Credit contractions and unemployment*

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Abstract

This paper investigates the impact of private credit contractions on labor market performance. Impulse responses for youth, long-term, and overall unemployment are estimated using local linear projections for a panel of 20 OECD countries over the period 1980-2013. The empirical findings suggest that disruptions in the credit market can generate sizable and statistically significant unemployment fluctuations. The impact for youth unemployment is even more pronounced, while lasting effects on long-term unemployment emphasize the existence of a sluggish recovery. Moreover, labor market outcomes depend heavily on the financial leverage of an economy prior to the onset of a credit contraction. These results underline the important relationship between frictions in the financial sector and unemployment.

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1 Introduction

The overall impact of a financial crisis on unemployment is generally different across countries depending on numerous factors, including – among others – economic structure, labor market institutions, and the policymakers' response at different levels. Nevertheless, it is undisputed that the most recent crisis has severely deteriorated labor market perspectives across the globe. It is estimated that nearly 202 million people, of which, 74.5 million young – aged 15-24 – were unemployed in 2013 worldwide, an increase of about 31.8 million – including 4.6 million young people – since the onset of the financial crisis in 2007 (ILO, 2014). OECD economies exhibited a massive increase of 15.2 million in total unemployment and 2.6 million in youth unemployment during the same period. Remarkably, youth unemployment has become one of the most urgent issues to deal with, characterized by a substantial rise as well as slow recovery (Verick, 2009; Bell and Blanchflower, 2011). The topic is of great importance, mainly due to the broader consequences of unemployment that policymakers should care about. Rising unemployment may lead to scarring effects – i.e., negative long-term effects on future labor market prospects –, social and/or political unrest, and growing inequality in the long run (Matsumoto, Hengge, and Islam, 2012).

This article investigates empirically the relationship between credit market frictions and unemployment. The Great Recession that started in 2007 has led to renewed interest in the potential linkages between the financial sector and labor market outcomes, and there is compelling evidence that frictions underlying financial crises primarily – although not exclusively – derive from imperfections in the credit markets (Schularick and Taylor, 2012).[1] In this regard, there are two main credit transmission channels at work. According to the first, credit imperfections affect unemployment through a financial accelerator mechanism, which amplifies and propagates shocks that arise in other sectors of the economy (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). The second channel is based on shocks that originate directly in the financial sector (see, e.g., Quadrini, 2011; Jermann and Quadrini, 2012; Kiyotaki and Moore, 2012). These credit market disturbances affect the ability of borrowing, as credit tightening generates a cut on financing

[1] Such disruptions may arise from the tightening of collateral or credit constraints, heightened uncertainty, reduced risk-bearing capacity of the financial intermediaries, or informational asymmetries.

new investment and vacancies. Related contributions suggest that perturbations in the financial sector have a sizable effect on business cycle fluctuations (e.g., Gilchrist and Zakrajsek, 2012; Meeks, 2012). In addition, Jermann and Quadrini (2012) show that financial shocks are transmitted to the real economy through the demand of labor.

Focusing on credit market frictions as a potential source of unemployment fluctuations is motivated by the second channel, according to which perturbations in the financial markets propagate directly to the real economy. Hence, the goal of this paper is to explore the empirical relevance of credit markets for unemployment dynamics, while taking account of labor market institutions.[2] In particular, the main contribution lies in investigating to what extent contractions in the private credit market affect youth, long-term, and overall unemployment, in a panel of 20 OECD countries, spanning the period 1980-2013. Moreover, since the financial fragility of an economy increases – along with excessive risk-taking and lower lending standards – as private debt piles up, the article explores the hypothesis that credit contractions, which arise after highly leveraged credit expansions tend to be followed by more severe unemployment and slower recovery.[3]

A dynamic approach provided by Jordá (2005) is applied to assess the magnitude and persistence of the negative impact of credit contractions on the labor market. The estimation of impulse response functions with local linear projections has several attractive features. First, it does not require the specification and estimation of the true multivariate system itself, and impulse responses can be calculated in a simple univariate framework. Second, local projection techniques – based on multi-step direct forecasts – are robust to the misspecification of the data generating process. Lastly, the method can conveniently accommodate nonlinearities in the response function.

The article's main findings suggest that disruptions in the private credit market can generate sizable and statistically significant unemployment fluctuations. According to the estimation results, a credit contraction in an OECD country is typically followed by an increase in total unemployment of nearly 1% at the peak. In addition, severe credit busts

[2] A rich set of works focuses on the role of labor market regulations in explaining differences in unemployment patterns (see, e.g., Blanchard and Wolfers, 2000; Nickell, Nunziata, and Ochel, 2005; Feldmann, 2009).

[3] Articles that discuss the importance of financial leverage and systemic fragility preceding economic downturns include Sharpe (1994) Rajan (2005), Perri and Quadrini (2011), Pagano and Pica (2012), Boeri, Garibaldi, and Moen (2012, 2013), Claessens and Kose (2013), and Gorton and Ordonez (2014).

are coupled with greater rise in unemployment than that of milder credit downturns, with differences amounting to 2% in the medium term. Furthermore, this paper provides evidence that sharp declines in private credit preceded by expansions with higher financial leverage trigger, on average, more severe unemployment. The impact on young workers is even more pronounced, increasing the rate of youth unemployment by about 2.5%, two years after the beginning of a contraction. Lasting effects on long-term unemployment point toward persistence and sluggish recovery. Finally, joblessness depends on labor market institutions, with more rigid labor market regulations associated with greater unemployment.

The remainder of the paper is organized as follows. Section 2 reviews the linkages between the financial sector and the labor market. Section 3 introduces the data and presents some preliminary analyses. Section 4 details the methodological framework and describes the empirical results, and finally, Section 5 concludes.

2 Related Literature

There is a large body of works that focuses on how adverse macroeconomic shocks affect labor market outcomes (e.g., Bruno and Sachs, 1985; Phelps, 1994; Blanchard and Wolfers, 2000). A rich literature explores the role of labor market institutions in accounting for the evolution of unemployment, and empirical evidence suggests that unemployment dynamics largely depends on the flexibility of these institutions (Scarpetta, 1996; Nickell, 1997; Blanchard and Wolfers, 2000; Botero, Djankov, Porta, and Lopez-De-Silanes, 2004; Nickell et al., 2005; Bassanini and Duval, 2009; Feldmann, 2009; Bernal-Verdugo, Furceri, and Guillaume, 2012). Moreover, Kawaguchi and Murao (2012) find that labor market regulations affect age-specific cohorts differently, with stricter policies especially raising youth unemployment rates.

More recent articles investigate the impact of financial crises on labor market performance and unanimously conclude that the aftermath of banking crises is associated with deep and lasting effects on unemployment, exacerbating the negative impact that recessions bring about (Reinhart and Rogoff, 2009a; Boeri et al., 2012; Calvo, Coricelli, and Ottonello, 2012; Bernal-Verdugo, Furceri, and Guillaume, 2013). In addition, a handful

of studies argue that highly leveraged countries – that are more dependent on finance – are more vulnerable during financial recessions. Pagano and Pica (2012) and Boeri et al. (2012, 2013) show using firm- and industry-level data that in financial crises, employment growth suffers disproportionately more in economies in which firms rely more heavily on external finance.[4]

Besides analyzing the effects of financial downturns on the real economy, the years following the start of the latest recession have witnessed a burgeoning of studies on the driving forces behind crisis events. Claessens, Kose, and Terrones (2009, 2012) and Mendoza and Terrones (2012) emphasize the importance of developments in financial and housing markets for business cycle fluctuations. A series of recent works demonstrate that financial crises can be regarded as credit booms gone bust (see Jordá, Schularick, and Taylor, 2011; Taylor, 2012a, b; Schularick and Taylor, 2012; Jordá, Schularick, and Taylor, 2013a).[5] In a historical analysis, these studies provide statistical evidence that financial crises in advanced economies originate strictly from developments in the financial sector, and there is no systematic correlation with either preceding inflation rates, current account deficits, or growth in public debt levels.[6] Moreover, the expansion of public debt tends to aggravate the effect only in the aftermath of the crises, resulting in more prolonged periods of recession (Jordá et al., 2013a). In contrast, domestic private credit growth is typically above normal before a financial crisis event, and even more, Jordá, Schularick, and Taylor (2013b) show that the credit intensity of an expansion phase prior to the onset of a crisis is closely associated with the severity of the recession. Thus, these articles corroborate the finding that private credit is the single reliable predictor of financial crises. Yet, linkages between the credit market and unemployment dynamics have

[4] In an earlier paper, Sharpe (1994) documents that highly leveraged firms experience greater variation in employment over the business cycle.

