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ABSTRACT

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JEL Classification: F30, G01 and O40
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How do credit conditions shape economic recoveries?

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Abstract

This paper investigates the role of credit in shaping economic recoveries and tries to shed some light on the phenomenon of creditless recoveries using industry-level data for a large sample of countries. We find that while a failure of the credit stock to recover to its pre-crisis level does not hamper growth, a failure of credit flows to recover slows down economic recovery. Next, we find that industries that are more dependent on external finance recover more quickly in countries with better financial development during creditless recoveries as defined by Calvo et al. (2006a). This indicates that certain mechanisms enable the economy to grow despite the creditless character of recovery. These mechanisms may include the availability of alternative sources of financing such as trade credit, the re-allocation to less credit dependent sectors, or the take-up of unutilized capacity. Finally, we find evidence that industries that are more dependent on trade credit as opposed to bank credit recover more quickly because they are less vulnerable to prolonged credit market disruptions. This "substitution effect" is stronger during creditless recoveries, giving support to the view that creditless recoveries are a response to protracted disruptions in official credit markets.

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1. Introduction

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 "creditless recoveries". In their seminal contributions, Calvo et al. (2006a, 2006b) 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 [see e.g. Claessens et al. (2008)]. 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 and episodes of systemic crises in emerging markets, which are typically characterized by creditless recoveries.

Several explanations of this phenomenon have been proposed in the literature. Calvo et al. (2006a, 2006b) 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. If this is the case, output can increase because of productivity gains without an accompanying credit expansion.

Finally, there is a more radical view that claims that creditless recoveries à la Calvo et al. 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 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, 2006b), but rather offers a different, possibly complementary, approach to studying 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 present paper is complementary to Coricelli and Roland (2010), who analyse 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 asymmetry in the role of financial markets during different phases of economic activity. While Coricelli and Roland (2010) focus on episodes of contraction, this paper focuses on recoveries, and in particular on creditless recoveries. As in our previous work, we focus on industry-level data. This allows us to use the methodology developed by Rajan and Zingales (1998) 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 most closely related paper is a recent contribution by Abiad et al. (2011).[1] Using aggregate and sectoral data, the authors find that average growth during creditless recoveries, defined in the Biggs sense 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, our paper differs from Abiad et al. (2011) in several dimensions. First and foremost, our point of view on creditless recoveries is different. In line with Calvo et al. (2006a) view, 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. focus on recoveries from episodes of negative output gaps.

For these reasons, we distinguish two types of creditless recoveries, the Calvo-type and the Biggs-type, and indeed we find evidence of sharply different output behaviour in the two types of recoveries, in accordance with the predictions of the Calvo et al. and Biggs et al. works. Moreover, 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 credit conditions. Our empirical specifications reflect this conceptual difference.[2]

[1] Kannan (2010) as well analyzes the sectoral dynamics during recoveries following financial crises.

[2] The specification of the sectoral empirical analysis differs from the one in Abiad et al.. We extend the seminal work by Rajan and Zingales (1998) to the phenomenon of recoveries. As in Rajan and Zingales, our identification of the impact of credit markets on output is based on the interaction between the sectoral dependence on external finance and the level of development of credit markets at the country level. Considering as in Abiad et al. (2011), only sectoral dependence on external finance, by using the US as a benchmark, amounts to use a sectoral fixed effect.

Our main conclusions are as follows. First, we identify two types of creditless recoveries, namely 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 events and seem to be associated with crises of a financial nature, giving support to the view that the disruption of credit markets is persistent following financial crises. However, our results highlight an important difference between those two types of creditless recoveries. A failure of the credit stock to recover to its pre-crisis level does not appear to hamper growth, on the contrary. By contrast, a failure of credit flows to recover seems to slow down economic recovery. This is consistent with results in the existing literature. Second, we find that industries that are more dependent on external finance recover more quickly in countries with better financial development during creditless recoveries in the Calvo sense. This indicates that, consistent with Calvo et al. (2006a, 2006b), certain mechanisms enable the economy to grow despite the creditless character of recovery. These mechanisms may include the availability of alternative sources of financing such as trade credit, the re-allocation to less credit dependent sectors, or the take-up of unutilized capacity. 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 to prolonged credit market disruptions in the aftermath of a crisis. 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 recoveries. This highlights a "contagion effect" of trade credit, i.e. the propagation of financial distress and bankruptcy through trade credit chains during crisis episodes [See e.g. Kiyotaki and Moore (1997), Calvo and Coricelli (1996), Coricelli and Roland (2010)]. Overall, the substitution effect seems to dominate and is found to be stronger during creditless recoveries.

