BIG RECESSIONS AND SLOW RECOVERIES

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ABSTRACT

It has been frequently claimed that financial crises are more painful and lead to slower recoveries partly because of excessive debt accumulation prior to the crisis (v.g. Reinhart & Rogoff, 2009; Hong and Tornell, 2005; Jordà, et al., 2013). This contrast with the view that magnitude and persistence of recessions are not associated with financial crises, instead they are simply the consequence of bigger and more persistence shocks (Stock & Watson, 2012). I evaluate whether any of these views is able to explain both, deep recessions and slow recoveries by computing average 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. But this effect disappears when the output loss caused by the recession is below the historical average. More importantly, neither the magnitude of the loss, nor the occurrence of financial crises, nor debt accumulation are associated with sluggish output growth during recoveries.

Keywords: Financial Crises, Deep Recessions, Slow Recoveries, Local Projections, Business Cycles, Debt Over-hang.

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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 financial crises 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 database gathered by Jordà et al. (2017).

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).

I found evidence that suggests that neither financial nature of the crisis nor the severity of the recession are 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 non-financial 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 magnitude and persistence of the underlying shock are determinants for both severity of the recession and speed of recovery, implies that standard DSGE models should be enough to explain these two features of the data. I analyse 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 determining the magnitude of the recession but it has no significant effect on output growth during the 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 let 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 real per capita GDP, consumption per capita, investment to GDP ratio, total loans, population, price index, current account and the systemic financial crises identifier.

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 (the real GDP) and perform the analysis in terms of how the 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 is 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 to classify recessions 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 recessions 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 1, this result in 71 out of 278 usable peak observations classified as financial.[1]

Table 1. Type of usable peaks by phases of financial development

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

In order to take into account 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 proposed in Jordà et al (2013)[2]. These phases are: pre-World War I period (1870-1914), interwar period (1918-1939), Bretton Woods period (1945-1971) and post Breton Woods period (1972-2013).[3] It is interesting to notice that there are no recessions 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[4].

Table 2.

Type of usable recessions by magnitude of the episode

	Non-Financial	Financial	Total
Small	138	35	173
Big	69	36	105
Total	207	71	278

[1] Episodes classified as financial by Jordà et al. (2013) are also classified as that following this methodology.
[2] This also allows for comparability of the results found in this paper with theirs.
[3] The use of an alternative partition of the data using the WWII as threshold does not change the qualitative results.
[4] The qualitative results hold, when we define big as output losses that are 1 standard deviation above the mean.

As can be seen in table 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.

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). This 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.

A first step to asses 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 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.

This suggest that financial crises are accompanied by more severe recessions on average. 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.

Table 3.

Average Output Loss 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	-4.1269	-1.9281	-1.2645	-1.8271	-6.8265	-6.7985	-6.8179
	(3.5518)	(3.9521)	(1.5124)	(1.5152)	(1.5234)	(4.4586)	(3.6424)	(4.1876)
Inter-Wars	-9.2770	-6.5479	-3.4129	-3.2632	-3.3318	-16.4442	-13.6648	-15.3324
	(11.7197)	(8.0778)	(4.6298)	(3.3222)	(3.8838)	(13.9407)	(10.9353)	(12.4799)
Bretton Woods	-1.2843	.	-0.7335	.	-0.7335	-1.8810	.	-1.8810
	(1.0997)	.	(.6438)	.	(.6438)	(1.1999)	.	(1.1999)
Post Bretton Woods	-2.2169	-4.2949	-1.2684	-1.7114	-1.3508	-4.4302	-5.7713	-5.0776
	(2.1378)	(2.9376)	(2.576)	(.)	(.)	(1.0369)	(2.5735)	(2.576)
Total	-3.4347	-4.8369	-1.7654	-2.1090	-1.8353	-6.7018	-7.5647	-6.9894
	(4.9929)	(5.2056)	(1.8956)	(2.4003)	(2.0057)	(7.1402)	(5.8234)	(6.714)

Notes: Standard deviations in parenthesis

In fact, differences between financial and non-financial episodes are reduced when the sample is divided by size. Then, it seems that the conclusion of financial recessions being in general more painful than normal recessions does not necessarily hold. This seem 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).