[5] A number of earlier studies have already established a strong relationship between the financial system – endogenous credit booms in particular – and economic instability (see, e.g., Kindleberger, 1978; Eichengreen and Mitchener, 2003). In addition, the seminal work of Reinhart and Rogoff (2009b) provides a comprehensive analysis on financial fallouts throughout history, and further supports these findings. For a discussion of the role of credit booms in macroeconomic fluctuations, see, for instance, Hume and Sentance (2009). Nonetheless, Schularick and Taylor (2012) assert that most of these studies lack statistical evidence.

[6] Previous papers that examine credit expansions preceding financial crises in emerging market economies include McKinnon and Pill (1997) and Reinhart and Kaminsky (1999). A more recent work by Mendoza and Terrones (2012) investigates credit booms in 61 emerging and industrial countries over the 1960-2010 period, and finds that credit expansions are similar in size across each group of countries, and are often followed by financial crises.

received less attention in the literature.

The dominant stream of related works are based on the seminal papers by Bernanke and Gertler (1989), Bernanke, Gertler, and Gilchrist (1996), Bernanke, Gertler, and Gilchrist (1999) and Kiyotaki and Moore (1997), which explain how financial market imperfections amplify and propagate shocks – that originate in other sectors – to the real economy through an accelerator mechanism. The underlying research suggests that endogenous developments in the financial sector, such as credit market imperfections, can significantly deteriorate labor market performance through the decline in production and investment (see, e.g., Acemoglu, 2001; Wasmer and Weil, 2004; Dromel, Kolakez, and Lehmann, 2010). Acemoglu (2001) reveals that differences in the European and U.S. credit markets due to financial system regulations lead to differences in long-run unemployment dynamics. Dromel et al. (2010) analyze the role of credit constraints on the speed of adjustment to steady-state unemployment and find that credit market imperfections increase the persistence of joblessness. Wasmer and Weil (2004), and more recently, Petrosky-Nadeau and Wasmer (2013), and Petrosky-Nadeau (2014) focus on the complementarity between search frictions in credit and labor markets. They show that credit imperfections aggravate the negative effect of labor market frictions on unemployment, but intense competition in the credit market enlarges the favorable effect of labor market deregulation.[7]

Another credit channel relies on the hypothesis that shocks, which arise directly in the financial sector can translate into the real economy. Quadrini (2011) proposes a possible mechanism by which exogenous forces can emerge in the financial markets, based on asset bubbles. Such bubbles can generate asset price movements that affect the real economy through the tightening of the borrowing constraint. The role of financial shocks has been discussed in numerous papers, including Gertler and Karadi (2011), Helbling, Huidrom, Kose, and Otrok (2011), Quadrini (2011), Jermann and Quadrini (2012) Kiyotaki and Moore (2012), and the findings suggest that these disturbances are especially important for business cycle fluctuations.[8] Furthermore, Quadrini (2011) and Jermann and Quadrini

[7] For an empirical contribution to the theory, see Gatti, Rault, and Vaubourg (2012).

[8] In an earlier paper, Benk, Gillman, and Kejak (2005) introduce credit technology and construct shocks to credit productivity in order to analyze the importance of financial development in shaping the business cycle.

(2012) argue that such perturbations have a sizable effect on labor market outcomes.[9] Jermann and Quadrini (2012) develop a model with debt and equity financing to explore the macroeconomic effects of disruptions in the financial sector and show that credit shocks have played an important role in capturing the dynamics of output and labor in the U.S. economy during the last decades. In particular, they find that financial shocks are transmitted to the real economy through the demand of labor. Finally, Bentolila, Jansen, Jimlénez, and Ruano (2013) and Chodorow-Reich (2014) analyze the impact of large credit supply shocks on firm-level employment in Spain and the U.S., respectively. Both articles exploit differences in lender health at the onset of the Great Recession, and provide evidence that bank lending frictions have a sizable effect on employment outcomes. Despite the predominantly theory-oriented studies, however, empirical works addressing the topic are limited. Hence, the aim of this paper is to contribute to the existing literature by providing novel evidence on the significant relationship between credit market disturbances and unemployment fluctuations at the aggregate level.

3 Data and preliminary analysis

3.1 Data

The study makes use of a cross-country dataset that covers 20 OECD economies spanning from 1980 to 2013.[10] The choice of sample period is justified by two reasons. First, as documented by Schularick and Taylor (2012), credit markets took time to recover in many countries after the collapse during World War II and grew very rapidly starting from the post-Bretton Woods era. Second, the paper innovates with respect to related literature by encompassing economic fluctuations following the most recent financial crisis.

The main data include annual series of output, unemployment, private credit, and a composite measure of labor market flexibility. Series of nominal GDP and overall unem-

[9] Monacelli, Quadrini, and Trigari (2011) propose and alternative transmission mechanism to capture the effect of financial disturbances on unemployment fluctuations. They embed financial market frictions in a matching model of the labor market with wage bargaining, where credit constraints affect the bargaining of wages. This channel also appears to be important for explaining the sluggish recovery that distinguishes financial crises from other recessions.

[10] The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

ployment rate are taken from the World Economic Outlook (WEO) database, while youth and long-term unemployment are from the OECD, Eurostat, and the World Bank's World Development Indicatiors (WDI) database.[11] The financial variable considered is credit to the non-financial private sector by domestic banks, and a balanced panel is obtained from a relatively new database constructed by the Bank of International Settlements (BIS).[12] Private credit series are converted into real terms using consumer price indexes (CPI) from the WDI database. Following Feldmann (2009), labor market flexibility is proxied by a composite indicator taken from the Economic Freedom of the World (EFW) database (Gwartney, Lawson, and Hall, 2013). The EFW component 'labor market regulations' measures labor market flexibility based on six sub-indicators: minimum wages; hiring and firing regulations; centralized collective bargaining; hours regulations; mandated cost of worker dismissal; and military conscription. The composite index as well as each sub-components are scaled to take values between 0 and 10, with higher values indicating more flexible labor market.[13] In addition, the paper uses an extensive set of other variables in the formal empirical analysis. A complete list of variables and their sources is provided in Appendix A.

3.2 Descriptive statistics

The aim of this paper is to explore the relationship between disruptions in the credit market and unemployment. Figure 1 displays the evolution of private credit together with total unemployment rate for the panel average over the last 33 years. It is evident from the figure that declining credit growth in a typical OECD country tends to be followed by an increase in the rate of unemployment. Notice that such negative comovement between the two time series existed already before the most recent financial turmoil, therefore pointing toward the existence of an important association between private credit contractions and

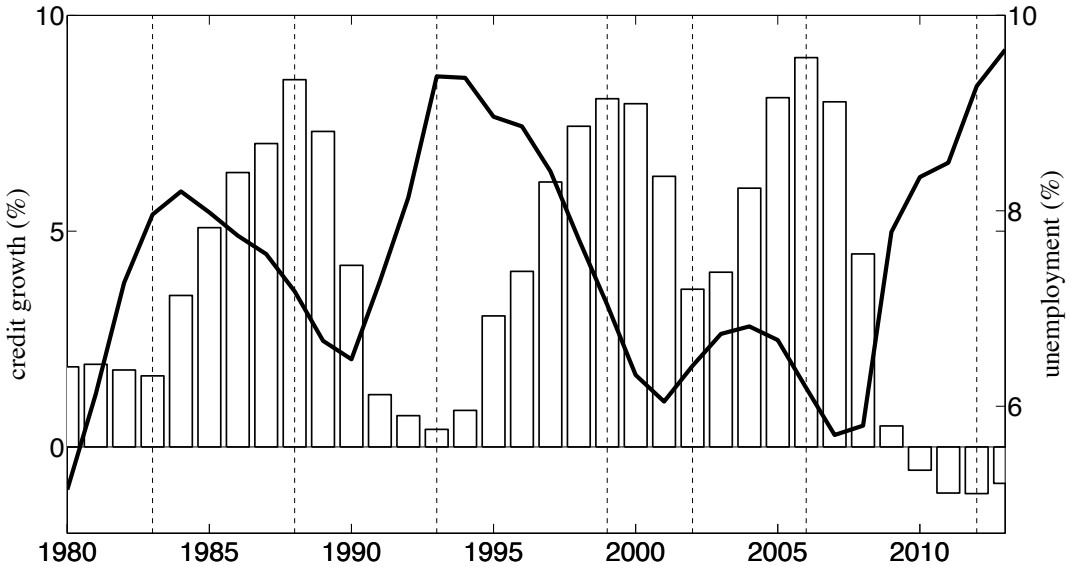
[11] Youth unemployment is defined as the share of the labor force aged 15-24 without work but available for and seeking employment. Long-term unemployment refers to the number of people with continuous periods of unemployment extending for a year or longer, expressed as a percentage of the total unemployed.

