, provided that the collateral constraint is binding, $\mu\alpha$ is strictly positive. Therefore, at the equilibrium point, the marginal benefit from hiring more labor is still higher than its marginal cost w. Nonetheless, entrepreneur z is constrained by available collateral and cannot increase further its labor demand.

Negative shock in ξ. In this new setting, a negative shock in the financial sector tightens the working capital constraint and has an immediate impact on labor demand. The production Z of intermediate goods

[8] However, we could also consider an alternative model where working capital is used for buying materials (intermediate inputs) in the production process or even for maintaining a sufficient amount of resources that are needed to sustain all the operating expenditures within the period.

falls down together with labor demand. In addition, the lower residual income of period 1 pushes entrepreneur z to invest less and to demand more intertemporal credit B' in order to limit the decrease in current consumption. This also exerts downward pressures on price q of investment goods and upward pressures on the interest rate R. In turn, lower supply of intermediate goods increases their price p inducing representative entrepreneurs i and c to reduce the production of investment and consumption goods. Therefore, according to these supply-side arguments, weak working capital positions are likely to result in lower employment and lower aggregate output Y, while exerting upward pressures on price levels of intermediate goods. Finally, as a consequence of lower labor demand, workers reduce their supply of intertemporal credit. At the new equilibrium, interest rates are higher than before the shock, wages are lower and the production falls down in all the representative sectors. To sum up, we have shown that financial markets can have large and persistent effects on output fluctuations through this working capital channel, which affects the economy on the supply side.

3.6 What happens in creditless recoveries

In sections 3.4 and 3.5 we outlined a general equilibrium model in which output fluctuations can be severely affected by the financial markets. The role of bank credit is more than evident in this context, since private credit to the non financial sectors is typically one of the main sources of external financing. Although workers and lenders are represented by a single representative agent in the model, in reality banks represent the main channel through which savings are made available to entrepreneurs.

Disruptions in the credit market can be easily reconnected to the models with financial frictions presented in the previous sections. Indeed, the negative shock in ξ can be interpreted as a credit shock that reduces the firms' capability to borrow money from banks. In the formal model, ξ represents the fraction of capital that can be recovered by lenders in the event of default. However, the same parameter ξ can be adopted

as a proxy for various factors that may actually constrain credit. Asset price declines (either current or anticipated) are one main reason for tightening credit conditions, since they exert a downward pressure on the value of collateral. However, debt overhang and the lack of investment opportunities may also induce the private sector to deleverage and the commercial banks to restrict credit supply. Banks may be also subject to stricter regulations and enhanced capital requirements, which affect their ability to lend. All these shocks affecting the borrowing capability of entrepreneurs can be represented through negative changes in ξ , with the consequences analyzed in previous sections.

In this framework, aggregate output will tend to move in the same direction of ξ. Indeed, as far as ξ does not grow back to the original level, we may expect output to remain depressed. However, as noticed in chapter 2, episodes of creditless recoveries reveal that this is not always true and that recovery in aggregate output can take place despite persisting lower levels of ξ. Therefore, it is of prime interest to understand which mechanisms could come into play to justify the occurrence of these puzzling phenomena. In the simplified two-period model the recession and the subsequent recovery phase cannot be analyzed simultaneously. However, we can reason as if the model could be iterated. Some exogenous parameter must change within the model to generate the recovery, as well as the negative shock in ξ generated the recession. If ξ does not return to the original level, some alternative change must necessarily compensate this shock to justify the recovery.

Let's start from considering the working capital channel of section 3.5. If financial shocks affect the economy through this supply channel, the binding collateral constraint is represented by condition (3.60). In this case, when ξ remains low, a viable opportunity of recovery lies in a proportional decrease of parameter α, i.e. the share of current expenditures[9] that entrepreneurs sustain by recurring to intra-period loans. Several factors can make possible a decline in α. First of all, α decreases when the representative entrepreneur z finds resources that are alternative to

[9]Hereinafter, we consider that working capital is used for all kinds of current expenditures, and not only labor costs as in the simplified model of section 3.5.

intra-period credit in order to finance day-by-day operations. One possibility is to increase the amount of equity and long-term debt that is not dedicated to fixed assets. In section 3.7 this component will be defined as *permanent* (or *Net*) *working capital*. Another possibility is to increase the use of *trade credit*. Indeed, trade credit eases the collateral constraint on intra-period credit even if all companies are simultaneously collecting both accounts payables and receivables. The only thing that matters, in fact, is that a smaller amount of current expenditures must be provided in advance by the banks to the representative entrepreneur z. Secondly, α may also decrease because entrepreneurs improve their *working capital management*. In practice, companies enhance the frequency of release of their current assets in the production process and, consequently, reduce their need of external funding. So doing, entrepreneurs are able to support increasing amounts of operating expenses (wh in the model) despite a stable injection of working capital. This concepts will be further developed in the next sections, when analyzing data at the firm level.

Alternatively, we have to consider the investment channel of section 3.4. If financial shocks affect the economy through the demand of investment goods, the binding collateral constraint is represented by condition (3.46). In this case, when ξ remains low, a viable opportunity of recovery lies in *retained earnings*. Firms retain a greater share of profits and do not distribute dividends among the shareholders. In our model, this can be accounted for by an increase in β, so that entrepreneur z postpones consumption and leaves more resources available for investment growth. However, we could also think of alternative (and more complicated) models where recapitalizations and retained earnings move resources from agent l to agent z and, consequently, circumvent the collateral constraint (3.46). In addition, moving to an open economy context, even *exchange rate devaluation* and *trade balance correction* may play an important role on creditless recoveries. Indeed, increasing net exports can sustain aggregate demand despite investments remaining subdued. This is just what seems to occur in Sudden Stop episodes and creditless recoveries originally identified in Calvo et al (2006a,b).

It is interesting to note how the different collateral constraint models

can be usefully connected to the different concepts of creditless recoveries presented in 2. Creditless recoveries in the Calvo sense [Calvo et al (2006a,b)] can be explained with respect to the collateral constraint on working capital of section 3.5. By contrast, creditless recoveries in the Biggs sense [Biggs et al (2009, 2010)] refer to the collateral constraint on intertemporal credit of section 3.4.

3.7 An accounting approach at the firm level

We have outlined a general equilibrium model and the different results that can emerge in the presence of financial frictions and financial shocks. In this section, we open a more detailed focus on what can actually happen at the enterprise level, consistently with models described above, to justify the occurrence of creditless recoveries. Therefore, we want to provide an insight into the channels through which financial shocks may affect the operations of a company, as well as channels through which the recovery can take place. As shown in chapter 2, a creditless recovery at the macro level can manifest itself in two ways. On the one hand, it can be the consequence of a composition effect, i.e. a redistribution in output growth which favors low-leveraged companies to the detriment of high-leveraged ones. Low-leveraged companies can be firms operating in industries that are technologically less dependent on external finance for capital expenditures, in the sense of Rajan and Zingales (1998), or in industries with technologically lower liquidity needs, in the sense of Raddatz (2006).[10] However, low indebtedness may also be induced by specific characteristics that are not technology-driven. For example, firms can be more independent from the credit channel thanks to advanced technologies adopted at the enterprise level or to an efficient financial management. Similarly, even the firm size and the years of activity can influence the degree of indebtedness.

[10] As mentioned in chapter 2, some studies on creditless recoveries have focused on redistributional effects that are just due to industry characteristics. Indeed, technology-driven characteristics are assumed to be exogenous with respect to the bank credit availability. Consequently, they are particularly useful to identify the role of credit markets for output dynamics avoiding problems of reverse causality.

On the other hand, a creditless recovery can be largely explained by deleveraging at the firm level, i.e. changes directly affecting the balance sheet items of each individual enterprise. This behavior effect is not driven by a better performance of low-leveraged firms during the recoveries, but by the ability of companies to return to pre-crisis levels of output while maintaining the levels of bank debt at lower values. In fact, this is what we might define a genuine creditless recovery at the firm level. Therefore, an accounting approach to analyse micro (individual) data can help us to reveal important details that could not be detected on macro (aggregate) data. In particular, we want to focus on the solutions that a company can adopt to make up for negative shocks in credit supply and get back on a path of positive growth. From financial statements, in particular, we can obtain accounts and ratios that are useful to identify which different mechanisms play an essential role in the occurrence of creditless recoveries.

Section 3.8 will be dedicated to the analysis of firm level data of European countries during the global financial crisis. First, however, we want to develop a specific framework that is very useful to explain how working capital components can interact with output fluctuations at the enterprise level. For the continuity of business activity, current assets need to be financed along with the investments in fixed assets. The latter tend to be made in large increments, they tend to constitute irreversible actions and largely contribute to the long-run production of the company. The former are strictly necessary to sustain recurring expenditures for maintenance costs, procurement of raw materials, payment of wages and other day-by-day necessities. Working capital is therefore essential for current operations of businesses. Since investments in working capital are more easily reversed, they are also more susceptible of short-run fluctuations. For this reason, in the next paragraphs we broaden our perspective on this issue by paying particular attention to the components and the sources of working capital.

First of all, we need to discuss the different possible definitions of working capital, according to standard concepts taken from the literature on working capital management. In financial statement analysis,

net working capital is typically defined as the excess of current assets over current liabilities, thus measuring the ability of a firm to meet its financial obligations in the short run. However, for our purposes, it is the financing perspective that matters for firms rather than the accounting definition. From this perspective, working capital refers to the gross amount of financing resources that are dedicated to current assets on the firm's balance sheet, i.e. cash money, accounts receivable and also inventories (which are comprehensive of both intermediate goods, work-in-progress and finished goods). Current assets also include all the other items that are relatively easy to be converted in cash and used for the standard productive cycle. On the contrary, fixed assets refer to long-term assets that support a firm's activities and are usually divided in tangible assets (e.g. property, plant and equipment) and intangible assets (e.g. R&D). We define *Gross Working Capital* as the capital invested in the total current assets of a firm, i.e. capital that is not dedicated to fixed assets. This definition identifies all the activities that can be used in daily production operations, independently from the sources used to finance them. On the contrary, *Permanent Working Capital* (or *Net Working Capital*) is the excess of current assets over current liabilities, thus measuring the part of Gross Working Capital that is financed by fixed capital, such as equity and long-term debt. The level of Permanent Working Capital depends on the nature of the company, but also on independent decisions of the entrepreneurs. Indeed, positive amounts of Permanent Working Capital are justified by a precautionary behavior, since they lower the risks incurred by firms of being unable to meet short-term obligations. Decreasing the permanent component of working capital may reduce financing costs but it also increases the risk of illiquidity. Consistently with previous definitions, we can also define *Temporary Working Capital* as the total amount of current liabilities, i.e. the non-permanent component of gross working capital. This is the amount of intra-period resources available to the daily operational activities.

According to the definitions adopted above, current assets and Gross Working Capital are two sides of the same coin. Indeed, they are arithmetically identical but conceptually distinct. Gross Working Capital is

the amount of funds that finance current assets. In many economic papers the term working capital is simply identified with all the operating expenditures for the purchase of production inputs such as intermediate goods or working hours. This view, indeed, is inaccurate with respect to the argument that we are going to develop. In our setting, the annual costs incurred for production inputs will be indicated as *operating expenses* and do not coincide with gross working capital. For example, the use of inventories increases the operating expenses, while reducing the gross working capital. Indeed, inventories *used* for the production process and inventories *accumulated* in the balance sheet are two completely different things. Therefore, in our analysis, it is important to keep the two measures of working capital and operating expenses well separated from each other.

Secondly, we need to explain the reasons why working capital exists and which factors affect its optimal amount. In a theoretical world where some ideal conditions are satisfied, it would be possible to give continuity to the production activity despite owning an infinitesimally small amount of current assets.[11] Therefore, in such a perfect economy, the optimal amount of working capital would be close to zero. In reality, however, these ideal conditions do not occur. Sub-optimal production technologies, markets and distribution systems justify the necessity to maintain adequate amounts of short-term assets to be financed through working capital. Current assets can be seen as funds that are temporarily frozen within the company, since they are not immediately spent or spendable, but they are likely to be available for operating expenses within a short time.

As also noticed in chapter 2, the output of a company and its working capital typically go hand in hand. As a company grows, it typically

[11] This could happen in an ideal and hypothetical situation where: (a) uncertainty on the future availability of raw materials and on their price is null; (b) the conversion of production inputs in finished products requires an infinitely small time; (c) firms do not have to finance any operating expenses in advance of production; (d) goods can be sold and converted instantaneously into cash required to buy new inputs; (e) there are no risks of unexpected costs justifying the maintenance of liquidity for precautionary reasons; (f) there are no potential opportunities suggesting the maintenance of liquidity for speculative reasons; (g) the financing needs of the companies are not cyclical or seasonal.

needs increasing current assets readily available to sustain new operating expenses and to maintain the higher level of activity. High levels of earning capacity, in turn, generate cash from operations and increase the available working capital. Against this background, we can represent the current value of production at the firm level by recurring to the following breakdown:

$$Y \equiv \frac{Y}{OPEX} \cdot \frac{OPEX}{CA} \cdot \frac{CA}{TWK} \cdot TWK \tag{3.62}$$

where Y is total output, $OPEX$ indicates the Operating Expenses, CA stands for Current Assets and TWK is the Temporary Working Capital, expressed through Current Liabilities. Both CA and TWK are obtained as simple averages of the balances at the beginning of the year and at the end of the year. The ratios on the right hand side of this identity can be interpreted as follows:

- $OR = \frac{Y}{OPEX}$ is the Operating Ratio, which represents the operational efficiency of a company. The higher this ratio, the greater the output in proportion to each monetary unit spent in operating costs.

- $GWKTR = \frac{OPEX}{CA}$ is the Gross Working Capital Turnover Ratio, which measures how many times in a year the gross working capital is released to fuel the production process. Indeed, if we identify an *operating cycle* as the period of time that is necessary to activate all the gross working capital held within a company, then $GWCTR$ can be interpreted as the number of operating cycles that the firm activates in a single year. Higher values of $GWKTR$ reveal either increasing demand for the goods produced by the firm or greater efficiency in the use of available current assets.

- $PFC = \frac{CA}{TWK}$ is the Permanent Financing Contribution, which indicates how much the Permanent Working Capital contributes to the Gross Working Capital. The higher this ratio, the greater the share of current assets which is not financed by Temporary Working Capital (i.e. current liabilities).

Accordingly, production growth at the firm level g_y can be approximated by the growth of its subcomponents:

$$\begin{aligned} g_y &\equiv (1+g_{or})(1+g_{gwktr})(1+g_{pfc})(1+g_{twk})-1 \\ &\simeq g_{or}+g_{gwktr}+g_{pfc}+g_{twk} \end{aligned} \tag{3.63}$$

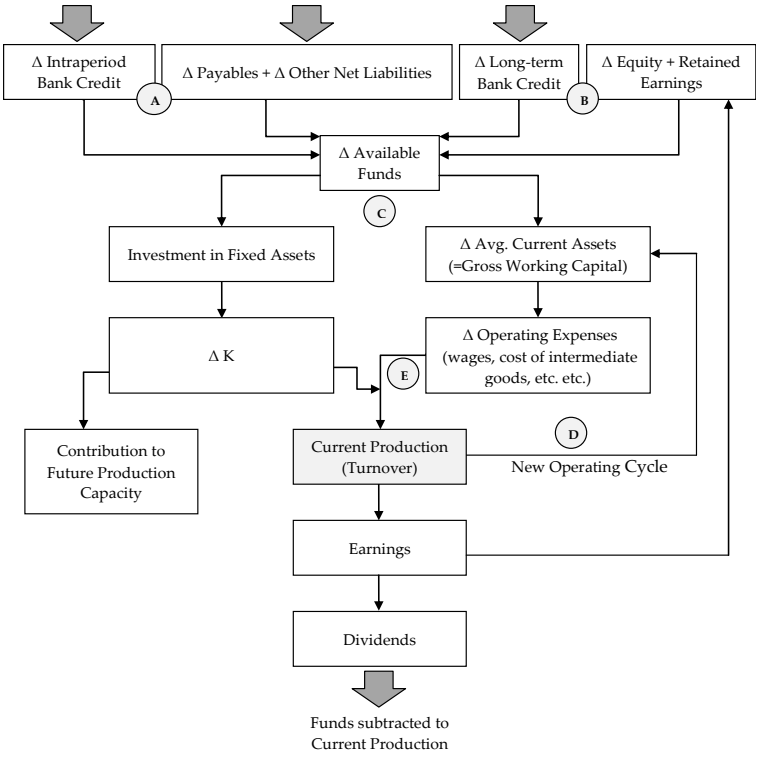
Decomposing output growth as just described allows us to identify and to measure the importance of the different channels that can determine fluctuations in the total production of a company. The scheme in figure 16 can help the reader to better comprehend the mechanisms behind these channels.

Under this scheme, fluctuations in the current production levels of a company can be explained through changes in accounts and ratios within the financial statement. Note that, in this context, we are not saying anything about causal relationships. A reduction in the current assets of a company may be forced by lower supply of financial resources, limiting its production capacity. However, the opposite can also occur, so that lower demand pushes the company to reduce its activities and to require fewer financial resources. The description of the relevant channels, indexed from letter (A) to letter (E) in figure 16, are briefly summarized in the following paragraphs.

(A) First of all, production growth can be made possible by an increase in the Temporary Working Capital (TWK) available to the company, i.e. its current liabilities. These sources of funding are inclusive of: accounts payables (i.e. trade credit), intra-period bank credit and other net liabilities available within the short run. Bank overdrafts are typically a major source of financing for a company. Therefore, an impaired financial sector may substantially increase the cost of raising liquidity that firms have to bear. Theoretically, the effects of a decrease in bank credit may also be mitigated by greater inflows of alternative funds, such as trade credit. Extending payment periods with major suppliers, for example, is a possible tool to finance working capital needs.

(B) Secondly, production growth is also made possible by an increase in Permanent Working Capital (PWK), which is the amount of long-term financing sources that are dedicated to finance current assets. The

Figure 16: Scheme of operating cycles at the firm level



main part of these resources is made of shareholders' funds and long-term bank debt. Firms with direct access to the financial markets can also rely on corporate bonds. Therefore, an increase of PWK may take place thanks to the increase of these funds. Higher shareholders' funds, in particular, may be the result of both recapitalizations and retained earnings. In particular, when external financing is not available (or too expensive), companies have to rely to a greater extent on internal finance. Therefore, cash flows generated are not redistributed through dividends to the shareholders, but they are immediately retained to finance the next operating cycles. Self-financing is not only a discretionary choice of the

management, since it also depends on the actual amount of earnings that can be retained and, consequently, on the level of external demand.

(C) However, PWK may also increase without an enlargement of long-term resources. Indeed, firms may simply enhance the PWK levels by moving long-term resources from the financing of fixed assets (i.e. capital expenditures) to the financing of current assets. In this case, the company sustains current production at the expenses of future production. Indeed, while current assets are mainly used for present activity, investments in fixed capital serve mainly for long-term production capacity. The management of a company may devote a greater share of available funding to current assets in order to curb a fall in present production or to foster the recovery, while taking away resources for future growth. Calvo et al (2006a,b), for example, see this option as a possible explanation for the occurrence of creditless recoveries, as also explained in chapter 2. However, as seen in the previous section, this behavior may still have a relevant impact on current production, by generating negative externalities for firms that produce investment goods.

(D) For a given level of current assets, present production may also grow thanks to an increase in the Gross Working Capital Turnover Ratio ($GWKTR$). Indeed, the production can increase without any change in current assets held by the company, provided that the management is able to increase the frequency of release of the current assets themselves in the production process. In fact, the $GWKTR$ ratio is influenced by several factors. First of all, the *efficiency* of the company in terms of working capital management, through actions that involve cash discount and cash collection policies, trade credit policies (i.e. times to collect accounts receivable and to repay accounts payables), and inventory policies (i.e. the ability to minimize stocks of intermediate goods and finished goods, while ensuring their availability in any instant of time).[12] Second, increasing $GWKTR$ could also mean increasing *aggressiveness* of the working capital policy. Indeed, working capital management implies a trade-off between profitability and liquidity. Excessive working capital, i.e.

[12]Just-in-time inventory techniques are one possible example of policies that may contribute to an increase of the $GWKTR$ ratio.

low $GWKTR$, leads to unnecessary accumulation of current assets and reduce potential profits. At the same time, scarce working capital may result in insufficient liquidity and in a reduction of the productive activity. Firms accept this risk when reducing current assets for a given level of operating expenses. Third, $GWKTR$ also depends on the *current demand* for goods produced and services provided by the firm. The higher the demand, the higher the frequency of the operating cycles. Indeed, if finished products are quickly sold, then they immediately bring new liquidity to the next operating cycle. By contrast, when demand collapses, the production shuts down and current assets remain frozen. Therefore, as observed so far, demand fluctuations are reflected in changes of both the PWK, through retained earnings, and the $GWKTR$, through higher frequency of operating cycles.

(E) The annual output of a firm may also grow thanks to the increase of the Operating Ratio (OR). Indeed, if production increases for a same amount of Operating Expenses, then the contribution of additional funding is not strictly necessary for the growth of business activity. The marginal productivity of inputs may increase thanks to the improved efficiency of the workforce and also thanks to technological progress, which may also derive from investments in fixed assets, both tangible (new plants and equipment) and intangible (R&D and marketing).

This scheme helps us to create a bridge with the models adopted in the previous sections and clarifies which alternatives may allow an increase in production despite continuous decline in bank lending. In the next section we just adopt this setting and make use of empirical data at the firm level to better assess which channels have actually accompanied the 2009 recession and the subsequent recovery.

3.8 Empirical analysis on firm-level data

We base our firm-level analyses on the same AMADEUS dataset introduced in chapter 2. As a starting point, we aggregate all firms of the sample and look at the annual growth rates of the various accounts and ratios individuated in the previous section. All the growth rates are com-

puted at prices and exchange rates of the previous year. Output at the firm level is proxied by *Operating Revenues* (*Turnover*). For each year in the period 2005-2011, we consider only firms whose data are also available in the preceding year, so that growth rates on aggregate data are not affected by variations in the sample of firms. The whole sample is an unbalanced panel, which consists of 12,810,348 firms in 39 European countries.[13] Alternatively, we also repeated our analyses on a balanced panel of firms whose data are available in all the years considered. While the main conclusions are broadly the same, observations reduce to 7,013,407 firms and some countries are particularly underrepresented. For this reason, in the next paragraphs we prefer to present the results obtained in the unbalanced sample.

