Big Recessions and Slow Recoveries

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Resumen no-técnico

La mayoría de los estudios que miden los impactos reales de las crisis financieras. han concluido que la ocurrencia de crisis financieras usualmente se acompaña de recesiones profundas. También han coincidido en que la acumulación de deuda previa a la crisis es un determinante de la magnitud de la caída en el producto y la duración de la recesión. Estudios recientes han encontrado evidencia contraria, en el sentido de que los efectos de la ocurrencia de crisis financieras tienen un efecto no significativo o nulo en la severidad y duración de la recesión. Del mismo modo, esta nueva literatura propone una explicación alternativa a las recesiones profundas y duraderas en el tamaño de los choques fundamentales que produjeron la recesión.

Este documento presenta una evaluación empírica de estas dos posiciones. Para esto se realiza un ejercicio econométrico en el que se estiman los ciclos económicos promedio para 17 países desarrollados, usando proyecciones locales. Los picos y valles del ciclo son identificados por metodologías estándar y se estiman las trayectorias del producto a partir de estos dos momentos. Esto permite identificar el tamaño de la pérdida promedio de una recesión y la tasa de crecimiento característica durante la recuperación. En el ejercicio se incluyen variables que permiten identificar la naturaleza de la crisis (financiera o no), el exceso de acumulación de deuda (con respecto a un promedio histórico), y el tamaño de los choques.

Se concluye que la ocurrencia de crisis financieras está asociada a recesiones más persistentes y profundas, sólo si el tamaño de la recesión es suficientemente grande (la pérdida de producto está por encima del promedio histórico). Pero, las recesiones profundas pueden o no estar acompañadas por una crisis financiera. De la misma manera, se rechazan la hipótesis de que el tamaño de la recesión, la ocurrencia de crisis financiera o la acumulación de deuda previa a la recesión causen una recuperación más lenta.

Big Recessions and Slow Recoveries[1]

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Abstract

It has been claimed that financial crises tend to be accompanied by deeper recessions and slower recoveries, partly due to debt burden (e.g. Reinhart & Rogoff, 2009; Hong and Tornell, 2005; Jordà, et al., 2013). I evaluate this claim against the contrasting view that magnitude and persistence of recessions is rather the consequence of bigger and more persistent shocks (Stock & Watson, 2012). To do so, I compute recovery and recession paths through the estimation of impulse responses by local projections methods (Jordà, 2005). I found that the occurrence of financial crises is associated with more severe recessions only if the recession itself is big enough (the output loss is above its historical average). More importantly, neither the magnitude of the loss, nor the occurrence of financial crises, nor high debt accumulation seem to be associated with sluggish output growth during recoveries.

Palabras clave: Financial crises, deep recessions, slow recoveries, local projections, debt overhang.

Códigos JEL: E37, E39, E44, G01

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1 INTRODUCTION

Recent episodes of financial crisis in developed countries, such as the subprime crisis in the United States that led to the great recession in 2007-2009, have emphasised the widely supported idea that economic downturns that are accompanied by financial crisis tend to be bigger and longer than other economic crises (e.g. Reinhart & Rogoff, 2009). To that extent, a bulk of empirical literature has dealt with the measurement of the real effects of financial crisis. A recurrent suggestion from this literature is that debt burden plays an important role in determining the duration and magnitude of the recessions (e.g. Hong and Tornell, 2005 and Jordà, et al., 2013 and 2015).

Conversely, other studies have found that financial crises have small or no effect on the severity of the recessions, as well as on the speed of recovery (e.g. Romer and Romer, 2015). It has been suggested as an alternative explanation that the crisis severity and speed of recovery are correlated with the size and persistence of the underlying shocks and that the effect of the financial nature of the crisis is negligible (Romer and Romer, 2015; Stock and Watson, 2012). Therefore, this last branch of literature suggests that slow recoveries are somewhat associated with deep recessions. This mixed evidence set a dilemma between the two approaches and bring about the question whether recessions and recoveries are significantly different when accompanied by a financial crisis or if this has something to do with the magnitude of the recession itself. To shed some light on this debate an empirical examination of the two positions is performed in this paper using the macro-financial data base gathered by Jordà et al. (2017).

In other words, the purpose of this paper is twofold. On one hand, I evaluate whether financial crises, and excessive debt play a role determining the severity of the recession and speed of recovery. And on the other hand, an evaluation of the effect on output dynamics of the magnitude of the shock itself is performed. This is done using local projection methods to estimate recession and recovery paths as in Jordà, et al. (2013).

The business cycle dynamics literature is related to this work, particularly the literature on whether business cycles accompanied by financial crises are different and on the sources of business cycles fluctuations. With respect to the shocks driving macroeconomic fluctuations, the literature has focused mainly on three: technology, monetary and fiscal shocks. Estimations of medium-scale DSGE models have highlighted the importance of identifying the contributions to output volatility by fluctuation sources (Smets and Wouters, 2003 and 2007). Then a problem that economists have had to tackle is how to identify such shocks (For a review see Ramey, 2016). This is of great importance if you try to compare episodes with different characteristics (for instance financial crisis with normal recessions).

Regarding, the effect of financial crises, most of the studies have found evidence supporting the idea that financial crises are accompanied by deeper and longer recessions. And most of them have used data for both developed and developing countries (v.g. Reinhart & Rogoff, 2009) or developing countries data exclusively (Berkmen, et al., 2012; Hong & Tornell, 2005). The identification strategy for the financial crisis episodes has been predominantly discursive (v.g. Reinhart & Rogoff, 2009; Claessens, et al., 2009; Bordo, et al., 2001; Jordà, et al., 2013, 2015 and 2017). This implies that most of the studies relied on dummy variables as indicators of the financial turmoil, and as Romer and Romer (2015) have highlighted, have used the peak to trough decline on output as a measure of the deepness of the recession.

In this respect, Romer and Romer (2015) and Stock and Watson (2012) differ from most of the literature in both the identification strategy and on the focus on developed countries. The former uses a modified discursive strategy, focusing on the cost of financial intermediation and assigning different values to the variable depending on the severity of the financial disruption. Then they use Jorda's (2005) local projection methods to estimate the effects of financial turmoil on the severity of the recession. They have also remarked on some problems with previous financial crisis effect literature including estimation bias and reverse causation. On the other hand, Stock and Watson (2012) use a dynamic factor model to identify the different shocks and quantify their contribution to output volatility for different recession episodes in the USA. As mentioned before, both studies found evidence that the severity of the recession is related to the magnitude and persistence of the underlying shocks.

By estimating recession paths using the Jordà method, Jordà et al. (2013 and 2015) and Romer and Romer (2015) reduce the downwards bias of the crisis in countries with very strong trend growth. Notwithstanding the reverse causation problem remains in the sense that crisis might be the result and the cause of recessions.

I use a very similar approach here. Unlike Jordà et al. (2013 and 2015), I control for the magnitude of the shock by grouping the data according to the deviation of the growth rate with respect to the country-specific historical mean. This allows me to evaluate the size claim by Romer and Romer (2005) and Stock and Watson (2012). Reverse causation remains a problem for the estimation of recession paths, and therefore the magnitude of the financial crises effect on the output loss. But this problem is reduced when estimating the effects of the financial crisis and the magnitude of the shock on the speed of recovery. This is one of the contributions of this paper with respect to previous literature.

In this respect, I found evidence suggesting that neither financial nature of the crisis nor the severity of the recession is associated with slower recoveries. This is, the output growth rate following either a big or a financial recession is not significantly sluggish compared with small or non-financial recessions. On the other hand, when grouped by size, financial crises are not accompanied by deeper than usual recessions if they are small.

Financial recessions are statistically distinguishable from normal downturns only if the output loss is above the historical mean. Additionally, some support is given to Jordà, et al. (2013) finding that debt accumulation during the expansion helps to determine the magnitude of the recession. This evidence is more significant for big non-financial recessions.