[12] The advantage of the data provided by the BIS is that the series are adjusted for breaks, which result from the combination of the various sources and methodological frameworks. Annual series are derived from quarterly data.

[13] See Feldmann (2009) for a comprehensive discussion on the conveniences of employing the EFW database.

joblessness.

Figure 1: Private credit and unemployment between 1980 and 2013, OECD average



Note: The sample period is 1980-2013 and annual averages are shown for 20 OECD economies. Annual change in private credit (bars, left axis, %) is plotted against total unemployment rate (solid line, right axis, %).

The upper panel of Table 1 reports summary statistics for the three measures of unemployment, private credit, private credit to GDP, and the composite index of labor market flexibility. One thing to notice is the disproportionately high ratio of average youth to overall unemployment that stands at 2.1. This suggests that youth unemployment has been a problem in many countries for several decades, and raises the issue of negative long-term consequences for the young as well as for the society as a whole. Youth unemployment in Southern European countries like Greece, Italy, or Spain is of particular concern, where it accounts, on average, for nearly one third of the labor force aged 15-24. Private credit is a variable trending generally upward over time, with mean growth of 4% per year. In financial recessions however, the trend is muted, exhibiting even negative growth rates in some occasions. This also applies to the ratio of private credit to GDP, a commonly used measure that captures the financial leverage of an economy.

The lower panel of Table 1 presents the correlation matrix for the key variables of interest. All cross-correlation coefficients are significant at 1%. The outcomes are suggestive of a negative contemporaneous correlation among private credit and unemployment,

which is even stronger if the past values of credit are considered. Hence, fluctuations in private credit seem to lead unemployment. Moreover, there is a significantly negative association between labor market regulations and unemployment, which appears to be more pronounced for the long-term unemployment series. This implies that in OECD

Table 1: Descriptive statistics

	Mean	Std. dev.	Min	Max
Total Unemployment	7.5	3.3	0.2	27.3
Youth Unemployment	15.8	7.8	3.2	58.3
Long-term Unemployment	33.3	15.2	4.3	75.6
Private Credit Growth	4.0	2.1	-18.8	25.9
Private Credit to GDP	80.9	12.2	25.3	205.3
Labor Market Index	5.9	1.7	2.6	9.3

Cross-correlation	Total U	Youth U	Long-term U	Private Credit	Credit to GDP	Labor Market I
Total Unemployment	1					
Youth Unemployment	0.87	1				
Long-term Unemployment	0.52	0.56	1			
Private Credit	-0.28	-0.29	-0.42	1		
Private Credit to GDP	-0.16	-0.17	-0.39	0.38	1	
Labor Market Index	-0.21	-0.27	-0.39	0.42	0.25	1

Note: Summary statistics for labor market variables refer to rates of total (Total U), youth (Youth U), and long-term (Long-term U) unemployment. Private credit growth is annual change of credit to the non-financial private sector by domestic banks, and the private credit to GDP ratio measures the financial leverage of an economy. Labor Market Index (Labor Market I) refers to a composite indicator of labor market flexibility taken from the Economic Freedom of the World database, scaled to take values between 0 and 10, with higher values indicating a more flexible labor market. All outcomes in the correlation matrix are significant at 1%.

countries with more flexible labor markets, long-term unemployment is lower, that is, less people suffer a year or longer period of joblessness, on average. In addition, young people are affected more by the type of labor market institutions, most likely due to hiring and firing rigidities.

3.3 Cyclical properties of credit market contractions

This subsection summarizes the cyclical properties of the financial series considered. A credit cycle is defined as a sequence of expansionary and contractionary phases in the annual series of (log-levels of) real private credit, where an expansionary phase lasts from trough to peak, whilst a contractionary phase lasts from peak to trough. The dating method used to identify turning points (i.e., peaks and troughs) in the financial cycle is motivated by the seminal papers by Bry and Boschan (1971) and Harding and Pagan (2002), which analyze the business cycle characteristics of various macroeconomic variables. Other works that employ this approach in order to describe financial cycles include Pagan and Sossounov (2003), Drehmann, Borio, and Tsatsaronis (2012) and Claessens et al. (2009, 2012). The Bry and Boschan (1971) algorithm searches for local minima (troughs) and maxima (peaks) in the panel based on a set of criteria, and the three main cyclical measures calculated are amplitude, duration, and slope. The amplitude of an expansionary phase is defined as trough-to-peak change in private credit, while the amplitude of a contractionary phase measures the change in credit from peak to trough. The duration of an expansion is the number of years between a trough and the following peak. Similarly, the duration of a contraction is the number of years from a peak to the subsequent trough. Finally, the slope is growth rate per year of private credit, given by the ratio of amplitude over duration for each phase.

Since the main focus of the paper is to assess the impact of credit market downturns on unemployment, cyclical properties are obtained only for the contractionary phases, for both private credit and unemployment (Table 2). Note that each peak in the private credit series (hereafter, credit peak) refers to the start of a credit contraction. In addition, contractionary episodes are divided into two groups, depending on the severity of the fall in private credit. Following Claessens et al. (2009), a peak-to-trough credit contraction is classified as severe if the decline in private credit falls within the top quartile of all credit contractions, and non-severe otherwise. A total number of 52 credit peaks, and therefore, credit contractions are detected for the panel of 20 OECD economies over 1980-2013, of which 13 are identified as severe. A typical contraction lasts somewhat less than 3 years, with a peak-to-trough fall in private credit by 7.6%. Not surprisingly, the loss in se-

vere contractionary episodes is even sharper, accounting for an annual decrease of 4.31%. Moreover, severe declines in credit last on average more than two times longer than milder contractions. Table 2 also highlights a clear association between the severity of a credit contraction and unemployment. In particular, overall unemployment increases by about 2 percentage points during a contractionary phase, whereas labor market performance deteriorates significantly more during severe contractions (3.01%) compared to other episodes (1.25%). The summary statistics are similar for youth and long-term unemployment.

Table 2: Cyclical characteristics of private credit contractions and unemployment

Type of contraction	Private Credit			Total U	Youth U	Long-term U
	Amplitude	Duration	Slope	Amplitude		
All	-7.61	2.72	-2.48	1.97	3.98	1.97
Severe	-16.82	4.44	-4.31	3.01	5.12	7.68
Non-Severe	-3.81	1.96	-1.87	1.25	3.10	0.39
Low Leverage	-8.46	3.29	-2.52	1.42	3.10	-0.18
High Leverage	-13.10	2.93	-3.93	3.73	7.48	10.67

Note: The table shows the cyclical properties for credit market contractions (Private Credit) together with total (Total U), youth (Youth U), and long-term (Long-term U) unemployment during a contractionary phase, for a sample of 20 OECD countries between 1980-2013. Amplitude is peak-to-trough change in real private credit (in percent) and unemployment rates (change in levels, in percentages). Duration is the number of years from peak to trough. Slope denotes the rate of change per year during a contraction (in percent). Severe credit contractions correspond to peak-to-trough declines in private credit that fall within the top quartile of all credit contractions. High (low) leverage refers to contractionary phases that follow private credit expansions with high (low) leverage. All values are reported in means.