As we can see in table 4, in the pre-crisis period 2005-2008 the positive growth in real total Turnover is made possible by corresponding movements in Temporary Working Capital. Indeed, in *normal* periods, the availability of current liabilities to finance day-by-day operations grows together with the production levels. By contrast, the Permanent Financing Contribution and the Operating Ratio are only slightly positive in 2005-2007 and turn negative in the pre-crisis year 2008. These ratios are the first to be negatively affected by the global financial crisis, anticipating the drop in real production. The lower Permanent Financing Contribution in 2008 reflects lower amounts of permanent capital dedicated to current assets with respect to the increase in TWK. This is not yet to be attributed to lower availability of long-term credit (still growing by 7.5 percent in 2008), but to insufficient growth in shareholders' funds and other permanent capital with respect to growth in fixed assets (still increasing by 6.8 percent in the same year). In particular, shareholders' funds increase by less than 4 percent in 2008 because of lower net incomes that can be retained by corporations. The lower OR, instead, reveals a lower operational efficiency at the beginning of the crisis period. Nevertheless, the most relevant components to observe during the crisis are the Gross Working Capital Turnover Ratio and the Temporary Work-

[13]Some observations that have unusual influence on aggregate accounts are treated as outliers and excluded from the sample. See also the Appendix A.

Table 4: Accounting decomposition of output growth

WHOLE SAMPLE (obs. = 12,810,348)					
Year	Y	TWK	PFC	GWKTR	OR
2005	5.3	4.6	0.7	-0.3	0.3
2006	7.4	6.1	1.0	-0.1	0.2
2007	5.7	7.7	0.7	-2.7	0.1
2008	3.4	5.9	-1.2	0.1	-1.4
2009	-11.5	-0.7	0.3	-10.8	-0.4
2010	5.8	-2.0	1.9	4.7	1.2
2011	5.5	3.7	0.3	1.9	-0.5
WESTERN AREA (obs. = 8,253,182)					
Year	Y	TWK	PFC	GWKTR	OR
2005	5.5	4.6	0.6	-0.1	0.3
2006	7.2	6.1	0.8	0.0	0.3
2007	5.4	7.4	0.5	-2.5	0.1
2008	3.4	5.4	-1.0	0.6	-1.5
2009	-10.8	-1.7	0.3	-9.1	-0.5
2010	6.3	-2.2	2.1	5.1	1.3
2011	5.1	3.7	0.4	1.4	-0.4
CENTRAL-EASTERN AREA (obs. = 4,557,082)					
Year	Y	TWK	PFC	GWKTR	OR
2005	3.6	4.3	2.4	-2.9	-0.1
2006	9.1	7.9	2.8	-1.7	0.1
2007	8.0	11.6	1.7	-5.1	0.2
2008	1.8	7.3	-0.4	-3.8	-1.0
2009	-14.6	5.8	-0.6	-18.1	-0.9
2010	4.0	-0.4	0.9	3.5	0.0
2011	6.2	3.3	0.3	2.6	-0.1

Y: Operating Revenues (Turnover); TWK: Temporary Working Capital; PFC: Permanent Financing Contribution; $GWKTR$: Gross Working Capital Turnover Ratio; OR: Operating Ratio. The *Western Area* includes Northern Europe, Western Europe and South-Western Europe. The *Central-Eastern Area* includes Central Europe, South-Eastern Europe and Other former Soviet States (see the Appendix A for countries within each group)

ing Capital. In the pre-crisis years, $GWKTR$ undergoes only a slight deterioration, as businesses hold an increasing amount of current assets for a same level of operating costs. However, in the midst of the crisis $GWKTR$ collapses (-10.8 percent in 2009) and the growth rate of TWK decreases by 6.6 percentage points in one year (from 5.9 percent in 2008 to -0.7 percent in 2009). To sum up, while in normal years production growth is accompanied by a proportional growth of Temporary Working Capital, during the recession year 2009 the TWK growth vanishes and the $GWKTR$ collapses together with aggregate output.

Evidences from this analysis should be taken as stylized facts useful for modeling the impact of financial frictions on the economy and the occurrence of creditless recoveries. However, they are not sufficient by themselves to explore cause-effect relationships. In this case, for example, it is not clear whether the recession starts from a liquidity crunch in the sense of Calvo et al (2006a,b) or an exogenous shock on aggregate demand. If the original problem is a liquidity crunch, evidences can be explained through the working capital constraint of section 3.5. The collapse of TWK growth generates downward pressures on aggregate demand and $GWKTR$ is negatively affected as a consequence. Conversely, if the original shock on aggregate demand is independent from the availability of credit, the first component to fall down is just $GWKTR$, while TWK growth halts for the excess of unused current assets. In chapter 4 we will see how a difference-in-differences approach can be used to identify the causal links between credit growth and output performance. However, the analysis of this section is extremely useful in itself to deepen our knowledge of changes that occurred at the firm level during (and after) the global financial crisis and to understand how they can be reconnected to the models shown above.

Table 4 also shows how the real output can start to recover after the recession. As we can see, in 2010 the annual change of TWK is even more negative (-2 percent) than in the trough year 2009. Therefore, the recovery is driven neither by a reprise in intra-period bank credit (still decreasing by about 7 percent in 2010) nor by alternative current liabilities, such as trade credit, whose growth is positive but still lower than 1 percent. Indeed, the output recovery takes place mainly thanks to a bounce-back effect in $GWKTR$ (+4.7 percent). Therefore, a higher frequency of operating cycles is sufficient to support growth notwithstanding the lower amounts of current liabilities. Indeed, large amounts of unused current assets are available after the recession. Even PFC and OR give a positive boost to productive activity in 2010, growing respectively by 1.9 and 1.2 percent. On the one hand, the Permanent Financing Contribution increases because fixed assets remain flat (+0.6 percent in 2010) and more undistributed profits can be dedicated to current assets, restraining the

decline of Gross Working Capital. Indeed, while non-current liabilities decrease by 1.6 percent in 2010, shareholders' funds increase by slightly less than 5 percent. On the other hand, the positive growth of the Operating Ratio is likely to be due to an attempt of the companies to mark an improvement in terms of efficiency. Only in 2011, i.e. the second recovery year, TWK also returns to a positive growth and gradually replaces $GWKTR$ as the main contributor of output expansion. Lower contribution of $GWKTR$ to output growth reveals that, after the early recovery years, the amount of unused current assets progressively decreases and higher gross working capital returns to be needed.

As in section 2.6, small and poorer countries weigh comparatively little in terms of total output once we aggregate data within the whole sample. Therefore, it is useful to make a distinction among different macroregions. In table 4 we present two sub-groups, the Western Area and the Central-Eastern Area, which consist respectively of 8,253,182 and 4,557,082 observations.[14] Actually, results referring to the Western Area are almost identical to those relating to the whole sample, since firms in this group of countries have by far the largest weight in total turnover. By contrast, the Central-Eastern Area presents some peculiar characteristics with respect to the whole sample. First of all, in the pre-crisis period 2005-2008 the growth in TWK is more robust than in western countries, with both short-term financial debts and trade debt increasing by more than 10 percent in 2007. Firms in CEE start from higher levels of $GWKTR$ (2.7 in 2005 compared to 2.1 in Western Europe), which is likely to indicate a more aggressive and risky working capital policy. In 2005-2008, output growth is accompanied by a continuous deterioration in $GWKTR$ and a more than proportional growth in current assets. Current assets are not only affected by the increase of Temporary Working Capital but also by positive changes in Permanent Working Capital. Indeed, thanks to the rapid increase of long-term financial debts, PWK grows more than proportionally to TWK until 2007.

[14]The total number of observations in the two sub-samples is lower than the number of observations in the whole sample because outliers are separately identified within each sub-sample.

Interestingly, current assets in CEE continue to show a positive growth (+5.2 percent) even in the recession year 2009, since the TWK growth is still positive (+5.8 percent) and PFC undergoes an only partial deterioration. Accordingly, the collapse of total turnover in CEE is almost entirely due to the large drop in $GWKTR$, i.e. the increasing amount of unused current assets. The TWK turns slightly negative only in the first recovery year, 2010, when the output reprise is mainly driven by $GWKTR$ (+3.5 percent) and by the positive contribution of permanent working capital. Indeed, notwithstanding a very weak growth in shareholders' funds and non-current liabilities, fixed assets remain flat in 2010 (+0.7 permanent) so that more permanent resources can be dedicated to day-by-day operations. This is also confirmed in 2011, when the annual change in fixed assets becomes slightly negative (-0.1 percent). However, as in Western Europe, by 2011 TWK gradually returns to be the main contributor of output expansion.

Finally, we also find interesting to make a distinction among creditless and credit-with recoveries within the two sub-samples. In section 2.4, we individuated a list of 19 countries where the recovery can be treated as creditless. However, in tables 5-6 we want to isolate those countries where the recovery has been more markedly creditless. To do this, we explore a continuous measure of *credit weakness* by considering the cumulative growth of real private credit by country during the recovery period 2010-2011. Credit to the private sector by country is obtained as indicated in chapter 2. The *creditless sample* is constituted by the five countries where private credit growth has been more negative: Norway, United Kingdom, Iceland, Netherlands and Denmark for the Western Area; Montenegro, Lithuania, Ukraine, Estonia and Latvia, for the Central Eastern Area. Symmetrically, the credit-with sample is constituted by those five countries where private credit growth has been more positive in 2010-2011: Italy, Sweden, Finland, France, Switzerland for the Western Area; Turkey, Serbia, Czech Republic, Cyprus and Slovakia for the Central Eastern Area.

As for the Western Area (table 5), the credit-with sample is characterized by weaker output growth in 2008 and a larger drop in 2009, but

Table 5: Credit recovery and decomposition of output growth in WE

WESTERN AREA: CREDIT-WITH SAMPLE (obs. = 4,683,729)					
Year	Y	TWK	PFC	GWKTR	OR
2005	3.9	3.9	0.8	-1.0	0.3
2006	7.3	5.7	0.9	0.1	0.4
2007	4.7	5.5	0.3	-1.3	0.3
2008	0.3	2.4	0.3	-1.2	-1.2
2009	-11.9	-2.2	1.0	-10.0	-0.9
2010	7.1	-0.1	1.2	5.1	0.8
2011	5.3	4.2	0.0	1.4	-0.4
WESTERN AREA: CREDITLESS SAMPLE (obs. = 1,222,055)					
Year	Y	TWK	PFC	GWKTR	OR
2005	5.7	3.7	1.5	0.2	0.2
2006	6.0	4.4	1.4	0.0	0.2
2007	5.6	7.6	1.0	-2.8	0.1
2008	4.8	5.6	-0.3	1.4	-1.8
2009	-7.9	0.5	-0.3	-8.6	0.5
2010	2.9	-3.2	2.0	2.6	1.6
2011	4.6	2.4	0.8	1.5	-0.2

Y: Operating Revenues (Turnover); TWK: Temporary Working Capital; PFC: Permanent Financing Contribution; $GWKTR$: Gross Working Capital Turnover Ratio; OR: Operating Ratio. The creditless sample of the Western Area includes: Norway, United Kingdom, Iceland, Netherlands and Denmark. By contrast, the credit-with sample includes: Italy, Sweden, Finland, France and Switzerland.

also faster recovery in 2010. In both credit-with and creditless countries the Gross Working Capital Turnover Ratio is the main contributor to the large fall in total turnover in the midst of the crisis. However, while in the creditless sample the Temporary Working Capital remains flat in 2009 (+0.5 percent), in the credit-with sample it drops by more than 2 percent in the same year. This may provide a possible justification for the faster reprise of bank credit in credit-with countries during the early recovery years. Indeed, it may simply reveal a stronger synchronization of the working capital cycle with respect to the production cycle. The faster the fall in TWK together with total output, the faster its subsequent reprise.

However, available data for the Western Area also reveal additional differences. The weaker bank credit in creditless countries mainly refers to long-term financing rather than to intra-period loans. Indeed, in creditless countries non-current liabilities decrease by 5.8 percent in 2010 and 4.8 percent in 2011, while their growth rates always remain positive in

the credit-with sample. In part, the decreases in non-current liabilities are accompanied by lower growth in fixed assets (decreasing by about 2 percent in 2010 and remaining almost flat in 2011). However, large part of the lower long-term credit is replaced by shareholders' funds, which grow more in creditless countries than in credit-with countries. These differences aside, the behavior of firms in the two sub-samples is quite similar. In both, output recovery takes place with the relevant contribution of $GWKTR$, but also thanks to the positive growth of OR and PFC. Firms try to improve their operating efficiency and to dedicate more permanent resources to day-by-day operations. However, while credit-with countries can rely on long-term external financing, creditless countries mainly rely on internal financing. To sum up, in the Western Area the creditless countries are characterized by slower output recovery, greater slowdown in fixed assets and higher reliance on shareholders' funds.

As for the Central-Eastern Area (table 6), differences between credit-with and creditless countries are much more pronounced. Table 6 shows that creditless countries are characterized by a markedly more abrupt collapse in total turnover in 2009, accompanied by a proportional drop in $GWKTR$. In these countries TWK growth is still positive (+6.9 percent) in 2009, notwithstanding the increasing amount of unused current assets. On the contrary, annual changes of shareholders' funds are negative since 2008, thus implying a negative development of Permanent Working Capital and of PFC. However, current assets grow slightly less than 5 percent in 2009 so that output fluctuations can be entirely attributed to $GWKTR$. In the following recovery years, TWK positively affects the output reprise in credit-with countries, while remaining flat in the credit-less countries. In fact, in the credit-with sample, TWK contributes more than $GWKTR$ to turnover growth already in 2010. By contrast, in the creditless sample turnover growth is mainly driven by the reprise in $GWKTR$.

However, it is also remarkable that in creditless countries TWK does not collapse, notwithstanding short-term financing debts decreasing by more than 5 percent and trade debt decreasing by more than 1 percent in both the recovery years, 2010 and 2011. Therefore, TWK in creditless

Table 6: Credit recovery and decomposition of output growth in CEE

CENTRAL-EASTERN AREA: CREDIT-WITH SAMPLE (obs. = 491,798)					
Year	Y	TWK	PFC	GWKTR	OR
2005	5.7	6.4	-0.3	-0.5	0.2
2006	8.4	6.6	3.3	-1.1	-0.5
2007	7.6	8.5	2.6	-2.5	-0.9
2008	2.5	5.9	1.2	-3.4	-1.0
2009	-13.4	0.5	0.8	-14.1	-0.5
2010	8.4	3.9	1.1	2.9	0.3
2011	6.7	5.7	0.8	0.1	0.2
CENTRAL-EASTERN AREA: CREDITLESS SAMPLE (obs. = 782,732)					
Year	Y	TWK	PFC	GWKTR	OR
2005	-1.1	-0.6	4.2	-5.0	0.6
2006	7.2	10.1	1.3	-3.8	0.0
2007	5.4	9.9	0.4	-4.9	0.5
2008	-1.3	5.9	-1.2	-3.4	-2.3
2009	-25.7	6.9	-2.1	-29.2	0.3
2010	4.5	0.3	-0.6	4.1	0.7
2011	7.8	1.4	2.1	3.8	0.4

Y: Operating Revenues (Turnover); TWK: Temporary Working Capital; PFC: Permanent Financing Contribution; $GWKTR$: Gross Working Capital Turnover Ratio; OR: Operating Ratio. The creditless sample of the Central-Eastern Area includes: Montenegro, Lithuania, Ukraine, Estonia and Latvia. By contrast, the credit-with sample includes: Turkey, Serbia, Czech Republic, Cyprus and Slovakia.

countries remains flat thanks to alternative current liabilities, such as accrued expenses and deferred income, taxes payable, issued promissory notes, liabilities towards affiliated companies, staff members and social security institutes. Hence, in countries where bank credit remains weak, recovery is made possible not only by unused current assets, but also by alternative current liabilities other than accounts payable. It should be noted that, in creditless countries, even non-current liabilities decrease in 2010 and 2011, respectively by 4.9 and 3.3 percent. Despite this, in 2011 the significant reduction in fixed assets (-4.5 percent) is sufficient to release new permanent resources for current activities, as revealed by the positive development of PFC (+2.1 percent).

Differently from creditless countries in the Western area, those in the Central-Eastern Area do not rely on higher shareholders' funds, i.e. retained earnings and recapitalizations, to deal with lower external financing. Instead, there are two alternative reasons why current assets do not

collapse in the Central-Eastern Area. First, lower intra-period loans are substituted by alternative current liabilities. Second, lower intertemporal loans are compensated by lower capital expenditures.

The determinants for the occurrence of creditless recoveries are not necessarily the same across different countries and they can also depend on the nature of the crisis episode. Therefore, approaches like the one described in this chapter can play a very important role in exploring the mechanisms that stay behind different episodes of creditless recoveries.

3.9 Concluding remarks

The theoretical model introduced in this chapter and the analysis made on AMADEUS firm-level data give us some important clues on the interactions between firms' balance sheet items and output fluctuations during both recession and recovery periods. In particular, several channels have been identified through which creditless recoveries may be possible at the enterprise level. It is interesting to point out that, in our setting, the notion of *production capacity* is not referred only to fixed assets, as typically assumed in most economic papers. Instead, production capacity also refers to the gross working capital which is potentially available to finance the operating cycles within a certain period.

Accordingly, in a recession period, the underutilization of production capacity implies that a certain amount of current assets remains frozen within the companies (or it has a very slow turnover) and does not contribute to the economic activity. At the beginning of the subsequent recovery years, firms can increase output levels by using their spare capacity, i.e. current assets that already exist within their balance sheets. This early stage of the recovery does not require additional external financing. However, as production approaches the initial levels, the amount of unused current assets progressively decreases. Therefore, we also identified specific additional mechanisms that can sustain (or allow a more intensive use of) gross working capital, notwithstanding banking credit remaining constrained.

High levels of unused current assets are generally due to a decline

in aggregate demand. However, this evidence does not prevent to suppose that the original trigger of the crisis is a shock in credit supply. Indeed, the drop in demand that affects most of the companies may be in turn generated by a slowdown of credit that limits the possibility of households and firms to buy investment goods, intermediate goods and durable consumption goods. The descriptive analysis made so far on firm-level data is not sufficient, by itself, to explore cause-effect relationships. Therefore, specific econometric analyses should get a more detailed view of cause-effect relations and also weigh the various channels identified above as possible determinants of creditless recoveries. Chapter 4 will give a taste of such an empirical work. However, we point out that future empirical research on financial crises and creditless recoveries could also usefully rely on accounts and ratios analyzed within this chapter.

Finally, the model presented here is sufficiently flexible to let us extend it to a wider set of economic problems. Calvo et al (2012), for example, developed similar arguments to explain the importance of a collateral constraint for the occurrence of jobless recoveries. We guess that further investigation of the possible contact points of such models may give very interesting results. Moreover, in a future research agenda it would be useful to make more explicit our model and to find numerical values for the parameters through appropriate calibration methodologies. Indeed, measurements from a calibration approach would definitely give further content to the theory behind creditless recoveries.

Chapter 4

The Credit-Output Relationship During the Recovery from Recession

4.1 Preamble

The global financial crisis that started in 2007 has generated renewed interest in the role of credit in shaping economic recoveries. Given that many credit markets froze during the crisis and credit recovered sluggishly in its aftermath, the natural question arises of how prolonged tight credit conditions affect economic recovery. The existing literature on credit and economic recoveries is dominated by the study of *credit-less recoveries*. In their seminal contributions, Calvo et al (2006a,b) coined the term *Phoenix Miracles* to describe a phenomenon whereby after systemic crises economic activity recovers without an accompanying recovery in the credit stock. The phenomenon has been mainly documented in emerging economies, but seems to play a role in industrial countries as well.[1] Calvo and Loo-Kung (2010) argue that the subprime crisis shares several characteristics of *Phoenix Miracles*. Reinhart and Rogoff (2009) have also drawn a parallel between the recent financial crisis

[1] See for example Claessens et al (2009).

and episodes of systemic crises in emerging markets, which are typically characterized by creditless recoveries.[2]

Several explanations of this phenomenon have been proposed in the literature. Calvo et al (2006a,b) argue that a *sudden underutilization of capacity* created by a crisis episode can rationalize a fast creditless recovery. Indeed, it appears that investment recovers much more slowly than GDP after systemic crises. This implies that GDP recovers mainly through the absorption of unused capacity. As investment is assumed to be a credit-intensive activity, lack of investment during recovery may explain why the recovery appears creditless. However, it is still unclear whether the failure of investment to recover in tandem with GDP is due to demand factors (low investment demand results in low demand for credit) or supply factors (prolonged credit market disruptions constrain firms' access to external finance). Claessens et al (2009) mention two additional explanations. First, creditless recoveries may be explained by a substitution between bank credit and other sources of financing such as trade credit or internal finance. This substitution may lead to the observation of creditless recoveries when credit is measured as bank credit as is usually the case in the literature. Second, creditless recoveries may be associated with a process of reallocation from more to less credit-intensive sectors.

Finally, there is a more radical view that claims that creditless recoveries *à la* Calvo are unlikely to exist. According to Biggs et al (2009, 2010), claims about the existence of creditless recoveries are based on the use of an inappropriate measure of credit, namely the stock of credit, instead of the more relevant flow of credit. The authors argue that some recoveries may appear creditless when one compares developments in the *stock* of credit to developments in GDP, a *flow* variable. They argue instead that developments in GDP are a function of new borrowing, or the flow of credit. They find that during recoveries previously identified as creditless the rebound in economic activity is highly correlated with the rebound in the flow of credit, even if it is poorly correlated with the growth in its stock. An implication of their paper is that for economic activity

[2]For more details on the existing literature on creditless recoveries and a comparison with the last global financial crisis, see also chapter 2.

to recover after a financial crisis, it is not necessary for the credit stock to increase but only for the flow of credit to recover. According to this view, a creditless recovery is a recovery during which the flow of credit fails to recover in tandem with GDP. In our view, the analysis by Biggs et al (2009, 2010) does not contradict the results by Calvo et al (2006a,b), but rather offers a different, possibly complementary, approach to study the role of credit conditions in shaping economic recoveries. Biggs et al (2009, 2010) underline the role of credit flows for financing new net investments and thus GDP growth. However, following crises, GDP recovers at least partly by using previously idle capacity, without the need for new investments. Recoveries during which the stock or the flow of credit fails to recover may be two distinct phenomena.