The paper is structured as follows. In section 2, we briefly describe the sample and the reasons why we choose to focus on industry-level data. In section 3, we investigate the frequency and characteristics of creditless recoveries in our sample. Importantly, we distinguish between two types of creditless recoveries: those that are characterized

by a failure of the credit stock to recover and those that are characterized by a failure of credit flows to recover. In section 4, we investigate whether industries that are more dependent on external finance are more or less affected by creditless recoveries in countries with better financial development. We also explore whether the two types of creditless recoveries we identified in section 3 have a differential impact on growth during recoveries. In section 5, we explore one potential mechanism that enables the economy to recover without bank credit, namely the substitution of trade credit for bank credit. We ask whether industries that are more dependent on bank credit as opposed to trade credit perform relatively better during creditless recoveries. Section 6 concludes and discusses avenues for further research.

2. Data sources and sample

As opposed to most of the existing literature, our analysis uses industry-level data for several reasons. First, studies based on aggregate data do not differentiate between credit to the corporate sector, which is used to finance investment, and credit to households, which includes consumption and housing loans. The latter do not affect long-run growth and should therefore be excluded from an analysis of the finance-growth nexus. Second, the behaviour of bank credit and its impact on the economy may crucially depend on the behaviour 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 ratio of credit to GDP as a measure of financial development 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[3]. Third, 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. Finally, the use of industry-level data allows us to overcome well-known endogeneity problems typical of analyses that rely on aggregate data. Indeed, financial development measured as the ratio of domestic credit to GDP may predict growth because financial markets are forward-looking and

[3] The data on the dependence of industries on bank credit relative to trade credit is taken from Raddatz (2008).

hence anticipate future growth. To circumvent this problem, we borrow the methodology of Rajan and Zingales (1998).

We use value added data from the UNIDO database. Our main sample covers a total of 103 countries across 28 manufacturing industries (3-digit ISIC Rev.2 level) between 1965 and 2002[4]. Data are deflated using CPI from the IMF IFS database[5]. Using the World Bank income categorization, 29 countries are "low income", 27 are "lower middle income", 27 are "upper middle income", and 32 are "high income".

Instead of working with annual data, we conduct our analysis on "episodes" of recovery. We trace the episodes of recovery at the industry level starting from the first year of positive change in value added after a downturn until value added reaches its pre-downturn level again. We measure the recovery in economic activity using the average percentage change of value added over the period of recovery as defined above. Our sample contains 6663 such episodes of recovery. The average growth rate during these recoveries is 19.2% but there is significant cross-country and industry variation (the standard deviation is 20.5%). On average recoveries last 1.52 years but again there is huge variation (the standard deviation is 98%) and recoveries can last between 1 and 11 years.

3. Creditless recoveries: descriptive statistics

3.1. How common and how different 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 by looking at the difference between the credit-to-GDP ratio in the last year and the first year of recovery episodes (Δstock). We interpret a negative difference as indicating the presence of a creditless recovery in the sense of Calvo et al. (2006), namely a recovery in value added to pre-downturn level that is not accompanied by an

[4] Since the time span is not the same across all countries, we have an unbalanced panel.
[5] The choice of CPI as deflator allowed us to retain the largest possible number of countries, as for many developing countries the CPI is the only price index available for a long time series.