To complement the analysis, this study examines how the decline in unemployment varies with the financial leverage of an economy. The build-up of leverage is potentially linked to the severity of a downturn through increased systemic fragility due to greater risk-taking (see, e.g., Claessens and Kose, 2013; Gorton and Ordonez, 2014). Consequently, economies in which firms depend more on external finance may be hit more heavily when a credit contraction occurs, as a subsequent deleveraging triggers larger cuts in hiring (Pagano and Pica, 2012; Boeri et al., 2012, 2013). An excess credit variable is constructed in the spirit of Jordá et al. (2013b), which refers to the excess rate of change per year in private credit to GDP in each expansionary episode preceding a credit

peak. A following credit contraction is then defined as highly leveraged if the excess rate during the credit expansion was above the full sample – country-specific – historical mean. The lower panel of Table 2 reveals that the amplitude of highly levered private credit contractions is, on average, larger than that of low leveraged contractions.[14] More interestingly, it appears that increases in each measure of unemployment are significantly greater following an expansionary phase with higher financial leverage. The descriptive results are formally tested in the next section.

3.4 Credit growth and unemployment around contractions

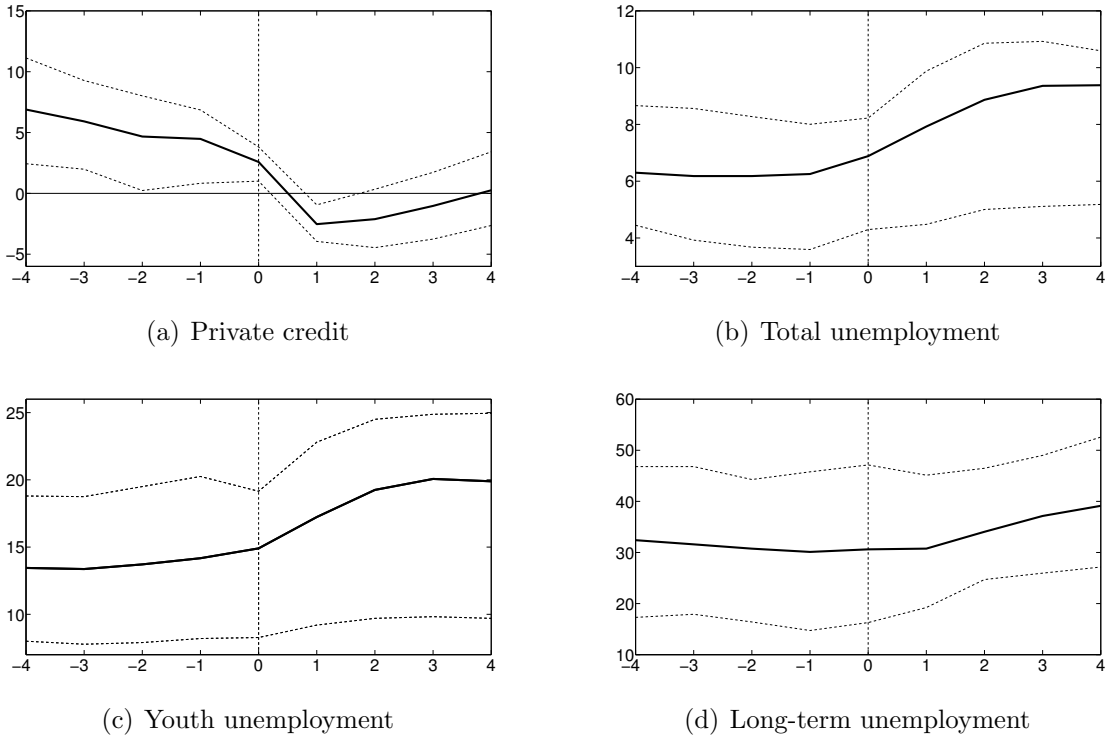
Figure 2 offers a visual analysis of the dynamics of private credit and unemployment around the onset of credit contractions. Year-on-year changes in credit growth and changes in the rates of total, youth, and long-term unemployment are shown for 4 years before and 4 years after a credit peak (at period 0). Means of each series are plotted together with the upper and lower quartiles, to account for possible outliers that might drive the results. Private credit growth typically declines already ahead of a credit peak and decreases even more before it eventually recovers (Figure 2/(a)). Furthermore, the figures suggest an association between the evolution of credit and unemployment. Slower credit growth one year before a peak is coupled with a rise in unemployment rates, which becomes sharper in the first year of a contractionary phase (Figure 2/(b)). On average, unemployment climbs by about 2.5 percentages after the beginning of a contraction and remains well above its pre-peak level for several years. The increase seems to be larger for youth unemployment (Figure 2/(c)), and long-term unemployment rises notably one year after a credit peak (Figure 2/(d)).[15] While private credit recovers, on average, four years following the start of a credit downturn, unemployment remains well above its pre-peak level. Thus, the observed labor market patterns do not only hint at high persistence, but reveal that credit contractions may lead to jobless recoveries.[16]

[14] 8 of the 22 highly levered credit contraction phases have still not ended by 2013. Since the inclusion of these episodes produces a downward bias in the cyclical characteristics, it does not affect the validity of the results. In addition, this explains why contractionary phases with low leverage last on average longer than highly levered credit contractions (Table 2).

[15] The lagged response of long-term unemployment to a credit contraction follows from the definition of the variable (see Section 3.1 for details).

[16] See Calvo et al. (2012) for an in-depth analysis on jobless recoveries following financial recessions.

Figure 2: Dynamics of private credit and unemployment around credit contractions



(a) Private credit

(b) Total unemployment

(c) Youth unemployment

(d) Long-term unemployment

Note: Solid lines indicate means of private credit growth (a) and rates of total, youth, and long-term unemployment (b)-(d) along with the top and bottom quartiles (dashed lines) for 4 years before and 4 years after a credit peak. Period 0 denotes the year of the credit peak, i.e., the beginning of a credit contraction. Change in private credit growth is in percents per year, and change in unemployment rates is in levels, in percentages.

4 Methodology and results

4.1 Empirical framework

In the econometrical investigation, the main focus is on the evolution of unemployment after a private credit expansion has reached its peak, i.e., after which a credit contraction begins. The methodology relies on the local projection approach introduced by Jordá (2005). The dynamic impact of private credit contractions on unemployment is directly estimated within the empirical framework, by calculating a collection of impulse response functions (IRFs) for a sequence of increasingly distant horizons. The greatest benefit of using direct local analysis is that IRFs can be obtained without the specification and estimation of the underlying multivariate system. Moreover, Jordá (2005) shows that

local projections are robust to the misspecification of the data generating process, and can easily accommodate nonlinearities in the impulse responses. To account for serial correlation induced in regressions for each future horizon, inference can be performed using heteroscedastic and autocorrelation robust standard errors. In addition, since lagged variables enter only as controls in the estimation equation, they are not used to derive the IRFs. Thus, the specification is not sensitive to the choice of the number of lags, and therefore, impulse responses generated using local projections are stable. Finally, another appealing feature of the method is that the confidence bands related to the IRFs can be derived from the standard errors of the estimated coefficients of interest, and therefore, no bootstrapping techniques or Monte Carlo simulations are required. The reader is referred to Jordá (2005) for further details.