Regarding the speed of recovery, table 4 shows the average accrued growth 1, 2 and 3 years after the trough. This data suggest 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. This last results is confirmed by the regression analysis that is presented in the following sections of the paper.

This 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 they suggest 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).

Table 4.

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

Notes: Standard deviation in parenthesis

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 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):

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

Where $\Delta_h y_{i,t+h}$ 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 $shock_{i,t}$ is a dummy taking the value of 1 when the shock hits. In the context of this paper the dummy variables indicate either a peak or a trough and whether the recession associated to them has being 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 data base 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 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 CRISIS AND MAGNITUDE EFFECTS

It has being 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 so, then they should have different recession and recovery paths regardless of the size group. To evaluate this, following the strategy depicted in last section, I estimate these paths using local projections (Jordà, 2005). Initially, the following two equations with only dummy shocks are estimated:

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

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

Where 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 compute 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.

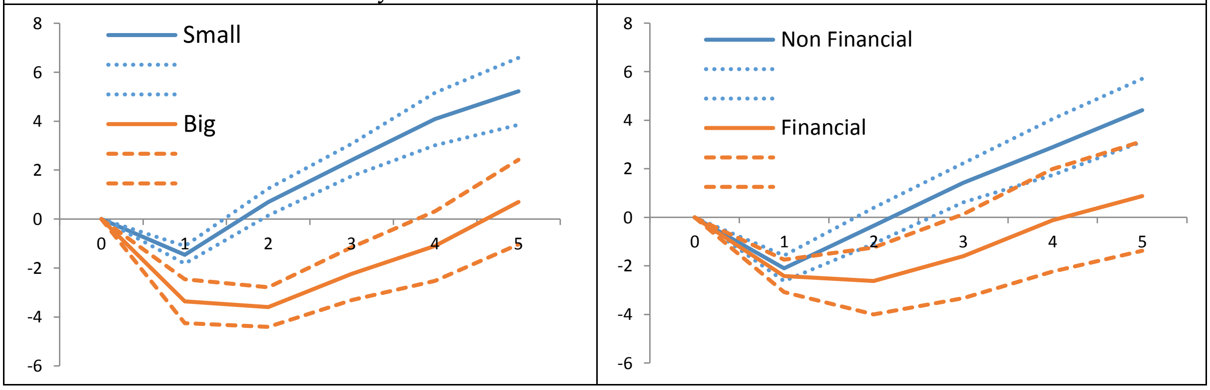
The estimation is done using panel data fixed effects and errors are clustered at country level. In this way, errors are allowed to be auto-correlated. Recession paths estimated using equation 2 (right panel of Figure 1) are qualitatively equivalent to the results reported in Table 5 in Jorda et al (2013).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

From this 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 recessions losses are fully recovered after one year, it takes two years to recover from a financial recession (this is until year 4).[5]

As can be noticed in Figure 1, this 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, as seen on Table 2. I will show latter that when grouped by size the financial crises matter only if the recession is severe enough. This is, there are no significant differences between normal and financial episodes when the 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.