The hypothesis that lower credit supply may have a significant impact on real sector performance builds on the significance of bank credit to the sectors likely to be bank dependent. In this chapter, we test empirically the hypothesis that creditless recoveries imply redistributional effects among industries with different dependence on external finance as a result of impaired financial intermediation. The identification strategy relies on the notion that, in the presence of market imperfections, different sources of funds (bank credit, the issuance of tradable bonds, and equity) are not perfect substitutes. If creditless recoveries stem from disruptions in the supply of bank credit, the more the recovery is creditless the more firms that are reliant on bank credit should perform relatively worse.

To test whether this hypothesis fits data, we extend the seminal work by Rajan and Zingales (1998) to the phenomenon of recoveries. In the initial study by Rajan and Zingales (1998), the specification focuses on analyzing the effect of financial development, and consequently on testing whether the sectors most dependent on external finance present higher rates of growth in countries with a higher level of financial development.[3] The innovation is to introduce the interaction between a country characteristic (financial development) and an industry characteristic (external financial dependence), thus avoiding some problems of identi-

[3]See also Levine (2005) for a general review of methods used in the literature.

fication present in the cross-country regressions typical of the literature on economic growth. Moreover, as commented by Claessens and Laeven (2005), the specification is less subject to the criticisms of omitted variable bias or model specification than are traditional approaches that relate financial sector development directly to economic growth. Following a similar approach than in Rajan and Zingales (1998), our identification of the impact of creditless recoveries on output is based on the interaction between the sectoral dependence on external finance and the rate of contraction of private credit at the country level during recovery episodes.

The most closely related paper is a recent contribution by Abiad et al (2011).[4] Using aggregate and sectoral data, the authors find that average growth during creditless recoveries, defined as recoveries during which the growth rate of real bank credit is zero or negative, is about a third lower than during *normal* recoveries. In addition, sectors that are more dependent on external finance are found to grow relatively less during creditless recoveries. The authors conclude that creditless recoveries reflect impaired financial intermediation. Despite the common theme of creditless recoveries, this chapter differs from Abiad et al (2011) in several dimensions. First and foremost, our point of view on creditless recoveries is different. In line with the view of Calvo et al (2006a), we find that the puzzling phenomenon is the one in which the economy travels along a V-shaped curve, with a sharp fall in output followed by a rapid recovery, and at the same time credit does not recover. By contrast, we find less puzzling that economies recover more slowly when credit fails to recover. Furthermore, we focus on recoveries from recessions, whereas Abiad et al (2011) focus on recoveries from episodes of negative output gaps. Finally, whereas Abiad et al (2011) investigate the negative impact of prolonged tight credit conditions on growth during recovery, we focus on exploring the channels that might explain the ability of the economy to recover quickly without credit. In particular, we focus on the ability of firms to substitute trade credit for bank credit. Trade credit can help firms to continue financing short-run working capital in the face of tight

[4]Kannan (2012) as well analyzes the sectoral dynamics during recoveries following financial crises.

credit conditions. Our empirical specifications reflect this conceptual difference.

The chapter is structured as follows. In part I (section 4.2, coauthored with Fabrizio Coricelli and Isabelle Roland), we focus on industry-level data available until 2003, thus preceding the last global financial crisis. The main objective is to analyze the real redistributional effects of recessions and recoveries among industries with specific characteristics, especially when bank credit fails to recover. Among other things, this part offers an interesting empirical distinction between the two types of creditless recoveries above mentioned, in the Calvo sense and in the Biggs sense. Part II (section 4.3) changes the perspective of the analysis, by focusing on firm-level data available for the European countries within the period 2003-2011. The dataset used in this study captures the global financial crisis and the early recovery years, thus allowing us to examine the heterogeneity existing across countries within the same single episode of generalized crisis for the world economy. In particular, countries are differentiated according to the dynamics of bank credit during recovery years. Moreover, while industry-level data in part I refer to manufacturing sectors only, firm-level data in part II include all sectors of the economy. In particular, services are users of goods produced by manufacturing sectors. This makes it possible to focus on a broader variety of companies with respect to the type of goods and services they produce and, then, to test the extent to which bank credit may limit firms' growth by reducing the demand for goods they produce rather than constraining their production capacity.

4.2 Part I

4.2.1 Introduction

Part I focuses on industry-level data by country between 1963 and 2003, thus excluding the last global financial crisis. The choice of this period is largely due to the availability of data. However, it also reflects a need to keep separate the recent financial crisis compared to other recession

episodes in the sample, since many countries experienced double-dip recessions and had not yet fully recovered to pre-recession levels by 2011.

The basic model of reference for analyzing the effect of creditless recoveries on economic growth takes as its starting point the specification adopted in Rajan and Zingales (1998), henceforth RZ. Industry-level data allow us to use the RZ methodology to identify the role of credit markets for output dynamics and thus avoid problems of endogeneity and reverse causality in the credit-output relationship. The differential performance of production growth across industries with different exogenous characteristics is the main channel through which the real impact of credit is identified. Differently from RZ, we are not looking here at long-rung growth. However, as showed in several subsequent studies, it is acceptable to adopt the same difference-in-differences approach employed by RZ to focus on the real effects of creditless recoveries. The recourse to the interaction between an indicator of *credit weakness* of the recovery and variables representing sectoral characteristics permits us to verify whether the sectors that share some peculiar feature grow slower in countries where the recovery is more markedly creditless.

Among other things, in part I we distinguish between episodes during which value added recovers without an increase in the credit stock (creditless recoveries in the Calvo sense) and episodes during which value added recovers without an increase in credit flows (creditless recoveries in the Biggs sense). Both types of creditless recoveries are not rare phenomena and typically follow larger drop in GDP per capita, although this feature is more clearly evident when considering creditless recoveries *à la* Calvo. In addition, we find that creditless recoveries in the Calvo sense are primarily an emerging market phenomenon, while creditless recoveries in the Biggs sense are almost as frequent in developed countries as in emerging markets.

Second, we find that industries that are more dependent on external finance recover more slowly when recoveries are classified as creditless, although this result is noticeable in emerging markets only. This indicates that in developed countries certain mechanisms enable the *external dependent* industries to grow despite weakness in bank credit. These

mechanisms may include an improved and easier substitutability among alternative sources of financing, such as the issuance of tradable bonds and equity, or the utilization of idle capacity. However, channels through which financial frictions may affect growth do not necessarily (or not only) involve industries' financial dependence, as a simple application of the RZ model would suggest. Alternative characteristics may be more important than dependence on external financing in affecting the reallocation among different sectors during creditless recoveries. Indeed, we are focusing here on the impact of impaired financial intermediation on the short-run output dynamics, rather than the impact of financial development on the long-run growth. Therefore, we also proceed to thoroughly test the relevance of other indicators of exposure to credit, such as tangibility of assets and structural characteristics of production (capital/labor intensity).

Finally, we explore one potential mechanism that may enable the economy to recover without bank credit, namely the substitution of trade credit for bank credit. Although further analyses at the firm level are needed to better discern the effects associated with trade credit during creditless recoveries, we find evidence that industries more dependent on trade credit tend to recover more quickly. At the industry level, indeed, a lower dependence on bank credit relative to trade credit allows a better output performance of firms during the peak-to-recovery episode, especially when the recovery is creditless (*substitution effect*). At the country level, by contrast, a lower dependence on bank credit relative to trade credit appears to have a negative impact on growth during recoveries. This suggests the existence of a propagation of financial distress through trade credit chains during crisis episodes (*contagion effect*).

Part I is complementary to Coricelli and Roland (2010), who analyze the finance-growth nexus during episodes of recession. Coricelli and Roland (2010) suggest that there exists a complex web of relationships between bank credit, trade credit, financial development and economic activity; and that these relationships may differ depending on whether the economy is going through an episode of growth, contraction or recovery. In other words, they highlight the importance of potential asym-

metry in the role of financial markets during different phases of economic activity. While Coricelli and Roland (2010) focus on episodes of contraction, this chapter focuses on recoveries, and in particular on creditless recoveries.

Part I is structured as follows. In section 4.2.2, we briefly describe the sample and the reasons why we choose to focus on industry-level data. In section 4.2.3, we investigate the frequency and characteristics of creditless recoveries in our sample. Importantly, we distinguish between the two types of creditless recoveries above mentioned, the Calvo-type and the Biggs-type. In section 4.2.4, we investigate whether industries that are more dependent on external finance are more or less affected by creditless recoveries. We also introduce more additional characteristics at the industry level than the RZ approach and, simultaneously, we explore whether the two types of creditless recoveries we identified in section 4.2.3 have a differential impact on growth during recoveries. In section 4.2.5, we ask whether industries that are more dependent on bank credit as opposed to trade credit perform relatively worse during creditless recoveries. In section 4.2.6 we discuss on the robustness of our regression analyses. Section 4.2.7 concludes and discusses avenues for further research.

4.2.2 Data sources and sample

As opposed to most of the existing literature, our analysis uses industry-level data for several reasons. First, the use of data at the sector level allows us to overcome well-known endogeneity problems typical of analyses that rely on aggregate data. Indeed, private credit growth may predict GDP growth just because the economic performance affects credit demand. To circumvent this problem, we borrow the RZ methodology, which builds on industry-level data. Second, GDP may be a misleading indicator of economic activity during recoveries because it often captures large fiscal interventions. Therefore, it seems more appropriate to use industry-level value added data to study the relationship between credit and recovery. Third, the behavior of bank credit and its impact on the

economy may crucially depend on the behavior of alternative sources of financing, such as trade credit. Indeed, as we mentioned earlier, it may happen that a creditless recovery takes place because firms switch to alternative sources of external finance when credit conditions are tight for a prolonged period of time. While we use the rate of contraction of private credit at the country level as a measure of *credit weakness* throughout the analysis, we also use data on the dependence of industries on bank credit relative to trade credit in order to address this point.[5]

We use value added data from the UNIDO database.[6] Our main sample covers a total of 28 manufacturing industries (3-digit ISIC Rev.2 level) between 1963 and 2003. Data are deflated using Consumer Price Indexes (CPI) at the country level from the World Bank and the IMF IFS database.[7] Instead of working with annual data, we conduct our analysis on *episodes* of recession and subsequent recovery. Following Calvo, Coricelli, and Ottonello (2012), henceforth CCO, we begin by locating these episodes within two samples of countries, defined as emerging markets and developed countries.

For emerging economies, Calvo et al (2006a) refer to countries that are sufficiently integrated in the world capital market.[8] Individual and consecutive years with negative change in real GDP since 1980 are classified as recession episodes at the country level. CCO make use of these same episodes but recur to data on GDP per capita to individuate the beginning and the end of the crisis, as well as its culminating year.[9] The

[5]Data on the dependence of industries on bank credit relative to trade credit are taken from Raddatz (2010).

[6]United Nations Industrial Development Organization. Industrial Statistics Database at the 3-Digit Level of ISIC Code, Revision 2 (2006).

[7]When CPI data are missing, we also recur to the Wholesale Price Index (WPI) in order to integrate our time series.

[8]In particular, Calvo et al (2006a) select 32 countries that were tracked by JP Morgan to build its Global Emerging Markets Index: Algeria, Argentina, Brazil, Bulgaria, Chile, Colombia, Croatia, Czech Republic, the Dominican Republic, Ecuador, El Salvador, Hungary, Indonesia, Ivory Coast, Lebanon, Malaysia, Mexico, Morocco, Nigeria, Panama, Peru, Philippines, Poland, Russia, South Africa, South Korea, Thailand, Tunisia, Turkey, Ukraine, Uruguay, and Venezuela.

[9]CCO excludes two types of episodes: those related to the disintegration of the Soviet Union and those in which GDP per capita did not fully recover its pre-crisis peak before another recession episode takes place. Long run phenomena, i.e. crises with a duration more

pre-crisis peak is identified with the year displaying the maximum level of GDP per capita preceding the first GDP contraction in the recession episode, while the full *output-recovery point* is the year in which GDP per capita comes back to the pre-crisis peak. The *trough* coincides with the minimum point within the peak-to-recovery period. Finally, we trace the *recession* and *recovery* periods by splitting the crisis years in the peak-to-trough period and the trough-to-recovery period.

For developed countries, instead, CCO consider episodes starting from the post-WWII period with respect to a relative small sample of countries.[10] In this case, CCO base the identification of peaks, troughs and recovery dates on quarterly data. Then, after getting observations on GDP per capita from the World Bank's World Development Indicators database (WDI), we take care of repeating the same exercise on yearly data.

For our analysis we rearrange the country classification relying on the FTSE Global Equity Indexes.[11] This classification is preferred to the one adopted in CCO since it is based on a comprehensive set of variables that is presumably relevant for our analysis, such as the total stock market capitalization, the breadth and depth of market, the restrictions on foreign investment, the efficiency of market infrastructure. In addition, it is extended to several additional countries which are included in the UNIDO dataset, although not considered in CCO. This arrangement allows us to compare the results obtained within two different samples: a *limited sample*, which covers the countries included in CCO, and a more *extended sample*, which covers all countries included in both the UNIDO database and the FTSE classification.

As shown in table 7, the limited sample consists of 73 episodes divided into 34 countries. All the countries classified as developed in CCO

than 2 standard deviation from the mean (15 years) are also excluded from the sample. We additionally have to exclude episodes finishing after 2003 because of data availability at the sectoral level.

[10] Based on NBER and ECRI information, CCO identify recession episodes in eleven countries: Austria, Australia, Canada, France, Germany, Italy, Spain, Sweden, Switzerland, United Kingdom and United States.

[11] In the FTSE classification (September 2013 update), 26 countries are classified as *Developed*, 10 are *Advanced Emerging*, 12 are *Secondary Emerging* and 26 are *Frontier*.

Table 7: Limited Sample (CCO) of recession episodes

Developed Countries									
Country	Peak	Trough	Recovery	Output Decline	Country	Peak	Trough	Recovery	Output Decline
AUS	1974	1975	1976	0.00%	ESP	1992	1993	1994	1.34%
AUS	1982	1983	1985	3.53%	FRA	1974	1975	1976	1.79%
AUS	1990	1992	1993	2.38%	FRA	1992	1993	1994	1.10%
AUT	1974	1975	1976	0.10%	GBR	1973	1975	1976	2.19%
AUT	1980	1981	1982	0.40%	GBR	1979	1981	1983	3.55%
AUT	1992	1993	1994	0.30%	GBR	1990	1991	1993	1.60%
CAN	1981	1982	1984	4.02%	ITA	1974	1975	1976	2.67%
CAN	1989	1992	1995	5.00%	ITA	1992	1993	1994	0.91%
CHE	1974	1976	1980	8.02%	KOR	1997	1998	1999	7.52%
CHE	1981	1982	1984	1.88%	SWE	1976	1977	1979	1.95%
CHE	1990	1993	1998	4.26%	SWE	1989	1993	1995	6.08%
DEU	1974	1975	1976	0.50%	USA	1973	1975	1976	2.58%
DEU	1981	1982	1983	0.30%	USA	1979	1980	1981	1.20%
DEU	1992	1993	1994	1.65%	USA	1981	1982	1983	2.84%
ESP	1978	1979	1980	0.84%	USA	1990	1991	1992	1.40%
ESP	1980	1981	1983	0.93%	USA	2000	2001	2002	0.05%
Emerging Markets									
Country	Peak	Trough	Recovery	Output Decline	Country	Peak	Trough	Recovery	Output Decline
ARG	1987	1990	1992	15.72%	MEX	1985	1988	1991	6.48%
ARG	1994	1995	1996	4.06%	MEX	1994	1995	1997	7.59%
BGR	1995	1997	2000	9.52%	MYS	1984	1986	1988	5.46%
BRA	1980	1983	1987	13.32%	MYS	1997	1998	2002	9.64%
BRA	1987	1988	1989	1.96%	PAN	1986	1989	1993	19.02%
BRA	1991	1992	1993	2.04%	PER	1997	1999	2002	2.97%
CHL	1981	1983	1987	16.43%	PHL	1990	1993	1996	5.13%
CHL	1998	1999	2000	2.02%	PHL	1997	1998	2000	2.73%
CIV	1991	1994	1997	8.86%	RUS	1997	1998	1999	5.04%
DOM	1989	1991	1993	8.35%	SLV	1980	1986	1994	19.99%
DZA	1992	1994	1999	7.09%	THA	1996	1998	2003	13.68%
ECU	1986	1987	1988	2.70%	TUN	1981	1982	1984	3.07%
ECU	1998	2000	2003	7.47%	TUN	1985	1986	1990	4.50%
LBN	1988	1989	1994	42.62%	TUR	1993	1994	1996	6.16%
LBN	1998	2000	2001	2.90%	TUR	1998	1999	2000	4.82%
MAR	1980	1981	1982	5.08%	TUR	2000	2001	2003	7.06%
MAR	1982	1983	1985	2.91%	URY	1981	1984	1992	21.50%
MAR	1986	1987	1988	4.60%	URY	1994	1995	1996	2.16%
MAR	1991	1993	1994	8.21%	VEN	1988	1989	1992	10.90%
MAR	1994	1995	1996	8.03%	VEN	1995	1996	1997	2.25%
MAR	1996	1997	1998	3.64%					

are still classified as developed according to the FTSE categorization that we adopt. South Korea is the only additional country that comes out from the group of emerging countries for being included among developed countries. By contrast, the extended sample offers the possibility to work on a dataset of 421 episodes divided into 143 countries. The limited sample has the advantage to be comparable with a dataset already used in previous work, while the larger number of observations in the extended sample should lead to increased precision when estimating unknown parameters.

Analyzing the extended sample (table 8), we obtain that the aver-

Table 8: Peak-to-recovery episodes in the extended sample

	Country Level		Sector Level			
	GDP	Duration	VA	Wages	Empl.	GFCF
Recession phase:	-2.8%	1.32	-4.7%	-3.2%	-3.1%	-10.4%
Recovery phase:	5.3%	1.55	3.8%	1.0%	0.0%	1.2%

Note: The average *Duration* of each phase is reported in years. For all other variables, average percentage changes are reported respectively for the peak-to-trough and the trough-to-recovery periods

age decline in GDP per capita at the country level during the recession episodes is 2.8 percent, though there is significant cross-country variation (the standard deviation is 3.2 percent). The average duration of the episodes in our sample is 2.88 years with a standard deviation of 1.33 years. The average duration of the recovery phase (1.55 years) tends to be slightly longer than average duration of the recession phase (1.32 years). Looking at sectoral data from the UNIDO dataset, during the recession periods the median decline is 4.7 percent for real *value added*, 3.2 percent for real *wages and salaries*, 3.1 percent for the *number of employees*. During the subsequent recovery period, the median growth rates are respectively 3.8, 1.0, 0.0 percent.[12] Finally, the real growth rate of *gross fixed capital formation* for the median sector is strongly negative (-10.4 percent) during the recession phase and recovers only partially (+1.2 percent) during the recovery phase.

4.2.3 How common are creditless recoveries?

As mentioned above, we make a distinction between recoveries during which the stock of credit fails to increase and those during which the flow of credit fails to increase. We first investigate the evolution of the stock of credit during episodes of recovery ($\Delta Stock$) by looking at the change in real credit per capita from output peak to full recovery point. Real credit per capita is obtained multiplying the *Domestic credit to private sector by banks in percentage of GDP* and the *GDP per capita in constant*

[12]Interestingly, sectoral data seem to confirm the finding in Calvo et al (2012) of the jobless nature of recoveries from financial crises.

LCU (local currency units). Both these measures are collected within the WDI dataset of the World Bank. We interpret a negative difference as indicating the presence of a creditless recovery at the country level in the Calvo sense, namely a recovery in GDP per capita to pre-downturn level that is not accompanied by a corresponding pick up in credit per capita.

In our extended sample, credit per capita increases in about 62 percent of the recoveries at the country level. During these *with-credit* recoveries, credit per capita increases by an average of 21.3 percent from output peak to full recovery point. In the remaining 38 percent of the recoveries, that we define *creditless*, real credit per capita decreases on average by 14.5 percent. The average decline in GDP per capita is 2.2 percent during recessions that precede with-credit recoveries and 3.8 percent during those preceding creditless recoveries. The average duration of peak-to-recovery episodes is also higher in case of creditless recoveries (3.16 years) than in case of with-credit recoveries (2.74 years).

Secondly, we investigate the evolution of the flows of credit during episodes of recovery by looking at the difference between the growth rate of real credit per capita in the recovery year and in the peak year of each episode ($\Delta Flow$). We define a creditless recovery in the Biggs sense as an episode of recovery for which this difference is negative. In our sample, the growth rate of credit per capita increases in about 45.6 percent of the country-level episodes. During with-credit recoveries *à la* Biggs, the growth rate of credit per capita increases by an average of 12 percentage points from output peak to full recovery point. In the remaining 54.4 percent of the episodes, defined as creditless *à la* Biggs, the growth rate of real credit per capita decreases on average by 14.8 percentage points. Then, creditless recoveries cannot be ruled out even when one focuses on the flow of credit rather than the stock as proposed by Biggs et al (2009, 2010). The average decline in GDP per capita is 2.6 percent during recessions that precede with-credit recoveries *à la* Biggs and 2.9 percent during those preceding creditless recoveries. Even under this definition, the average duration of peak-to-recovery episodes is still higher in case of creditless recoveries (2.99 years) than in case of with-credit recoveries (2.75 years), though the difference is less pronounced.

In summary, there is evidence of the presence of creditless recoveries both in the sense of Calvo and Biggs. Furthermore, creditless recoveries are not a rare phenomenon. In addition, our descriptive statistics show that a failure of credit to recover typically follows larger drops in GDP per capita. Indeed, creditless recoveries may be explained, at least in part, with a bounce-back effect. This is also in line with the view expressed in Calvo et al (2006a) that

> "*Phoenix Miracle-type recoveries are highly suggestive of sudden underutilization of capacity. This is so, because after large drops in output, it would be difficult to rationalize speedy post-collapse recovery, unless idle resources are part of the equation*".

However, this feature is more clearly evident when considering creditless recoveries *à la* Calvo. A failure of credit flows to recover, i.e. in the Biggs sense, may signal shocks in intertemporal credit supply, which is more important for investment in fixed capital and long-run growth. However, when credit stocks also fail to recover, then shocks are more likely to be extended to intra-period credit, which also affects current spending and induces more severe recessions.

Using the FTSE classification,we can also analyze differences among *Developed Countries* (DC) and *Emerging Markets* (EM).[13] The phenomenon of creditless recoveries has been mainly documented in emerging economies. However, according to Claessens et al (2009) it also seems to play a role in industrial countries. Tables 9 and 10 show descriptive statistics on the occurrence of creditless recoveries, respectively in the Calvo and Biggs sense. Data in our extended sample are grouped by country cluster. Table 9 shows that the decline in GDP per capita is consistently higher during recessions that precede creditless recoveries in the Calvo sense rather than during recoveries with credit. This is true across all country categories. However, consistent with Calvo's finding that creditless recoveries are primarily an emerging market phenomenon, creditless recoveries in the Calvo sense are less frequent in

[13] *Emerging Markets* include groups classified as *Advanced Emerging*, *Secondary Emerging* and *Frontier* in the FTSE classification.