In order to obtain impulse responses using a least-squares dummy variable model, the paper strictly follows Jordá et al. (2013b). To begin with, average impulse responses of unemployment across countries and credit peaks for $h = 1, 2, ..., H$ future horizons are defined as:

$$\begin{aligned} IR(\Delta_h U_{i,t(p)+h}, C) &= E_{it(p)}(\Delta_h U_{i,t(p)+h} | C_{it(p)} = 1, \Omega) \\ -E_{it(p)}\Delta_h(U_{i,t(p)+h} | C_{it(p)} &= 0, \Omega), \qquad h = 1, 2, ..., H, \end{aligned} \tag{1}$$

where $U_{i,t(p)+h}$ denotes unemployment for each country $i = 1, 2, ..., N$, and for every horizon h following a discrete treatment, and $C_{i,t(p)}$ is a binary indicator that takes value 1 for a credit peak, and zero otherwise. The subscript $t(p)$ refers to the period of the p^{th} credit peak in country i, derived from the Bry and Boschan (1971) dating algorithm in Section 3.3. As noted before, the interest lies in analyzing the change of unemployment following the onset of a credit contraction $t(p)$ to some distant period $t(p) + h$ after the peak. Thus, a credit peak may be understood as a period in which a country's private credit expansion comes to an end – and a contractionary episode starts –, and Expression 1 measures the average treatment response of unemployment to contractions across the panel, conditional on a set of economic variables represented by Ω. Impulse responses are then obtained by estimating the following fixed effects panel regression for

$h = 1, 2, ..., H$ horizons:

$$\Delta_h U_{i,t(p)+h} = \alpha_i^h + \sum_{j=1}^{2} \beta_j^h \Delta U_{i,t(p)-j} + \gamma_h C_{i,t(p)} + \delta_h L_{i,t(p)} + \theta' \mathbf{X_{i,t(p)}} + \epsilon_{i,t(p)}^h, \qquad (2)$$

where $\Delta_h U_{i,t(p)+h}$ is the change of unemployment from time $t(p)$ to each future period $t(p) + h$, country fixed effects denoted by α_i capture unobserved country-specific heterogeneity, $L_{i,t(p)}$ is the composite index of labor market flexibility, and the lagged changes of $U_{i,t(p)}$ control for the persistence of unemployment. $\mathbf{X_{i,t(p)}}$ is a vector of control variables that potentially affect outcomes, including (1) GDP growth; (2) CPI inflation rate; (3) change in public debt to GDP; (4) change in trade openness; (5) population; and (6) output gap, which controls for the unemployment effects of business cycle fluctuations.[17]

4.2 Estimation results

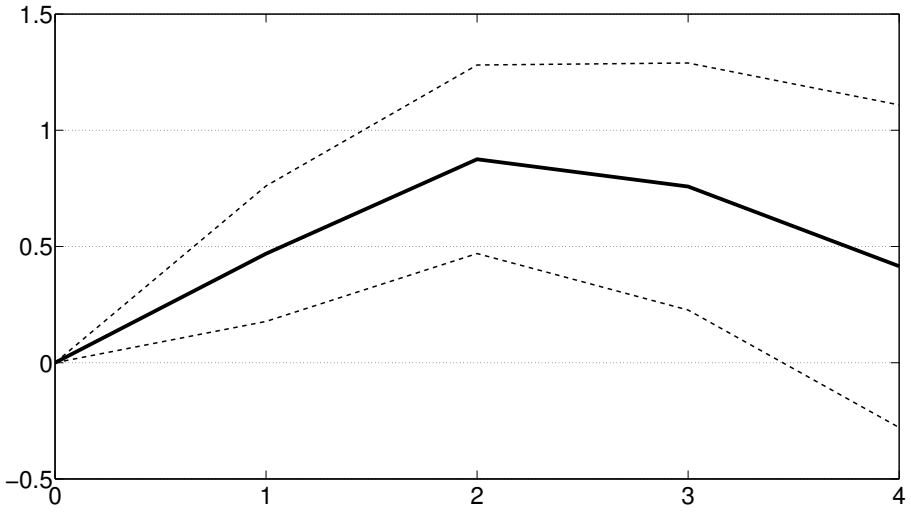
Estimated coefficients γ_h for changes in unemployment are computed for four years following the onset of a credit contraction, and correction for heteroskedasticity is applied using White-robust standard errors.[18] Figure 3 displays average impulse responses along with the 95% confidence bands for total, youth, and long-term unemployment. The figures suggest that the impact of a private credit contraction on unemployment is sizable and statistically significant, increasing total and youth unemployment rate by nearly 1% and 2.5% two years following the credit peak, respectively. Long-term unemployment rises only in the second period after the onset of a contraction, and the effects become significant after three years, highlighting the substantial persistence of unemployment. The increasing duration of involuntary joblessness can be explained by hysteresis effects operating through various mechanisms; for instance, jobless workers become both less attractive (Ball, 2009) and more discouraged (Krueger and Mueller, 2011) over time, as unemployment lasts longer. Furthermore, the findings are in line with the existing concerns that structural unemployment in OECD countries has been shifted upwards following the most recent financial recession, and that the increase in unemployment could

[17] Output gap is annual real GDP detrended using the Hodrick and Prescott (1997) filter, with the smoothing parameter set to 100.

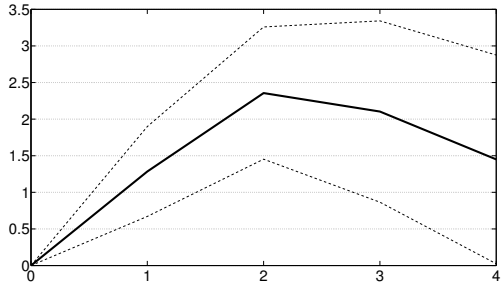
[18] For $h > 4$ horizons, several credit peaks surrounding the outbreak of the most recent global financial crisis would be omitted from the estimation.

persist even when the economies recover (e.g., Guichard and Rusticelli, 2011). Estimation

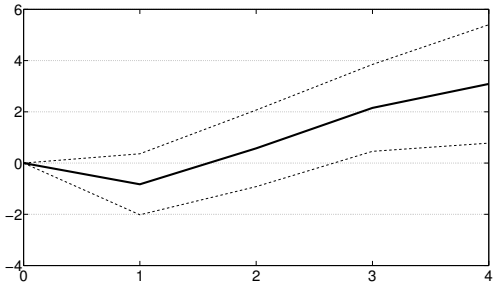
Figure 3: The impact of credit contractions on unemployment



(a) Total unemployment



(b) Youth unemployment



(c) Long-term unemployment

Note: Impulse responses estimated by local linear projections for a panel of 20 OECD countries between 1980-2013. Solid lines represent the change in total, youth, and long-term unemployment rates following the onset of a private credit contraction at period 0 (in levels, in percentages). Dashed lines correspond to the 95% confidence bands.

results are shown in Table 3. The coefficients for the lagged differences in unemployment are significant, indicating the persistence of the corresponding variable. The negative sign of the coefficient for the composite labor market index shows that more flexible labor markets are associated with lower unemployment.[19] This is consistent with the empirical evidence for OECD countries provided by Blanchard and Wolfers (2000) and Bassanini and Duval (2009).

[19] Impulse response functions of unemployment estimated for contractionary episodes characterized by flexible and rigid labor markets separately lend further support to this finding (Appendix B).

Table 3: Estimation results

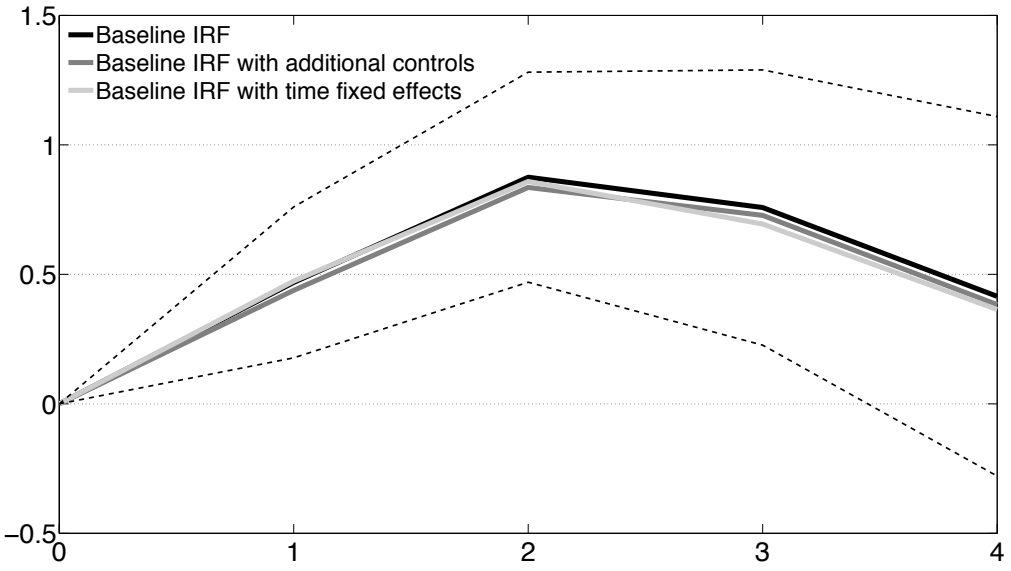
Change in unemployment (relative to year 0)	**Year 1**	**Year 2**	**Year 3**	**Year 4**
1-Period Lagged Change in Unemployment	0.375***	0.488***	0.417**	0.490**
	(0.101)	(0.147)	(0.187)	(0.232)
2-Period Lagged Change in Unemployment	0.018	0.117	0.218**	0.154
	(0.046)	(0.076)	(0.106)	(0.127)
Credit Peak	0.469***	0.875***	0.758***	0.415
	(0.149)	(0.207)	(0.271)	(0.354)
Labor Market Index	-0.071*	-0.148**	-0.153*	-0.077
	(0.038)	(0.064)	(0.084)	(0.097)
GDP Growth	-0.114***	-0.191***	-0.202***	-0.178***
	(0.021)	(0.035)	(0.042)	(0.040)
Output Gap	0.169***	0.454***	0.745***	0.958***
	(0.019)	(0.034)	(0.045)	(0.054)
CPI Inflation	0.003	0.009**	0.012**	0.008
	(0.003)	(0.004)	(0.006)	(0.007)
Change in Public Debt to GDP	0.009*	0.006	0.009	0.009
	(0.005)	(0.008)	(0.009)	(0.011)
Change in Trade Openness	-0.002	-0.002	-0.022*	-0.039**
	(0.006)	(0.010)	(0.013)	(0.016)
Population	0.001	0.003	0.006	0.017
	(0.006)	(0.011)	(0.013)	(0.015)
Number of Observations	620	600	580	560
R^2	0.50	0.54	0.57	0.60
Country Fixed Effects	yes	yes	yes	yes

