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Article

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Productivity in Europe during the Great Recession: Any evidence for creative destruction?

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Abstract

This article analyses the effects of the financial crisis and the Great Recession on productivity in Europe by studying the process of labour force reallocation between companies. Using micro-data on company balance sheets, a fixed-effects panel estimation of the predictors of the post-crisis evolution of the number of employees for a given company is used. Identification is achieved through the use of pre-crisis values of covariates. The results are in line with the theoretical predictions derived from Schumpeterian (“creative destruction”) endogenous growth models. Pre-crisis productivity is a predictor of a higher number of employees, which means creative destruction is taking place to some extent. Companies in financially dependent sectors perform worse in the context of the financial crisis. Indebtedness has an uneven effect: positive for large companies and negative for smaller ones.

Keywords

Productivity; business cycles; financial constraints; indebtedness; company performance.

JEL classification

O47; E32; L2.

Introduction

The impact of the 2008 financial crisis and the Great Recession on productivity has been very heterogeneous across European countries. Some of them, like Spain, have seen significant increases in labour productivity during the period 2008-2013. In others, for example the UK or Greece, there has been a decrease in labour productivity. This empirical observation provides a recent motivation for the study of the underlying mechanism that links a recession or a financial crisis to the evolution of productivity.

Do recessions help reorganise the economy? Or are they damaging to long-term productivity growth? The answer to these questions is also interesting from a normative sense, with regards to policy in terms of recessions. If a crisis destroys the most unproductive companies, then it is inefficient to help them survive during difficult times. If, on the contrary, companies are struck because of reasons out of their control and not related to productivity, it might be positive to subsidise them during crises.

Many theoretical papers have developed models to analyse this issue (c.f. Caballero and Hammour 1994, or Hall 2000, for instance), reaching diverging conclusions. In the data, labour productivity is apparently procyclical, which would support the theory that recessions are negative for the evolution of productivity. However, since the effects of reorganisation are not immediate, this observation is not conclusive. It might be that the reallocation that happens during recessions does improve long-run productivity (Galí and Hammour, 1991).

The main contribution of this paper to this stream of literature is its new approach: I study the evolution of productivity through the use of panel micro-data on company balance sheets. This will help to understand which the best predictors of company performance during a (financial) crisis period are. I predict, following Schumpeterian growth models and previous studies like Caballero and Hammour (1994), that more productive companies grow more during the crisis, which would imply that recessions are good for productivity. However, I also predict that more financially dependent companies will grow less during the crisis (Barlevy 2003), which could have as a consequence the closure of companies that would otherwise be productive and have a negative effect on productivity. The effect of indebtedness depends on company size: it is negative for small companies but positive for larger ones. I focus on EU-15 countries.

The paper is structured as follows. In part 2 I analyse in detail the Schumpeterian concept of “creative destruction” and point out the main studies that had been undertaken that try to establish a connection between business cycles, recessions and the evolution of productivity (both from a theoretical and empirical point of view). Then, in part 3, I present some basic stylised facts about the evolution of productivity as a result of the Great Recession.

Part 4 refers to the formal framework of Schumpeterian endogenous growth models, in which I am based to derive the main theoretical predictions about the channels that can be explaining the performance of a company during a crisis and, therefore, the overall level of productivity. In part 5, I use a panel-data approach, with data on balance sheets of European companies, to test the previous hypotheses by analysing which are the main predictors of company success in the context of a crisis. Part 6 presents the main results.

Literature review

The concept of “creative destruction” is usually associated with and was made famous by Schumpeter (1939; 1942). Creative destruction is a natural process that happens in capitalist economies and that consists, basically, on the replacement of older, less productive activities by newer, more productive ones.

Individuals or companies who discover new products, processes or techniques enjoy a period of high income derived from their innovation. But, naturally, on the other side, companies that were selling or manufacturing similar products suffer the adverse effects of this innovation, in form of a reduction in sales. If the innovation is significant and they are not able to react, they may be forced to close.

However, initially creative destruction was not considered a consequence of recessions. Actually, Schumpeter argues that some recessions are caused by a creative destruction process: the appearance of new products or ways of manufacturing can be so striking to the already established industries that it might cause a recession (Schumpeter, 1942, p. 132).