Figure 1. Recession paths without controls

Recession Paths by Size	Financial non-Financial Recession Paths



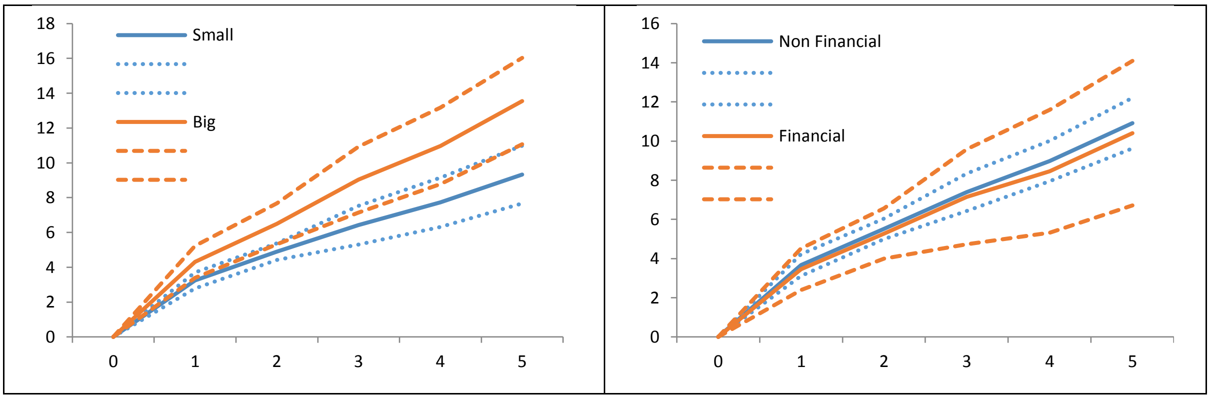
On the other hand, recovery paths estimations are reported in Figure 2. In this case, the sum $\alpha + \beta_j$ in equations 1 and 2 corresponds to the cumulative growth rate h years after the trough. The results from these estimations suggest that financial recessions do not seem to exhibit a significantly different recovery path from a non-financial recession (right panel Figure 2).[6]

Figure 2. Recovery paths without controls

Recovery Paths by Size	Financial non-Financial Recovery Paths

[5] This is no longer true when allowing a financial crisis episodes 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.

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



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. Which means, it takes longer to recover from a bigger loss at a given growth rate. This implies that other factors should be playing a role determining the speed of recovery.

Some previous findings for the US last three recessions, suggest that 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

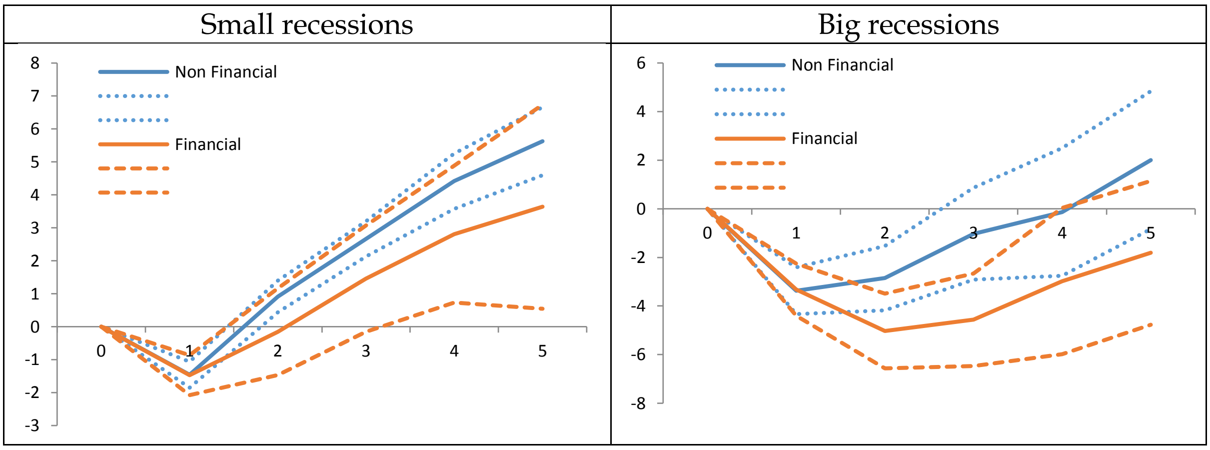
Up to know, the evidence presented shows a remarkable similitude of the results obtained using financial and size dummies. By interacting this two categories we can get further insight about the average recession and recovery paths. To do so, a regression of cumulative growth as a function of the interaction of the dummy variables is run. Specifically, the following equation is estimated:

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

Where 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.

The results of this regression are plotted in Figure 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 Jorda 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 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.