Table 9: Creditless recoveries in the Calvo sense by income group

	Creditless Recoveries		Recoveries With-Credit		Proportion of Creditless Recoveries
	Output Decline	ΔStock	Output Decline	ΔStock	
DC:	2.6%	-10.5%	2.0%	18.5%	35.8%
EM:	5.0%	-18.6%	2.5%	24.9%	40.6%

Note: *Output Decline* = Average decline in GDP per capita during the recession period; Δ*Stock* = Change in credit per capita between pre-crisis peak and full-recovery year

Table 10: Creditless recoveries in the Biggs sense by income group

	Creditless Recoveries		Recoveries With-Credit		Proportion of Creditless Recoveries
	Output Decline	ΔFlow	Output Decline	ΔFlow	
DC:	2.4%	-14.4 p.p.	1.9%	10.5 p.p.	53.1%
EM:	3.4%	-15.4 p.p.	3.4%	13.8 p.p.	55.9%

Note: *Output Decline* = Average decline in GDP per capita during the recession period; Δ*Flow* = Change in the growth rate of credit per capita between pre-crisis peak and full-recovery year (expressed in percentage points).

developed countries. Furthermore, in developed economies, GDP per capita falls by less both during the recession phase and during the whole peak-to-recovery period.

In contrast, when we look at creditless recoveries in the Biggs sense (table 10), we can see that they are almost as frequent in developed countries as in emerging markets. Even differences in output decline during the recession phase and differences in credit recovery are less pronounced between the two groups, suggesting that creditless recoveries *à la* Biggs are not primarily an emerging market phenomenon.

4.2.4 Creditless recoveries and dependence on external finance

In this section, we explore the link between creditless recoveries and growth by asking whether industries that are relatively more dependent on external finance have a worse relative performance when recoveries are classified as creditless. For our regressions we use a difference-in-

differences approach to identify causal links between credit growth and industries' output performance. If disruptions of financial intermediation are at the roots of creditless recoveries, their effect may be felt disproportionately more by those sectors that rely more heavily on external finance.

The measure of dependence on external finance that we use is the one obtained at the sectoral level in RZ. This is defined as capital expenditures minus cash flow from operations divided by capital expenditures, i.e. the flow of investments financed outside of retained earnings. Even the working assumption is the same adopted in RZ. According to this assumption, there are technological reasons why some sectors depend more than others on external finance, regardless of the country. External dependence is determined by technological factors, such as production time, project scale, gestation period, capital intensity, and the importance of R&D investment.[14] RZ identify the external financial dependence at the sectoral level within a benchmark country with developed capital markets, the United States, in which firms are assumed not to face frictions in their access to financing. If a sector in the benchmark country has certain inherent characteristics, those same characteristics will remain valid in all the other countries of the sample analyzed. While the absolute value of the index may vary across countries and time, for the methodology to work it is sufficient that the industry ranking remains broadly the same.[15]

Based upon this premise, we estimate the following model.

$$Growth_{s,e} = \alpha \cdot Interaction_{s,e} + \sum\nolimits_{s} \beta_s \cdot d_s + \sum\nolimits_{e} \beta_e \cdot d_e + \varepsilon_{s,e} \quad (4.1)$$

where s denotes the industry sector and e identifies the recession-to-recovery episode, that stretches from the pre-crisis peak to the full-

[14] The same assumption has been later employed in several research works, such as Braun and Larrain (2005), Kroszner et al (2007), Dell'Ariccia et al (2008) and Abiad et al (2011). In contrast, Furstenberg and Kalckreuth (2006) question it, while Fisman and Love (2007) tried to introduce a measure of *growth opportunities* at the sectoral level as alternative proxy of external finance dependence. However, this is not the focus of our paper and we mostly follow the prevailing literature.

[15] Rajan and Zingales (1998), for example, support this assumption with data from Canada.

recovery year for each occurrence at the country level. The d's denote dummy variables. The variable d_s stands for the sector dummy and it is likely to incorporate technological characteristics that may affect the growth of different industries in times of crisis. The dummy d_e identifies the single episodes detected at the country level and thus incorporates all those specific features that may characterize each crisis event. Among the others, it certainly incorporates the different GDP growth rates of the country between the pre-crisis peak and the full-recovery year of each episode.

$Growth_{s,e}$ is the real growth in sectoral output (O) over the peak-to-recovery period in sector s during episode e. In alternative to output we could also consider value added (VA) or other relevant sectoral variables, such as employment (E), total wages and salaries (W) or gross fixed capital formation ($GFCF$). Finally, $Interaction_{s,e}$ is obtained multiplying $CreditlessMeasure_e$ by $SectorCharacteristic_s$. $CreditlessMeasure_e$ is the measure that we adopt to evaluate whether a recovery is creditless or not. It can be a dummy or a continuous variable. $SectorCharacteristic_s$ is the dependence on external finance measured by RZ or an alternative variable that incorporates some peculiar characteristic of the sector such as tangibility, capital intensity or the relative use of trade credit. This variable is assumed to be constant across countries and years, since it only depends on technological characteristics of each sector. Both $CreditlessMeasure$ and $SectorCharacteristic$ are omitted from the regressions, when not interacted, since they are already incorporated in the fixed effects by recession episode and by sector.[16] Finally, standard errors in all the regressions are clustered by recession episode so that t-statistics result to be robust to correlation between errors within each episode.

Table 11 shows the results when referring to creditless recoveries in the Calvo sense. We consider as $CreditlessMeasure$ a dummy variable that is equal to one when the change in real credit per capita from output

[16] Reported results are obtained after identifying influential observations and removing extreme outliers from the regressions. All relevant conclusions are confirmed when we do not exclude outliers.

Table 11: Creditless recoveries in the Calvo sense (dummy variable) and Dependence on External Finance

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.0857 [-0.826]	0.0229 [0.539]	-0.3271 [-1.148]	-0.1115 [-1.509]	-0.0034 [-0.049]	-0.3586** [-2.212]
N	1251	786	465	3002	2029	973
r2	0.23	0.29	0.27	0.18	0.22	0.18
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.0354 [-0.700]	0.0341 [0.776]	-0.1535 [-1.211]	-0.1061* [-1.713]	0.0178 [0.285]	-0.4196*** [-3.255]
N	1176	767	409	2901	2012	889
r2	0.31	0.25	0.40	0.19	0.21	0.19

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = 1 when the change in real credit per capita from output peak to full recovery point is negative. $SectorCharacteristic$ = Dependence on external finance from RZ(1998)

peak to full recovery point ($\Delta stock$) results to be negative. Dependence on external finance is adopted as the relevant $SectorCharacteristic$ variable. We expect the coefficient on the interaction term to be negative. Indeed, worsening credit conditions should not have as large an impact for industries that primarily finance their investments with internal funds as for industries that rely more heavily on external funds. A negative coefficient would confirm that internal and external funds are not perfect substitutes and would provide us an important proof that financial markets are imperfect.

Actually, the coefficient on $Interaction$ results to be negative both in the full sample (indicated as Full) and in the emerging markets subsample (EM). These results are confirmed by considering growth in both value added and output as relevant variable. The negative coefficients for the emerging markets result significantly different from zero in the extended sample, which contains a larger number of observations. By

Table 12: Creditless recoveries in the Calvo sense and Dependence on External Finance

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.4214***	0.1682	-0.5617***	-0.22	0.0878	-0.5743***
	[-2.793]	[1.001]	[-3.210]	[-1.451]	[0.654]	[-3.429]
N	1234	786	448	2959	2003	956
r2	0.24	0.29	0.27	0.18	0.22	0.18
Diff.	-2.98%	0.61%	-4.65%	-1.28%	0.42%	-4.05%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.1803**	0.1164	-0.2148**	-0.0942	0.1046	-0.3307**
	[-2.099]	[1.212]	[-2.401]	[-0.835]	[0.951]	[-2.278]
N	1160	767	393	2859	1986	873
r2	0.35	0.25	0.42	0.19	0.21	0.19
Diff.	-1.34%	0.53%	-2.27%	-0.55%	0.50%	-2.33%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Dependence on external finance from RZ(1998)

contrast, in the developed countries subsample (DC) the coefficient on $Interaction$ is positive and close to zero. Therefore, the negative coefficient on $Interaction$ is entirely due to the subsample of emerging markets, probably reflecting the consequences of a lower financial development, the scarcity of alternative sources of funding and more pervasive financial frictions.

Recall that our objective here is to understand whether some reallocation takes place among different industries when the stock of bank credit at the end of a recovery phase is lower than at the beginning of the crisis. The results in table 11 seem to tell us that sectors that are more dependent on external finance *à la* RZ suffer the most during recoveries in emerging markets classified as creditless. These conclusions are confirmed and strengthened in table 12, where we consider a continuous measure of credit performance instead of the dummy variable to distin-

guish creditless recoveries in the Calvo sense. $CreditlessMeasure$ here is the difference between real per capita credit in the recovery year and the peak year. The sign is reversed, so that decreases in real per capita credit (i.e. the creditless cases) are represented by positive values. Accordingly, we can refer to this continuous measure as $CreditWeakness$ of the peak-to-recovery episode. When we refer to the emerging markets subsample the coefficient on $Interaction$ is negative as expected. Moreover, in this case the coefficient is significantly different from zero not only when we consider the extended sample but also in the limited sample extrapolated from CCO.

To get a sense of the magnitude of this effect, we can measure the differential in real growth rate across industries within the different kinds of recovery episode. This differential effect measures how much faster an industry at the 75th percentile level of $SectorCharacteristic$ grows with respect to an industry at the 25th percentile level when we have a recession episode at the 75th percentile of the $CreditlessMeasure$ rather than one at the 25th percentile. As for the $SectorCharacteristic$ variable, the 75th percentile (industries that are highly dependent on external finance) stands between *Textiles* and *Miscellaneous Petroleum and Coal Products*, while the 25th percentile (low dependence industries) stands between *Other Non-Metallic Mineral Products* and *Petroleum Refineries*. Let us apply the calculation within the EM subsample. At the 75th percentile of the $CreditlessMeasure$ distribution (the creditless case) the annual growth rate of real credit per capita from peak to recovery is almost zero, while at the 25th percentile (the with-credit case), the real credit per capita increases by 22.3 percentage points. According to our estimations, the differential in the growth rate amounts to about -4 percentage points in terms of total real output and -2.3 in terms of real value added. Therefore, our results suggest that the redistributive effects of creditless recoveries are not only statistically significant, but also economically meaningful.

The same conclusions cannot be drawn when we consider creditless recoveries in the Biggs sense. In table 13 the dummy for $CreditlessMeasure$ is set equal to one when the difference between the growth rate of real credit per capita in the full-recovery year and in the

Table 13: Creditless recoveries in the Biggs sense (dummy variable) and Dependence on External Finance

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	0.0227	0.0557	-0.0279	0.0417	0.021	0.0805
	[0.213]	[1.461]	[-0.092]	[0.607]	[0.395]	[0.447]
N	1251	786	465	3002	2029	973
r2	0.23	0.29	0.26	0.18	0.22	0.18
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	0.0177	0.0677	-0.1339	-0.0089	0.0327	-0.1139
	[0.336]	[1.624]	[-1.118]	[-0.165]	[0.671]	[-0.852]
N	1176	767	409	2901	2012	889
r2	0.31	0.25	0.40	0.19	0.21	0.18

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$
Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = 1 when the annual change of real credit per capita is lower in the recovery year than in peak year. $SectorCharacteristic$ = Dependence on external finance from RZ(1998)

pre-crisis peak year is negative. As we can see from the table, the coefficient on $Interaction$ is never significant although it still tends to turn negative in the case of emerging markets.

However, table 14 shows that when we refer to the EM subsample the coefficient on $Interaction$ is still negative and significant once we consider a continuous measure of credit performance to identify creditless recoveries in the Biggs sense. Here, $CreditlessMeasure$ is the difference between annual growth rate of real credit per capita in the recovery year and the peak year. As in the Calvo case (table 12), the sign is reversed so that decreases in the growth rate of credit (i.e. the creditless cases *à la* Biggs) are represented by positive values. When considering the real growth rate in value added as the dependent variable, the coefficients on the interaction term are negative and significant at the 1 percent level in the extended sample (5 percent in the limited sample), while they are negative but not significant when considering total output. In the case

Table 14: Creditless recoveries in the Biggs sense and Dependence on External Finance

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.3308	0.3007	-0.5733	-0.1036	0.0692	-0.4908
	[-0.970]	[1.479]	[-1.292]	[-0.757]	[0.894]	[-1.645]
N	1234	786	448	2959	2003	956
r2	0.23	0.29	0.25	0.17	0.22	0.17
Diff.	-1.69%	0.98%	-7.26%	-0.47%	0.28%	-3.35%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.3079	0.2493	-0.5545**	-0.2010	0.0643	-0.8425***
	[-1.518]	[1.633]	[-2.437]	[-1.027]	[0.667]	[-3.197]
N	1160	767	393	2859	1986	873
r2	0.35	0.25	0.43	0.19	0.21	0.19
Diff.	-1.58%	0.91%	-7.36%	-0.90%	0.27%	-5.53%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between annual change of real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Dependence on external finance from RZ(1998)

of value added, the differential in the growth rate is even higher than in the Calvo-type recoveries, amounting to -5.5 percentage points in the extended sample. In summary, not only creditless recoveries *à la* Biggs can occur, but they also have relevant redistributive effects among industries. Indeed, this is not inconsistent with the theory. In fact, the RZ measure of dependence on external finance refers to the fraction of capital expenditures that is not financed with cash flow from operations and the type of bank lending that finances capital expenditures is typically intertemporal rather than intra-period credit. Therefore, one should actually expect that the trend of credit flows has a more important role than the trend of credit stocks when relying on the external finance dependence as $SectorCharacteristic$ variable.

These conclusions are also strengthened once we consider the real growth of GFCF from peak to recovery as dependent variable (not re-

ported). In the case of creditless recoveries in the Biggs sense, the coefficient on $Interaction$ for the EM subsample becomes negative (-1.696) and significant at the 5 percent level. This confirms that for this kind of creditless recoveries the growth reallocation may be due, at least in part, to the difficulties in ensuring a stable and continuous growth of fixed capital.

However, the dependence on external financing is not the only relevant sector characteristic for vulnerability to financial frictions. Indeed, other mechanisms may induce a reallocation of growth among different sectors during creditless recoveries. These include the different accessibility that individual industries may have to bank loans when financial frictions strongly affect the recovery, but also technological characteristics that make it possible to intensify the use of inputs already available (e.g. fixed capital) at the expense of productive inputs that require greater reliance on intra-period financing (e.g. labor). Then, other variables can be introduced, such as $Tangibility$ and $CapitalIntensity$, which may result even more economically meaningful for growth reallocation when the recoveries are creditless. Tables below show the results obtained using these measures as $SectorCharacteristic$ variables instead of the external dependence. Creditless recoveries in the Calvo sense and in the Biggs sense are always identified through the continuous version of $CreditlessMeasure$.

According to Braun (2002), $Tangibility$ is the ability of assets to serve the role of securing access to external finance under an incomplete contractual setting. The level of $Tangibility$ for each sector is proxied by the ratio of net property, plant and equipment over total assets. The higher the level of $Tangibility$, the lower the degree of exposure of a given sector to the agency issue. If sectors with lower $Tangibility$ perform relatively worse when recoveries are creditless, this would indicate that a process of reallocation takes place from sectors that have difficult access to bank credit to sectors that have easy access to bank credit (i.e. high $Tangibility$). This would be a clear consequence of financial frictions affecting this type of crisis events. Table 15 shows that when considering emerging markets and creditless recoveries in the Calvo sense, the

Table 15: Creditless recoveries in the Calvo sense and Tangibility

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	0.4022	-0.2585	0.3831	0.1114	-0.2624	0.4943
	[0.628]	[-0.608]	[0.473]	[0.289]	[-1.021]	[0.727]
N	1234	786	448	2959	2003	956
r2	0.23	0.29	0.25	0.17	0.22	0.17
Diff.	1.68%	-0.56%	1.88%	0.38%	-0.75%	2.06%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	0.3532	-0.2838	0.5833**	0.4043	-0.1364	1.1699*
	[1.658]	[-0.776]	[2.372]	[1.409]	[-1.230]	[1.724]
N	1160	767	393	2859	1986	873
r2	0.35	0.25	0.43	0.19	0.21	0.19
Diff.	1.56%	-0.76%	3.64%	1.39%	-0.39%	4.88%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Tangibility

coefficient on the interaction term is positive as expected. However, coefficients are significantly different from zero (at the 5 or 10 percent level) only for value added.

Table 16 shows that the coefficient on $Interaction$ is more significant when considering creditless recoveries in the Biggs sense. Indeed, the relevance of the interaction term within the EM subsample is still higher in table 16 than in table 15 both from a statistical and an economical point of view. Interestingly, the differential in the growth rate is even higher considering $Tangibility$ rather than $ExternalDependence$, amounting now to about 12 percentage points (more than 17 in the limited sample).

Again, this result is not surprising. Indeed, the dependence on external financing *à la* RZ only refers to fixed capital expenditures and thus excludes working capital. While capital expenditures are essential for growth opportunities in the medium term, it is presumable that working capital plays a more important role in the short term. Therefore, the

Table 16: Creditless recoveries in the Biggs sense and Tangibility

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	1.6430*	0.8471	1.8591	0.4827	0.0533	1.7818**
	[1.900]	[1.234]	[1.519]	[1.455]	[0.270]	[2.321]
N	1234	786	448	2959	2003	956
r2	0.24	0.29	0.25	0.17	0.22	0.17
Diff.	4.98%	1.64%	13.95%	1.30%	0.13%	7.21%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	1.6191***	0.2601	2.2322***	0.6021	-0.1843	3.1085**
	[3.223]	[0.387]	[4.491]	[1.099]	[-0.949]	[2.501]
N	1160	767	393	2859	1986	873
r2	0.36	0.25	0.44	0.19	0.21	0.20
Diff.	4.91%	0.56%	17.55%	1.60%	-0.46%	12.09%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between annual change of real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Tangibility

measure of external dependence adopted in RZ might not necessarily be the best exogenous characteristic to consider when we look at recoveries from recession episodes, although it has been the most commonly used variable in the literature on long-run growth. $Tangibility$, on the contrary, is likely to capture industries' accessibility to inter-period and intra-period bank credit, thus affecting the ability of industries to finance both fixed and operating capital in periods of higher and sustained financial frictions.

Industries also vary in terms of the intensity with which they use alternative productive resources. In tables 17 and 18 we adopt $CapitalIntensity$ of each industry, i.e. the intensity with which physical capital is used for the production, as the $SectorCharacteristic$ variable. Even for this variable, we still recur to measures provided in Braun (2002). The sign of the coefficient for the interaction term should be positive as before. This expectation is attributable to two argu-

Table 17: Creditless recoveries in the Calvo sense and Capital Intensity

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	2.5252**	0.4608	3.1897**	1.024	0.0232	2.0909*
	[2.592]	[0.274]	[2.162]	[1.503]	[0.029]	[1.885]
N	1234	786	448	2959	2003	956
r2	0.24	0.29	0.25	0.17	0.22	0.17
Diff.	1.72%	0.16%	2.55%	0.57%	0.01%	1.42%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	0.4375	-0.0678	1.2680	1.3559	0.0812	3.1367
	[0.532]	[-0.042]	[1.037]	[1.212]	[0.201]	[0.963]
N	1160	767	393	2859	1986	873
r2	0.35	0.24	0.42	0.19	0.21	0.19
Diff.	0.31%	-0.03%	1.29%	0.76%	0.04%	2.13%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Capital Intensity

ments that should reinforce one another. First of all, $Tangibility$ and $CapitalIntensity$ are positively correlated (correlation is higher than 0.8) and the ranking of the industries with respect to these characteristics does not differ too much. Sectors that use more intensively physical capital are also characterized by higher tangibility of assets and, then, lower financing constraints. Secondly, when credit supply is scarce, high physical-capital-intensive industries are likely to take advantage of the already existing physical capital to support the production, while reducing the cost of financing for alternative inputs that typically require major utilization of working capital, such as labor force and the relative wages.

Table 17 shows the results obtained when considering creditless recoveries in the Calvo sense. The coefficient on $Interaction$ is positive as expected, especially for emerging markets. However, results are significantly different from zero only when considering real growth in total output rather than value added. Therefore, in this case redistributive ef-

fects are more relevant for the level of production than for the return on labor and capital.[17]

The introduction of $CapitalIntensity$ as the $SectorCharacteristic$ gives additional insights, which permit to further deepen our analysis. As stated above, industries that use more intensively physical capital may take advantage of the existing fixed capital to support their production during creditless recoveries. This would allow them to save on alternative resources, which may require a higher intake of external funding, at least in the short term. If this is true, we should expect that employment remains relatively weaker in these industries than in the low capital-intensive ones. This is actually what we obtain from our regressions, as shown in table 18.

Table 18 replicates regressions in table 17, but now the dependent variables are respectively employment, real wages and real GFCF. Moreover, we include here an additional control variable, ro_PtR, which is the real growth of sectoral output from the pre-crisis peak to the full recovery year. We expect the coefficient on ro_PtR to be strictly positive since all the dependent variables considered here are likely to move in the same direction than total production. Actually, the coefficient is positive and strongly significant for both the DC and EM subsamples and for all the dependent variables. For employment and real wages, it also always results lower than one, revealing that the use of labor force tends to be less volatile than the level of production. In practice, employment and real wages grow less than production in sectors where output growth is positive, but they also drop less than production in sectors where it fails to recover.

Once we control for ro_PtR, a significant coefficient on $Interaction$ reflects an additional consequence of creditless recoveries on employment and real wages. As we can see from the results obtained within the extended sample, the coefficient on $Interaction$ is negative and strongly significant. This confirms our initial hypothesis that, during creditless

[17] Although we do not report the results here, the coefficient on $Interaction$ continues to be positive and significant even when considering creditless recoveries in the Biggs sense, but the differential effect is lower than in case of $Tangibility$.