Furthermore, the claim that the magnitude and persistence of the underlying shock are determinants for both the severity of the recession and the speed of recovery, implies that standard DSGE models should be enough to explain these two features of the data. I analysed this using simulated data from a basic RBC model and found that the model is able to reproduce big and small recessions and that the recoveries are not associated with the size of the shock. In fact, recovery period growth after big recessions seems to be slightly faster than after episodes with small output losses.

Overall, the evidence found in this paper suggest that neither the financial nature of the crisis nor the magnitude of the shocks producing the downturn are associated with sluggish recoveries. It is

also found that debt run-ups play a statistically significant role in determining the magnitude of the recession, but it has no significant effect on output growth during recovery.
Other factors should be playing a role determining both the magnitude of the recession and the speed of recovery. Gali, et al. (2012) identify policy tightness (zero lower bound), risk premium and investment specific technology shocks as the main drivers of slow recoveries in the US. It is needed to dig further into the determinants of slow recoveries but that is beyond the scope of this paper and is left for future research.

The rest of the paper is organised as follows: in the next section, the data and identification of the turning points are described. The methodology for the estimation of recession and recovery paths and the initial data analysis are presented in section 3. Section 4 contains the initial regression analysis regarding the magnitude and financial crises effects. Section 5 presents the analysis of the effect of debt accumulation on both recession and recovery paths. Section 6 explains the robustness of the regression results to the inclusion of economic controls. In section 7, an estimation of recession paths is presented to evaluate whether a basic RBC model is able to generate what we observe in the data. Finally, section 8 concludes.

2 DATA AND TURNING POINTS IDENTIFICATION

In this paper, I used the panel data information gathered by Jordà et al. (2017). This panel has information for 17 developed economies from 1870 to 2013 on annual frequency. It includes variables for the real economy, credit, government and financial crisis dates among others. For the purpose of this paper, I am using the series real per capita GDP, consumption per capita, investment to GDP ratio, total loans, population, price index, current account and a systemic financial crises identifier. A description of this data is provided in the Appendix.

On the other hand, to be able to determine whether recession and recovery paths differ across episodes according to the characterizations by size and financial nature, business cycle turning points need to be identified. To do so, I use the Harding and Pagan (2002) algorithm for annual frequency, which is equivalent to the use of Bry and Boschan (1971) algorithm. In practice, this is similar to identifying the last positive growth period in a sequence as a peak, with the advantage that the algorithm guarantees that peaks and troughs alternate.

I identify turning points for a single variable (real GDP) and perform the analysis in terms of how output behaves during recessions and recoveries. Given the frequency of the data and the purpose of the paper, there are no great gains from using a multivariable turning points identification strategy.

Accordingly, 375 peaks and troughs are identified. Following Jordà et al. (2013) I excluded from the data episodes that are influenced by wars. To do so, peaks happening 2 years after a war or 5 years before were excluded (and its corresponding trough too). I also excluded recessions for which there are not enough data points to get a full window for a recession path. As a consequence, peaks and troughs happening on or after 2009 are excluded. Then the sample is reduced to 278 usable peaks.

Additionally, the analysis presented here requires recessions to be classified as being accompanied or not by a financial crisis. This is done using the systemic financial crisis variable. This variable was built using the results from previous literature on financial crises including Bordo et al. (2001) and Reinhart and Rogoff (2009), among others (Jordà, et al., 2017). A recession is labelled as financial if a crisis episode is reported 2 years before or after the peak. This is done avoiding the association of a crisis episode to more than one recession by favouring the episode that is preceded by a financial crisis. As can be seen in Table 2.1, this results in 71 out of 278 usable peak observations classified as financial.[3]

Table 2.1 Number of usable peaks by phases of financial development and type of episode

Phases of Financial Development	Non-Financial	Financial	Total
Pre WWI	112	29	141
Inter-Wars	20	19	39
Bretton Woods	25	0	25
Post Bretton Woods	50	23	73
Total	207	71	278

Source: Author's calculations

[3] Episodes classified as financial by Jordà et al. (2013) are also classified as that following this methodology.

To consider varying economic conditions (average growth and volatility) and differences in credit access across time, data is partitioned according to the four phases of financial development as proposed in Jordà et al (2013)[4]. These phases are: the pre-World War I period (1870-1914), the interwar period (1918-1939), the Bretton Woods period (1945-1971) and the post Breton Woods period (1972-2013).[5] It is interesting to notice that no recessions are classified as financial during the Bretton Woods period.

A second classification needed for the analysis is the one regarding the size of the recession measured as the logarithmic percentage difference between the peak and the next trough, i.e. the accrued loss during the contractionary phase of the cycle. Using this variable, a recession is classified as big if the output loss exceeds its mean for a particular country during a particular phase of financial development[6].

Table 2.2 Number of usable peaks by type, magnitude of the episode and phases of financial development

	Small			Big		
	Non-Financial	Financial	Total	Non-Financial	Financial	Total
Pre 1st WW	78	14	92	34	15	49
Inter-Wars	11	13	24	9	6	15
Bretton Woods	13	0	13	12	0	12
Post Bretton Woods	35	8	43	15	15	30
Total	**137**	**35**	**172**	**70**	**36**	**106**

Source: Author's calculations

As can be seen in Table 2.2., about half the financial crises are classified as big. In total there are 105 recession episodes where the output loss exceeded the respective historical mean. It can also be observed that most of the recessions classified as non-financial are also small (138 episodes). In the next section I analyse further the data according to the classifications used in the paper. Also I explain how local projections are used in this paper to estimate the average recession paths for each of these groups of recessions.

[4] This also allows for comparability of the results found in this paper with theirs.
[5] The use of an alternative partition of the data using the WWII as threshold does not change the qualitative results.
[6] The qualitative results hold, when we define big as output losses that are 1 standard deviation above the mean.

In Table 1.2., we can also see the number of usable episodes by phases of financial development, the severity of the recession and financial nature of the episode. Interestingly, during the inter-wars period most of the financial recessions produced below average output losses. Moreover, a higher number of non-financial rather than financial recessions were classified as big.

The financial recessions categorised as big include the great depression in the United States, the 1929 episodes in France Italy and Japan and the 1930 recessions in Norway and Sweden. Meanwhile, the big non-financial recessions include among others the 1923 Danish recession, the 1925 and 1929 British recessions, and the 1929 Swiss and Dutch episodes. The 1929 non-financial recession can be linked to the great depression in the USA, but they were the by-product of trade no financial effects of the latter.

In the next section, I analyse further the data according to the classifications used in the paper. I also explain the usage of local projections in this paper to estimate the average recession paths for each of these groups of recessions.

3 BIG RECESSIONS AND FINANCIAL CRISIS

As stated in the introduction, the purpose of this paper is to evaluate the claims that financial crises are accompanied by deeper and longer recessions on the one hand (Reinhart & Rogoff, 2009). And on the other, that this effect is negligible and slow recoveries are rather associated with a magnitude effect of the recession itself (Stock & Watson, 2012). That is, the magnitude of the recession is, if anything, weakly associated with financial crises and the speed of recovery depends on the magnitude and persistence of the underlying shocks.

The first step to assess those statements is to analyse the raw data on recession episodes according to the classifications presented in the previous section. In particular, to examine the mean and variance of recession magnitudes corresponding to financial or non-financial episodes. In terms of severity, Table 3.1 shows that both the output loss mean and standard deviation are bigger for episodes accompanied by financial crises. This is true for almost all phases of financial development with the exception of the inter-wars period when the opposite is true.