Figure 3. Recession paths grouped by size

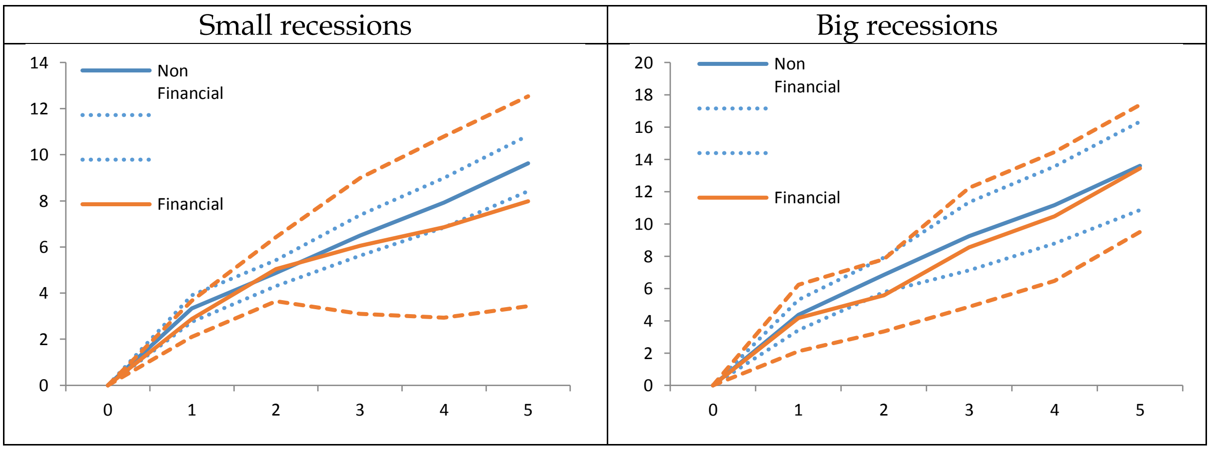


On the other hand, the average economy is fully recovered from a non-financial big recession 4 years after the trough. This numbers are considerable high when compared with the single year it takes for an average economy to recover from a small recession (whether financial or not). These results are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

Regarding recovery paths, 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.

Figure 4. Recovery paths grouped by size



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.

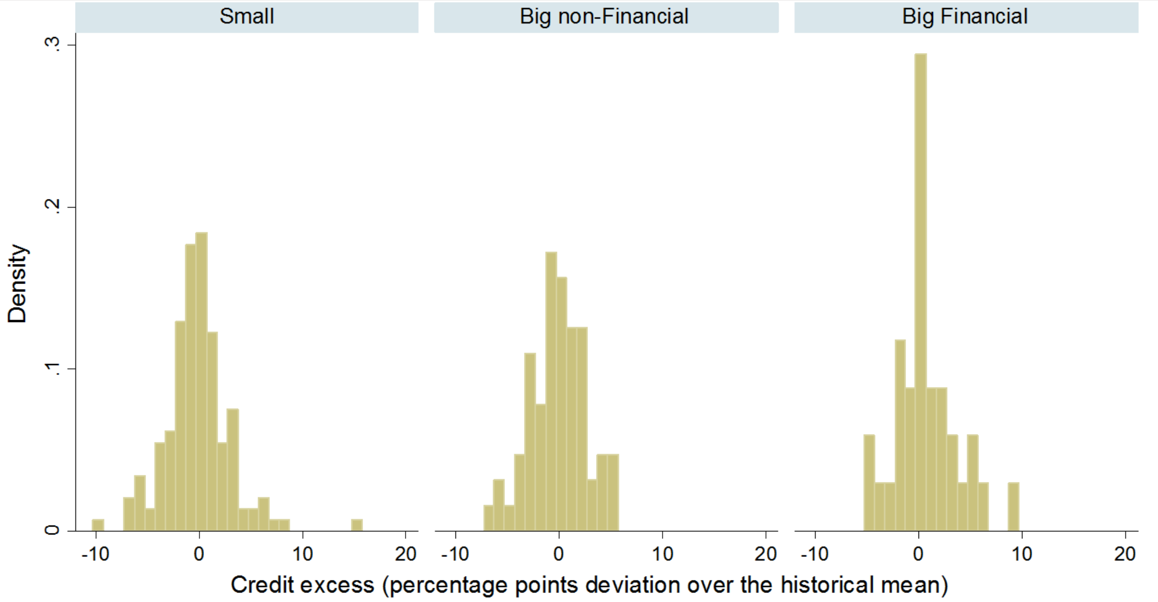
Notice that the results showed that the size of the recessions does not seem to determine the speed of recovery. But finding the determinants of the size of the recession might be important for the duration of the recovery. To do so we add to the analysis the most usual explanation in the literature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