Table 18: Creditless recoveries in the Calvo sense and Capital Intensity: Alternative dependent variables

Limited sample (CCO)						
Dep.Var.	Employment		Real Wages		Real GFCF	
Sample	DC	EM	DC	EM	DC	EM
Interaction	-0.0946	-2.0011***	-0.2486	-1.3337*	3.4657	-3.6617
	[-0.083]	[-3.239]	[-0.217]	[-1.844]	[1.426]	[-0.218]
ro_PtR	0.5242***	0.3448***	0.5579***	0.3063**	0.4862***	0.9342**
	[8.698]	[3.163]	[10.176]	[2.762]	[3.752]	[2.321]
N	787	434	733	433	629	228
r2	0.71	0.60	0.75	0.59	0.25	0.64
Extended sample						
Dep.Var.	Employment		Real Wages		Real GFCF	
Sample	DC	EM	DC	EM	DC	EM
Interaction	0.1548	-1.8699***	-0.0302	-1.1705***	-1.4332	-52.1202
	[0.253]	[-5.338]	[-0.069]	[-3.075]	[-0.458]	[-1.408]
ro_PtR	0.4195***	0.5616***	0.5382***	0.5193***	0.9063**	1.6625***
	[26.508]	[5.128]	[46.443]	[6.717]	[2.504]	[3.385]
N	1973	923	1906	923	1690	650
r2	0.81	0.64	0.86	0.74	0.22	0.16

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Capital Intensity

recoveries, high capital-intensive industries tend to contain the reprise in employment and real wages proportionally more than low capital-intensive industries. Instead, when real GFCF is adopted as dependent variable, the coefficients are still negative, especially for the EM subsample, but they are not significantly different from zero, reflecting highly heterogeneous behavior during recoveries with respect to investments.

4.2.5 Recovery and relative dependence on bank credit versus trade credit

The natural question arises whether firms are able to substitute other forms of external finance for bank credit when credit conditions remain

Table 19: Recovery and relative dependence on bank credit

		Calvo-type Recoveries		Biggs-type Recoveries	
		Creditless	With-Credit	Creditless	With-Credit
Raddatz indicator	≥ 0.89	-2.1%	3.2%	0.4%	2.3%
by SECTOR	< 0.89	1.6%	6.6%	4.3%	5.3%
Raddatz indicator	≥ 1.00	1.4%	5.2%	2.4%	5.1%
by COUNTRY	< 1.00	-1.6%	1.1%	-0.6%	0.6%

For each sub-group, the cells report the median increase of *real output by sector* from peak year to full recovery year.

strained for a prolonged period following downturns. In the presence of market imperfections, other sources of external finance such as bond and equity issuance are not perfect substitutes for bank loans. In addition, conditions are most likely to be strained in bond and equity markets following downturns as agency problems worsen in those markets too. Trade credit may be a better viable alternative to bank credit and other forms of market-based external finance. Therefore, we investigate whether industries that rely more on bank credit relative to trade credit experience lower rates of recovery.

We use data from Raddatz (2010) on the ratio of *short-term debt to payables* at the country and industry level as an indicator of dependence on bank intermediaries relative to trade credit as sources of short-term financing. A low value for this ratio (henceforth the *Raddatz Indicator*) indicates that a larger part of short term financing is obtained from trade credit. The median ratio of bank credit to trade credit at the industry (country) level in our extended sample is 0.89 (1.00).

Table 19 summarizes the median rate of real output growth by sector depending on whether the Raddatz indicator at the industry or country level is above or below the sample median. Creditless recoveries are kept separate from recoveries with credit. Calvo-type recoveries are creditless when $\Delta stock$ is negative (as in table 9), while Biggs-type recoveries are creditless when $\Delta flows$ is negative (as in table 10). Again, growth rates refer to the whole peak-to-recovery period.

In general, industries that are more dependent on bank credit as op-

posed to trade credit seem to grow more slowly. This is the case following any type of crisis considered here. The picture looks strikingly different at the country level. In general, industries in countries that are more dependent on bank credit as opposed to trade credit seem to grow more quickly. Again, this is true across all types of crises considered here.[18] At the industry level, a higher dependence on bank credit relative to trade credit renders firms more vulnerable to credit market disruptions during the crisis. Therefore, industries that rely relatively more on alternative sources of external financing, such as trade credit, may fare better during the peak-to-recovery period. We call this effect the *substitution effect*.

At the country level, by contrast, a higher relative dependence on bank credit appears to have a positive impact on growth during these episodes. This highlights a *contagion effect* of trade credit, i.e. the propagation of financial distress and bankruptcy through trade credit chains during crisis episodes.[19] This is also consistent with the theoretical model in Coricelli and Roland (2010), in which a higher dependence on bank credit relative to trade credit increases the likelihood of production-chain equilibrium. When credit markets are underdeveloped and enterprise activity is financed by trade credit, shocks may induce a break-up of credit and production chains, leading to sudden and sharp economic contractions. The relative development of a banking sector can reduce the probability of such collapses and hence plays a crucial role in softening output declines and spurring recovery.

Since trade credit may play a role in explaining the creditless character of certain recovery episodes, we could expect the *substitution effect* to be larger during creditless recoveries. Tables 20 and 21 show the results obtained in our previous regressions when introducing the Raddatz Indicator at the industry level as $SectorCharacteristic$ variable. We should expect negative values for the interaction term. Indeed, the higher the importance of intermediaries versus suppliers, the lower the possibility to recover when financial frictions restrain bank lending. Industries that

[18] The results are similar if we consider the product of the Raddatz Indicators at the country and industry level.

[19] See e.g. Kiyotaki and Moore (1997), Calvo and Coricelli (1996).

Table 20: Creditless recoveries in the Calvo sense: The role of trade credit

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.0640	-0.0131	-0.0966	-0.0356	0.0299	-0.0988
	[-0.887]	[-0.111]	[-1.065]	[-0.736]	[0.488]	[-0.788]
N	1234	786	448	2959	2003	956
r2	0.23	0.29	0.25	0.17	0.22	0.17
Diff.	-0.64%	-0.07%	-1.13%	-0.29%	0.20%	-0.98%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	0.0358	0.0604	0.0114	-0.0783	-0.0079	-0.1066
	[0.519]	[0.730]	[0.134]	[-0.831]	[-0.284]	[-0.408]
N	1160	767	393	2859	1986	873
r2	0.35	0.25	0.42	0.19	0.21	0.19
Diff.	0.38%	0.39%	0.17%	-0.64%	-0.05%	-1.06%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Short-Term Debt to Trade Credit

rely relatively more on bank credit are therefore at a stronger disadvantage during creditless recoveries.

The results show that coefficients on $Interaction$ are not significantly different from zero when considering creditless recoveries in the Calvo sense (table 20) while negative and significant results are obtained when considering creditless recoveries *à la* Biggs (table 21).

This result is not easy to interpret, because trade credit is especially important for short-term financing and then we could expect significant values even in case of creditless recoveries *à la* Calvo. In addition, significant values in the limited sample are obtained for developed countries when we look at total output as the dependent variable, but only for emerging markets when we consider value added. Although the sign tends to be negative as expected, these conflicting results lead us to postpone definitive conclusions on the stronger effects associated with trade

Table 21: Creditless recoveries in the Biggs sense: The role of trade credit

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.2066	-0.3090***	-0.1769	-0.1388*	-0.0987	-0.2443
	[-1.563]	[-3.131]	[-0.951]	[-1.785]	[-1.318]	[-1.452]
N	1234	786	448	2959	2003	956
r2	0.23	0.29	0.25	0.17	0.22	0.17
Diff.	-1.49%	-1.42%	-3.16%	-0.89%	-0.57%	-2.36%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.2825**	-0.0918	-0.3575**	-0.2702*	-0.1239	-0.6887*
	[-2.196]	[-0.818]	[-2.158]	[-1.803]	[-1.073]	[-1.907]
N	1160	767	393	2859	1986	873
r2	0.35	0.25	0.43	0.19	0.21	0.19
Diff.	-2.04%	-0.47%	-6.70%	-1.71%	-0.74%	-6.39%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between annual change of real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Short-Term Debt to Trade Credit

credit during creditless recoveries.

In part II of this chapter (section 4.3) we will possibly reinforce our final judgment with an analysis carried out on data at the firm level.

4.2.6 Further considerations on control and instrumental variables

We tried to include additional control variables to our regressions in order to check whether the estimated coefficients are biased by the omission of some significant variable which summarize additional structural features of sectors in each country and which is possibly correlated with our interaction term.

One possible control variable is the average growth of the dependent variable in sector s during the three years preceding the peak of each episode e, hereinafter indicated as $Precr\_gr_{s,e}$. Indeed, we should ex-

Table 22: Creditless recoveries in the Calvo sense and Dependence on External Finance: Alternative

Dep:Output	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.3909**	0.1683	-0.5239***	-0.1900	0.0889	-0.5379***
	[-2.506]	[1.001]	[-3.032]	[-1.249]	[0.662]	[-3.361]
Precr_gr	-0.3734	-0.0075	-0.5364	-0.4707***	-0.0407	-0.7294***
	[-1.402]	[-0.056]	[-1.253]	[-2.825]	[-0.365]	[-3.018]
N	1178	786	392	2852	2002	850
r2	0.25	0.29	0.28	0.17	0.21	0.18
Diff.	-2.78%	0.61%	-5.52%	-1.10%	0.43%	-3.33%
Dep:VA	Limited sample (CCO)			Extended sample		
Sample	Full	DC	EM	Full	DC	EM
Interaction	-0.1761**	0.1180	-0.2038**	-0.0600	0.1129	-0.3286**
	[-2.055]	[1.206]	[-2.259]	[-0.515]	[1.019]	[-2.089]
Precr_gr	-0.3041*	-0.1389	-0.3380	-0.2110	-0.0434**	-0.7445***
	[-1.908]	[-0.817]	[-1.647]	[-1.516]	[-2.222]	[-4.226]
N	1106	767	339	2746	1984	762
r2	0.35	0.25	0.42	0.18	0.21	0.20
Diff.	-1.31%	0.54%	-2.15%	-0.35%	0.55%	-2.15%

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Cluster-robust t statistics in brackets, after clustering by recession episode. The set of dummies includes fixed effects by industry and by recession episode (coefficients not reported). $CreditlessMeasure$ = difference (-) between real credit per capita in the recovery year and the peak year. $SectorCharacteristic$ = Dependence on external finance from RZ(1998)

pect that in the peak-to-recovery period the relevant variable tends to increase relatively less in sectors whose growth was higher during the pre-crisis period. This may indicate that sectors showing a larger and more sustained trend during the pre-recession period are subject to some significant correction as a consequence of the crisis. If high $Precr\_gr$ reveals capacity utilization well above the long-term equilibrium, then a negative sign of the coefficient may just signal the tendency to a natural adjustment during the peak-to-recovery episode. Among other things, this variable may actually help to distinguish industries that are more pro-cyclical in the demand of their goods from industries that are less volatile.

For the sake of simplicity, we only report table 22 which replicates the regressions in table 12 with the addition of our new control variable. The coefficient on $Precr\_gr$ results to be negative as expected, while the coefficient on $Interaction$ remains substantially unchanged with respect to baseline regressions. Although not reported here, this evidence is confirmed for all the other regressions. The inclusion of the new variable does not alter the results discussed above.

For completeness, instead of $Precr\_gr$, we also tried to use an alternative control variable, i.e. $Volatility_{s,c}$. This variable is nothing more than the standard deviation of the annual rate of real growth of each dependent variable, measured by sector s within each country c. This proxy is obtained by our own computations on the UNIDO dataset. Once introduced the $Volatility$ variable in additional regressions, the relative coefficient results to be not significantly different from zero and, again, we do not obtain relevant changes with respect to the interaction term.

Finally, a major concern associated with the OLS estimates is the possibility that $CreditWeakness$, the continuous measure of credit recovery, is endogenous to the dependent variable. For example, relative higher growth of sectors that typically demand more bank credit for their activity could induce a stronger recovery in credit. The cause-effect relationship would be reversed compared to the one we want to analyze. To address this issue, we also tried to use an instrumental variables (IV) estimation strategy to identify the exogenous effect of $CreditWeakness$ interacted with $SectorCharacteristic$ on the dependent variable. One possible candidate as an instrumental variable could be a measure that captures credit market outcomes prior to the recession episode, as is typically done in the literature to predict financial crises.[20] Specifically, we use the interaction between $SectorCharacteristic_s$ and $Credit\_at\_Peak_e$ as an instrument for the $Interaction$ variable, where $Credit\_at\_Peak_e$ is the cyclical component of real credit per capita at the output peak of each specific episode e.

The coefficient on $Interaction$ in our IV estimations tends to have the same sign than in OLS regressions and very often it is also higher in ab-

[20]See e.g. Calvo et al (2012), Schularick and Taylor (2012), Gourinchas et al (2001).

solute values. Unfortunately, estimates generally result not significant. On the one hand, we suspect that the reason for insignificant coefficients is largely due to the loss of efficiency that is attached to the IV estimator and to the use of an instrument for $Interaction$ which results to be very weak. On the other hand, we also have to consider that the endogeneity bias is reduced for the OLS estimator when the potentially endogenous regressor ($CreditWeakness$ in our case) is interacted with an exogenous covariate ($SectorCharacteristic$). Indeed, recent econometrical works demonstrated that the OLS estimator of the interaction term is still consistent and asymptotically normal, and standard inference can be applied, under reasonable conditions regarding higher-order dependencies in the data.[21] It should be noted, however, that this consistency is restricted to the coefficient on the interaction term only and not to the full marginal effect of the endogenous regressor. Since the main empirical result in our specification only depends on the interaction variable, we can assign significant relevance to the OLS inference without having to resort to instrumental variables techniques. In other words, we have the remarkable fact that since the economic variable of interest is the interaction term, we do not necessarily have to resort to IV estimators, especially when it is particularly difficult to find suitable instruments in terms of strength and exogeneity.

4.2.7 Concluding remarks

The "Great Recession" that started in 2007 has generated renewed interest in the role of credit in shaping economic recoveries, in particular the question of how prolonged credit market disruptions may affect the pace of economic growth in the aftermath of the crisis. The existing literature on credit and economic recoveries is dominated by the study of *creditless recoveries*, a phenomenon whereby economic activity recovers in the absence of credit growth. In part I of this chapter, we investigated the role of credit in shaping economic recoveries and tried to shed some light on the phenomenon of creditless recoveries using industry-level data for a

[21] See, in particular, Bun and Harrison (2014).

large sample of peak-to-recovery episodes.

Our main conclusions are as follows. First, we identify two types of creditless recoveries, namely episodes during which GDP per capita recovers without an increase in the credit stock (creditless recoveries in the Calvo sense) and episodes during which GDP per capita recovers without an increase in credit flows (creditless recoveries in the Biggs sense). Both types of creditless recoveries are not rare events. However, our results highlight an important difference between those two types of creditless recoveries. Creditless recoveries *à la* Calvo are associated with relatively larger drops in GDP per capita during the recession phase. This is consistent with arguments on the existence of a bounce-back effect among the determinants of creditless recoveries.

Second, we find that industries that are more dependent on external finance have a worse relative performance when recoveries are classified as creditless, but this result only applies to emerging markets. This suggests that in developed countries certain mechanisms enable the external dependent industries to grow despite the creditless character of recovery. These mechanisms may include an improved and easier substitutability among alternative sources of financing (such as the issuance of tradable bonds and equity). In addition, redistributive effects among industries are at work especially during creditless recoveries in the Biggs sense. This can be explained by the fact that the dependence on external financing refers to investments in fixed capital, which typically involve intertemporal rather than intra-period credit.

However, the dependence on external financing is not the only sector characteristic that induces a reallocation of growth among different sectors during creditless recoveries. The different accessibility to bank loans ($Tangibility$) is also at work. The more credit supply is constrained during the recovery, the higher is the reallocation toward sectors that posses collateral associated with tangible assets, defined as *intrinsic collateral* in Calvo (2011). Moreover, we highlight a relatively better performance of industries that can intensify the use of physical capital already available rather than productive inputs requiring additional funding, such as labor. In particular, we find that in these industries the reprise in employ-

ment and real wages remains proportionally weaker than the reprise in output during creditless recoveries. This result, which seems to confirm a partial redistribution of productive inputs from labor to capital, is absolutely relevant, since it constitutes a potential connection between our analysis of creditless recoveries and the existing literature on jobless and wageless recoveries. Interestingly, in this case, it is precisely the definition of creditless recovery *à la* Calvo to have a greater relevance.

Finally, we find that industries that are relatively more dependent on trade credit as opposed to bank credit recover more quickly. At the industry level, a higher dependence on bank credit relative to trade credit renders firms more vulnerable during the peak-to-recovery episode (*substitution effect*). At the country level, by contrast, a higher relative dependence on bank credit appears to have a positive impact on growth during recoveries (*contagion effect*). This suggests the existence of a propagation of financial distress and bankruptcy through trade credit chains during crisis episodes. According to our estimations, the availability of alternative sources of financing such as trade credit could favor some industries at the expense of others especially when the recovery is creditless. In this case, the reallocation process would depend neither on the dependence on external finance nor on the accessibility to bank credit, but rather on the accessibility to an alternative source of financing. However, further analyses at the firm level are needed to better discern the effects associated with trade credit during creditless recoveries. Among other things, in part II (section 4.3) of this chapter we just try to shed further light on this.

There is a large scope for further research into the role of credit in shaping economic recoveries. In particular, our work highlights two important issues that may warrant further investigation. First, additional work is needed to empirically distinguish the mechanisms that enable economic activity to recover in the absence of credit growth. Second, supplementary research could try to shed some further light on the distinction between creditless recoveries in the Calvo and Biggs sense. These two types of creditless recoveries seem to be two separate phenomena, with a differential impact on growth.

4.3 Part II

4.3.1 Introduction

In part II we analyze data available at the enterprise level for the European countries with particular reference to the period from 2003 to 2011, so capturing the recent global financial crisis and the early recovery years, but excluding the double-dip recessions that hit several economies after 2011. Since real GDP of several European countries had not yet fully recovered to pre-recession levels by 2011, it is not possible to mark the last year of each recovery episode by identifying the full-recovery point as in part I of this chapter. Thus, in part II we do not work on peak-to-recovery growth rates but rather on year after year observations, after differentiating among three periods: pre-recession, recession (from peak to trough) and recovery (after the trough).

As in part I of this chapter, the objective is to analyze the real redistributional effects of recessions and recoveries among firms and industries with specific characteristics. But unlike the previous analysis, we focus here on the heterogeneity existing across countries within a same single period of generalized crisis. In particular, the regressions we introduce aim to differentiate country-level episodes according to the weakness of bank credit during recovery years. Firm level data extracted from the AMADEUS dataset allow in-depth analysis of the behavior of individual companies in countries that are experiencing different degrees of financial frictions.

As already noted in part I, *dependence on external finance* is not the only characteristic that induce a reallocation of growth among different sectors as a result of impaired financial intermediation.[22] In this context, indeed, we are not so much interested in the long-term impact of financial development on real growth but rather in the short-term impact of financial shocks on output fluctuations. In the short run, firms' reliance on credit can be of two types. On the one hand, it can be due to some technological characteristics that make some industries more vulnerable

[22] See also the model presented in chapter 3.

in their productive capacity when credit is not available (*supply channel* of transmission). On the other hand, reliance on credit can be due to the lower demand of goods that are typically purchased with the help of external financing, such as investment or intermediate goods (*demand channel* of transmission). In the first case, companies performing worse are those more dependent on credit to finance investments in fixed capital or their current spending on productive inputs. By contrast, in the second case, companies performing worse are those selling a disproportionate share of their output for gross fixed capital formation uses or intermediate consumption uses. For this reason, it is particularly appealing to understand how far credit can induce output fluctuations through the demand channel rather than the supply channel. The AMADEUS dataset is particularly useful to this end. Indeed, while the UNIDO database contains data only for industries in the manufacturing sector, a wider range of sectors is covered in the AMADEUS dataset. This allows the researcher to usefully focus on a broader and more heterogeneous spectrum of companies with respect to the type of goods and services they produce. Indeed, it is just looking at the relative *production line position* of each company that we can test the extent to which bank credit limits firms' growth by reducing the demand for goods they produce rather than constraining their production capacity.

Finally, we want to use firm-level data in order to further analyze whether industries that are relatively more dependent on trade credit as opposed to bank credit recover relatively faster when credit market disruptions are prolonged in the aftermath of a crisis. Again, we try to compare this potential *substitution effect* with the existence of a *contagion effect* of opposite sign. The latter catches the fact that trade credit chains may accelerate the propagation of financial distress and negatively affect growth of firms which recur more extensively to this source of financing.

Part II is structured as follows. In section 4.3.2, we describe the advantages of a firm-level analysis. In section 4.3.3 we present a baseline specification for our regressions, while in section 4.3.4 we introduce fully specified regressions by distinguishing the different types of recovery in accordance to the weakness of bank credit. In section 4.3.5, we deal

with the measurement of sector characteristics that will prove useful for our estimates, such as the dependence on external finance, the liquidity needs and the production line position. In sections 4.3.6 and 4.3.7 we discuss about the results of our regression analyses. In the end, section 4.3.8 is dedicated to summary conclusions.

4.3.2 Evidence from firm-level data

Relevant data at the firm level are obtained from AMADEUS in both advanced and emerging European countries during the period 2003-2011. Not considering the years after 2011 limits problems associated with double-dip recessions and also with the delay of some countries in releasing data for AMADEUS. Data collection and cleaning required time and huge effort but allow us to work on a considerable number of observations within a broad spectrum of countries.[23] The availability of data at the enterprise level offers several advantages. First of all, as we shall see in section 4.3.5, it enables us to recalculate sector characteristics, such as external dependence, based on a more recent period than the analysis of Rajan and Zingales (1998) (henceforth RZ) and on a subset of developed European countries that represents a more credible benchmark than the United States for the rest of Europe.[24] Secondly, as noted in Braun and Larrain (2005), one benefit of using firm-level as opposed to industry-level data is that aggregate fluctuations can be thought to be less endogenous to firm-specific shocks than to industry-specific ones. Indeed, it is reasonable to assume that recessions are exogenous to each firm given its small weight with respect to the whole economy. The same assumption is stronger when considering industry-level fluctuations, given the small number of sectors that can be considered. Creditless recoveries may be actually triggered by industry-specific shocks that propagate throughout the economy either through their effect on aggregate demand or via pro-

[23] See Appendix A for details on the firm-level database AMADEUS.

[24] While it is true that exogenous sectoral characteristics need to be estimated within countries where financial frictions are sufficiently reduced (as shown in part I), it is also true that many previous research works are likely to be based on U.S. benchmarks only because no data are readily available for other countries.

duction linkages. This creates problems in regressions if the origins of creditless recoveries are rooted in shocks to the same group of industries that happened to be more dependent on external finance.