increase of the credit-to-GDP ratio. In our sample, there are 4000 industry-level recoveries during which the credit-to-GDP ratio increases (by an average of 4.8 percentage points). During these recoveries, the average growth rate is 18.3%. There are 2542 recoveries during which the credit-to-GDP ratio decreases (by an average of 7.8 percentage points)[6]. During these recoveries, the average growth rate is higher, namely 20.5%. Second, we investigate the evolution of the flows of credit during episodes of recovery by looking at the difference between the growth rate of the credit-to-GDP ratio in the last year and the first year of recovery episodes (Δflow). We define a creditless recovery in the sense of Biggs et al. (2009) as an episode of recovery for which this difference is negative[7]. In our sample there are 2354 episodes of industry-level recovery during which the growth rate of the credit-to-GDP ratio increases between the first and last years of recovery (by an average of 9.3 percentage points). The average rate of growth during those episodes is 18.2%. There are 2850 episodes of recovery for which the growth rate of the credit-to-GDP ratio is lower in the last year than in the first year of recovery (by an average of 10.5 percentage points)[8]. During these episodes the average rate of growth is lower, namely 17.4%. The descriptive statistics indicate that 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).

In conclusion, our data indicate the presence of creditless recoveries both in the sense of Calvo and Biggs. Creditless recoveries are not a rare phenomenon. Creditless recoveries in the Calvo sense make up 39% of the total number of recoveries on which we have data on the change in the credit-to-GDP ratio between the first and last year of recovery. Creditless recoveries in the Biggs sense make up 55% of the total number of recoveries on which we have data on the change in the growth rate of the credit-to-GDP ratio between the first and last year of recovery.[9] In addition, our descriptive statistics highlight an important difference between creditless recoveries in

[6] In total, we have data on the change in the credit-to-GDP ratio for 6542 recovery episodes.
[7] Note that although Abiad et al. (2011) use a similar definition, ours is more "stringent". Abiad et al. (2011) 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*. Our definition, by contrast, is based on the *entire duration* of each recovery episode.
[8] In total, we have data on the change in the growth rate of the credit-to-GDP ratio for 5204 recovery episodes.
[9] Note that there is an overlap between Calvo type and Biggs type creditless recoveries.

the sense of Calvo and Biggs. A failure of the credit stock to recover to its pre-crisis level, i.e. a creditless recovery in the Calvo sense, does not appear to hamper growth, on the contrary. By contrast, a failure of credit flows to recover, i.e. a creditless recovery in the Biggs sense, seems to slow down economic recovery.

3.2. Are creditless recoveries an emerging market phenomenon?

The phenomenon of creditless recoveries has been mainly documented in emerging economies; but according to Claessens, Kose and Terrones (2008) it also seems to play a role in industrial countries. Using the World Bank income classification, Tables 1 and 2 look at the occurrence of creditless recoveries (in the Calvo and Biggs sense respectively) by income group in our sample.

[Insert Table 1 here]

The average growth rate during recovery episodes is consistently higher during creditless recoveries in the Calvo sense across *all* income categories. Consistent with Calvo's finding that creditless recoveries are primarily an emerging market phenomenon, the numbers for low income countries are striking. Not only are creditless recoveries much more frequent in low-income countries, their average growth rate during creditless recoveries in the Calvo sense is 22.9% (roughly the same as during other recoveries) while the credit to GDP ratio decreases by a staggering 19.8 percentage points.

[Insert Table 2 here]

Except for upper middle income countries, the average growth rate during recovery episodes is consistently lower during creditless recoveries in the Biggs sense across *all* income groups. Low-income countries do not stand out as they did in Table 1, suggesting that creditless recoveries in the Biggs sense are not primarily an emerging market phenomenon.