Table 3.1 Average accrued output loss (peak-to-through output reduction) by financial development phase, size, and financial nature of the crisis

	Non-Financial	Financial	Small			Big		
			Non-Financial	Financial	Total	Non-Financial	Financial	Total
Pre 1st WW	-3.4151 (3.5518)	-4.1269 (3.9521)	-1.9281 (1.5124)	-1.2645 (1.5152)	-1.8271 (1.5234)	-6.8265 (4.4586)	-6.7985 (3.6424)	-6.8179 (4.1876)
Inter-Wars	-9.2770 (11.7197)	-6.5479 (8.0778)	-3.4129 (4.6298)	-3.2632 (3.3222)	-3.3318 (3.8838)	-16.4442 (13.9407)	-13.6648 (10.9353)	-15.3324 (12.4799)
Bretton Woods	-1.2843 (1.0997)	. .	-0.7335 (.6438)	. .	-0.7335 (.6438)	-1.8810 (1.1999)	. .	-1.8810 (1.1999)
Post Bretton Woods	-2.2169 (2.1378)	-4.2949 (2.9376)	-1.2684 (1.0689)	-1.7114 (.8477)	-1.3508 (1.0369)	-4.4302 (2.3924)	-5.7713 (2.6643)	-5.0776 (2.5735)
Total	-3.4347 (4.9929)	-4.8369 (5.2056)	-1.7654 (1.8956)	-2.1090 (2.4003)	-1.8353 (2.0057)	-6.7018 (7.1402)	-7.5647 (5.8234)	-6.9894 (6.714)

Notes: Standard deviations in parenthesis

Source: Author's calculations

This suggests that financial crises are, on average, accompanied by more severe recessions. Notwithstanding, there is a caveat: the dispersion of the severity of the recession is also greater for financial crises, implying that financial crises can also be accompanied by smaller, less painful recessions. In fact, differences between financial and non-financial episodes are reduced when the sample is divided by size. Thus, it seems that the conclusion of financial recessions being more painful than normal recessions does not necessarily hold. This seems to be in accordance with the view that the crisis severity and speed of recovery are correlated with the size and persistence of the underlying shocks (Romer & Romer, 2015; Stock & Watson, 2012).

Table 3.2 Average growth after trough by size and financial nature of the crisis

Horizon	Non-Financial	Financial	Small			Big		
			Non-Financial	Financial	Total	Non-Financial	Financial	Total
1 year	3.6137 (2.7655)	3.5186 (2.5587)	3.2925 (2.6704)	2.9789 (1.9871)	3.2348 (2.5558)	4.2711 (2.86)	4.1932 (3.0418)	4.2501 (2.8928)
2 years	5.4235 (4.2133)	5.4026 (4.0389)	4.7929 (3.7262)	5.2060 (3.2612)	4.8690 (3.6391)	6.7136 (4.8465)	5.6484 (4.9059)	6.4264 (4.8579)
3 years	7.5944 (6.0151)	6.6443 (6.8792)	6.5763 (5.2774)	5.9981 (7.2795)	6.4696 (5.679)	9.4057 (6.8098)	7.2167 (6.5571)	8.7217 (6.7793)

Notes: Standard deviation in parenthesis

Source: Author's calculations

Regarding the speed of recovery, Table 3.2 shows the average accrued growth one, two and three years after the trough. This data suggests that there are no significant differences between growth rates during the recovery of financial and non-financial recessions. Interestingly, it also shows that big recessions' average recovery speed is faster than that of smaller recessions. I confirm these results with the regression analysis that is presented in the following sections of the paper.

The visual examination of the moments of the magnitude of the recession and speeds of recovery by size and financial nature is not enough to draw sound conclusions. But it suggests that it is necessary to group data by size to get a clear picture of the role played by the financial nature of the episodes, so that this is not confused with a scale effect as suggested by some authors (v.g. Stock & Watson, 2012 and Romer & Romer, 2015).

To unveil the correlation between big recessions, financial crises and slow recoveries in the next two sections of the paper an empirical evaluation of size and financial crisis effects is performed. To do so, the recession and recovery paths are estimated using local projection methods (Jordà, 2005). With a twofold purpose of making the results comparable to the ones found by Jordà, et al. (2013) and to evaluate the claim that debt burden plays a role in determining the magnitude and duration of a crisis, I interact credit excess with the classification variables and include the same controls used by the aforementioned authors.

According to this methodology, recession and recovery paths are defined as the cumulative impulse responses of output growth to a particular shock as in Jordà et al (2013, 2015). For the purpose of this paper, it is enough to classify the shocks in terms of financial, non-financial, big and small categories. Also, the recoveries are defined as the responses from the trough to the same dummy variables. In practice, we need to estimate the following regression for every horizon point (h=1-5):

$$\Delta_h y_{i,t+h} = \alpha + \alpha_i + \beta_1 \text{shock}_{i,t} + \beta_2 X_{i,t} + u_{i,t}$$

Here $\Delta_h y_{i,t+h}$ stands for the log difference of output between periods t and t+h, α is the common constant, α_i are individual country i fixed effects. The variable $\text{shock}_{i,t}$ is a dummy taking the value of one when the shock hits. In the context of this work, the dummy variables indicate either a peak or a trough and whether the recession associated with them is classified as financial, non-financial, big or small. Finally, $X_{i,t}$ is a vector of covariates and $u_{i,t}$ is the vector of robust errors associated with the estimation.

The estimation is done using panel data fixed effects and errors are clustered at the country level. In this way, errors are allowed to be auto-correlated. This is necessary to get valid inference from LP estimators (Jordà, 2005) and it is the equivalent to HAC errors in a time series framework.

The parameters of interest are the common trend (α) and the marginal cumulative effect of the shock (β_1). The sum of the two gives us the average recession and recovery paths depending on whether we are using peak or trough dummies. In the next section, an assessment of whether recession and recovery paths differ significantly among classifications is presented. To do so, I use the financial database for 17 developed countries gathered by Jordà, et al. (2017). In a latter section, we use this same methodology and simulated data to find out whether macroeconomic theory is able to reproduce the patterns found in the data and to get some insight on the claim that the magnitude of the shock is correlated with the speed of recovery.

4 AN EVALUATION OF FINANCIAL CRISES AND MAGNITUDE EFFECTS.

It has been claimed that financial crises have a differential effect on economic growth in the short and the medium run producing deeper recession and slower recoveries (e.g. Reinhart and Rogoff, 2009 and Claessens, et al., 2009). If this is true in general, then they should have different recession and recovery paths regardless of the group size. To evaluate this, following the strategy described in the last section, I estimate these paths using local projections (Jordà, 2005). Initially, the following two equations with only dummy shocks are estimated:

(1) $$\Delta_h y_{i,t+h} = \alpha + \alpha_i + \beta_B B_{i,t} + \beta_S S_{i,t} + u_{i,t}$$

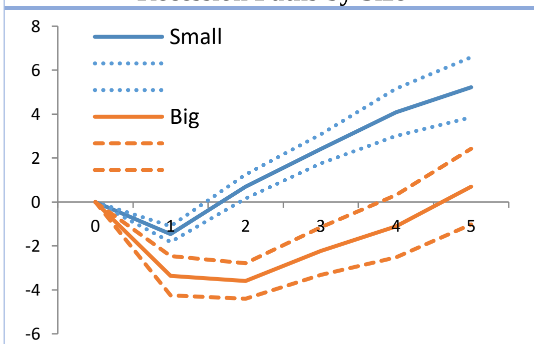
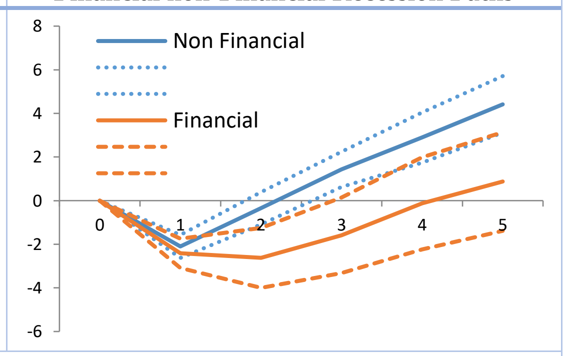
(2) $$\Delta_h y_{i,t+h} = \alpha + \alpha_i + \beta_F F_{i,t} + \beta_N N_{i,t} + u_{i,t}$$

Here B stands for big, S for Small, F for Financial and N for non-financial. The time horizon h refers to the number of periods ahead of either the peak or the trough. As indicated before, when dummy variables take the value of one at peaks the estimated cumulative impulse responses correspond to the recession paths. Conversely, when unitary values are taken at troughs, the estimation results can be interpreted as recovery paths. These paths are computed as the sum of $\alpha + \beta_j$ where j stands for B, S, F or N; and α can be interpreted as the average growth trend net of countries fixed effects.