The AMADEUS database has additional positive attributes. As mentioned above, it covers all industries of an economy and not only manufacturing firms. Moreover, it is not limited to public quoted companies but instead covers a very large number of non-listed firms. Since listed firms are generally much larger, older and have direct access to financial markets, their dependence on external finance may be different from the average firm. In support of our considerations, even Klapper et al (2006) show that data extrapolated from AMADEUS actually provide a fairly representative overview of economic activity in European countries.

4.3.3 Methodology and empirical approach: Baseline regression

As in part I of this chapter, we use a difference-in-differences approach to identify causal links between credit growth and output performance. If creditless recoveries are determined by frictions in financial intermediation, then they should negatively affect, above all, firms that rely more heavily, either by demand or by supply channel, on a proper functioning of the bank credit market. To provide a benchmark, as in Abiad et al (2011), we start by looking at the relative performance of different sectors during all recoveries, irrespective of credit conditions. Our benchmark specification is the following:

$$
\begin{aligned}
& Growth_{i,t} \\
&= \alpha \cdot lnSize_{i,t-1} \\
&+ \beta_1 \cdot Recession_{c,t} + \sum_{j=2}^{m} \beta_j \cdot (Recession_{c,t} \cdot SectorCharacteristic_{j,s}) \\
&+ \gamma_1 \cdot Recovery_{c,t} + \sum_{j=2}^{m} \gamma_j \cdot (Recovery_{c,t} \cdot SectorCharacteristic_{j,s}) \\
&+ \gamma_{m+1} \cdot (Recovery_{c,t} \cdot OutputLoss_i) + \sum_i \delta_i \cdot d_i + \varepsilon_{i,t} \qquad (4.2)
\end{aligned}
$$

where i, s, c, t denote firm, sector, country and year respectively. The dependent variable, $Growth$, is the output performance of firm i at time t proxied with the real growth rate of $OperatingRevenues$ ($Turnover$). Real figures are obtained dividing all nominal figures by the country's deflator.[25]

Regressors include fixed effects at the firm level, denoted by letter d. Since we have data at the firm level, a significant component of turnover growth is probably due to firm characteristics. In addition, since firm fixed effects are nested within country and industry clusters, we do not need to specify country-specific and industry-specific fixed effects. By means of firm-specific fixed effects we indirectly control also for characteristics that are specific to either an industry or a country, as well as for characteristics that are specific to an industry when located in different countries, i.e. industry-country interaction effects, as long as these are persistent in time.

Instead, the country-year components of growth are considered through specific *episode dummies* that vary depending on whether the country at time t is experiencing a recession (*Recession* dummy equal to one), a recovery (*Recovery* dummy equal to one) or it is going through years of normal growth (both *Recession* and *Recovery* equal to zero). We identify recessions by country as those years with a negative growth in real GDP, while recoveries by country coincide with years of positive growth following the recession. This excludes Poland from the recession and recovery episodes because it didn't experience any recession during the last financial crisis. And it also excludes Greece and Croatia from recovery episodes because their growth remained negative within the 2010-2011 period. The *Recession* and *Recovery* dummies capture a time-country aspect, identifying the overall state of each economy at time t.

But the main variables of interest in the regression are the industry-country-year components of growth, which will permit us to assess the actual existence of redistributional effects during recession and recovery episodes. These components are represented by interaction terms

[25]For all countries, GDP deflator data are from the IMF IFS (line 99), with integrations from the IMF World Economic Outlook (WEO).

obtained as the products of peculiar characteristics j of each sector s, $SectorCharacteristic_{j,s}$, and the *episode dummies* for year t and country c.

As we can see, the specification that we run for our baseline regression is perfectly symmetric for recession and recovery episodes with respect to these interaction terms. The summation symbol for the interaction terms indicates that we can include (and in fact we do include) more than one sectoral characteristic j at one time. In section 4.3.5, we describe exhaustively which variables are considered as $SectorCharacteristic$ and how they are measured within our sample. The measures representing sectoral characteristics are assumed to be constant across years and are included in the regressions as differences with respect to their average values within the sample. Thus, coefficients β_1 and γ_1 on the episode dummies refer to companies with average values of $SectorCharacteristic$. Instead, coefficients β_1 and γ_1 on the interaction terms allow us to understand what happens during recession and recovery years in industries that deviate positively or negatively with respect to these average values.

By controlling for firm-specific effects and introducing the interaction terms, we significantly reduce the concerns about potential relevant omitted variables. The reason is that, in presence of fixed effects, the results could only be biased by an omitted variable that varied through years (and through the interaction of year by firm) and, at the same time, was correlated with our variable of interest, i.e. the interaction of $SectorCharacteristic$ with the *episode dummies*. This is clearly less plausible than having omitted variables correlated with relevant measures at the country level, as typically occurs in biased cross-country regressions. However, as we can see from the specification reported above, we also control for two additional variables that may constitute relevant firm-year components of growth, i.e. $OutputLoss_i$ and $lnSize_{i,t-1}$.

$OutputLoss_i$ is the fall in real output at the firm level during the years of recession. In firms where production has fallen more, it is likely to observe a more significant bounce-back effect during the recovery period, substantiated by a reprise in firms' capacity utilization. Since output de-

cline during the recession phase may help to explain growth in recovery years, $OutputLoss_i$ is interacted with the $Recovery$ dummy. By introducing this additional control variable, we isolate that part of higher growth during the recovery years that is due to the utilization of greater idle capacity. This arrangement will result useful even in section 4.3.4, where we introduce a measure of bank credit weakness as additional regressor.

Indeed, the utilization of existing productive capacity does not require the availability of large external funding and, thus, it fosters a component of growth that is independent from persistent weakness in credit supply. Then, the omission of $OutputLoss_i$ from our specification may result in biased estimates.

Secondly, we also include an index for the size of firm i at time $t-1$, $lnSize_{i,t-1}$, to account for *convergence* effects, i.e. the tendency of smaller firms to experience higher growth in their assets and turnover. $lnSize_{i,t-1}$ is the lagged value of $TotalAssets$ of firm i, expressed in natural logarithms. Note that $lnSize$ is not actually captured by fixed effects because it is not built as a time-invariant measure.

4.3.4 Methodology and empirical approach: Fully specified regression

If financial conditions play an important role on aggregate cyclical behavior, one expects the response to negative shocks to depend on some peculiar firm or industry characteristics, such as the agents reliance on financial markets. When considering dependence on external finance, we should presumably obtain, as in part I, that industries more dependent on external finance suffer relatively more than other industries when impaired credit affects the recovery. Indeed, firms in less dependent industries should be able to dampen the reduction in production thanks to the higher availability of internal funds.

Our baseline regression in section 4.3.3 is irrespective of credit conditions. In the following specification, on the contrary, we allow the coefficients on recoveries to change depending on the weakness of bank credit in order to make a distinction between the different types of recovery.

The new specification can be represented as follows:

$$
\begin{aligned}
& Growth_{i,t} \\
&= \alpha \cdot lnSize_{i,t-1} \\
&+ \beta_1 \cdot Recession_{c,t} + \sum_{j=2}^{m} \beta_j \cdot (Recession_{c,t} \cdot SectorCharacteristic_{j,s}) \\
&+ \gamma_1 \cdot Recovery_{c,t} + \sum_{j=2}^{m} \gamma_j \cdot (Recovery_{c,t} \cdot SectorCharacteristic_{j,s}) \\
&+ \gamma_{m+1} \cdot (Recovery_{c,t} \cdot OutputLoss_i) \\
&+ \lambda_1 \cdot ClessRecv_{c,t} + \sum_{j=2}^{m} \lambda_j \cdot (ClessRecv_{c,t} \cdot SectorCharacteristic_{j,s}) \\
&+ \sum_i \delta_i \cdot d_i + \varepsilon_{i,t} \qquad (4.3)
\end{aligned}
$$

where $ClessRecv$ is the interaction between the $Recovery$ dummy and a $CreditWeakness$ variable, which defines how much a recovery is creditless. To explore a continuous measure of $CreditWeakness$ we consider the inverse of the cumulative growth in real $PrivateCredit$ by country during the recovery period 2010-2011, where $PrivateCredit$ is obtained as indicated in chapter 2. Higher values of $CreditWeakness$ indicate larger decreases in private credit and constitute the signal of a recovery more markedly creditless. This measure should provide a sufficiently accurate information on the crediltess-ness of the recovery with respect to the use of a simple dummy of creditless recovery.Abiad et al (2011), for example, simply define a creditless recovery as one in which the growth rate of real bank credit is zero or negative in the first three years of recovery.

The coefficients of prime interest here are those on the interactions between $SectorCharacteristic$ variables and $ClessRecv$. As well as the $SectorCharacteristic$ variables, even $CreditWeakness$ is expressed as the difference with respect to its average value within the sample. Thus, the coefficients γ refers to recovery episodes characterized by average values of $CreditWeakness$. Instead, the coefficients λ allow us to understand what happens during episodes that deviate positively (*creditless re-*

coveries) or negatively (*credit-with recoveries*) with respect to these average values.

4.3.5 Description and measurement of sector characteristics

Before moving on to illustrate the results of our estimations, we use this section to present the $SectorCharacteristic$ variables that will prove useful for our specifications and we also describe their measurement within our dataset.

Financial dependence. As in part I of this chapter, the first sector characteristic that we take into consideration is the dependence on external finance, which allows a direct comparison with the RZ model. Then, we need to rank industries according to an index of external financial dependence, $ExtDep$, in order to identify which agents are more or less financially constrained. Several authors, as well as our analysis in part I, directly recur to the variable constructed by RZ, considering it suitable as a reliable indicator for their estimations. Here, on the contrary, we follow an independent methodology and make use of AMADEUS data at our disposal to recompute a new measure of external dependence. So doing, we obtain an indicator which covers a wider range of industries with respect to RZ, which circumscribe the analysis to manufacturing sectors, and referring to a more recent period. Indeed, the new measure is based on observations of European firms over the pre-crisis period 2003-2007. The choice of a sufficiently short period, which comes immediately before the crisis, serves to assure that production technology do not change within the period analyzed. In the short run, the degree of financial dependence by sector can be reasonably assumed to be constant over the years considered.

Despite the adoption of an autonomous methodology, the working assumption is still the same adopted in RZ and reported in part I. Only technological reasons justify the differences in external dependence of individual industries. RZ recur to U.S. firms since the choice of a finan-

cially developed country to act as benchmark should avoid the problem of identification between the demand for external funds and its supply. The higher the financial development in the reference country, the fewer are the restrictions on access to the supply of financing, which is exactly what we want to measure. Following a similar argument, we use countries in Northwestern Europe[26] to act as benchmark within our dataset. Excluding Southwestern Europe and Central-Eastern Europe should help to avoid the problems of identification aforementioned.[27] At the same time, the simultaneous inclusion of bank-based economies, such as France, and market-based economies, such as the United Kingdom, is useful to capture some different aspects of financial dependence.

One clear advantage of using the AMADEUS database is the wide coverage of countries and firms. One disadvantage is that fewer data items are available for each firm with respect to the COMPUSTAT dataset used by RZ. This precludes us from measuring our index of financial dependence as the share of capital expenditures that is not financed from cash flow from operations, as in its original version. Alternatively, we proxy financial dependence by means of balance sheet data, recurring to the *Debt to Total Capital* ratio. In line with other EU industry studies such as de Guevara and Maudos (2009) and Inklaar and Koetter (2008), we exclude accounts payable, i.e. trade debt, from both the numerator and the denominator of the ratio because they do not relate to borrowing from the financial sector. Accrual liabilities are also excluded from this definition of debt. Then, the numerator can be expressed as *Interest Bearing Debt*, obtainable in AMADEUS dataset by the sum of *Non Current Liabilities* and *Current Liabilities: Loans*. The denominator can be expressed as the sum of *Stockholders' Equity* and *Interest Bearing Debt*, obtainable as *Total Assets* net of *Current Liabilities: Creditors* and *Current Liabilities: Other Current Liabilities*. The higher the Debt to Total Capital ratio, the more the company is financing its operations with debt compared to internal funds. For each firm in Northwestern Europe with positive debt, we take

[26] See Appendix A for the list of countries belonging to each geographical subgroup.

[27] However, we have also verified that industry ranking remains broadly the same once we include all the countries of our dataset for computing the external dependence by sector.

the median ratio over the pre-crisis years 2003-2007. Then we regress the values so obtained for the individual *Sector* dummies and we interpret the relative coefficients as the degree of financial dependence of each industry.

Furstenberg and Kalckreuth (2006) raise the issue that young and small firms have different dependence on external finance. Thus, in order to better isolate the systematic between-industry component of the dependence on external finance, we also control for *Size Class*, *Age Class*, *Country* and *Quoted Company* dummies. Underlying these calculations are 664,559 firm observations. Firms are divided into four size classes (*Micro*, *Small*, *Medium*, *Large*) according to their turnover, total assets and the number of employees. The partition into age classes is obtained by dividing the sample in five quintiles by age. The variable *Quoted Company* takes the value of one if a company is listed on a Stock Exchange and zero otherwise.[28] Then, following this approach, we are able to identify those factors other than technological reasons that affect the amount of financing obtained by any single firm. OLS regressions confirm that coefficients on *Country* dummies are significantly different from each other, notwithstanding the regression is restricted to countries in Northwestern Europe. This can be due, in part, to a difference in financial restrictions existing within each country and, in part, to different criteria by country that the companies should satisfy to be included in the AMADEUS dataset. This may shape the distribution of firms with respect to characteristics that affect financing needs or the access to finance. In addition, the coefficients on dummy variables tend to be higher in the case of large firms, as these are less restricted in their access to external finance than others of smaller size. Larger companies are likely to have also accumulated a higher level of debt just to increase their size in earlier periods. According to our estimations the Debt to Total Capital ratio tends to be, *ceteris paribus*, nearly 8 percentage points higher in large companies than in micro firms. We also obtain that the coefficients are lower for quoted companies than for unlisted companies by about 7.5 percentage points and that they significantly decrease when we move from younger firms

[28] See Appendix A for additional information.

Table 23: Industry Ranking by External Financing needs ($ExtDep$)

Accommodation	0.139	Manuf. of Chemical Products	-0.029
Food and Beverage Service Activ.	0.127	Manuf. of Textiles	-0.030
Real Estate Activities	0.124	Repair of Computers and Other Goods	-0.031
Manuf. of Food Products	0.112	Manuf. of Machinery and Equipment	-0.037
Rental and Leasing Activities	0.083	Manuf. of Basic Metals	-0.038
Veterinary Activities	0.073	Wholesale Trade, excl. Motor Vehicles	-0.041
Manuf. of Beverages	0.067	Office Administrative, Office Support	-0.045
Trade and Repair of Motor Vehicles	0.054	Manuf. of Pharmaceutical Preparations	-0.050
Air Transport	0.053	Manuf. of Wearing Apparel	-0.050
Retail Trade, excl. Motor Vehicles	0.053	Manuf. of Tobacco Products	-0.051
Manuf. of Coke and Petroleum Pr.	0.045	Legal and Accounting Activities	-0.053
Land Transport and Via Pipelines	0.036	Manuf. of Electrical Equipment	-0.057
Manuf. of Wood; Products of Wood	0.032	Manuf. Of Electronic and Optical Pr.	-0.058
Water Transport	0.031	Specialised Construction Activities	-0.061
Printing and Recorded Media	0.015	Repair and Installation of Machinery	-0.062
Construction of Buildings	0.008	Motion Picture, Sound Recording	-0.069
Manuf. of Non-Metallic Mineral Pr.	0.006	Travel Agency and Related Activities	-0.075
Manuf. of Furniture	0.001	Other Professional & Scientific Activ.	-0.078
Manuf. of Paper and Paper Products	0.000	Telecommunications	-0.086
Civil Engineering	-0.001	Programming and Broadcasting Activ.	-0.087
Manuf. of Motor Vehicles	-0.008	Publishing Activities	-0.087
Manuf. of Other Transport Equip.	-0.008	Security and Investigation Activities	-0.096
Manuf. of Rubber and Plastic Prod.	-0.015	Architectural and Engineering Activ.	-0.104
Manuf. of Fabricated Metal Products	-0.020	Advertising and Market Research	-0.107
Warehousing & Support Activities	-0.021	Employment Activities	-0.109
Other Manufacturing	-0.022	Information Service Activities	-0.110
Services to Buildings and Landscape	-0.027	Scientific Research and Development	-0.113
Manuf. of Leather and Related Prod.	-0.027	Activity of Head Offices & Consult.	-0.118
Postal and Courier Activities	-0.029	Computer Programming & Consult.	-0.143

to older enterprises. The coefficient on the fifth quintile by firm age is 18.5 percentage points lower that the coefficient on the first quintile. These results are mainly attributable to credit demand. Indeed, both older firms and quoted companies rely less pressingly on bank lending, since the former may have accumulated a larger share of retained earnings over time and the latter may substitute more easily bank credit with equity.

Finally, table 23 shows the coefficients estimated for the *Sector* dummies after controlling for the additional variables aforementioned. In this way, we just obtained an industry ranking by dependence on external financing, that we indicate with the notation $ExtDep$. Coefficients are reported as differences with respect to their average values within the sample. The *Accommodation* sector presents the highest level of external dependence, followed by *Food and Beverage Service Activities* and *Real Estate Activities*, while at the opposite extreme we find information

and communication activities (such as *Computer Programming* and *Information Service Activities*) as well as professional, scientific and technical activities.

Liquidity needs. The RZ measure of external dependence is mainly aimed at capturing a firm's long-run requirements for external funds as a source of physical capital formation. This does not exhaust our research interest. In fact, we also want to emphasize the needs of an industry for liquid funds as the main determinant of its vulnerability to financial conditions in the short run. Similarly to Raddatz (2006), we need to rank industries according to an index of *Liquidity Needs*, in order to identify which agents are more intensely constrained by short-run external liquidity dependence. Liquidity needs, as much as financial dependence, are considered to be industry specific (depending, for example, on the length of the production process and the mode of operation) and invariant across countries. The ongoing amount of liquid funds that a firm invests to finance its operations corresponds to the economic concept of working capital. Firms in industries that require relatively large amounts of working capital will typically be more dependent on the availability of liquid funds. Again, balance sheet data from AMADEUS dataset do not provide exact information on this item. But a proxy for the relative importance of external liquid funds can be obtained by looking at the ratio of *Current Liabilities: Loans* to *Operating Revenues (Turnover)*, which captures the ability of a firm to pay its current liabilities with ongoing income. The higher the ratio, the larger is the need of external funds for liquidity purposes.

As in the measurement of external dependence, we take the median ratio for each firm in Northwestern Europe with positive numerator over the pre-crisis years 2003-2007. Then we regress data per firm so obtained with respect to the same dummies mentioned above. Underlying these calculations are 486,652 firm observations. Coefficients on the *Sector* dummies give us the desired industry ranking by liquidity needs, which we indicate with the notation $LiqNeeds$. Table 24 shows the coefficients rescaled as differences with respect to their average values within

Table 24: Industry Ranking by Liquidity needs ($LiqNeeds$)

Real Estate Activities	0.096	Retail Trade, excl. Motor Vehicles	-0.011
Accommodation	0.065	Manuf. of Rubber and Plastic Prod.	-0.012
Manuf. of Beverages	0.061	Manuf. of Wood; Products of Wood	-0.013
Water Transport	0.060	Land Transport and Via Pipelines	-0.014
Rental and Leasing Activities	0.060	Warehousing & Support Activities	-0.014
Construction of Buildings	0.031	Manuf. of Motor Vehicles	-0.014
Food and Beverage Service Activities	0.024	Manuf. of Machinery and Equipment	-0.016
Manuf. of Pharmaceutical Preparat.	0.017	Manuf. of Leather and Related Prod.	-0.017
Manuf. of Tobacco Products	0.016	Manuf. of Electrical Equipment	-0.017
Scientific Research and Development	0.016	Veterinary Activities	-0.018
Manuf. of Food Products	0.014	Printing and Recorded Media	-0.018
Air Transport	0.012	Information Service Activities	-0.018
Manuf. of Coke and Petroleum Pr.	0.011	Telecommunications	-0.018
Motion Picture, Sound Recording	0.009	Other Professional & Scientific Activ.	-0.019
Manuf. of Chemical Products	0.006	Manuf. of Fabricated Metal Products	-0.020
Programming and Broadcasting Activ.	0.000	Manuf. of Furniture	-0.022
Legal and Accounting Activities	-0.001	Services to Buildings and Landscape	-0.022
Civil Engineering	-0.001	Wholesale Trade, excl. Motor Vehicles	-0.022
Manuf. of Other Transport Equipment	-0.001	Trade and Repair of Motor Vehicles	-0.025
Manuf. of Paper and Paper Products	-0.005	Architectural and Engineering Activ.	-0.026
Manuf. Of Electronic and Optical Pr.	-0.005	Repair of Computers and Oth. Goods	-0.028
Publishing Activities	-0.006	Repair and Installation of Machinery	-0.031
Office Administrative, Office Support	-0.006	Travel Agency and Related Activities	-0.034
Manuf. of Textiles	-0.006	Computer Programming & Consult.	-0.037
Other Manufacturing	-0.007	Postal and Courier Activities	-0.037
Manuf. of Wearing Apparel	-0.007	Advertising and Market Research	-0.038
Activity of Head Offices & Consult.	-0.007	Specialised Construction Activities	-0.042
Manuf. of Non-Metallic Mineral Pr.	-0.010	Security and Investigation Activities	-0.045
Manuf. of Basic Metals	-0.011	Employment Activities	-0.051

the sample. As we could expect, *External Dependence* and *Liquidity Needs* are positively correlated, but there are industries whose position varies greatly within the two rankings. *Scientific Research and Development*, *Programming and Broadcasting Activities*, *Motion Picture and Sound Recording* are low ranked for their needs of external funds as a source of physical capital formation, but they are relatively high ranked when looking at liquidity needs. Conversely, *Trade and Repair of Motor Vehicles*, *Veterinary Activities*, *Postal and Courier Activities* are ranked high for their external dependence *à la* RZ, but not for their liquidity needs.