Note: Estimated coefficients of the local linear projections model for 1-4 years after the onset of a private credit contraction (year 0). The dependent variable is change in total unemployment rate (in levels, in percentages). ***, **, and * represent statistical significance at 1, 5, and 10 percent levels, respectively. White-robust standard errors are in parentheses. All variables and their sources are defined in Table A1.

Estimates for real GDP growth, output gap, inflation and the change in trade openness appear to be significant, with the expected signs. In addition, results are qualitatively similar for youth and long-term unemployment (not reported here, available upon request).

In order to assess the sensitivity of the regression outcomes, Equation 2 is re-estimated by including an extensive set of controls that can potentially shape the evolution of unemployment over time. These variables are: (1) GDP per capita growth; (2) the current account to GDP ratio; (3) general government final consumption expenditure (in percent of GDP); (4) total investment (in percent of GDP); and (5) change in real exchange rates, to account for the competitiveness of the economies. The estimated coefficient for credit contractions using additional control variables remains statistically significant, and the results are similar to those of the baseline specification. In addition, the outcomes are robust to the inclusion of time fixed effects, confirming the important association between developments in the private credit market and unemployment dynamics. Impulse responses

Figure 4: The impact of credit contractions on unemployment: alternative specifications



Note: Impulse responses estimated by local linear projections for a panel of 20 OECD countries between 1980-2013. Solid lines represent the change in total unemployment rate following the onset of a private credit contraction (at period 0), for three different specifications (in levels, in percentages): (i) baseline (black); (ii) baseline expanded with additional controls (dark gray); (iii) baseline with time fixed effects (light gray). Dashed lines correspond to the 95% confidence bands of the baseline impulse response function.

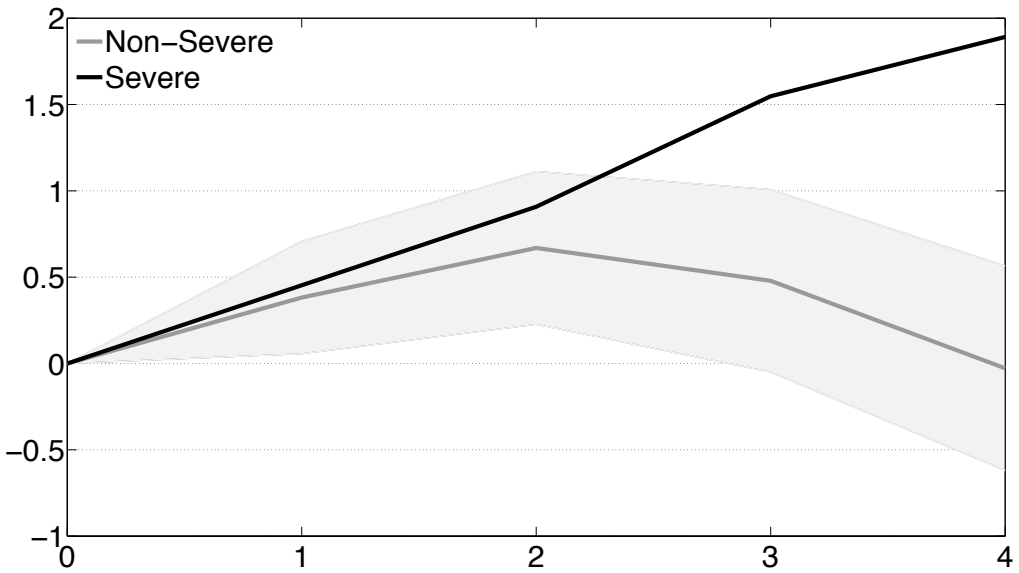
for each specification together with the baseline estimates are reported in Figure 4.

Notice that the impact of credit contractions on unemployment is obtained for the years after the occurrence of a credit peak, therefore the estimation is not likely to be subject to potential reverse causality. Yet, to alleviate identification concerns, the differential variation due to the severity of a credit downturn is examined next. In particular, impulse responses of unemployment to non-severe and severe private credit contractions are estimated as follows:

$$\Delta_h U_{i,t(p)+h} = \alpha_i^h + \sum_{j=1}^{2} \beta_j^h \Delta U_{i,t(p)-j} + \gamma_h^{NS} C_{i,t(p)}^{NS} + \gamma_h^S C_{i,t(p)}^S + \delta_h L_{i,t(p)} + \theta' \mathbf{X}_{\mathbf{i},\mathbf{t}(\mathbf{p})} + \epsilon_{i,t(p)}^h, \quad (3)$$

where γ_h^{NS} and γ_h^S measure the average response of unemployment following non-severe ($C_{i,t(p)}^{NS} = 1$) and severe ($C_{i,t(p)}^S = 1$) private credit contractions, respectively. Other than this, Equation 3 is completely identical to the baseline specification given by Equation 2.

Figure 5: The impact of credit contractions on unemployment: non-severe vs. severe credit contractions



Note: Impulse responses estimated by local linear projections for a panel of 20 OECD countries between 1980-2013. Solid lines represent the average change in total unemployment rates following the onset of a non-severe (gray) and severe (black) private credit contraction (at period 0), separately (in levels, in percentages). The shaded area corresponds to the 95% confidence bands of the impulse response to a non-severe private credit contraction. Severe credit contractions are defined as peak-to-trough declines in private credit that fall within the top quartile of all credit contractions.

The impulse responses displayed in Figure 5 reveal the differential impact on the unemployed, which depends largely on the discrete treatment assigned to the severity of a credit downturn. Severe private credit busts are typically followed by greater, and long-lasting increases in unemployment, whilst the impact of other, non-severe contractions is moderate, with unemployment recovering, on average, already after four years. The differences become statistically significant three years after the onset of a credit contraction, amounting to about 1% in period 3, and 2% in period 4.