The estimation is done using panel data fixed effects and errors are clustered at the country level. In this way, errors are allowed to be auto-correlated. Recession paths estimated using equation 2 (right panel of Figure 1) are qualitatively equivalent to the results reported in Table 5 in Jordà, et al. (2013, p. 13). Quantitative differences with respect to those results might arise since the data available has been reviewed and augmented in terms of coverage.

From these regressions we can conclude that average financial recessions seem to be deeper and one year longer than non-financial ones. While on average non-financial recession losses are fully recovered after one year, it takes two years to recover from a financial recession (this is until year 4).[7]

Figure 4.1 Recession paths without controls

Recession Paths by Size	**Financial non-Financial Recession Paths**
	

Notes: Error bands at 5% of significance
Source: Authors Calculations

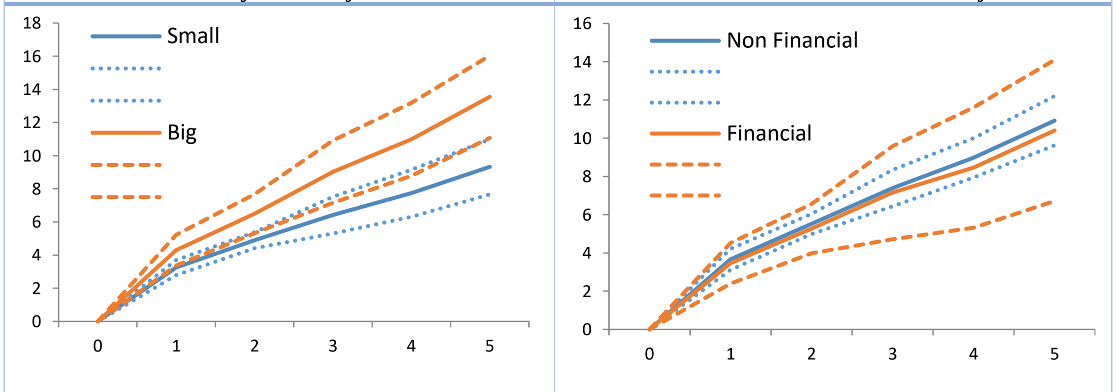
As can be noticed in Figure 4.1 Recession paths without controls, these same results are extendable to big recessions when comparing them with small ones. This might be due to a much higher proportion of financial recessions being categorized as big. I will show later that when grouped by size financial crises matter only if the recession is severe enough. That is, there are no significant differences between normal and financial episodes when output losses are small. In other words, for a recession to be more severe it is not enough to be accompanied by a financial crisis.

[7] This is no longer true when allowing a financial crisis episode to be associated with more than one recession when we do not include controls. In this case the financial recession is not significantly different from the non-financial for the whole sample.

On the other hand, estimations of recovery paths are reported in Figure 4.2. In this case, the sum $\alpha + \beta_j$ in equations 1 and 2 corresponds to the cumulative growth rate h years after the trough. The results from these estimations suggest that financial recessions do not seem to exhibit a significantly different recovery path from a non-financial recession (right panel, Figure 1.2).[8]

Figure 4.2 Recovery paths without controls

Recovery Paths by Size	Financial non-Financial Recovery Paths



Notes: Error bands at 5% of significance
Source: Authors Calculations

Regarding the severity of the recession, growth rates during recoveries from big recessions seem to be higher than from small recessions on average. This implies that the time to recover from an average big or a financial recession is longer due to a scale effect. This means that it takes longer to recover from a bigger loss at a given growth rate. It also implies that other factors should be playing a role in determining the speed of recovery.

Some previous findings for the last three recessions in the US, suggest that the zero lower bound and wage rigidities played a role determining the speed of recovery (Gali, et al., 2012). A similar role has been attributed to fiscal consolidation. The most frequent culprit in the literature is debt overhang (e.g. Hong & Tornell, 2005). The latter will be evaluated in a following section.

Financial nature is only important if the recession is big

Up to now, the evidence presented shows remarkable similarities between the results obtained using financial and size dummies. By interacting these two categories, we can get further insight

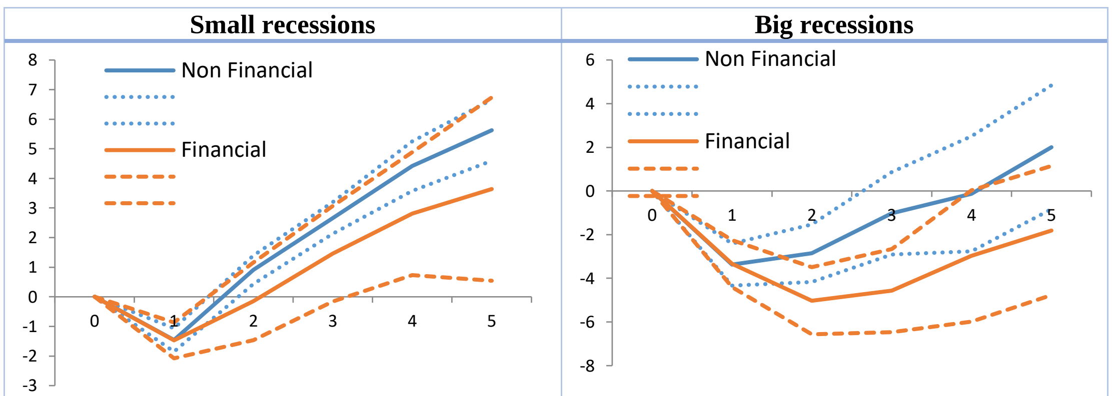
[8] This result is consistent when allowing for a financial crisis episode to be associated with more than one recession.

about the average recession and recovery paths. To do so, a regression of cumulative growth as a function of the interaction of the dummy variables is run. Specifically, the following equation is estimated:

$$\Delta_h y_{i,t+h} = \alpha + \alpha_i + \beta_{bf} B_{i,t} * F_{i,t} + \beta_{bn} B_{i,t} * N_{i,t} + \beta_{sf} S_{i,t} * F_{i,t} + \beta_{sn} S_{i,t} * N_{i,t} + U_{i,t} \quad (3)$$

Here N, F, B, S are defined as before and β_{jk} is the response of the cumulative growth to the interaction of the treatment variables identifying recessions episodes by size (j={b,s}) and financial non-financial nature (k={f,n}). This is equivalent to estimating equation 2 grouping by size.