It was afterwards that the hypothesis that recessions induce a creative destruction process has been widely studied. Many of the papers studying this issue follow the data analysis undertaken by Davis and Haltiwanger (1992), that find out that job reallocation is significantly countercyclical (e.g. Caballero and Hammour 1994; Mortensen and Pissarides 1994).

There are two main explanations that can support this hypothesis of creative destruction during recessions. First, during a recession there is a decrease in profitability of companies and production units. In this adverse situation, the first companies or units to be affected are the least productive ones, which are forced to reduce their number of employees (or close). An increase in the overall level of productivity naturally follows.

Second, during recessions opportunity costs of productive factors are lower, since unemployment is high and there are large levels of unused capital. In this situation, there are incentives to undertake riskier, potentially very productive activities, which might have not been interesting during an expansionary phase (due to production factors already being profitable in established activities). This incentive to entrepreneurship also results in increased levels of productivity.

If these phenomena are actually taking place, recessions would have a “cleansing effect” (Caballero and Hammour, 1994) through two main channels: the creation of new production units and the destruction of existing ones. In general, an insulation effect can take place during recessions: most of the change in demand is absorbed through the reduction in the creation of new production units, and it only partially causes the destruction of existing ones. Nevertheless, this insulation effect is not complete, since destruction of production units actually happens. In fact, labour data show that job destruction is much more responsive to current economic conditions than job creation.

A fact that stands against this hypothesis is that labour productivity is mainly procyclical. If creative destruction actually took place during recessions, productivity would rise. Caballero and Hammour (1994) blame this on factors like labour hoarding or externalities, while Galí and Hammour (1991) conclude, through a VAR approach, that the effects of business cycles on productivity happen in the long run. This would imply that procyclical productivity could be compatible with creative destruction and would not necessarily imply that the theory should be rejected.

Hall (2000) suggests a simplified channel through which creative destruction might be happening: “reorganization” can be considered as a costly economic activity (in terms of jobs), which can be basically equated with unemployment. The reason for that is that workers cannot work and efficiently look for the best job for them at the same time. Therefore, only in periods with high unemployment can significant reorganisation take place: recessions boost productivity.

The policy implications drawn by the different authors are varied (Schumpeter (1942), for instance, was particularly contrary to keep subsidised unproductive sectors), but in general they recognise that, even if their evidence points towards

creative destruction, measures should be taken to smooth the effects of recessions.

Another stream of literature stands against the theory that recessions help reorganise the economy and states that economic downturns might even have an adverse effect on the allocation of labour and capital. For instance, much in the line of the labour productivity issue mentioned above, Barlevy (2002) points out that two effects might be happening at the same time. During a recession less efficient jobs are destroyed, but it might be the case that it complicates the creation of more efficient ones via a “sully effect”. Companies post fewer vacancies and agents are afraid of being unemployed for a long time, so they stick to their low-productive job as much as they can. A matching model calibrated with data from the United States (US) indicates that the sully effect has a larger magnitude than the cleansing effect, which would imply that the frictions created by recessions outweigh (in terms of productivity improvement) the benefits of destroying less productive matches, units or activities.

The damage of recessions can also be analysed from the point of view of firms. Frequently, young firms are seemingly unproductive but have the potential to become productive in the long run as they grow. These potentially productive firms suffer particularly the effects of recessions and can be destroyed during early stages of their development, before their potential can be fully realised (and known by the economic agents). This effect is negative in overall productivity and for economic growth, but due to its characteristics it is quite difficult to apprehend from data (“scarring” effect in Ouyang 2009).

From a more general perspective, Caballero and Hammour (2005) find out that empirical evidence seems to show that recessions decrease the level of restructuring in the economy: there is resource misallocation as a result of recessions. They point out two main channels through which this might happen: the first of them is financial (firms have a very limited access to financing during recessions and in the period that immediately follows a recession), the second one is a selection mechanism (low-productivity firms cannot be created during a recession, so they cannot be destroyed afterwards, reducing the economy’s restructuring following a recession).

The relevance of the financial channel is also highlighted by Barlevy (2003). The reallocation that takes place during economic downturns might not go from least productive sectors to more productive ones, but the other way around, depending on the credit situation of the company or the economic sector. During recessions, there are credit market frictions and it is difficult for companies to secure financing. In this context, activities that require large amounts of credit might fail due to the impossibility of securing the required finance, while (maybe less productive) activities that do not need as much financing might survive for a longer time.