4.3 Unemployment and financial leverage

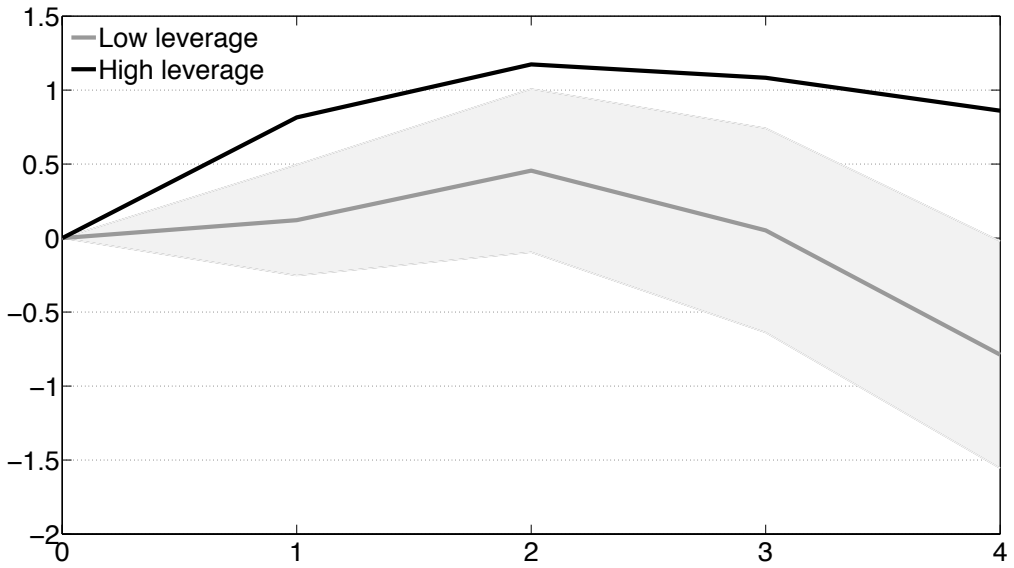
The stylized facts provided in the preliminary analysis are indicative of the existence of an important relationship between the financial leverage of an economy before the onset of a contractionary phase and the subsequent changes in unemployment. Recall from Section 3.3 that the study builds on Jordá et al. (2013b) to determine the intensity of each credit expansion prior to a financial downturn. Hence, credit market contractions are classified as highly leveraged if the excess rate of change per year in the private credit to GDP ratio during the expansion was above the full sample historic mean, and low leveraged otherwise. In order to validate the hypothesis through a formal statistical examination, impulse responses to private credit contractions associated with low and high financial leverage are estimated separately. Specifically:

$$\Delta_h U_{i,t(p)+h} = \alpha_i^h + \sum_{j=1}^{2} \beta_j^h \Delta U_{i,t(p)-j} + \gamma_h^L C_{i,t(p)}^L + \gamma_h^H C_{i,t(p)}^H + \delta_h L_{i,t(p)} + \theta' \mathbf{X_{i,t(p)}} + \epsilon_{i,t(p)}^h, \quad (4)$$

where γ_h^L and γ_h^H measure the average impulse response to credit contractions with low ($C_{i,t(p)}^L = 1$) and high ($C_{i,t(p)}^H = 1$) leverage, respectively. Impulse responses to both types of treatments are depicted in Figure 6. By dividing the sample based on the intensity of the credit build-up of the expansionary phase preceding each credit contraction, the trajectories of changes in unemployment are considerably different. It appears that a subsequent decline in total unemployment is, on average, three times greater when the expansion was highly leveraged. The labor markets recover relatively quickly, about three periods after the beginning of a low leveraged credit contraction, while total unemploy-

ment persists and remains nearly 1% above its pre-peak level following a highly levered contraction, even after 4 years. Qualitatively similar predictions are obtained by Pagano and Pica (2012) and Boeri et al. (2012, 2013), which show that sectors that rely more heavily on external funding are more vulnerable to adverse financial shocks, characterized by greater job destruction rates than low leveraged sectors.

Figure 6: The impact of credit contractions on unemployment: low vs. high leverage



Note: Impulse responses estimated by local linear projections for a panel of 20 OECD countries between 1980-2013. Solid lines represent the average change in total unemployment rates following the onset of a private credit contraction (at period 0) with low (gray) and high (black) financial leverage, separately (in levels, in percentages). The shaded area corresponds to the 95% confidence bands of the impulse response to a low leveraged private credit contraction. Credit market contractions are classified as highly (low) leveraged if the excess rate of change per year in the private credit to GDP ratio during the preceding expansionary phase was above (below) the full sample historic mean.

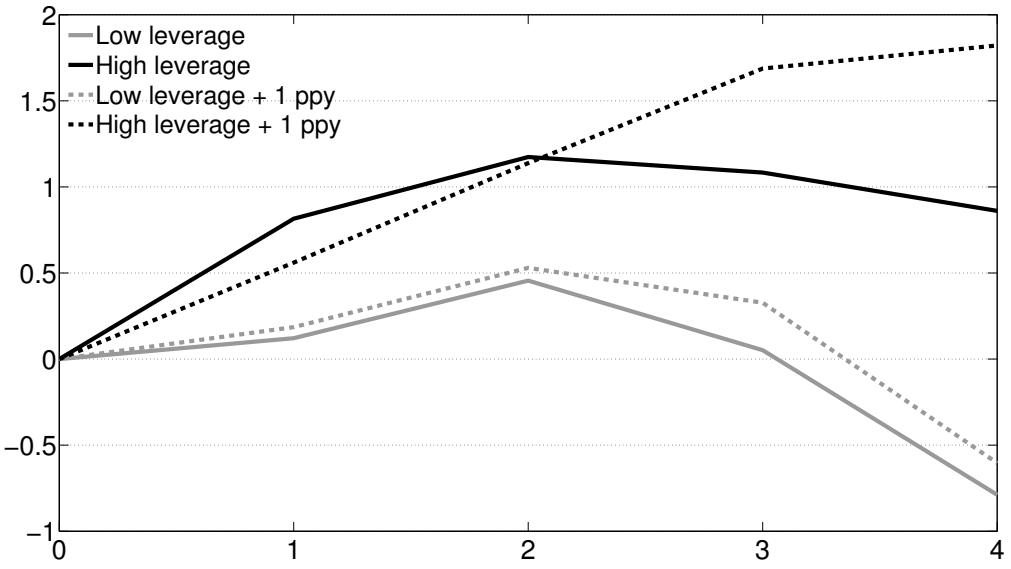
Besides analyzing the average response of unemployment to low and highly leveraged contractions, the marginal treatment responses due to perturbations of the excess credit variable are considered. As shown in Jordá et al. (2013b), the binary indicators of credit contractions are interacted with a term that measures the deviation of excess credit in each – low and highly leveraged – expansionary phase from its corresponding leverage-type

mean:

$$\Delta_h U_{i,t(p)+h} = \alpha_i^h + \sum_{j=1}^{2} \beta_j^h \Delta U_{i,t(p)-j} + \gamma_h^L C_{i,t(p)}^L + \lambda_h^L (\phi_{i,t(p)} - \bar{\phi}_L) C_{i,t(p)}^L$$
$$+\gamma_h^H C_{i,t(p)}^H + \lambda_h^H (\phi_{i,t(p)} - \bar{\phi}_H) C_{i,t(p)}^H + \delta_h L_{i,t(p)} + \theta' \mathbf{X}_{\mathbf{i,t(p)}} + \epsilon_{i,t(p)}^h, \tag{5}$$

where the continuous treatments $(\phi_{i,t(p)} - \bar{\phi}_L)$ and $(\phi_{i,t(p)} - \bar{\phi}_H)$ denote the excess rates of credit relative to the leverage-specific mean in the preceding low and highly leveraged expansion phases, respectively. The new coefficients of interest λ_h^L and λ_h^H measure the marginal effect of a unit perturbation applied to the excess credit variable $\phi_{i,t(p)}$ for each type of expansion. In particular, excess rates are perturbed here by 1 percentage point per year (ppy) above their mean. The impulse responses along with the perturbed paths are shown in Figure 7. It seems that unemployment generally suffers more in the medium-term, whereas the treatment effects of an increment of 1 ppy in the excess credit measure in the first two years are rather subdued. The marginal impact of a contraction following

Figure 7: The impact of credit contractions on unemployment: increased financial leverage