Figure 4.3 Recession paths grouped by size including controls



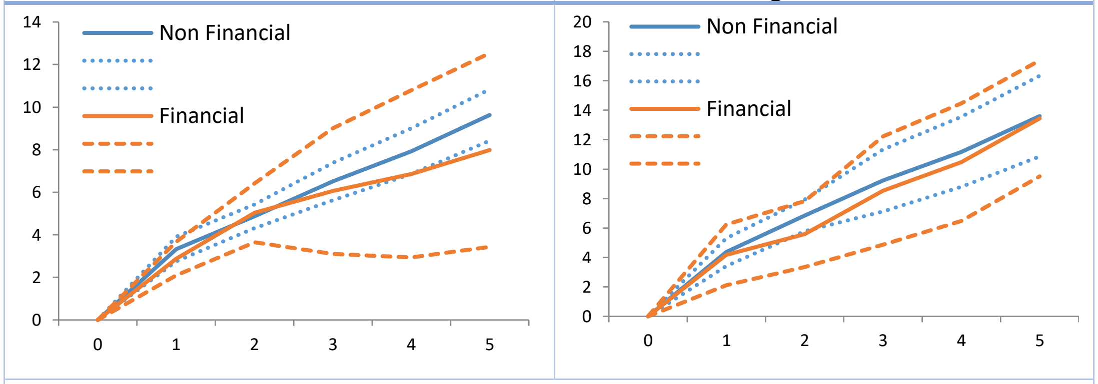
Notes: Error bands at 5% of significance
Source: Authors Calculations

The results of this regression are plotted in Figure 1.3. It is observed that small recessions are not significantly different among them irrespective of whether they are classified as financial or not. Some of Jordà et. al (2013) results still hold conditional on output losses being higher than the historical mean during a particular financial development phase (right panel Figure 4.3). Taking this condition into account, financial crises are accompanied by recessions 1 year longer on average. This implies that the cumulative output loss is around 2 percentage points bigger on average. As a consequence, the economy is significantly below its initial output level 4 years after a peak associated with a financial crisis.

On the other hand, the average economy is fully recovered from a non-financial big recession 4 years after the trough. These numbers are considerably higher than the single year it takes for an average economy to recover from a small recession (whether financial or not). These results are consistent when using an alternative financial recession identification that allows for financial crises episodes to be linked with more than one recession.

Figure 4.4 Recovery paths grouped by size including controls

Small recessions	**Big recessions**



Notes: Error bands at 5% of significance
Source: Authors Calculations

Regarding recovery paths (Figure 4.4), as before, we can get the cumulative impulse responses to the treatment variables by changing the reference point to the trough in equation 3. In this case the results suggest that the recovery paths are not significantly different whether recessions are accompanied by a financial crisis or not. This means that, in terms of output growth rates during the recovery, there are no differences between financial and non-financial episodes.

This confirms the results reported when using equation 2. We can conclude also that there are no significant differences among recoveries from big and small recessions. This also confirms that on average big recession take longer to recover because the output loss is bigger and not because of a slower growth rate.

The usual suspects

From the analysis up to this point we observe that deep recessions can be accompanied by financial crises, but this is not an unequivocal relationship. There are deep recessions that are not related with financial crises and there are financial crises accompanied by small recessions. Then the determinants of the size of the recession, and therefore the time of recovery, are not necessarily associated to the nature of the crisis. The usual culprits in the literature are debt overhang (v.g.

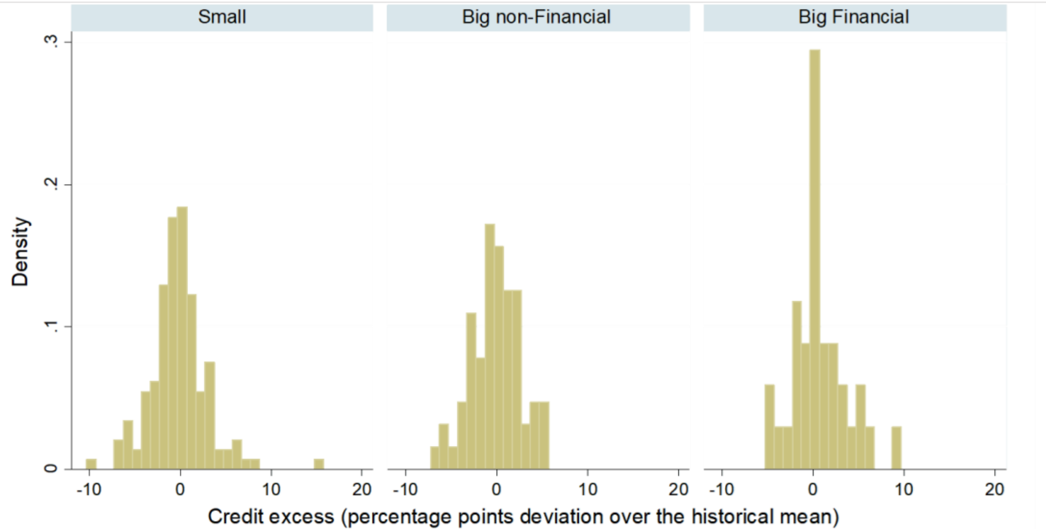
Dell'Ariccia et al, 2008; Hong and Tornell, 2005; Kannan, 2012; Jorda et al, 2013), asset bubbles (v.g. Jorda et. al, 2015), different magnitude of the shocks (Stock and Watson 2012), Monetary and fiscal policy tightness (v.g. Hall, 2016; Gali et al., 2012) among other causes that might be also associated with slow recoveries.

Notice that the results showed that the size of the recessions does not seem to determine the speed of recovery. But finding the determinants of the size of the recession might be important for the duration of the recovery. To do so we add to the analysis the most usual explanation in the literature in the next section. This is: debt accumulation. Exploring other alternatives is out of the scope of this paper and is left for future research.

5 DEBT RUN-UP AND OUTPUT LOSS

Jordà et al. (2013) evaluated the effect on the recession paths of credit excess – defined as the deviation in percentage points of the average credit to GDP ratio growth during the expansion from its historical average during a particular phase. They concluded that credit excess has a significant negative impact on the recession paths whether accompanied by a financial crisis or not. This is, recessions are deeper and longer if there was excessive credit growth during the expansion.

Figure 5.1 Density of credit excess by size and financial nature of the crisis



Notes: Small recessions are grouped together irrespective of whether accompanied by a financial crisis or not.

Source: Authors Calculations

As can be seen in Figure 5.1, a high percentage of big financial crisis are preceded by "excessive" debt to GDP ratio growth. Additionally, looking at the distributions of credit excess for the three classification, there seems not to be a clear difference between them. This suggests that if excessive debt plays a role independently from the magnitude of the recession or the occurrence of financial crises, then the effect should be similar across types of episodes.

To evaluate the importance of debt run ups, we should compute the different recession paths accounting for credit excess. Given the availability of data on credit excess, the usable sample of business cycles peaks is reduced to 245, of which 65 are associated with financial crisis, 89 exhibit excess credit and 98 recessions are considered big.

Since the number of big financial and small financial recessions preceded by abnormal debt to GDP ratio growth are just 22 and 12 respectively, the assessment of the effect of a debt run-up on the severity of a recession is done using credit excess variable (E) as previously defined instead of using a treatment dummy. To do so, the following regression is estimated:

$$\Delta_h y_{i,t+h} = \alpha + \alpha_i + \beta_{bf} B_{i,t} * F_{i,t} + \beta_{bn} B_{i,t} * N_{i,t} + \beta_s S_{i,t} + \beta_{bfd} B_{i,t} * F_{i,t} * E_{i,t} + \beta_{bnd} B_{i,t} * N_{i,t} * E_{i,t} + \beta_{sd} S_{i,t} * E_{i,t} + U_{i,t} \quad (4)$$

We already showed that financial recessions are only different from non-financial conditional on being deep. As a consequence, in equation 4 the interaction between the dummies small and financial is excluded. This means that we are having results for small recessions, big non-financial and big financial episodes. This should not make a big difference in terms of the interpretation of the results since they are focused on the contribution of debt overhang to deep recessions and speed of recovery.

As can be noted by the results reported in Table 5.1, the significant effects on the recession paths vary widely among types of episodes. All episodes seem to be deeper when accompanied by excessive debt. While the most significant effects are for big non-financial recessions. For the latter, one percentage point of credit excess implies an additional cumulative output loss of 2.111% with respect to the peak after 5 years on average. This is much bigger than the average effect on small recessions (0.41%).