Production line position. Financial frictions during recession and recovery episodes may even affect industries for reasons unrelated to their direct dependence on external finance or their liquidity needs. Indeed, industries produce goods with different durability and goods that target

different final users. As both durable and investment goods are typically more pro-cyclical, we might be confusing the effects of these characteristics with that of dependence on external finance. In Braun and Larrain (2005), for instance, industries producing durable goods are more affected during recessions, just like industries more dependent on external funds. In order to consider the extent to which the availability of bank credit at the country level affects the demand for goods produced by individual firms, and not only their production capacity, we rank firms according to a couple of industry measures of relative *production line position*. The two indexes introduced, $GfcfUse_s$ and $IntermUse_s$, just measure the percentage of commodities in sector s that enters respectively into gross fixed capital formation and intermediate consumption uses. So doing, we differentiate among those industries producing mainly consumption goods or services and industries that, instead, concentrate their activity on the production of intermediate and investment goods. The two indexes have been built employing Input-Output tables contained in the OECD STAN database and submitted by Eurostat for the EU27 aggregate in the pre-recession year 2008.[29]

We calculate the two measures within the EU-27 aggregate, assuming that they represent relatively stable attributes of industries across different countries. At the top of $GfcfUse_s$ we have industries classified in the *Construction* section, as well as *Manufacture of Machinery and Equipment* and industries providing *IT and other information services*. Although this measure does not perfectly coincide with one of durability, the proximity between durable and investment goods industries should result quite high so that their relative classifications may partly overlap. At the top of $IntermUse_s$, instead, we have *Manufacture of Basic Metals* but also specific administrative and support service activities, such as *Employment Activities* and *Rental and Leasing Activities*, or other professional activities, such as *Advertising and Market Research*. Conversely, at the bottom of the two indexes we have typical industries directly providing consumption

[29]The *(i;j)*-th entry of this Use Table reports the value of inputs of commodity i used in the production of industry j in the European economy. An additional set of columns also records the value of commodity i that enters into final uses, namely consumption, investment, net changes in inventories, and net exports.

goods such as *Accomodation*, *Food Service Activities* and *Retail Trade*.

4.3.6 Regression results

In this section we present the results of the estimation of regressions presented in section 4.3.3 and 4.3.4. As a reminder, the dependent variable $Growth$ is the annual growth rate of *Operating Revenues (Turnover)* by firm computed in real terms over the period 2003-2011. All estimates in this section are obtained from winsorised data, by setting all data below the 1st percentile to the 1st percentile, and data above the 99th percentile to the 99th percentile. In all regressions, standard errors are clustered by firm. We start by estimating the regressions as defined in our baseline specification. Results are reported in the two columns of table 25. In column 1 we consider $ExtDep$ as the relevant $SectorCharacteristic$ variable influencing the supply channel of transmission, while in column 2 we consider the variable $LiqNeeds$. The specifications reported in both the two columns also comprehend $GfcfUse$ and $IntermUse$ as $SectorCharacteristic$ variables influencing the demand channel of transmission. All these measures are introduced as differences with respect to their average values within the sample.

The coefficient on $lnSize$, which accounts for convergence effects, is negative as expected. Ceteris paribus, turnover growth tends to be higher in smaller firms, which are likely to have higher development margins. Once we control for this variable and for firm fixed effects, we can then check how recession and recovery years resulting from the global financial crisis affect growth at the firm level. Relative to the pre-crisis period, recession years are associated with a fall of 13.5 percentage points in turnover growth by firm. By construction, this drop is referred to a representative and theoretical firm with average values of all the $SectorCharacteristic$ variables. However, the negative coefficients on the interactions $Recession\_X\_IntermUse$ and $Recession\_X\_GfcfUse$ indicate that the decline in growth is highly heterogeneous with respect to sectors, with a significantly larger fall in firms producing investment and intermediate goods rather than consumption goods. This is consis-

Table 25: Baseline OLS regressions

Dep: Growth	(1)	(2)
lnSize	-0.4950***	-0.4949***
	[-399.932]	[-400.003]
Recession	-0.1351***	-0.1352***
	[-221.564]	[-225.640]
Recession_X_LiqNeeds	0.0235	
	[1.273]	
Recession_X_ExtDep		0.0787***
		[6.307]
Recession_X_IntermUse	-0.1165***	-0.1009***
	[-47.748]	[-30.515]
Recession_X_GfcfUse	-0.1287***	-0.1160***
	[-37.953]	[-28.216]
Recovery	-0.0747***	-0.0749***
	[-108.966]	[-110.711]
Recovery_X_OutputLoss	0.3317***	0.3316***
	[254.696]	[254.764]
Recovery_X_LiqNeeds	0.1224***	
	[6.028]	
Recovery_X_ExtDep		0.0662***
		[4.714]
Recovery_X_IntermUse	-0.0103***	-0.0029
	[-3.701]	[-0.769]
Recovery_X_GfcfUse	-0.0354***	-0.0297***
	[-9.428]	[-6.488]
N	12,896,398	12,896,398
r2	0.14	0.14
F	40993.290	40552.156

Robust t-statistics are presented below the coefficients.
Significance (p-value): *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

tent with the different procyclicality characterizing each industry. We can estimate a differential effect for each $SectorCharacteristic$ variable during the recession years, i.e. the difference in turnover growth when moving from firms in low ranked sectors (15th percentile by sector) to firms in high ranked sectors (85th percentile by sector). The estimated effect corresponds to a decline by about 3 percentage points with respect to $GfcfUse$ and more than 5 points with respect to $IntermUse$. Thus, different production line positions have a meaningful redistributive effect among sectors during recession years.

Conversely, the dependence on external finance seems not to constitute a major obstacle to growth during recession years. Indeed, the coefficients on $Recession\_X\_ExtDep$ and $Recession\_X\_LiqNeeds$ are both positive. However, we will show in table 26 that this result is strongly

influenced by the fact that we are estimating our regressions in a single sample, without distinguishing between more developed countries and developing countries. In fact, it is reasonable to assume that financial frictions are much greater in emerging markets than in developed countries and, consequently, that firms suffered more in Central Eastern Europe (CEE) than in Western Europe (WE) during the financial crisis. Since in WE a larger share of firms belongs to sectors characterized by high values of $ExtDep$ and $LiqNeeds$,[30] this translates into a positive bias of the coefficients relating to these sector characteristics. Thus, positive coefficients could be actually due to the omission of a variable that takes into account the different performance of developed and emerging countries in crisis years.

Let's move on to recovery years. The coefficient on $Recovery$ is still significantly negative, indicating that growth at the firm level is still weaker than in pre-crisis years. However, the coefficient is less negative than the coefficient on $Recession$ as we should expect, since the recovery has a positive across-the-board level effect on firms' growth. Moreover, the positive and significant coefficient on $Recovery\_X\_OutputLoss$ proves the existence of a meaningful bounce-back effect. Companies that experienced a more pronounced fall in recession years tend to have a sharper rebound in recovery years, other factors being equal.

Even in recovery years, growth continues to be disproportionately lower for industries that produce intermediate and investment goods. But coefficients on the relative interaction terms are now lower in absolute value than those referring to recession years. The redistribution of growth between sectors therefore occurs especially in the recession phase. However, since the bounce-back effect is only partial (the coefficient is 0.33) and the coefficients on the interaction terms remain negative, we can say with certainty that early years of recovery have not compensated in any way for the greatest losses suffered in recession years by the companies that produce intermediate and investment goods.

[30] It should be noted that this is evidence is fully consistent with RZ findings, according to which sectors more dependent on external finance tend to grow relatively more (and then to have a higher weight) in countries with greater financial development.

Finally, the coefficients on the interaction terms relative to $ExtDep$ and $LiqNeeds$ remain positive also with regard to the recovery phase. However, even in this case, we prefer to postpone further comments to the description of results in table 26, where we split the sample in WE e CEE countries.

Table 26 just shows how the coefficients change across the two geographical sub-regions, thus allowing separate specifications for more advanced economies and developing countries within the European continent. As we can see, the $Recession$ dummy is associated with a much greater fall in CEE firms. This would eventually reflect the scarcity of alternative sources of funding or more pervasive agency problems in countries where financial frictions are more relevant. Again, the drop during recession years is highly heterogeneous with respect to sectors, with a significantly larger fall in firms producing investment and intermediate goods rather than consumption goods. Moreover, the across-industry difference in performance with respect to the production line position is even more pronounced in CEE than in WE. Indeed, if we recalculate the differential effects as for table 25, we obtain that during recession years in CEE countries the turnover growth declines by about 10 percentage points when moving from low ranked sectors to high ranked sectors with respect to $GfcfUse$ and by more than 13 percentage points with respect to $IntermUse$. In WE countries, these declines respectively reduce to about 3.5 and 4.5 percentage points.

However, the most important difference with respect to results in table 25 is that now the dependence on external finance actually seems to constitute an obstacle to output growth during recession years. The coefficient on $ExtDep$ interacted with the $Recession$ dummy is negative and significantly different from zero for WE firms, with an estimated differential effect equal to a decline of about 2 percentage points. Within the CEE subsample, the same coefficient is negative but not significant. Instead, the negative coefficient on $LiqNeeds$ interacted with the $Recession$ dummy is significantly different from zero in both CEE and WE, with estimated differential effects respectively equal to -1.1 and -1.4 percentage points. These estimates are still lower in absolute values than those ob-

Table 26: Baseline OLS regressions by Geographical Region

Dep: Growth	CEE		WE	
	(1)	(2)	(3)	(4)
lnSize	-0.5375***	-0.5374***	-0.3688***	-0.3689***
	[-327.745]	[-327.821]	[-218.433]	[-218.457]
Recession	-0.3050***	-0.3034***	-0.0707***	-0.0701***
	[-202.606]	[-211.316]	[-124.886]	[-125.397]
Recession_X_LiqNeeds	-0.2605***		-0.3110***	
	[-4.926]		[-18.111]	
Recession_X_ExtDep		-0.0539		-0.1383***
		[-1.812]		[-12.018]
Recession_X_IntermUse	-0.2529***	-0.2540***	-0.0859***	-0.0981***
	[-43.701]	[-32.833]	[-43.625]	[-35.226]
Recession_X_GfcfUse	-0.4107***	-0.4137***	-0.1400***	-0.1488***
	[-47.757]	[-41.882]	[-42.985]	[-37.185]
Recovery	-0.2214***	-0.2203***	-0.0259***	-0.0252***
	[-129.594]	[-134.140]	[-40.637]	[-39.779]
Recovery_X_OutputLoss	0.3976***	0.3977***	0.2919***	0.2921***
	[183.449]	[183.512]	[197.560]	[197.998]
Recovery_X_LiqNeeds	-0.2149***		-0.3008***	
	[-3.628]		[-16.406]	
Recovery_X_ExtDep		-0.0692*		-0.1840***
		[-2.017]		[-14.478]
Recovery_X_IntermUse	-0.0542***	-0.0598***	-0.0219***	-0.0449***
	[-7.987]	[-6.622]	[-9.711]	[-14.144]
Recovery_X_GfcfUse	-0.1024***	-0.1084***	-0.1203***	-0.1379***
	[-10.285]	[-9.485]	[-34.494]	[-32.004]
N	4,603,276	4,603,276	8,293,122	8,293,122
r2	0.17	0.17	0.10	0.10
F	24445.063	24389.601	17875.155	17075.617

Robust t-statistics are presented below the coefficients.
Significance (p-value): *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

served for $GfcfUse$ and $IntermUse$. Therefore, over recession years, the main redistributive effects are due to the type of goods sold, i.e. the demand channel of transmission, rather than to sector characteristics influencing the need for external financing, i.e. the supply channel of transmission. These results induce us to think that in the short run the financial crisis hit especially firms selling goods and services that typically require credit to be acquired rather than firms that need credit to buy those goods as factor inputs.[31]

As for the subsequent recovery years, the coefficient on $Recovery$ still indicates that growth at the firm level remains weaker than in pre-

[31]Moreover, it would be also useful to make a further distinction among inputs for investments and intermediate goods and inputs for consumption goods.

crisis years. This is especially evident in CEE, where at the same time, however, we can observe a more pronounced bounce-back effect, as revealed by the higher coefficient on $Recovery\_X\_OutputLoss$. Even recovery years as well as recession years continue to be relatively worse for industries that produce intermediate and investment goods rather than consumption goods, other factors being equal. But the lower coefficients on the relative interaction terms (in absolute values) confirm that the redistribution of growth between firms producing different goods mainly occur in the recession phase.

Interestingly, both the coefficients relating to $ExtDep$ and to $LiqNeeds$ remain fairly similar when interacted with $Recession$ and $Recovery$ dummies. This indicates that the redistributive effects between industries depending on external finance to different extents do not cease to exist in the early years of recovery, but rather remain largely unchanged following the recession phase.

We are now particularly interested in heterogeneous behavior during creditless and with-credit recoveries. Indeed, from the perspective of a financial dependent firm, the availability of funding during a creditless recovery may feel very much like that in a recession. To investigate this issue, we finally turn to the fully specified regression of section 4.3.4. Table 27 shows that the coefficient on $ClessRecv$ is significant in all the four specifications and negative as expected, reflecting weaker performance during recoveries that are more markedly creditless. Indeed, we remind that $ClessRecv$ is the $Recovery$ dummy multiplied by $CreditWeakness$. And $CreditWeakness$, in turn, represents the percentage drop in real Private Credit by country from trough year to 2011. The differential effect of $CreditWeakness$ during recovery years can be measured as the difference in turnover growth when moving from a representative country where the recovery is with-credit (15th percentile of $CreditWeakness$ by country, corresponding to Finland in WE and Czech Republic in CEE) to a representative country where the recovery is creditless (85th percentile, corresponding to Iceland in WE and Estonia in CEE). The estimated effect corresponds to a decline by more than 4 percentage points in CEE and nearly 7 percentage points in WE, which are highly meaningful ef-

Table 27: Fully specified OLS regressions by Geographical Region

Dep: Growth	CEE		WE	
	(1)	(2)	(3)	(4)
lnSize	-0.5381***	-0.5380***	-0.3708***	-0.3709***
	[-327.324]	[-327.388]	[-219.279]	[-219.324]
Recession	-0.3046***	-0.3030***	-0.0688***	-0.0682***
	[-202.373]	[-211.096]	[-121.115]	[-121.753]
Recession_X_LiqNeeds	-0.2563***		-0.2970***	
	[-4.849]		[-17.190]	
Recession_X_ExtDep		-0.0545		-0.1333***
		[-1.835]		[-11.592]
Recession_X_IntermUse	-0.2523***	-0.2538***	-0.0844***	-0.0963***
	[-43.615]	[-32.803]	[-42.953]	[-34.635]
Recession_X_GfcfUse	-0.4102***	-0.4135***	-0.1370***	-0.1457***
	[-47.709]	[-41.874]	[-42.052]	[-36.400]
Recovery	-0.2200***	-0.2199***	-0.0455***	-0.0447***
	[-128.837]	[-133.975]	[-65.322]	[-63.956]
Recovery_X_OutputLoss	0.3979***	0.3980***	0.2922***	0.2924***
	[183.369]	[183.431]	[197.563]	[197.946]
Recovery_X_LiqNeeds	-0.1711**		-0.2204***	
	[-2.892]		[-11.558]	
Recovery_X_ExtDep		-0.0645		-0.1478***
		[-1.886]		[-10.386]
Recovery_X_IntermUse	-0.0560***	-0.0601***	-0.0310***	-0.0511***
	[-8.160]	[-6.600]	[-11.521]	[-13.635]
Recovery_X_GfcfUse	-0.1029***	-0.1086***	-0.1474***	-0.1631***
	[-10.331]	[-9.498]	[-36.564]	[-32.885]
ClessRecv	-0.1689***	-0.1554***	-0.3960***	-0.3963***
	[-11.139]	[-10.401]	[-65.624]	[-64.191]
ClessRecv_X_LiqNeeds	-2.6559***		1.0723***	
	[-5.529]		[6.652]	
ClessRecv_X_ExtDep		0.3446		0.6168***
		[1.209]		[4.906]
ClessRecv_X_IntermUse	-0.7605***	-0.5500***	-0.2895***	-0.2237***
	[-11.589]	[-6.729]	[-10.969]	[-6.272]
ClessRecv_X_GfcfUse	-0.3445***	-0.2237*	-0.5081***	-0.4552***
	[-3.765]	[-2.189]	[-13.023]	[-9.707]
N	4,603,276	4,603,276	8,293,122	8,293,122
r2	0.17	0.17	0.10	0.10
F	17553.05	17511.81	12807.02	12234.26

Robust t-statistics are presented below the coefficients.
Significance (p-value): *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

fects from an economic standpoint. The lower differential effect in CEE countries is in part attributable to the fact that the global financial crisis and the associated financial frictions already have, in themselves, a much more negative impact in CEE firms regardless of the evolution of bank credit, as revealed by the coefficients on $Recession$ and $Recovery$ dummies. In WE countries, on the other hand, bank credit growth provides an additional signal to distinguish those economies where the financial shocks may have had a major impact.

At the firm level, the gap in performance between creditless and with-credit recoveries also depends on sectoral effects. The significant and negative coefficients on $ClessRecv\_X\_GfcfUse$ and $ClessRecv\_X\_IntermUse$ (i.e. the interactions of $GfcfUse$ and $IntermUse$ with the $ClessRecv$ term) indicate that during creditless recoveries firms that sell investment and intermediate goods performed relatively worse. So not only they suffered generally more than other firms during the financial crisis, but the gap accumulated is also proportionately greater in creditless countries. The interpretation of the interactions between $ClessRecv$ and $SectorCharacteristic$ variables is akin to a difference-in-differences specification. This diff-in-diffs effect measures how much an industry at the 85th percentile level of the $SectorCharacteristic$ variable grows with respect to an industry at the 15th percentile level when we have a recovery episode at the 85th percentile of $CreditWeakness$ rather than one at the 15th percentile. According to our estimations, the diff-in-diffs impact of going from a CEE country experiencing a credit-with recovery to another CEE country experiencing a creditless recovery translates into a growth decline by about 9 percentage points in sectors with higher $IntermUse$ and by about 2 percentage points in sectors with higher $GfcfUse$. For WE countries, these declines become respectively equal to 2.3 and 2 percentage points. Again, these numbers appear economically meaningful. Since the demand for investment and for intermediate goods is hit harder when financing frictions are more prevalent, then the differential impact is proportionally stronger during creditless recoveries.

When moving to consider the sectoral dependence on external financ-

ing, the coefficient on $ClessRecv\_X\_ExtDep$ is positive, although significantly different from zero in the WE sub-region only. Here the diff-in-diffs impact results to be equal to 1.5 percentage points. This result indicates that redistributive effects across industries within creditless countries did not materialize at the expense of sectors that are more reliant on external funds to finance their physical capital. These sectors, as reported above, suffered more during both recession and recovery years as a consequence of the global financial crisis, and it is not the negative change in bank credit to constitute an additional and immediate obstacle for their short-run growth. Instead, the negative evolution of bank credit mainly hit sectors producing investment and intermediate goods. These considerations do not lead to reject the hypothesis that creditless recoveries following the recent financial crisis are the result of impaired financial intermediation. Rather, they highlight that, in the short term, frictions in the credit market affect the economy mainly on the demand side rather than on the supply side.

Finally, the coefficient on $ClessRecv\_X\_LiqNeeds$ is also strongly significant, but the sign is reversed when moving from WE countries to CEE countries. In WE the sign is positive but the diff-in-diffs impact is not particularly meaningful (+0.8 percentage points) from an economical point of view. Conversely, in CEE the sign is negative and the diff-in-diffs impact (-3 percentage points) is quite relevant. In CEE countries, where financial frictions are more prevalent, industries more dependent on external finance for their working capital (i.e. those with higher liquidity needs) perform relatively worse when the recovery is not accompanied by credit growth. This redistributive effect is additional to that already captured by the negative coefficient on $Recovery\_X\_LiqNeeds$, which acts regardless of bank credit growth.

4.3.7 Additional results by trade credit dependency

Finally, table 28 shows how the differential impact of recessions, recoveries and creditless recoveries varies with the firms' reliance on trade credit before the global financial crisis. We define *Trade Credit Dependency*

Table 28: Fully Specified OLS regressions by use of trade credit (CEE)

Dep: Growth	Low TCD	High TCD
	(1)	(2)
lnSize	-0.4955***	-0.5580***
	[-221.635]	[-211.361]
Recession	-0.2401***	-0.3086***
	[-118.147]	[-147.052]
Recession_X_LiqNeeds	-0.7948***	0.3056***
	[-11.638]	[3.823]
Recession_X_IntermUse	-0.2813***	-0.1519***
	[-39.384]	[-17.399]
Recession_X_GfcfUse	-0.3996***	-0.3461***
	[-33.312]	[-29.106]
Recovery	-0.1755***	-0.1679***
	[-74.674]	[-65.843]
Recovery_X_OutputLoss	0.2112***	0.2445***
	[59.920]	[52.320]
Recovery_X_LiqNeeds	-0.5165***	-0.1328
	[-6.797]	[-1.458]
Recovery_X_IntermUse	-0.1302***	0.0612***
	[-14.964]	[5.755]
Recovery_X_GfcfUse	-0.1259***	-0.0272
	[-8.888]	[-1.942]
ClessRecv	-0.3727***	-0.1142***
	[-12.624]	[-6.085]
ClessRecv_X_LiqNeeds	-1.7640*	-2.7817***
	[-2.256]	[-4.205]
ClessRecv_X_IntermUse	-0.7092***	-0.8501***
	[-5.653]	[-10.769]
ClessRecv_X_GfcfUse	-0.2116	-0.4255***
	[-1.144]	[-3.897]
N	2,067,908	1,963,879
r2	0.15	0.16
F	7234.954	7288.4

Robust t-statistics are presented below the coefficients.
Significance (p-value): *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

(TCD) by firm as the ratio of trade credit to short term debt. This can be obtained in AMADEUS dataset as the ratio between *Current Liabilities: Creditors* and *Current Liabilities*. For each firm, we take the median ratio over the pre-crisis years 2003-2007. On the one hand, when a predominant share of short term external finance is in the form of trade credit, firms are relatively less exposed to shocks in bank credit supply. On the other hand, trade credit dependency may be the chain for a more rapid transmission of financial shocks. In addition, it is still possible that firms resulting more reliant on trade credit are just those more constrained by

financial institutions even before the crisis.[32] If this is the case, firms with high TCD may have less room to further substitute trade credit for bank loans.