3.3. Creditless recoveries and the nature of the preceding crisis

The natural question arises of to what extent the emergence of creditless recoveries depends on the nature of the preceding crisis. We therefore investigate the characteristics of recoveries depending on whether they follow or coincide with a banking crisis, a currency crisis, a systemic sudden stop or a sharp collapse in the credit-to-GDP ratio. We use the banking and currency crisis dummies from Cerra and Saxena (2008), based on Caprio and Klingebiel (2003), and match them to our data set. We also use the systemic sudden stops (SSS) identified by Calvo et al. (2006) to uncover episodes of systemic sudden stops in our sample[10]. While it has become standard practice to use external sources to identify crisis episodes in a data set (see e.g. Kannan, (2010); Abiad et al. (2011)), we believe that this approach is subject to numerous caveats[11]. Therefore, we build an alternative indicator variable for banking crises that is defined *within* our data set. We build a dummy variable that captures whether a recovery episode was preceded by a significant collapse of credit. More precisely, the dummy variable is equal to 1 for episodes of recovery that are preceded by a crisis during which the collapse of the credit-to-GDP ratio is above the median collapse during such episodes in the sample. It is also important to keep in mind the fact that the banking crisis episodes identified by Cerra and Saxena (2008) are "systemic" episodes. While the crisis episodes identified within our sample are characterized by a sharp collapse in the credit-to-GDP ratio, we do not make any judgement about their potentially systemic nature. Henceforth, we will refer to banking crises identified by Cerra and Saxena (2008) as "systemic banking crises" and banking crises identified within our sample as "credit collapses".

Table 3 summarizes the characteristics of recoveries depending on the nature of the preceding crisis. It is apparent that creditless recoveries are associated with financial

[10] The definitions of the crisis dummies, data sources and explanations on how the dummies were matched with our data set are given in Appendix 1.

[11] A great deal of judgement may go into the compilation of lists of crisis episodes as it is sometimes unclear where the line should be drawn between crisis and non-crisis episodes. Caprio and Klingebiel (2003), which is the main source for Cerra and Saxena's banking crisis dummies, underline this problem. They define a systemic banking crisis as "much or all of bank capital being exhausted". The vagueness of this definition already testifies to the degree of judgement necessarily involved in such an exercise. According to Caprio and Klingebiel (2003) the identification of banking crises is complicated by the lack of data on banking sector losses, official estimates that understate banking sector problems, and the difficulty in identifying the timeframes of banking crises (when they start and end).

crises, especially systemic episodes, as opposed to other downturns. This provides some evidence that creditless recoveries are associated with prolonged credit market disruptions.

[Insert Table 3 here]

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 recover more slowly in countries with better financial development. Our measure of dependence on external finance follows Rajan and Zingales (1998) and is defined as the share of capital expenditure financed outside of retained earnings. Rajan and Zingales (2008) compute this ratio for U.S. firms and use the U.S. ratios as proxies for the dependence on external finance in other countries, assuming that the averaged ratios for the U.S. represent the intrinsic external financing needs of the various industries. We estimate the following model.

$$\text{Growth}_{j,k} = \text{Constant} + \beta_{1\ldots m}\,\text{Country}_k + \beta_{m+1\ldots n}\,\text{Industry}_j + \beta_{n+1}\,\text{Share}_{j,k} + \beta_{n+2}\,\text{Interaction}_{j,k} + \beta_{n+3}\,\text{Recovery}_{j,k} + \beta_{n+4}\,\text{Recovery}_{j,k} * \text{Interaction}_{j,k} + \beta_{n+5}\,\text{Creditless Recovery}_{j,k} + \beta_{n+6}\,\text{Creditless Recovery}_{j,k} * \text{Interaction}_{j,k} + \varepsilon_{j,k} \quad (1)$$

Where $Growth_{j,k}$ = Average growth over the recovery period in country k industry j; $Country_k$ = country indicators; $Industry_j$ = industry indicators; $Share_{j,k}$ = Industry j's share of manufacturing in country *k* in first year of the episode; $Recovery_{j,k}$ = dummy that is equal to 1 if the industry-level episode is a recovery; $Interaction_{j,k}$ = indicator of external dependence of industry j multiplied by the credit-to-GDP ratio of country k; *Creditless* $Recovery_{j,k}$ = dummy that is equal to 1 if the industry-level episode is a creditless recovery either in the Calvo sense or the Biggs sense.