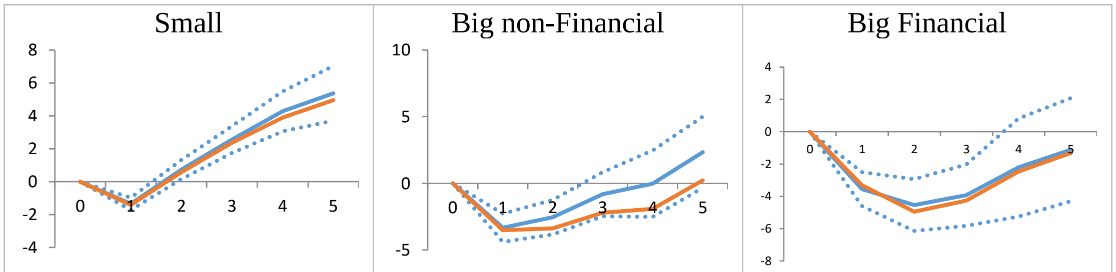
Table 5.1 Regression results: Interactions with credit excess from peak

VARIABLES	Year 1	Year 2	Year 3	Year 4	Year 5
Small x Credit Excess	-0.0647**	-0.148*	-0.197*	-0.376**	-0.410**
	(0.0251)	(0.0748)	(0.112)	(0.132)	(0.146)
Big x Credit Excess	-0.183	-0.835***	-1.386***	-1.898***	-2.111***
	(0.189)	(0.186)	(0.376)	(0.615)	(0.587)
Financial x Credit Excess	0.231	-0.411**	-0.340	-0.248	-0.213
	(0.136)	(0.147)	(0.295)	(0.339)	(0.410)

Notes: Robust standard errors in parentheses
Significance levels: *** p<0.01, ** p<0.05, * p<0.1
Source: Authors Calculations

On the other hand, it seems that most of the effect of debt run ups recessions is concentrated in the magnitude of the output loss and that it only affects the paths of big non-financial episodes (Figure 1.6). This is confirmed by the results of the regression from the trough reported in Table 5.2, according to which there are no significant effects of debt run-ups on growth rates during the recoveries at 5% of significance for every type of episode.

Figure 5.2 Typical recession paths and debt run-up effect.



Recession path
Recession path with 1 percentage point of credit excess

Notes: Error bands at 95% of significance.
Source: Authors Calculations

The rationale for this could be associated with two effects of debt run-ups. Firstly, if this is due to a high public debt, governments will be forced to pursue fiscal consolidation programmes causing an initial deeper output loss. Secondly, financial frictions literature suggest that negative shocks associated with financial crises, restrict credit and slow the pace of investment delaying recovery (e.g. Bernanke and Gertler, 1989; Gertler et al., 2010). Notwithstanding, this channels seem to be affecting only the magnitude of the recession itself but no hurting the growth potential of the economy on the medium run.

Table 5.2 Regression results: Interactions with credit excess from trough

VARIABLES	Year 1	Year 2	Year 3	Year 4	Year 5
Small x Credit Excess	-0.0824	-0.0620	-0.275*	-0.291*	-0.259
	(0.0766)	(0.125)	(0.134)	(0.161)	(0.229)
Big x Credit Excess	0.157	-0.0290	0.0677	-0.248	0.157
	(0.139)	(0.273)	(0.367)	(0.527)	(0.566)
Financial x Credit Excess	0.00968	0.538	0.666	0.861	1.048
	(0.200)	(0.583)	(0.696)	(0.848)	(0.713)

Notes: Robust standard errors in parentheses
Significance levels: *** p<0.01, ** p<0.05, * p<0.1
Source: Authors Calculations

To sum up, credit excess has a significant effect on the severity of the recession but not on the speed of recovery. This effect is less important for small recessions and for recoveries from big financial recessions. Given their mixed significance, it is needed to check whether debt accumulation effects disappear once controls are introduced in section 6.

6 ROBUSTNESS CHECK: INCLUDING ECONOMIC COVARIATES

The results reported in the previous section suggest that recessions that are big are significantly different from small recession but only with respect to the size of the shock. This is, the magnitude of the loss is not associated with a slower recovery. This is also true for financial recessions. Regarding the effect of debt on recessions and recovery paths, findings from previous literature (Jordà, et al., 2013) are somewhat confirmed with some caveats. Big non-financial recessions are the most significantly affected by excessive debt accumulation. Excess debt growth has a magnifying effect on output loss, but growth during the recovery seem to be not significantly affected. As with size and financial crisis effect, debt overhang seem to play no role determining the speed of recovery, defined as the growth rate during the recovery.

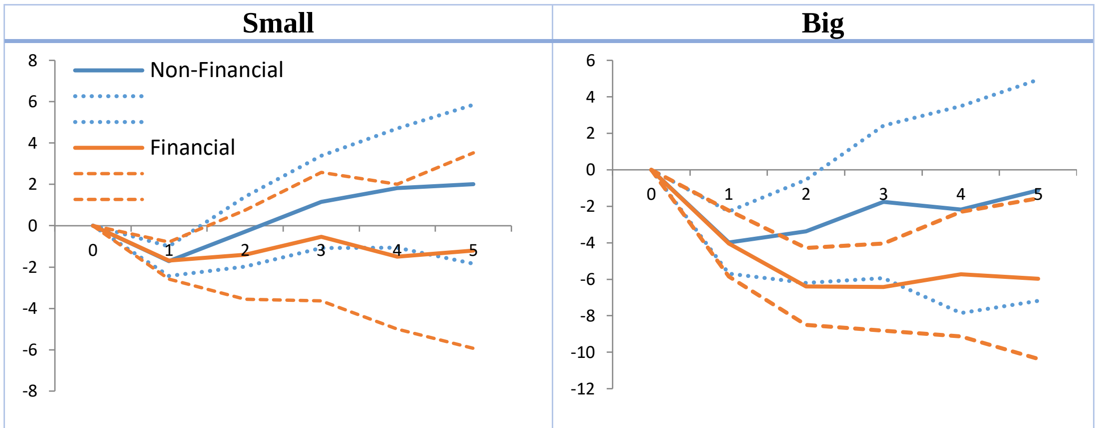
Notwithstanding, these results are not entirely believable, since omitted variable bias could be present. This is, the dynamics of output growth is determined by more factors apart from the nature of the crisis or whether the recovery is caused by a big or a small shock. To remove this possible bias, regression 3 is modified by introducing economic controls as follows:

$$\Delta_h y_{i,t+h} = \alpha + \alpha_i + \sum_j \beta_j T_{j,i,t} + \sum_{k=0}^{K} \Gamma_k X_{i,t-k} + U_{i,t} \qquad (5)$$

Where $(\alpha + \beta_j)$ is a point of the average recession or recovery path associated with treatment $T_{j,i}$. Notice that here treatment j refers to the interaction of financial dummies with size dummies, such that we are having 4 groups as in equation 3. Finally, $X_{i,t-k}$ is a matrix of economic controls.

For comparability with the results reported by Jordà et al. (2013) in what follows I am reporting the results of this regression when including the same controls used by them. These controls are: the growth rates of real GDP per capita and real total loans per capita, the CPI inflation rate, the short-term and long-term interest rates, the investment to GDP and the current account to GDP ratios. Controls are included contemporaneously and lagged one period.