Instead of including dummies as control variables, we split the sample in two according to whether the observations correspond to firms with TCD above (High TCD) or below (Low TCD) the median within the CEE subsample. We concentrate here on CEE countries because the reliance on trade credit is supposed to have a larger impact in economies characterized by more relevant financial frictions and lower substitutability between the different forms of finance. Table 28 shows that firms more dependent on trade credit are hit relatively harder in recession years, as the coefficient on the *Recession* dummy is more markedly negative for high TCD companies (column 2). This seems to confirm the possibility that financial shocks are transmitted more quickly through the relative use of trade credit. At the same time, however, the coefficient on $Recession\_X\_LiqNeeds$ is significantly negative only for firms with low TCD (column 1). This indicates that trade credit can be actually a valid source of financing to support business activities in sectors characterized by higher liquidity needs, especially when financial shocks restrict access to other forms of financing. In practice, during the recession years, the higher TCD has been a major obstacle only for companies that have not high liquidity needs for technological reasons. On the contrary, in industries with high liquidity needs the higher reliance on trade credit has mitigated the fall. Liquidity needs produce a strong differential behavior between low TCD firms even during the subsequent recovery years, as the coefficient on $Recovery\_X\_LiqNeeds$ is still strongly negative in column (1), differently from what can be observed for high TCD firms.

Finally, table 28 shows that the coefficient on $ClessRecv$ is more markedly negative for low TCD firms. The differential effect for $CreditWeakness$ during recovery years corresponds to an average decline by nearly 10 percentage points in low TCD firms while only 3 percentage points in low TCD firms. When considering the credit weakness

[32] To examine these issues further, see also Raddatz (2010), Petersen and Rajan (1994, 1997), Zakrajsek (1997), Fisman and Love (2003).

of the recovery, redistributive effects across sectors, i.e. the coefficients on the interaction terms, are more pronounced for high TCD firms, just because in low TCD firms the worse performance is generalized, regardless of the liquidity needs of the industry. To sum up, in countries where the recovery is more visibly creditless, firms that are less reliant on trade credit recover more slowly since they are more exposed to shocks in bank credit supply. This is valid regardless of the industry they belong to. On the contrary, firms that are more reliant on trade credit are better prepared to cope with the fall of bank credit, so that only industries with higher liquidity needs suffer to a greater extent the weakness of bank lending.

4.3.8 Concluding remarks

As revealed in chapter 2, the recovery from the global financial crisis has been creditless in a number of economies, and thus slower than average. In part II of this chapter (section 4.3) we have just shown that these creditless recoveries are not simply determined by a decrease in the demand for bank credit. Our estimations, indeed, show that in countries with higher credit weakness output growth remain feeble especially in those firms that are more vulnerable to bank finance. This suggests that creditless recoveries are also induced by disruptions on the supply side of the bank credit market. For example, banks facing a negative capital shock may have chosen to reduce credit supply to meet capital requirements. The finding that creditless recoveries are associated with impaired financial intermediation has important consequences from a policy standpoint. In fact, measures designed at addressing the undercapitalization of banks and restoring credit supply should help firms that are more reliant on bank finance to recover faster.

Furthermore, we have analyzed two channels of transmission through which credit weakness my affect output fluctuations in the short term. On the one hand, an impaired credit market may lower the demand of goods that are typically purchased with the help of external financing, such as investment or intermediate goods. This damages com-

panies that sell their output for gross fixed capital formation or intermediate consumption uses (*demand channel* of transmission). On the other hand, the impaired credit market may also affect those companies that are more dependent on credit to finance investments in fixed capital or their current spending on productive inputs. When credit fails to recover, the productive capacity of these firms is eroded to a greater extent (*supply channel* of transmission). However, our estimates reveal that the supply channel is much less relevant, especially when considering the dependence on external financing *à la* Rajan-Zingales rather than short-term liquidity needs. Indeed, in the short run, the fall in investments mainly affects firms producing investment goods rather than those postponing the expansion of their fixed capital.

Finally, we explore the behavior of firms that are relatively more dependent on trade credit as opposed to bank credit during the last crisis. We concentrate on CEE countries because the reliance on trade credit is supposed to have a larger impact in economies characterized by more relevant financial frictions and lower substitutability between the different forms of finance. We obtain that, on average, CEE firms more dependent on trade credit have been hit relatively harder during recession years of the global financial crisis. Indeed, trade credit dependency may be the chain for a more rapid transmission of financial shocks. However, we also find that in countries where the reprise is more visibly creditless, firms that are more reliant on trade credit recover more quickly since they are less exposed to shocks in bank credit supply. In addition, a higher reliance on trade credit also results to have mitigated the fall in industries with high liquidity needs. When financial shocks restrict access to other forms of financing, trade credit results to be a valid alternative resource to support business activities in industries that require relatively large amounts of working capital.

Appendix A

AMADEUS firm-level data

A.1 Introduction

The corner-stone of this paper's empirical framework is a comprehensive cross-country firm-level panel dataset, called AMADEUS. This is a commercial dataset collected via national sources by Bureau van Dijk (BvD), an electronic publishing firm providing company information and business intelligence. It provides a collection of accounts from companies balance sheets and income statements across 41 countries in both Western and Eastern Europe.[1] Both consolidated and unconsolidated annual accounts are available in AMADEUS, and these are pretty much comparable across countries. As such, it is a longitudinal database providing rich variation across countries, years, industries and firm size. The database also provides qualitative information as number of employees, if the firm belongs to a group, and if it is listed on a stock market. See table 29 and table 30 for a detailed list of financial variables available in AMADEUS.

Sample selection and data cleansing. The original BvDEP AMADEUS software does not allow for directly managing and analyzing very large

[1] Amadeus actually contains information for 44 countries, but there are no available balance sheets and income statements for Albania, Belarus and Kosovo.

Table 29: Balance Sheet variables available in AMADEUS Database

Fixed Assets	Intangible assets + Tangible assets + Other fixed assets
Intangible Fixed Assets	Formation expenses, research expenses, goodwill, development expenses, etc.
Tangible Fixed Assets	Buildings, machinery, etc.
Other Fixed Assets	All other fixed assets (incl. Financial Fixed Assets) such as long term investments, shares and participations, etc.
Current Assets	Stocks + Debtors + Other current assets
Stocks	Total inventories (raw materials + in progress + finished goods)
Debtors	Trade receivables (from clients and customers only)
Other Current Assets	All other current assets such as receivables from other sources (taxes, group companies), short term investment of money and Cash at bank and in hand
Cash	Detail of the Other current assets (including Cash Equivalent)
Total Assets	Fixed assets + Current assets
Shareholders' Funds	Total equity (Capital + Other shareholders' funds)
Capital	Issued Share capital (Authorized capital)
Other Shareholders' Funds	All Shareholders' funds not linked with the Issued capital such as Reserve capital, Undistributed profit, include also Minority interests
Non-Current Liabilities	Long Term Debt + Other non Current Liabilities
Long Term Debt	Long term financial debts: e.g. to credit institutions (loans and credits) and bonds
Other non Current	Other long term liabilities (trade debts, group companies, pension loans, etc.) + provisions + deferred taxes
Liabilities	Other long term liabilities (trade debts, group companies, pension loans, etc.) + provisions + deferred taxes
Provisions	Provisions (social security, taxes, etc.)
Current Liabilities	Loans + Creditors + Other current liabilities
Loans	Short term financial debts (e.g. to credit institutions + part of Long term financial debts payable within the year, bonds, etc.)
Creditors	Debts to suppliers and contractors (trade creditors)
Other Current Liabilities	Pension, personnel costs, taxes, intragroup debts, accounts received in advance, etc
Tot.Shareh.Funds & Liab.	Shareholders' funds + Non current liabilities + Current liabilities
Number of Employees	Total number of employees included in the company's payroll

Source: AMADEUS

Table 30: P&L Account variables available in AMADEUS Database

Operating Revenue / Turnover	Net sales + Other operating revenues + Stock variations. The figures do not include VAT. Local differences may occur regarding excises taxes and similar obligatory payments for specific market of tobacco and alcoholic beverage industries
Sales	Net sales
Cost of Goods Sold	Cost of sold goods, production, services. Costs directly related to the production of the goods sold + depreciation of those costs
Gross Profit	Operating revenue - Cost of goods sold
Other Operating Expenses	All costs not directly related to the production of goods sold such as commercial costs, administrative expenses, etc. + depreciation of those costs
Operating Profit (Loss)	EBIT. All operating revenues - all operating expenses (Gross profit-Other operating expenses)
Financial Revenue	All financial revenues such as interest, incomes from shares, etc.
Financial Expenses	All financial expenses such as interest charges, write-off financial assets
Financial Profit / Loss	Result from financial activities of the company (Financial revenue - Financial expenses)
Profit (Loss) bef. Taxation	Operating profit (EBIT) + financial profit
Taxation	All taxes related to the accounting period (paid, accrued or deferred)
Profit (Loss) after Taxation	Profit before taxation - Taxation
Extr. and oth. Revenue	All extraordinary revenues and other revenues belonging to the 'ordinary' activities of the company
Extr. and oth. Expenses	All extraordinary expenses and other expenses not belonging to the 'ordinary' activities of the company
Extr. and oth. Profit (Loss)	All extraordinary and other result not belonging to the 'ordinary' activities of the company
Profit (Loss) for Period	Net income for the Year. Before deduction of Minority interests if any (Profit after taxation + Extraordinary and other profit)
Material Costs	Detail of the purchases of goods (raw materials + finished goods). No services
Cost of Employees	Detail of all the employees costs of the company (including pension costs)
Depreciation	Total amount of depreciation and amortization of the assets
Interest Paid	Total amount of interest charges paid for shares or loans

Source: AMADEUS

amounts of data. So we initially have to download all the data that we could potentially work on and then, in a second step, we proceed to an appropriate cleaning procedure. In our paper we refer to an edition updated as of March 2013 and complemented with previous vintages of AMADEUS, in order to increase the time-horizon of the dataset and to include more firm-years observations.[2]

Since we are generally interested in changes over time of the relevant variables, we must have at least two consecutive years of data for a firm to remain in our sample. Therefore, observations are downloaded for firms whose accounts are available for at least two consecutive years over the period 2003-2011. This period is sufficiently large to include a whole business cycle and the up and down of interest rates.

We also require reporting firms to have some basic accounting information in their accounts. At least one period with non-missing information on employment (or alternatively turnover), operating profits and total assets is required for the initial download, as well as information on the industry code and the country of origin. The reason for dropping those that do not report this minimal information is that there could be country differences in the criteria for including firms with no information on their accounts. In addition, this criterion excludes any phantom firms established for tax or other purposes. Moreover, we must be sure that the database doesn't contain at the same time consolidated accounts of a group and unconsolidated accounts of affiliates and subsidiaries belonging to the same group. To avoid double-counting, we exclude all the unconsolidated accounts of firms where the company headquarter also presents a consolidated account. Indeed, whenever available, the consolidated accounts are most suitable for providing information about the financial situation of a company with subsidiaries.

We then impose a number of restrictions on the data, taking care of the sample selection. Following the definitions of the Eurostat's Structural Business Statistics (SBS), we limit our analysis to industries in the *non-financial business economy*, including industry, construction and

[2]This trick is necessary since outer years are gradually removed from the available dataset.

a well-defined group of services. In particular, we have to exclude financial and insurance activities (NACE Rev. 2 Section K) because of the specific nature of their financial ratios, as well as agriculture, forestry and fishing (Section A), public sector (Section O) and basically non-market services, such as education, health, social work, activities of households, membership organizations and extra-territorial organizations (Sections P-U, excl. Divisions 95). Following Klapper et al (2006), we also exclude: a) mining (Section B), where activities are mostly country-specific; b) utilities (Sections D-E), where industries are generally highly regulated or state-owned.

To sum up, our dataset will refer to 58 two-digit industry divisions covered by NACE Rev. 2, Sections C, F to J, L to N plus Division 95. In addition, since the cross country dimension of our analysis necessitates harmonization, we remove all firms with legal forms other than the equivalent of Public and Private Limited Liability Companies, i.e. all other forms such as sole proprietorships (where there is only one shareholder) and partnerships (where at least one partner is liable for the firm's debts). In fact, coverage in AMADEUS for these kind of firms is poor and uneven and their inclusion would make our analysis harder to interpret. As shown in table 31, we start with a downloaded raw sample of 6,076,469 firms located in 41 countries over the period 2003-2011.

In a second step, we clean the raw sample by applying a variety of predetermined rules. BvDEP already implements by itself several procedures to authenticate the quality of data contained in the database.[3] Anyway, since the quality controls by BvDEP are typically only executed on peers of companies, we carry out additional consistency checks and cleaning of the data.[4] The database contains apparent mistakes, probably due to erroneous reproduction from other databases or for other reasons. First of all, we remove all observations with negative or non-positive values for variables where such information clearly represents

[3]These procedures include among the others: indexation search strategies to guarantee the uniqueness of individual records; data analyses on groups of company at an aggregate level; checks on the concordance between national classifications and international standards.

[4]Similar approaches can be found in Kremp and Stöß (2001) and Gal et al (2013).

Table 31: Available number of observations in the AMADEUS database

Non-farm, non-financial business sector, 2003-2011

Country	Firms in Raw Sample	Firms in Final Sample	TOTAL ASSETS				
			Observations by class size (%)				Available obs.
			Micro	Small	Med.	Large	
Austria	8,656	4,816	30.9	23.5	34.8	10.8	28,530
Belgium	201,325	188,873	85.2	12.0	2.2	0.6	1,341,888
Bosnia	14,897	12,345	56.6	33.8	8.2	1.4	76,617
Bulgaria	77,825	49,410	52.6	34.3	11.0	2.1	230,302
Croatia	91,392	87,007	84.4	12.4	2.6	0.6	542,172
Cyprus	658	622	39.1	38.2	18.7	4.0	1,736
Czech Rep.	128,397	114,136	70.0	20.9	7.3	1.8	564,909
Denmark	84,739	69,198	76.6	18.2	4.2	1.0	335,035
Estonia	65,295	60,188	87.6	10.1	2.0	0.2	375,591
Finland	130,448	112,504	82.9	13.5	2.7	0.9	642,670
France	677,894	648,807	87.0	11.8	1.0	0.3	4,093,617
Germany	129,024	99,525	41.7	29.7	21.8	6.8	626,103
Greece	21,844	21,241	40.9	47.3	9.7	2.1	156,591
Hungary	183,979	163,017	82.3	13.9	3.1	0.7	826,062
Iceland	17,252	14,002	93.6	5.0	1.1	0.4	93,070
Ireland	9,835	6,533	54.7	27.7	14.9	2.8	45,342
Italy	849,749	792,347	77.6	18.7	3.1	0.6	4,587,346
Latvia	19,520	16,843	52.4	33.4	12.3	2.0	65,405
Liechtenstein	4	.	.	.	.	.	.
Lithuania	14,395	11,555	30.0	44.1	21.7	4.2	47,037
Luxembourg	6,284	4,357	62.1	21.7	12.0	4.3	17,915
Macedonia	1,409	735	46.8	35.8	13.8	3.6	1,893
Malta	1,563	1,333	80.9	9.6	7.0	2.5	7,652
Moldova	817	784	61.7	18.3	14.7	5.3	4,980
Monaco	1	.	.	.	.	.	.
Montenegro	280	273	11.2	35.6	37.0	16.2	883
Netherlands	27,546	18,683	35.9	25.5	29.7	8.8	120,013
Norway	193,719	182,275	84.6	12.5	2.3	0.6	1,195,897
Poland	69,952	59,086	26.7	45.6	21.9	5.9	292,673
Portugal	256,761	241,022	81.7	15.3	2.6	0.4	1,451,458
Romania	438,722	424,950	87.3	10.2	2.1	0.4	2,670,131
Russian Fed.	712,899	629,631	34.1	50.3	12.4	3.2	2,711,974
Serbia	67,974	66,649	79.6	14.9	4.5	1.1	421,935
Slovakia	42,200	34,793	66.3	22.9	8.7	2.1	110,621
Slovenia	41,924	35,257	74.9	17.7	5.9	1.5	119,380
Spain	841,594	765,392	78.0	18.9	2.6	0.5	4,687,345
Sweden	11,426	10,367	13.5	37.0	37.4	12.1	78,952
Switzerland	318	281	10.1	30.6	32.1	27.3	1,987
Turkey	3,862	3,642	20.5	41.9	25.0	12.6	12,736
Ukraine	232,331	197,708	67.8	24.3	6.5	1.5	1,263,616
Un.Kingdom	397,759	285,537	75.5	11.9	9.3	3.3	2,032,209
Total	6,076,469	5,435,724	74.4	19.4	4.9	1.3	31,884,273

Source: AMADEUS and own calculations

errors in the reporting activity. In this preliminary sample we also eliminate observations that violate basic accounting norms, comparing the accounting AMADEUS variables to values computed using accounting identities. Since small differences can be due to approximations, we only remove observations whenever the AMADEUS value and the computed value differ by more than 2 percent. The processes that lead to this preliminary database affect a relatively small number of observations, but they're strictly necessary to remove possible data errors and firms that will be not appropriate for our study.

We then apply outlier filtering based on some relevant financial ratios, such as: (a) Balance Sheet variables divided by Operating Revenues or by Number of Employees; (b) Profit & Loss Account variables divided by Total Assets or by Capital. Based on these ratios, we filter out observations outside the interquintile range, minus or plus five times the interquintile range itself.[5] We apply this procedure separately in each cell characterized by the same two-digit NACE industry, country, year and size class.[6] A similar procedure is also applied with respect to the annual growth of the ratios themselves, in order to identify suspicious outliers with implausibly large longitudinal changes. This approach should pos-

[5]The so called Tukey test is designed on the basis of first and third quartiles ($Q_{0.25}$ and $Q_{0.75}$) and inter-quartile range ($IQR = Q_{0.75} - Q_{0.25}$). An observation is labeled as an outlier when it falls outside the interval $[Q_{0.25} - k \cdot IQR \ ; \ Q_{0.75} + k \cdot IQR]$, where we set $k = 5$. In order to account for the skewness of the distribution, we apply a modified form of this approach, where k is corrected for a simple measure of asymmetry, represented by the Octile Skewness (OS):

$$OS = \frac{Q_{0.875} + Q_{0.125} - 2 \cdot Q_{0.50}}{Q_{0.875} - Q_{0.125}} \tag{A.1}$$

The OS value lies between -1 and +1, with a 0 value indicating symmetric data. Although better measures of skewness exist (like the *Medcouple*, introduced by Brys et al (2004)), they are too computationally expensive for our dataset. The modified interval of critical values is given by the following formula:

$$[Q_{0.25} - k \cdot e^{-4 \cdot OS} \cdot IQR \ ; \ Q_{0.75} + k \cdot e^{3 \cdot OS} \cdot IQR] \quad \text{if} \quad OS \geq 0 \tag{A.2}$$

$$[Q_{0.25} - k \cdot e^{-3 \cdot OS} \cdot IQR \ ; \ Q_{0.75} + k \cdot e^{4 \cdot OS} \cdot IQR] \quad \text{if} \quad OS < 0 \tag{A.3}$$

[6]A detailed definition of size classes is at the end of this Appendix. In this context, we bring Medium-sized and Large enterprises together in a single cell, because of their low numerousness.

sibly eliminate the majority of firms participating in merger or acquisitions. After applying the exclusion criteria described above, we have a smaller, comprehensive sample of firms, which enhances comparability across a large number of European countries.

Finally, after dropping observations which do not pass our filters, for each variable we also exclude firm-year observations when they are isolated, i.e. when information is not available in previous or following years. Liechtenstein and Monaco are also excluded from the final sample, since the number of observations is particularly low. As we can see from table 31, providing information on the number of firms and observations for each country before and after data cleaning, the sample size of our preliminary database is reduced by 10 percent to 5,435,724 firms. The reduction is particularly high for some countries, with deletions above 30 percent for Austria, Bulgaria, Ireland, Luxembourg, Macedonia, Netherlands. For Total Assets we are left with non-missing data for 31,884,273 firm-year observations, i.e. on average 5.9 years of available data for each firm. However, the total number of firm-year observations changes significantly across variables.

It is important to point out that there are substantial cross-country differences in the collection of company accounts in AMADEUS. In some countries, for example, small firms are not obliged to file data. Heterogeneous coverage across countries and class sizes is obviously a key issue and it will be reflected in the way the results are interpreted. Therefore, we have to be cautious about conclusions derived from cross-country comparisons. On the contrary, within-country differences are not affected by this issue, unless there are systematic biases in reporting firms within a country. When introducing our empirical analysis on the AMADEUS dataset, we have to take in account that results across the pooled sample are a good starting point for descriptive statistics, but they can partly reflect the specific characteristics of firms across the different subsets. Referring to macroregions, rather than individual countries, should help to reduce the problems of heterogeneous coverage.

Since the use of a of a limited number of groups makes it easier to highlight the main messages of the descriptive analysis, we take into con-

sideration the following clusters:

(a) European Macroregions (6 clusters):

   i. *Northern Europe*: United Kingdom, Ireland, Iceland, Sweden, Norway, Denmark, Finland;

   ii. *Western Europe*: France, Belgium, Netherland, Luxembourg, Germany, Austria, Switzerland;

   iii. *South-Western Europe*: Portugal, Spain, Italy;

   iv. *Central Europe and Baltics*: Poland, Czech Republic, Slovakia, Hungary, Slovenia, Estonia, Latvia, Lithuania;

   v. *South-Eastern Europe*: Croatia, Bosnia, Serbia, Montenegro, Macedonia, Greece, Romania, Bulgaria, Cyprus, Malta, Turkey;

   vi. *Other former Soviet States*: Russia, Ukraine, Moldova.

(b) Two-Digit NACE Industries (8 broad areas of activity):

   i. *Manufacturing*: Section C;

   ii. *Construction*: Section F;

   iii. *Wholesale trade*: Division 46;

   iv. *Retail trade*: Divisions 45, 47 and 95;

   v. *Transport and communication*: Section H and J;

   vi. *Accommodation and food services*: Section I;

   vii. *Real estate*: Section L;

   viii. *Business services*: Section M and N.

(c) Size Classes (4 classes defined in terms of the average number of employees or, alternatively, turnover):

   i. *Micro Enterprises*: fewer than 10 employees or turnover lower than EUR 2 billion;

   ii. *Small Enterprises*: 10 to 49 employees or turnover between EUR 2 billion and EUR 10 billion;

iii. *Medium-sized Enterprises*: 50 to 249 employees or turnover between EUR 10 billion and EUR 50 billion;

iv. *Large Enterprises*: more than 250 employees or turnover higher than EUR 50 billion.

(d) Age Classes (5 classes based on quintiles by age in 2011):

i. *Newly Born Enterprises*: up to 3 years old;

ii. *Young Enterprises*: 4 up to 6 years old;

iii. *Mid-Age Enterprises*: 7 up to 10 years old;

iv. *Mature Enterprises*: 11 up to 15 years old;

v. *Established Enterprises*: 16 years and older.

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