[Insert Table 4 here]

The coefficient on *Share* is significantly negative in both estimations, indicating the presence of convergence effects. The coefficient on the *Interaction* variable is positive in both estimations (but only significant in the second), indicating that industries that are more dependent on external finance grow faster or experience smaller downturns in countries with better financial development. This is in line with the results in Rajan and Zingales (1998) and Coricelli and Roland (2010) respectively. Unsurprisingly, the coefficient on the recovery dummy is significantly positive in both estimations. Consistent with the results of section 2, the coefficient on creditless recoveries in the Calvo sense is significantly positive and that on creditless recoveries in the Biggs sense is significantly negative. This indicates that creditless recoveries in the Calvo sense on average are characterized by a higher rate of growth, in line with the findings of Calvo et al. (2006a,b). By contrast, the rate of recovery is significantly lower during creditless recoveries in the Biggs sense, in line with the finding in Biggs et al. (2009) of a positive correlation between recovery of GDP and positive credit flows. In both specifications, the sum of β_{n+3} and β_{n+5} is positive as expected. The coefficient on the interaction between the creditless recovery dummy and the *Interaction* variable is positive for both types of creditless recoveries, but only significant for creditless recoveries in the Calvo sense. This is consistent with Calvo et al. (2006a, 2006b) according to which creditless recoveries (Phoenix Miracles) are characterized by a relatively faster recovery rate. The creditless-ness of recovery captures the fact that despite a lower demand or supply of credit, other mechanisms enable the economy to grow without credit. These mechanisms may include the availability of alternative sources of financing such as trade credit, a reallocation towards less credit dependent sectors, or the take-up of unutilized capacity. To get a sense of the magnitude of this effect, consider the following experiment. The industry at the 80th percentile of external dependence (high dependence) is “Machinery”. The industry at the 20th percentile (low dependence) is “Apparel”. The country at the 80th percentile of development as measured by the average credit-to-GDP ratio in the first year of all episodes is the United Kingdom, while the country at the 20th percentile is Costa Rica. The coefficient estimate on the interaction between the creditless recovery dummy and external dependence then *adds* 29% growth in real value added in “Machinery” in the UK as compared to “Apparel” in Costa Rica. The fact that the coefficient is insignificant for creditless recoveries in the Biggs sense suggests that these mechanisms are not at work, or less so, during these types of creditless

recoveries. Again, this seems to be in line with the finding in Biggs et al. (2009) of a positive correlation between recovery of GDP and positive credit flows.

By contrast, the coefficient on the interaction between the recovery dummy and the *Interaction* variable is significantly negative in both estimations. This is consistent with credit conditions remaining tight following *any* type of downturn because of increased agency problems and financial accelerator mechanisms [Bernanke, Gertler, and Gilchrist (1999), and Kiyotaki and Moore (1997)] and the absence of alternative "engines of growth" that appear to be at work during creditless recoveries. In other words, firms have few alternatives to bank loans available to them to finance their growth at a time when credit conditions are tight. Hence, industries that are more dependent on external finance suffer disproportionately more in countries where bank credit is ex-ante important (countries with a high credit-to-GDP ratio).

5. Recovery and relative dependence on bank credit versus trade credit

Since credit conditions remain strained for a prolonged period following downturns, in particular financial crises, the natural question arises whether firms are able to substitute other forms of external finance for bank credit. 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 (2008) on the ratio of short-term debt to payables at the country and industry-level as an indicator of the industry-level and country-level dependence on bank credit relative to trade credit (henceforth the Raddatz indicator). The median ratio of bank credit to trade credit at the industry (country) level in our sample is 0.88 (0.91). Table 5 summarizes the average growth rate depending on whether the Raddatz indicator at the country or industry level is above or below the sample median - for all episodes of recovery and those that follow specific types of crises.

[Insert Table 5 here]

In general, industries that are more dependent on bank credit as opposed to trade credit seem to recover 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 recover more quickly. Again, this is true across all types of crises considered here[12]. At the industry level, a higher dependence on bank credit relative to trade credit renders firms more vulnerable to prolonged credit market disruptions in the aftermath of a crisis. Therefore, industries that rely relatively more on alternative sources of external financing, such as trade credit, may fare better during recovery. 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 recoveries. This highlights a "contagion effect" of trade credit, i.e. the propagation of financial distress and bankruptcy through trade credit chains during crisis episodes [see e.g. Kiyotaki and Moore (1997), Calvo and Coricelli (1996)]. 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 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.