Figure 6.1 Recession paths estimation including controls



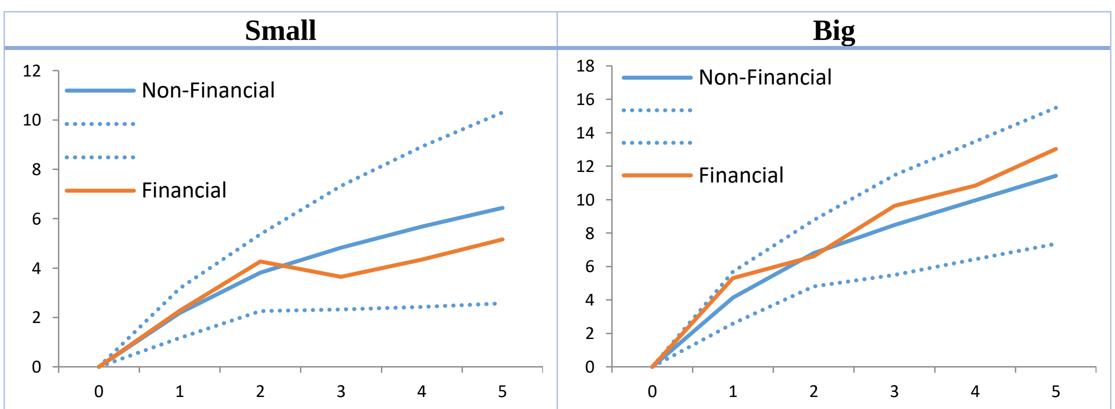
Notes: Error bands at 95% of significance.

Source: Authors Calculations

The results reported in Figure 1.7 are consistent with the ones found with regression 3. Small recession are statistically the same whether financial or not. Big recessions are deeper than small ones and when they are accompanied by a financial crises they experienced a second year of negative growth and therefore the output loss associated with them is bigger.

When the analysis is made for recovery paths (Figure 1.8.), we can conclude that average growth rates during recovery are not affected significantly by the nature of the crisis and that big recessions are recovering at a higher growth rate than small recessions. This is also a robust result from previous sections.

Figure 6.2 Recovery paths estimation including controls



Notes: Error bands at 95% of significance.

Source: Authors Calculations

In section 5 we found that debt run-ups have a significant impact on the magnitude of the recession especially for big non-financial recessions. Again, to confirm those results, we run a regression with controls $X_{i,t-k}$ as in equation 6 including treatment dummies for small, big non-financial and big financial episodes. Interactions between these three dummy variables and the excess credit variable are also included.

$$(6) \qquad \Delta_h y_{i,t+h} = \alpha + \alpha_i + \sum_j \beta_j T_{j,i,t} + \sum_j \delta_j T_{j,i,t} * E_{i,t} + \sum_{k=0}^{K} \Gamma_k X_{i,t-k} + U_{i,t}$$

In this specification the δ_j parameters are giving us the impact of 1 additional percentage point credit excess on the recession and recovery paths for the average episode of type j. As can be seen in Table 6.1, these coefficients are only significant at the 5% for small recessions in year 1 and for big non-financial recessions from the second year onwards. [9]

Table 6.1 Regression results: Interactions with credit excess from peak

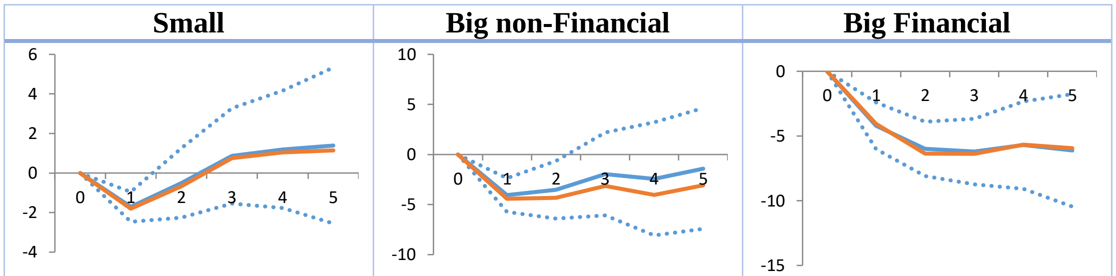
VARIABLES	Year 1	Year 2	Year 3	Year 4	Year 5
Small*Credit Excess	-0.0961**	-0.163*	-0.105	-0.155	-0.246
	(0.0381)	(0.0814)	(0.120)	(0.132)	(0.184)
Big*Credit Excess	-0.372*	-0.805**	-1.203**	-1.622**	-1.691**
	(0.199)	(0.287)	(0.501)	(0.676)	(0.645)
Financial*Credit Excess	0.153	-0.374*	-0.178	0.0321	0.166
	(0.145)	(0.184)	(0.288)	(0.317)	(0.382)

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
Source: Authors Calculations

Furthermore, it can be seen in Figure 1.9 that on average credit excess negatively affects growth for big non-financial recessions, such that the contribution keeps growing until it reaches about 1.7 additional percentage points of output loss after 5 years. It is also noticeable that once controls are introduced the significance of the effect of credit excess on small and big financial recessions diminishes.

[9] One possible explanation for the effect on big financial recessions to be less important could have to do with the dummy variable associated with them already picking up some of its effect.

Figure 6.3 Regression results: Interactions with credit excess from peak



____ Recession path
____ Recession path with 1 percentage point of credit excess

Notes: Error bands at 95% of significance.

Source: Author's calculations

When the regression is run taking the trough as a reference point, I found that credit excess has a significant impact at 5% only for recovery paths from a big financial recession on years 2 and 5. It can be seen in Table 6.2 that from the second year of recovery, the accrued growth is significantly pushed upwards. This results goes against the argument that debt overhang help to explain slow recoveries.

Table 6.2 Regression results: Interactions with credit excess from peak

VARIABLES	Year 1	Year 2	Year 3	Year 4	Year 5
Small*Credit Excess	-0.0138	0.150	0.0466	-0.0942	-0.123
	(0.105)	(0.166)	(0.174)	(0.199)	(0.259)
Big*Credit Excess	0.379	0.439	0.663	0.451	0.744
	(0.242)	(0.346)	(0.472)	(0.598)	(0.631)
Financial*Credit Excess	0.158	1.010**	1.164	1.339*	1.450***
	(0.204)	(0.380)	(0.680)	(0.760)	(0.471)

Robust standard errors in parentheses

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

Source: Author's calculations

Therefore, we can conclude that excessive debt accumulation during the expansion preceding a recession. Help to explain the magnitude of the output loss, especially for big non-financial recessions. On the other hand, I did not find statistical evidence supporting the claim that debt overhang is associated with slower recoveries. Therefore, the analysis made in this paper only supports a positive effect of the magnitude of recessions on the speed of recovery. This finding is analysed in the next section when comparing it with what a standard business cycle model implies.

7 Size Effect Revisited

The analysis presented in this paper showed that the financial nature of the recession and the debt over hang seem not to be associated with growth rates variability during recoveries. In fact, the size of the recession is the only factor playing a statistically significant role. Contrary to what some authors suggest (v.g. Romer & Romer, 2015), big recessions are not associated with sluggish recoveries, but with faster growth rates during the recovery phase. This implies that the size of the shock is not positively correlated with persistence of the recession.

In a similar way to Romer and Romer (2015), Stock and Watson (2012) concluded that the 2007-2009 recession in the US was the product of bigger and more persistent shocks. Both of these studies suggest a positive relationship between size and persistence of the recessions. Moreover, they conclude that the mechanisms of the crisis plays no or a limited role determining the magnitude and persistence of a recession.

Assuming that those authors are right and the size of the recession is associated with a higher persistence, then a simple DSGE model should be enough to recreate small and big recessions. More importantly, It should be enough to generate big recessions that are at the same time more persistent.