As can be seen in Figure 5, 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 in Figure 5, 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.

Figure 5. Density of Credit Excess by Size and Financial Nature of the Crisis



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

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:

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

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.

Table 4. Regression results: Interactions with credit excess from peak

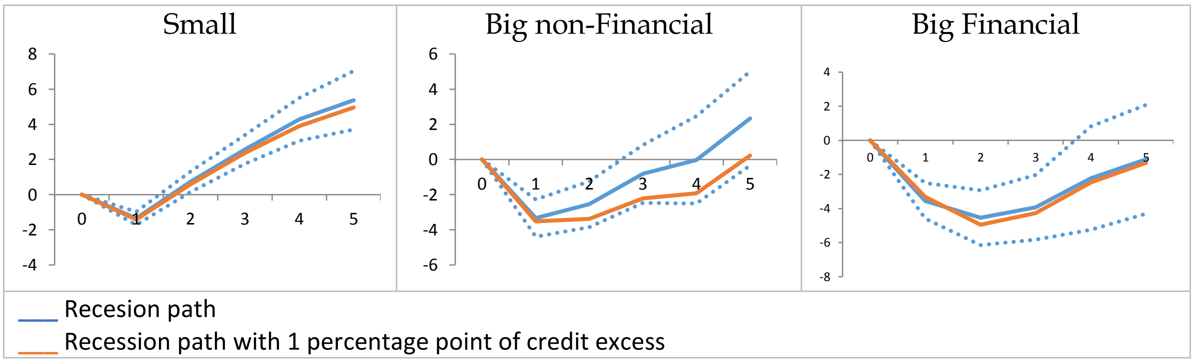
VARIABLES	Year 1	Year 2	Year 3	Year 4	Year 5
Small x (Credit Excess)	-0.0647** (0.0251)	-0.148* (0.0748)	-0.197* (0.112)	-0.376** (0.132)	-0.410** (0.146)

Big x (Credit Excess)	-0.183 (0.189)	-0.835*** (0.186)	-1.386*** (0.376)	-1.898*** (0.615)	-2.111*** (0.587)
Financial x (Credit Excess)	0.231 (0.136)	-0.411** (0.147)	-0.340 (0.295)	-0.248 (0.339)	-0.213 (0.410)

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

As can be noted by the results reported in Table 4, 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%).

Figure 6. Typical recession paths and debt run-up effect.



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 6). This is confirmed by the results of the regression from the trough reported in Table 5, 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.

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 (v.g. Bernanke & 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.

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

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

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: CONTROLLING FOR 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:

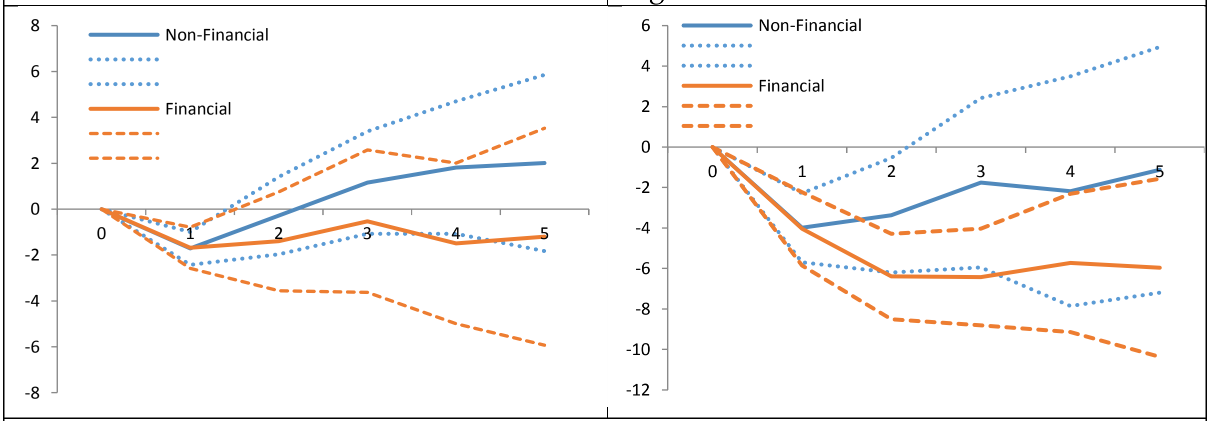
$$\Delta_h y_{i,t+h} = \alpha + \alpha_i + \sum_j \beta_j T_{j,i,t} + \sum_{k=0}^{K} \Gamma_k X_{i,t-k} + U_{i,t} \qquad (5)$$

Where $(\alpha + \beta_j)$ is a point of the average recession or recovery path associated with treatment $T_{j,i,t}$. 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 7. Recession paths estimation including controls

Small	Big



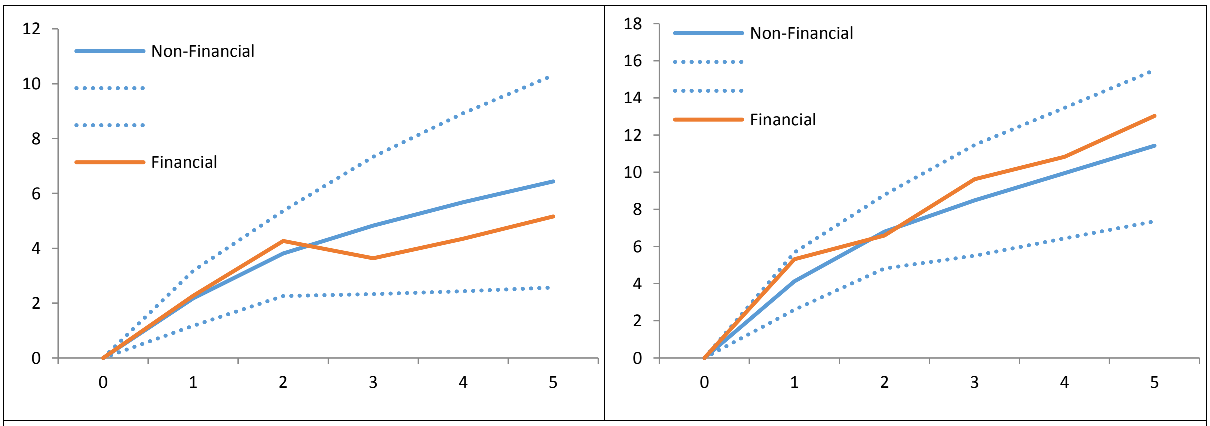
Notes: Error bands at 95% of significance.

The results reported in Figure 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 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 8. Recovery paths estimation including controls

Small	Big



Notes: Error bands at 95% of significance.

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 5 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.

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

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, 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.[7]

Table 6.