In order to investigate whether the conclusions above survive econometric analysis, we use data from Raddatz (2008) to estimate the following model by OLS on the sub-samples of all recoveries and creditless recoveries[13].

$$Growth_{j,k} = Constant + \beta_1 Share_{j,k} + \beta_2 Interaction_{j,k} + \beta_3 Bank_k + \beta_4 Bank_j + \beta_5 Bank_j * Bank_k + \varepsilon_{j,k} \quad (2)$$

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

[13] Data from Raddatz (2008) are only available for 40 countries. Our sample size is reduced accordingly.
We use the sub-sample of recovery episodes rather than the full sample because this allows us to avoid the inclusion of many interaction terms that make the interpretation of results rather cumbersome.

where $Bank_k$ is the Raddatz indicator for country k and $Bank_j$ is the Raddatz indicator for industry j. The other variables are as before.

[Insert Table 6 here]

The results on the sample of all recoveries are consistent with the descriptive statistics. The coefficient on the *Interaction* variable is significantly negative, indicating that industries that are relatively more dependent on external finance recover more slowly. More importantly, the results confirm the existence of both a "substitution effect" and a "contagion effect" of trade credit identified in the descriptive statistics. The coefficient on the Raddatz indicator at the industry level is significantly negative. Firms in industries that rely more heavily on trade credit recover more quickly than firms in other industries. This provides further evidence that credit market disruptions persist after crisis episodes and constrain recovery when firms are heavily dependent on bank loans. By contrast, the coefficient on the Raddatz indicator at the country level is significantly positive and the interaction term between the Raddatz indicator at the country and industry levels is significantly positive[14], indicating that industries that are more reliant on bank credit do better during recoveries in countries that have a higher degree of reliance on bank credit. These results confirm the existence of a "contagion effect" through trade credit chains. The sign of the overall effect at the industry level depends on the direct "substitution" effect and the interaction term with the country-level indicator. The substitution effect appears to dominate because the overall impact of the industry-level indicator on growth is negative when evaluated at the median level of the country-level indicator.

To get a sense of the magnitude of the combined effects of the relative dependence on bank credit at the industry and country levels, consider two cases: an industry with a low dependence on bank credit in a country with a high dependence on bank credit (favourable case) versus an industry with a high dependence on bank credit in a country with a low dependence on bank credit (unfavourable case). The industry at the 80th percentile of dependence (high dependence) is "Non-ferrous metals". The industry at the 20th percentile (low dependence) is "Other non-metallic mineral

[14] The positive interaction term is confirmed by estimating model (2) where the country-level and industry-level Raddatz indicators are replaced by country-level and industry-level fixed effects. These results are not reported here for brevity.

products". The country at the 80th percentile of dependence is Iceland[15], while the country at the 20th percentile is France. The coefficient estimates on the terms involving the industry-level and country-level Raddatz indicators *add* 37% growth to "Other non-metallic mineral products" in Iceland compared to "Non-ferrous metals" in France.

We obtain similar results on the two subsamples of creditless recoveries. However, while the coefficient on the *Interaction* variable becomes insignificant, both the "substitution effect" and the "contagion effect" of trade credit are markedly stronger. In particular, the negative coefficient on the industry-level Raddatz indicator and the positive interaction term between the country-level and industry-level indicators have become substantially larger. The overall impact of the industry-level Raddatz indicator remains negative at the median value of the country-level Raddatz indicator and is of similar amplitude as in the full sample of recoveries. The stronger effects associated with trade credit during creditless recoveries seem intuitive. While credit market disruptions persist after crisis episodes, this is *a fortiori* the case during creditless recoveries. Industries that rely relatively more on bank credit are therefore at a stronger disadvantage during creditless recoveries. On the other hand, prolonged disruptions also undermine confidence in broader credit markets, including trade credit relationships. These disruptions and the resulting "contagion effect" are likely to be more acute during creditless recoveries.

In conclusion, we find evidence showing that industries that rely more heavily on trade credit fare better during recoveries. In addition, this "substitution effect" is larger during creditless recoveries. This suggests that trade credit may play a role in explaining the creditless character of certain recovery episodes.

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

[15] Note that Iceland is out of sample, but we stick to the 80^{th}-20^{th} percentile comparison for illustrative purposes.