According to Barlevy (2003), more efficient projects require more credit in equilibrium. Therefore, the effect of recessions, in this situation, would be exactly the opposite of the one suggested by creative destruction.

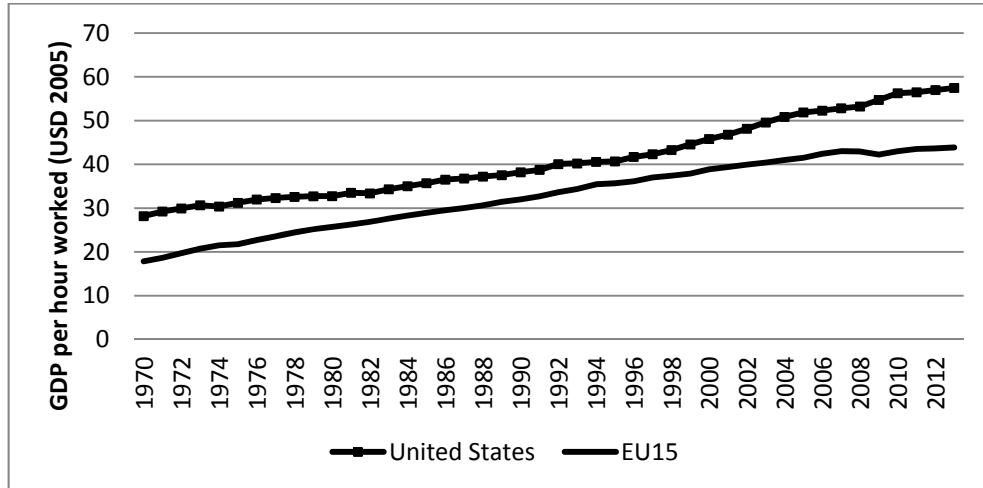
Based on all of these observations, a substantial literature, surveyed in Aghion, Akcigit and Howitt (2015a) and whose main contributions are summarised in Aghion, Akcigit and Howitt (2015b), has used models that generate endogenous growth from a Schumpeterian paradigm. Aghion and Saint Paul (1998) develop a model of productivity growth under cyclical fluctuations and analyse which kinds of assumptions are necessary to generate procyclical or countercyclical productivity improvements. They find that considering productivity growth as a cost in terms of current production induces procyclical productivity, while considering that productivity growth is a cost independent of current production induces countercyclical productivity.

Most related with the analysis in this paper, Aghion, Hemous and Kharroubi (2014) find that countercyclical fiscal policy has larger effects for sectors that rely heavily on external finance.

1. Stylised facts: the evolution of productivity

A first step towards analysing the effects of the crisis on productivity, and later on trying to separate whether creative destruction or some other force was taking place, is the analysis of the general evolution of macro-variables.

Figure 1. Labour productivity US-EU15



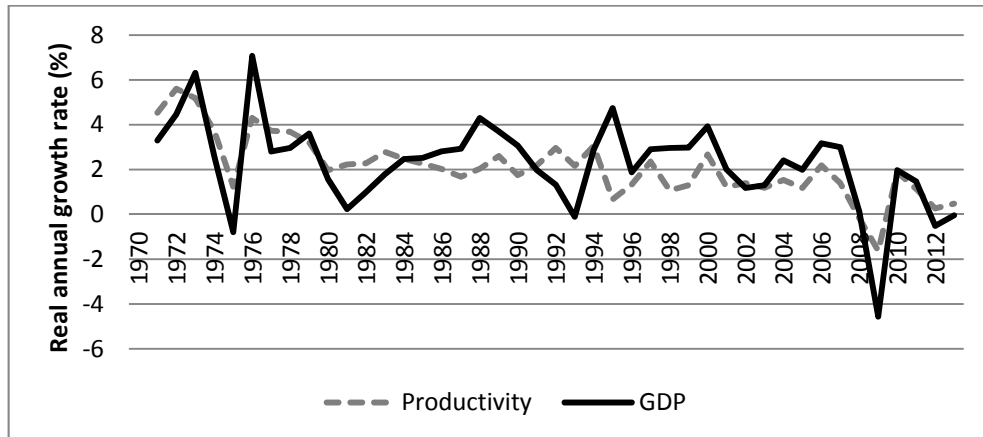
Source: own elaboration from OECD data. EU15 includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

A simple look at productivity trends (Figure 1) indicates that productivity has been growing quite steadily over the past 40 years in both Western Europe and the US. The US has an overall higher level of productivity than Europe, though until around 2000 it seemed that the gap was slowly closing. For example, Blanchard (2004) provides an analysis of this. In recent times, and particularly after the financial crisis, the US has managed to maintain a more sustained growth of productivity than the European Union.