Regression results: Interactions with credit excess from peak

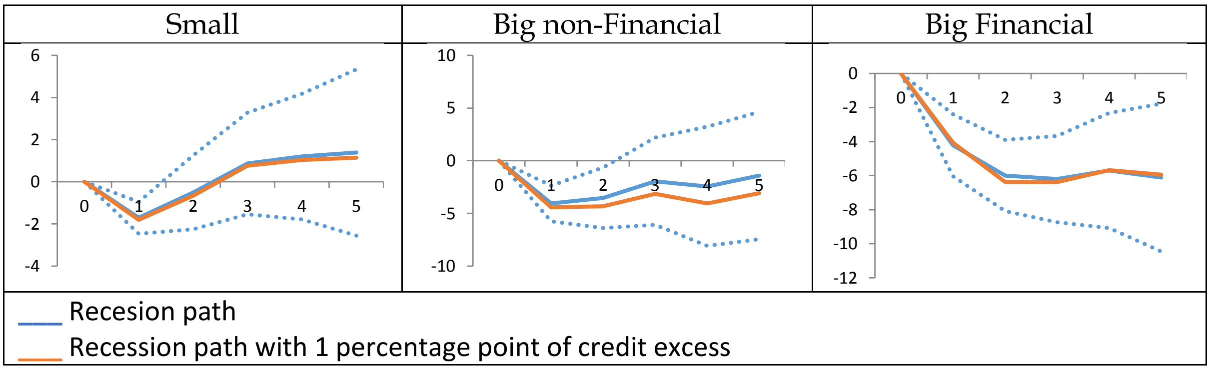
VARIABLES	Year 1	Year 2	Year 3	Year 4	Year 5
Small*(Credit Excess)	-0.0961**	-0.163*	-0.105	-0.155	-0.246
	(0.0381)	(0.0814)	(0.120)	(0.132)	(0.184)
Big*(Credit Excess)	-0.372*	-0.805**	-1.203**	-1.622**	-1.691**
	(0.199)	(0.287)	(0.501)	(0.676)	(0.645)
Financial*(Credit Excess)	0.153	-0.374*	-0.178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

[7] 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.

Furthermore, it can be seen in Figure 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.

Figure 9. Regression results: Interactions with credit excess from peak



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 7 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 7. 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

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

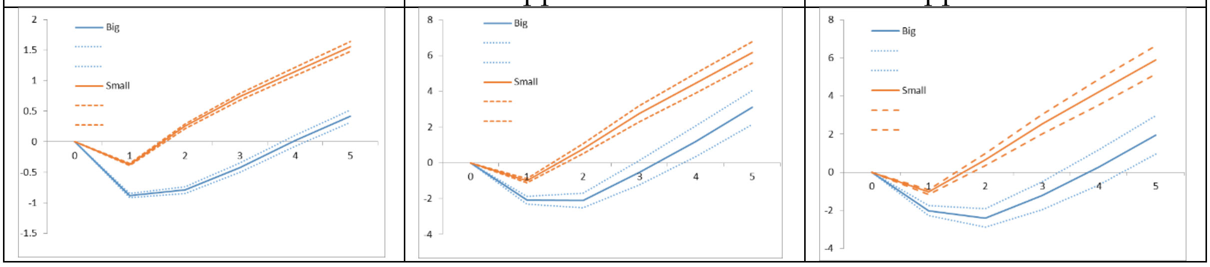
The analysis presented in this paper showed that the financial nature and the debt over hang seem not to be associated with growth rates variability during recoveries. In fact, the size of the recession is the only factor playing a statistically significant role. Contrary to what some authors suggest (v.g. Romer & Romer, 2015), big recessions are not associated with sluggish recoveries, but with faster growth rates during the recovery phase. Related to this, Stock and Watson (2012) concluded that the 2007-2009 recession in the US was the product of bigger and more persistent shocks. But is not clear whether persistency is associated with the size of the shocks or whether the type of shock is playing a role.

Using simulated series from an typical RBC model (King & Rebelo, 1999) and then estimating the typical recession and recovery paths conditional on the size of the recession, It is test in this section whether theory supports the findings in this paper or the suggested positive association between persistence and 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 & 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.

Figure 10. Typical recessions from simulated data

AR(1) plus trend	RBC first order approximation	RBC second order approximation



The results reported in Figure 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.

The previous result might have nothing to do with the fitness of the RBC model. As seen in Figure 5, 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

n 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 the size and financial nature of the crisis using annual data for 17 countries (Jordà, et al., 2017).

The evidence presented here allows concluding 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-products of bigger and more persistent shocks (Romer & Romer, 2015; Stock & 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 plays 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.

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