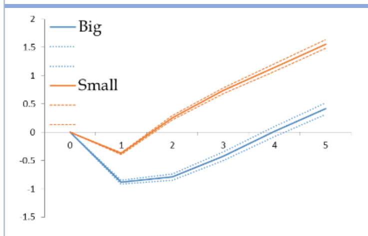
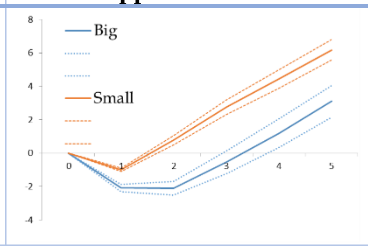
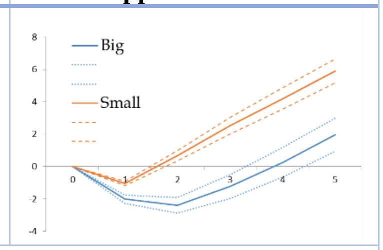
I test in this section whether theory supports the findings in this paper or the suggested positive association between persistence and size of the recession supported by the aforementioned literature. To do so, I use simulated series from a typical RBC model (King & Rebelo, 1999) and then I estimate the typical recession and recovery paths conditional on the size of the recession.

To make comparable the results from this Monte Carlo experiment with the results obtained from the data presented previously, I use the same calibration as in King and Rebelo (1999) and add a trend to the stationary data obtained from the simulation. Then, I add 4 consecutive data points to form an annual observation. Finally, as before I identify turning points using the Bry and Boschan (1971) algorithm and estimate the impulse responses by local projections methods (Jordà, 2005).

Additionally, the error bands are computed as the by-result of estimations for 10,000 rounds of simulations.

The results reported in Figure 1.10 look overwhelmingly similar to those obtained from the estimation of equation 1 using empirical data. A typical big recession has two consecutive years of negative growth, 1 more than an average small recession. Additionally, the characteristic growth path during the recovery from a big recession is not significantly different from the recovery path from a small episode.

Figure 7.1 Typical recessions from simulated data

AR(1) plus trend	**RBC first order approximation**	**RBC second order approximation**
		
Notes: Error bands at 95% of significance.		
Source: Author's calculations		

The previous result might have nothing to do with the fitness of the RBC model. As seen in Figure 7.1, when replicating the exercise for a typical AR(1) process plus trend we obtained very similar results to the ones obtained with a linear approximation of the RBC model. A bigger shock produces a deeper initial fall in output. What the non-linearities of the model are adding is the amplification of the shock to the second year.

This means that even in theoretical models the size and persistence of the shocks are not enough to explain the business cycle dynamics. Amplification and transmission mechanisms are important to determine the effect of the shock in a DSGE model. In the case of a standard RBC model, the amplification mechanisms (general equilibrium dynamics and non-linearities) help to determine the duration of the recession (the number of periods with negative growth).

Therefore, some economic mechanisms should be explaining both deep recession and slow recoveries (apart from the description of the data as an AR processes). Popular mechanisms are financial frictions and policy shocks. The former may produce credit crunches during the recovery affecting investment dynamics, while the latter may affect output growth if government are restricted in the use of policy instruments, for instance by a fiscal consolidation programme or a zero lower bound (Gali, et al., 2012). Evaluating these explanation is out of the scope of the purpose of this essay. It is lead for future research to evaluate empirically what factors –apart from the ones evaluated in the previous sections of the paper– might explain slower recoveries and whether theoretical models account for them.

8 CONCLUSIONS

In this paper, I test the views that big recessions and slow recoveries are the consequence of the financial nature of the crises or the by-product of bigger and more persistent shocks. To do so, I estimate by local projections the recession and recovery paths conditional on size and financial nature of the crisis using annual data for 17 countries (Jordà, et al., 2017).

The evidence presented here allows to conclude that financial recessions are more painful than normal recessions conditional on them being big enough. Furthermore, it can also be concluded that the severity of the recession is, if something, associated with faster growth during recoveries. Besides, recoveries from financial crises are not significantly slower in general.

On the other hand, the claim that deep recessions and slow recoveries are the by-product of bigger and more persistent shocks (Romer and Romer, 2015; Stock and Watson, 2012) is an incomplete answer. Using simulated data from a simple RBC model, I concluded that non-linearities play a role determining the magnitude and duration of a recession. Therefore, other factors such as rigidities and frictions may be responsible for the recession magnitude and the sluggishness of the recovery.

The role of debt run-ups was also evaluated. The evidence confirms partly Jordà et al. (2013) finding that debt accumulation play a role determining the magnitude of the recession.

Notwithstanding, the statistical evidence does not support that debt over-hang plays a role determining growth during recoveries. Further research is needed to unveil additional factors explaining both big recessions and slow recoveries.

8.1 APPENDIX: DATA DESCRIPTION

I use the Macro Financial data base gathered by Jordà, Schularick, and. Taylor (2017) (JST from now on). For comparability with Jordà et al (2013), I use the same variables they used in their full model. This is, the real per capita GDP, consumption per capita, investment to GDP ratio, total loans, population, price index, current account and the systemic financial crises identifier. The data is available for the following 17 countries: Australia, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States of America.

Systemic financial crisis variable.

To begin with, the financial crises dummy was build using previous literature results. In particular, Reinhart and Rogoff (2009) and Bordo et al. (2001) were used for most of the episodes and countries. These two references are the main contributors to the financial crisis dummy and therefore the definitions they use for systemic financial crises are worth to mention. For Bordo et al. (2001) a financial crisis is an episode of "financial-market volatility marked by significant problems of illiquidity and insolvency among financial-market participants and/or by official intervention to contain such consequences" (Bordo et al. 2001, pp 55).

Notwithstanding the definition of systemic financial crisis used by the authors is the one reported in Laeven and Valencia (2008). That is, financial crises are "events during which a country's banking sector experiences bank runs, sharp increases in default rates accompanied by large losses of capital that result in public intervention, bankruptcy, or the forced merger of major financial institutions" (Jordà et al., 2010, pp. 5). According to this, the financial crisis variable takes a value of one if in a given year for a given country an event with the characteristics mentioned before happened.

Real per capita GDP

The real per capita GDP is an index using 2005 as base year. This is a spliced series that relies on Barro and Ursua (2010) data base for the 1970-2004 period. Form 2005 onwards the series is completed using growth rates from the World Bank.

Real Consumption per capita

This is an index with 2006 as base year. As with the real per capita GDP, the main source for this information is the series collected by Barro and Ursua (2010) for the period 1901-2009. From 2010 onwards the series is completed using the World Bank Data on household final consumption expenditure per capita (constant 2005 US$, Chain linked).

Investment to GDP ratio

This is also a spliced series. Depending on the country the sources change. Although multiple sources are used, JST (2017) have tried to improve the robustness of the series by replacing multisource data on Nominal Gross Capital Formation with data form the IMF – International Financial Statistics for the post-WWII period. The investment ratio is then constructed by dividing the nominal gross capital formation by the nominal GDP. The latter is also a multisource data series that relies on the IMF – International Financial Statistics for the post-WWII period.

Total Loans

This variable refers to the total loans to non-financial private sector expressed in nominal terms in local currency. It is used to build the total loans to GDP ratio using the nominal GDP, as described before. This ratio is used to build the variable credit excess, which is defined as the deviation in percentage points from the historical average of the total loans to GDP ratio by phases of financial development as defined in Jordà et al. (2013).

The sources for the total loans are diverse among countries and depending on the case are completed using data form the IMF – IFS. For more information check the documentation of the JST (2017) database.

Population

The population is a series taken from the Madison Database (2008), Historical statistics of the world economy, for the period 1870 – 2009. It is completed with data on population growth form the IMF for the period 2009 – 2013. When the data was not available for a specific country in the main database it was completed with information form alternative sources. A special case is Finland, where the whole series (1870 – 2013) was taken from Statistics Finland (2016).

Price index

It is a collection of consumer price indexes with base year 1990. For most of the countries the series is based on A. Taylor (2002) A Century of Purchasing–Power Parity, Review of Economics and Statistics, vol. 84(1), p139–150. The series is completed with data on average consumer inflation from the IMF – World Economic Outlook.

Current account

Finally, the current account is a nominal, local currency series. It is used to compute the current account to GDP ratio, using the nominal GDP series as described before. The series is constructed from multiple sources. For more details check Jordà et al. (2017).

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