A simple analysis of labour productivity growth rates in the EU15 (Figure 2) confirms the procyclicality that had already been analysed by Caballero and Hammour (1994). In particular, labour productivity fell significantly during the mid-1970s recession and the current financial crisis. Less significant falls in output (early 1980s, early 1990s) did not have such a remarkable effect on productivity.

This contemporaneous relationship between productivity and GDP is probably mostly due to the fact that companies adjust labour slower than production (labour hoarding), a fact that has been widely studied in literature, as for example in Burnside, Eichenbaum and Rebelo (1993).

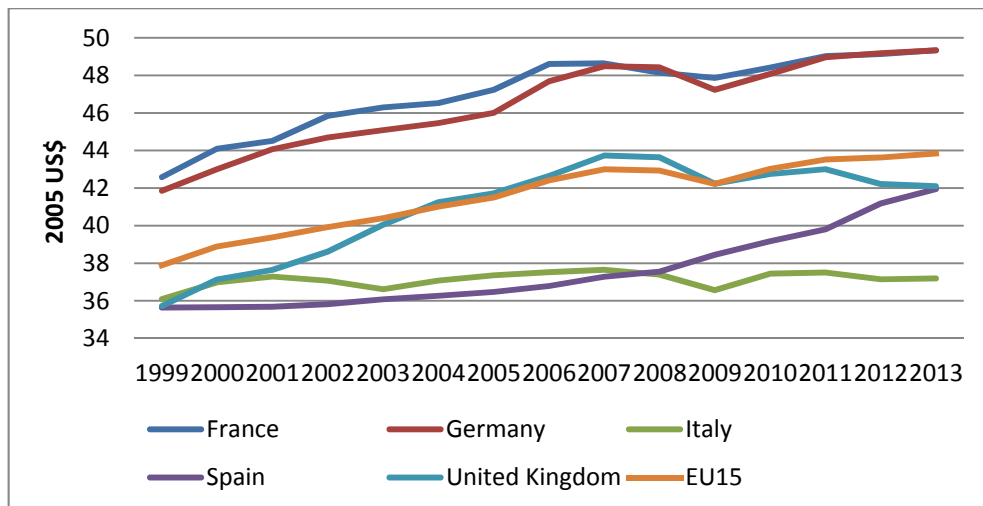
Figure 2. GDP and labour productivity (GDP/hours worked) growth rates (EU15)



Source: own elaboration from OECD data.

The main focus of attention of this work is the evolution of productivity as a result of the current crisis.

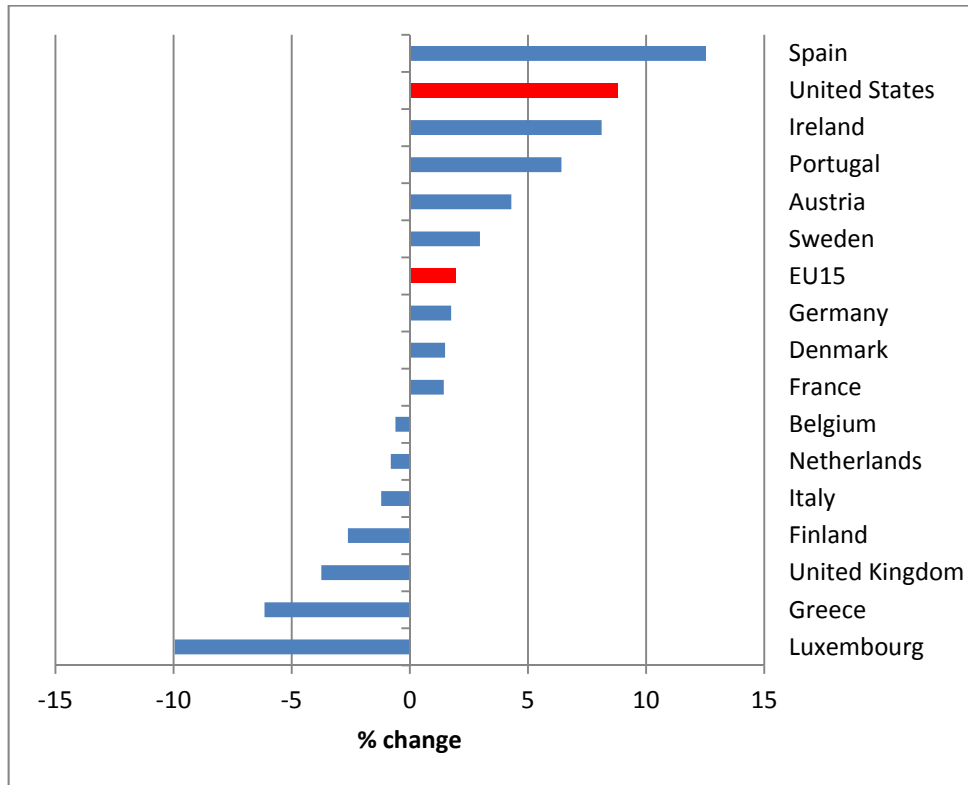
Figure 3. Labour productivity (GDP per hour worked) in constant terms