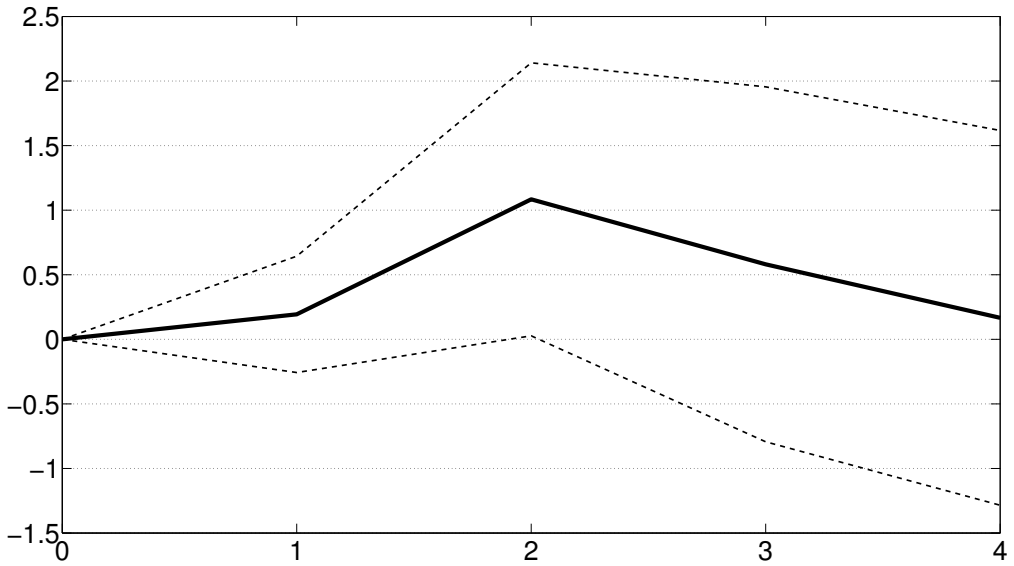
Note: Impulse responses estimated by local linear projections for a panel of 20 OECD countries between 1980-2013. Solid lines represent the change in total unemployment rates following the onset of a private credit contraction (at period 0) with low (gray) and high (black) financial leverage, separately (in levels, in percentages). Dashed lines correspond to trajectories when the excess rates of credit are perturbed by 1 percentage point per year (ppy) above their respective leverage-type mean. Credit market contractions are classified as highly (low) leveraged if the excess rate of change per year in the private credit to GDP ratio during the preceding expansionary phase was above (below) the full sample historic mean.

a highly (low) leveraged credit expansion is initially negative (close to zero), however, the coefficients become positive and statistically significant from the third year for both types of contractions. Again, similar results are found for youth and long-term unemployment, not reported here.

4.4 Credit contractions and financial crises

Credit market disruptions cannot be investigated in isolation from banking crises. According to the definition introduced by Laeven and Valencia (2012), financial crises are events with significant signs of financial distress – e.g., bank runs – and immense losses in the financial system, suggesting a clear association with disturbances in the credit markets. Hence, to complement the analysis, this final subsection compares financial crises to credit market contractions regarding their impact on labor market outcomes. A total

Figure 8: The impact of financial crises on unemployment



Note: Impulse responses estimated by local linear projections for a panel of 20 OECD countries between 1980-2013. Solid lines represent the change in total unemployment rate following the onset of a financial crisis at period 0 (in levels, in percentages). Dashed lines correspond to the 95% confidence bands. Financial crisis dates are taken from the database by Laeven and Valencia (2012).

of 21 systemic financial crisis episodes are found in the panel, based on the banking crises database by Laeven and Valencia (2012), and Equation 2 is estimated by replacing the treatment variable for credit peak $C_{it(p)}$ with a binary indicator that takes the value 1

for starting dates of financial crises in period $t(p)$, and zero otherwise. Note that the subscript $t(p)$ here refers to the year of the onset of a financial crisis episode in country i. Impulse responses together with the 95% confidence bands are depicted in Figure 8. Although the results are reminiscent of those obtained for credit market contractions, one should notice that the impact of the outbreak of a crisis on unemployment is initially more subdued. A possible explanation for such differences is that private credit is still increasing, albeit at a slower rate, during the start of a financial recession, and therefore the effects of a 'financial crisis shock' do not propagate immediately to the labor market. An in-depth analysis of the differences is, however, beyond the scope of this paper, and would provide one fruitful avenue for future research.

5 Conclusion

This paper investigates empirically the role of financial markets in shaping unemployment fluctuations. The study makes use of an annual dataset covering 20 OECD economies spanning from 1980 to 2013 and analyzes the effect of contractions in private credit on labor market performance. Specifically, the Bry and Boschan (1971) dating algorithm is applied to identify credit peaks, i.e., turning points in credit cycles to estimate the impact of subsequent credit contractions on unemployment. Impulse responses of total, youth, and long-term unemployment are obtained using local linear projections introduced by Jordá (2005) for a variety of different specifications.

The main results provide new evidence on the significant linkages between private credit and unemployment fluctuations. In particular, the findings of the paper suggest that disturbances in the credit market affect both the level and persistence of unemployment, with more severe credit contractions followed by greater decline in joblessness. Moreover the empirical exercise reveals that the detrimental effect on labor market perspectives depends heavily on the financial leverage of an economy. Increased intensity of a credit boom preceding a contractionary phase triggers, on average, higher unemployment. Regarding the estimates for youth unemployment, the impact is even more pronounced. Lasting effects on long-term unemployment point toward high persistence and sluggish recovery. Finally, the results are consistent with existing literature, showing that jobless-

ness depends on the flexibility of labor markets, with more rigid labor market regulations associated with greater unemployment.

The findings of the paper highlight the empirical relevance of the credit transmission channel for joblessness, yet, further theoretical research is necessary for the better understanding of the fundamental mechanisms. In terms of practical implications, the evidence that credit market disruptions translate to the labor market suggests that policies directed to better financial regulation and improved macro-prudential supervision are capable of reducing unemployment and its negative consequences.

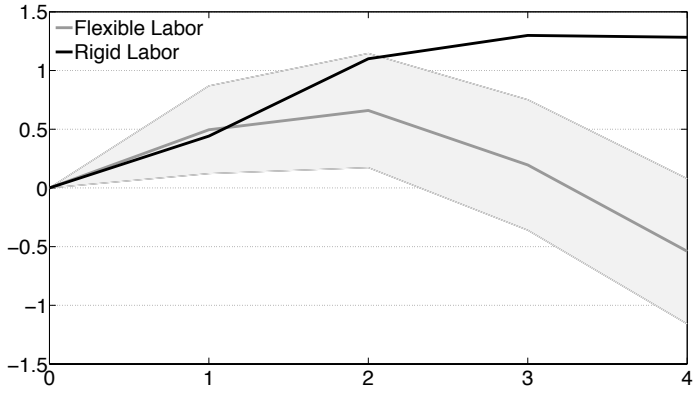
A List of variables

Table A1: Definition and sources of variables

Variable	Variable definition	Source
Private credit	Credit to the non-financial private sector by domestic banks, adjusted for breaks (in billions of national currency).	BIS
Total unemployment rate	Percentage of the total labor force that is currently unemployed.	WEO
Youth unemployment rate	Percentage of the total labor force ages 15-24 that is currently unemployed.	Eurostat, OECD, and WDI
Long-term unemployment rate	Number of people with continuous periods of unemployment extending for a year or longer, as a fraction of the total unemployment (in percentages).	Eurostat and WDI
Labor market regulations indicator	Composite measure of labor market flexibility. Scaled to take values between 0 and 10, with higher values indicating more flexible regulation.	EFW
Nominal GDP	Gross domestic product in current prices (in billions of local currency).	WEO
Real GDP	Gross domestic product per capita in constant prices (in 2005 US Dollars).	WDI
Consumer price index	Consumer prices, all items, index (2005 = 100).	WDI
Real exchange rate	Real effective exchange rates, index (2005 = 100).	WDI
Population	Total population (in millions).	WDI
Public debt	Gross general government debt (in percent of GDP).	IMF and WEO
Trade openness	Sum of exports and imports of goods and services (in percent of GDP).	WDI
Total investment	Total value of the gross fixed capital formation (in percent of GDP).	WEO
Current account balance	Sum of net exports of goods and services, net primary income, and net secondary income (in percent of GDP).	WEO
Government consumption	General government final consumption expenditure (in percent of GDP).	WDI

B Figures

Figure B1: The impact of credit contractions on unemployment: rigid vs. flexible labor market institutions



(a) Total unemployment

(b) Youth unemployment

Note: Impulse responses estimated by local linear projections for a panel of 20 OECD countries between 1980-2013. Solid lines represent the average change in total (a) and youth (b) unemployment rates following the onset of a private credit contraction (at period 0) with flexible (gray) and rigid (black) labor market institutions, separately (in levels, in percentages). The shaded areas correspond to the 95% confidence bands of the impulse response functions. Credit market downturns are characterized by flexible (rigid) labor market institutions, if the composite indicator of labor market flexibility was above (below) the full sample historic mean at the beginning of the contraction (at period 0).

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