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 this paper, we investigate the role of credit in shaping economic recoveries and try to shed some light on the phenomenon of creditless recoveries using industry-level data for a large sample of countries.

Our main conclusions are as follows. First, we identify two types of creditless recoveries, namely 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 events and seem to be associated with crises of a financial nature, giving support to the view that the disruption of credit markets is persistent following financial crises. However, our results highlight an important difference between those two types of creditless recoveries. A failure of the credit stock to recover to its pre-crisis level does not appear to hamper growth, on the contrary. By contrast, a failure of credit flows to recover seems to slow down economic recovery. This is consistent with results in the existing literature. Second, we find that industries that are more dependent on external finance recover more quickly in countries with better financial development during creditless recoveries in the Calvo sense. This indicates that, consistent with Calvo et al. (2006a, 2006b), certain mechanisms enable the economy to grow despite the creditless character of recovery. These mechanisms may include the availability of alternative sources of financing such as trade credit, the re-allocation to less credit dependent sectors, or the take-up of unutilized capacity. The fact that this effect is not present during creditless recoveries in the Biggs sense suggests that these mechanisms are not at work during this type of creditless recoveries. 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 to prolonged credit market disruptions in the aftermath of a crisis. 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 recoveries. This highlights a "contagion effect" of trade credit, i.e. the propagation of financial distress and bankruptcy through trade credit chains during crisis episodes [See e.g. Kiyotaki and Moore

(1997), Calvo and Coricelli (1996), Coricelli and Roland (2010)]. Overall, the substitution effect seems to dominate and is found to be stronger during creditless recoveries.

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 shed light on the mechanisms that enable economic activity to recover in the absence of credit growth. Second, further research could try to shed some 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.

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Appendix 1: Description of the crisis episodes

	Definition	Source
Banking crises	Dummy = 1 if a systemic banking crisis (as defined in Cerra and Saxena, 2008*) coincides with the first year of the recovery episode or any year of the preceding downturn episode; otherwise 0 *A systemic banking crisis is defined as much or all of bank capital being exhausted.	Cerra and Saxena (2008) Note: Cerra and Saxena use Caprio and Klingebiel (2003) as their main source.
Credit collapses	Dummy = 1 for episodes of recovery that are preceded by a crisis during which the collapse of the credit to GDP ratio is above the median collapse during such episodes in the sample; 0 otherwise.	Own calculations
Currency crises	Dummy = 1 if a currency crisis (as defined in Cerra and Saxena, 2008*) coincides with the first year of the recovery episode or any year of the preceding downturn episode; otherwise 0. *A currency crisis is defined by constructing an exchange market pressure index (EMPI) for each country. The EMPI is defined as the percentage depreciation in the exchange rate plus the percentage loss in foreign exchange reserves. Dummy = 1 if the EMPI is in the upper quartile of all observations across the panel.	Cerra and Saxena (2008)
Systemic sudden stops	Dummy = 1 if a systemic crisis (as defined in Calvo et al., 2006b*) coincides with the first year of the recovery episode or any year of the preceding downturn episode; otherwise 0. *3S episodes are defined as crises that occur during periods of "Systemic Sudden Stop" i.e., periods of capital inflow collapse.	Calvo et al. (2006b)

Appendix 2: Tables

Table 1: Creditless recoveries in the Calvo sense by income group

	Creditless recoveries			Recoveries with credit			Proportion of creditless recoveries
	Growth	Δstock	Obs	Growth	Δstock	Obs	
High income: OECD	15.2%	-8.1pp	928	13.2%	6.2 pp	1677	36%
High income: non OECD	22.8%	-6.8pp	190	20.3%	6.8 pp	393	33%
Upper middle income	22.8%	-4pp	551	19.5%	3.9 pp	858	39%
Lower middle income	25.2%	-2.9pp	506	24.9%	2.8 pp	853	37%
Low income	22.9%	-19.8pp	367	22.8%	2.2 pp	219	63%

Note: Growth = Average growth over the recovery period; Δstock = Change in the credit-to-GDP ratio between the last and first years of the recovery episode; Obs = number of observations.