Source: own elaboration from OECD data.

The evolution of productivity was clearly divergent among the largest European economies (Figure 3). We can see mainly four big types of countries in the graph: those that kept a rising level of productivity with a drop after the onset of the crisis, but that currently show a positive tendency (France, Germany, EU15 as a whole); those that showed a significant rise of productivity before the crisis and a significant decrease afterwards (UK); the opposite pattern, with a significant rise of productivity after the crisis (Spain); and the particular Italian case, in which productivity kept stagnant during the whole period.

Figure 4. Percentage change in productivity 2013/2007



Source: own elaboration from OECD data.

Including other EU-15 countries on the list confirms the hypothesis that the effects of this crisis in productivity have been quite diverse across Europe. It is relevant to note that there is no consistent relation between being worse struck by the crisis and the evolution of productivity. Some of the countries that suffered a deeper recession (Spain, Ireland, Portugal) top the chart, while others (namely Greece) are at the bottom. The US is offered as a benchmark, with an evolution which showed to be quite significantly better than most of the European countries.

Stylised facts and creative destruction

Therefore, in the most basic of analyses, countries like Spain, Ireland or Portugal show a priori evidence that the recession has fostered creative destruction in the sense of Caballero and Hammour (1994), while countries like the UK or Italy show basic evidence of a scarring or sullyng effect in the sense of Barlevy (2002) or Ouyang (2009).

A simple Schumpeterian growth model. Finance.

In order to provide a formal framework to undertake the analysis of labour reallocation, I rely on Schumpeterian models by Aghion and Howitt (1998 and 2009). These authors were the first to develop a comprehensive theory of endogenous growth based on a Schumpeterian vision of business cycles.

It is from simple Schumpeterian models that I derive the main hypotheses that I later test empirically. In a dynamic Schumpeterian model, production units that do not adapt to new technologies face closure because they reach one point in which they can no longer cover the amount of fixed costs they have to face. This implies that the workers of that production unit will be fired and sent into unemployment.

In the context of a recession, the likelihood that firms that did not undertake reorganisation investments go bankrupt is higher (as can be derived from Aghion

and Saint-Paul (1998)'s model of "opportunity costs" with fixed costs of production). Therefore, we can hypothesise that the natural process of destruction of unproductive units is sped up during recessions due to the general drop in demand (what Aghion and Howitt (1998, p.242) call "disciplinary effect").

This would imply an increase in the aggregate level of productivity.

From the combination of these models I draw hypothesis 1:

(H1) I expect that, when a recession arrives, the likelihood that firms that did not update their technology recently have to close production units is higher than before. This effect has as a result an overall increase in the level of productivity.

I derive hypothesis 2 from a fully-fledged endogenous growth Schumpeterian model. Let's assume that companies can invest in research, which is costly, but can potentially make the company generate an innovation (the probability of this happening is increasing the amount of research). This innovation implies that the products sold by the company will have a better quality, so it will lead its sector for a certain amount of time, in which it will obtain an extraordinary monopoly rent. After that period, the rest of the companies in the sector will copy the innovation and the monopoly rent will be gone.

When financial constraints are introduced in such a model, companies need to borrow from the financial system to finance this research. Banks need to screen companies that demand credit in order to discern whether they will be able to repay. The higher this "screening cost" is, the lower is the probability of innovation and the overall growth rate.

I expect that countries in a financial crisis will be less willing to lend funds to companies, thus implying an increase in the level of screening costs. This is because, in a crisis context, many companies are going bankrupt and have financial trouble, so banks need to screen their debtors very carefully to make sure their projects are viable. Furthermore, when the interbank market or international capital markets are dried up, banks cannot easily borrow from them, so they will be very unwilling to lend money. Moreover, during the recent financial crisis some capital ratio requirements were raised, which further constrained the willingness of banks to lend.

All of these factors, amongst others, drive up the screening costs. In this line we derive the second main hypothesis that I test.

(H2) Countries in a financial crisis should have a higher level of screening costs. Therefore, industries in those countries should suffer from a lower probability of innovation and lower growth rates. This is particularly true for industries that are more dependent on external finance.

3. Empirical study: panel data on balance sheets

3.1. Data and variables

The analysis is based on data from Amadeus (Bureau Van Dijk), a database of financial information from a large number of public and private European firms. The sample chosen corresponds to the EU15 from 2004 to 2013 (this is due to data availability, but allows for sufficient observations per company both in the pre-crisis and post-crisis period). I only consider companies with at least 10

employees⁵, to avoid issues with data reliability, and I dropped companies without enough observations of the variables that interest me.⁶

3.2. Methodology

3.2.1. Hypotheses

As I have argued before, I am interested in testing two hypotheses:

Has the labour force grown more after the crisis in companies that were more productive before? If the crisis was a “creative destruction” recession, then we should expect that the least-productive companies suffered from the biggest job losses, i.e., the crisis should have generated some positive labour reallocation (H1).

Has the financial dependence of industries played any role in the evolution of the number of employees in companies? If finance had a relevant role in job destruction, we expect the most financially-dependent sectors to suffer the largest job losses (a company that doesn’t need any external finance will not be affected, at least directly, by higher screening costs) (H2).

I add a third hypothesis, derived from Nickell, Wadhani and Wall (1992), as a control variable to make sure that we are properly identifying H2 and because of its own interest:

(H3) Does the level of indebtedness of a company play any role on the evolution of the number of employees after the crisis strikes?

In all cases, I use (log) number of employees as a dependent variable. This is due to two reasons. First, it allows to summarise, in a clearly comparable metric, how different companies evolved during the crisis period. Second, it is interesting per se, as employment outcomes are of utmost importance for policy makers.

3.2.2. Identification strategy

To answer these questions I use a temporal identification strategy, since endogeneity implies that it is not possible to directly run a regression of growth of the number of employees in a given year on these covariates in that same year (for example, maybe indebtedness decreases due to the fact that banks refuse to lend more money).

To avoid it, we use pre-crisis values, i.e., we calculate both productivity for a company, finance dependence for a sector (RZ_US and RZ_eur, computed respectively from US and European data) and indebtedness for a company as an average of the values these ratios had between 2004 and 2007. They are introduced in the regression in an interaction term with a crisis dummy.

The basic idea, for example with regards to the financial dependence component, is how much, *ceteris paribus*, belonging to a financially-dependent sector (measured in the pre-crisis years for identification) conditioned the evolution of a company once the crisis struck.

The identification strategy proposed is methodologically equivalent to Blalock, Gertler and Levine (2008) or Dell’Ariccia, Detragiache and Rajan (2008). It is alike

⁵ This does not imply a significant reduction in sample size, as small companies are frequently not present in the database, and allows to control for possible nonrandom selection of firms into the sample.

⁶ Details about the variable definitions and sample selection criteria are available from the author on request.

to a difference in differences approach that tries to compare how different were the evolutions of companies that had different levels of productivity and finance dependence in the pre-crisis years.

The exogeneity of pre-crisis levels of productivity, finance dependence and indebtedness depends on several assumptions. In particular, it requires that there is no unobserved factor that is correlated both with pre-crisis productivity levels and with trends in terms of the number of employees.

To test the first hypothesis (H1) I check whether pre-crisis productivity is a good predictor of post-crisis increases in the number of employees. I expect that companies with a higher level of productivity before the crisis were the ones that were the least affected by the recession and therefore their number of workers increased.