Table 2: Creditless recoveries in the Biggs sense by income group

	Creditless recoveries			Recoveries with credit			Proportion of creditless recoveries
	Growth	Δflow	Obs	Growth	Δflow	Obs	
High income: OECD	12.2%	-8.6pp	1145	13.3%	6.3pp	1031	53%
High income: non OECD	18.3%	-10.3pp	293	22%	10.7pp	189	61%
Upper middle income	19.7%	-13.9pp	584	18.9%	14.1pp	491	54%
Lower middle income	23.8%	-9.8pp	615	24.8%	8.6pp	447	58%
Low income	19.5%	-13pp	213	23.2%	12.9pp	196	52%

Note: Growth = Average growth over the recovery period; Δflow = Change in the growth rate of the credit to GDP ratio between the last and first years of the recovery episode; Obs = number of observations.

Table 3: Characteristics of recoveries following different types of crises

	Growth	Δstock	Δflow
All downturns except financial crises	19.9%	0.0 pp	0.0 pp
Systemic banking crises	21.4%	- 6.2 pp	- 3.5 pp
Credit collapses	13.2%	-0.8 pp	1.2 pp
Currency crises	17.9%	-0.7 pp	-2.7 pp
SSS	20.6%	- 1.4 pp	-6.3 pp

Note: Growth = Average growth over the recovery period; Δstock = Change in the credit-to-GDP ratio between the last and first years of the recovery episode; Δflow = Change in the growth rate of the credit-to-GDP ratio between the last and first years of the recovery episode; Obs = number of observations.

Table 4: Creditless recoveries and relative dependence on external finance

Growth	**coefficient**	**t-stat**	**p-value**
Creditless recoveries Calvo sense			
Share	-0.958	-9.18	0.000
Interaction	0.049	1.64	0.101
Recovery	0.214	29.21	0.000
Recovery*Interaction	-0.184	-6.37	0.000
Creditless Recovery	0.023	2.32	0.020
Creditless Recovery*Interaction	0.062	2.27	0.023
Constant	-0.252	-2.57	0.010
Number of obs = 18491 Root MSE = 0.1060			
Growth	**coefficient**	**t-stat**	**p-value**
Creditless recoveries Biggs sense			
Share	-0.960	-9.19	0.000
Interaction	0.056	1.84	0.066
Recovery	0.238	31.71	0.000
Recovery*Interaction	-0.173	-5.99	0.000
Creditless Recovery	-0.036	-3.81	0.000
Creditless Recovery*Interaction	0.040	1.53	0.126
Constant	-0.255	-2.60	0.009
Number of obs = 18491 Adj R-squared = 0.1060			

Table 5: Recovery and relative dependence of bank credit

Growth	Raddatz indicator - industry		Raddatz indicator - country	
	> 0.88	< 0.88	> 0.91	< 0.91
All recoveries	18.6%	19.7%	21%	14%
Banking crises (CS)	21.1%	21.7%	24.2%	14.1%
Banking crises (own)	12.3%	14.2%	13.9%	11.4%
Currency crises	17.3%	18.5%	19.7%	13.2%
SSS	19.6%	21.7%	22.9%	10.3%

Table 6: Recovery and relative dependence on bank credit – recovery sub-sample (p-values between brackets)

Growth	All recoveries	Creditless recoveries (Calvo)	Creditless recoveries (Biggs)
Share	-1.194 (0.000)	-1.341 (0.000)	-1.117 (0.000)
Interaction	-0.029 (0.029)	-0.009 (0.633)	-0.010 (0.526)
$Bank_k$	0.258 (0.008)	-0.003 (0.844)	-0.002 (0.880)
$Bank_j$	-0.051 (0.000)	-0.073 (0.000)	-0.072 (0.000)
$Bank_j$ *$Bank_k$	0.021 (0.019)	0.043 (0.003)	0.046 (0.000)
Constant	0.191 (0.000)	0.233 (0.000)	0.202 (0.000)
Impact of $Bank_j$ at median $Bank_k$	-0.032	-0.034	-0.030
Number of obs	3798	1453	1739
Adj R-squared	0.0539	0.0456	0.0584