To test the second hypothesis (H2) I check whether a measure of finance-dependence of a company is a good predictor of post-crisis decreases in the number of employees. I expect that more financially-dependent companies were more affected by the recessions and had to dismiss more workers. This goes in line with Kleemann and Wiegand (2013), who found that, in a database of German firms, financially constrained ones generated significantly less employment than unconstrained ones, *ceteris paribus*.

To test the third hypothesis (H3) I check whether the fact of being more indebted in the pre-crisis years is a good predictor of post-crisis decreases in the number of employees.

It is relevant to note that in a normal situation, industries that are more externally dependent have in general a higher growth than the ones who do not, in countries with better institutions to support external finance (e.g. accounting standards) (Rajan and Zingales, 1998).

3.2.3. Panel data specification

The available dataset expands, as I have described, from 2004 to 2012-2013. This availability allows us to run panel data estimations under the fixed effects assumption.

Using fixed effects allows to control for the many omitted variables that unavoidably arise in this kind of regression, both observables that were not conditioned on and unobservables that cannot be directly introduced in a regression (e.g., good management) but that do affect the outcome of a company. However, the fact that they stay constant through time does not allow to specifically control for possible pre-existing trends.

Furthermore, we allow for covariance of the errors of the same firm in different years by clustering them at firm level, using again the same methodological approach as Blalock, Gertler and Levine (2008). We do so because it is natural to expect that standard errors of the same firm will be correlated through time via unobserved factors that are not specifically modelled in our regression.

In this case, the type of equation that we estimate is (where i represents firm and j represents sector):

$$\log emp_{it} = \beta_1 + \beta_2 * (prod_i * crisis_t) + \beta_3 * (RZ_j * crisis_t) + \beta_4 * (indebt_i * crisis_t) + \alpha_i + \gamma_t + \epsilon_{it}$$

The dependent variable is in this case the log number of employees.

RZ is a finance dependence measure for a given sector, calculated following Rajan and Zingales (1998) (whether the European version, RZ_eur; the current US version, RZ_US, or the original version in their paper, RZ); *indebt* is the ratio (loans + long-term debt)/tangible fixed assets; *prod* refers to the pre-crisis level of labour productivity (added value/number of employees).

Further, α_i is the fixed effect for every company and γ_t is a dummy for every year (which is reported) that summarises the overall economic situation of that year. Coefficients of every year are reported as differences with respect to 2004. I cannot directly include country dummies because they are correlated with the fixed effects, but I consider differential cross-country effects later on.

4. Results

4.1. Basic results

The basic regression results are presented in Table 4 and Table 5. Results using the original measure of Rajan and Zingales (1998) and thus neglecting the non-manufacturing sectors, and also using the absolute number of employees, are presented in Appendix A (Table A.1).

Table 4. Main regression, all firms

Dependent variable: log number of employees	All companies (10+ employees)	
	RZ_eur	RZ_US
RZ measure		
Pre-crisis productivity * crisis	0.0000912*** (0.00002)	0.0000903*** (0.00002)
RZ external dependence * crisis	-0.0001835*** (0.00005)	-0.0001716*** (0.00004)
Pre-crisis indebtedness * crisis	-0.0000034*** (1.4e-6)	-0.00000339** (1.4e-6)
Year 2005	0.0428574*** (0.001)	0.0429737*** (0.001)
Year 2006	0.0816191*** (0.002)	0.0813291*** (0.002)
Year 2007	0.1381333*** (0.002)	0.1371525*** (0.002)
Year 2008	0.1859196*** (0.002)	0.1851432*** (0.002)
Year 2009	0.1853602*** (0.002)	0.1863146*** (0.002)
Year 2010	0.2084462*** (0.002)	0.2099721*** (0.002)
Year 2011	0.1966012*** (0.002)	0.1984595*** (0.002)
Year 2012	0.172461*** (0.003)	0.1742194*** (0.002)
Year 2013	0.192023*** (0.003)	0.1933403*** (0.003)
Constant	3.614179*** (0.002)	3.599731*** (0.002)
Observations	1095872 (130320 firms)	1140805 (135633 firms)
F	1236.74***	1317.35***
R ²	0.0464	0.0475

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Special caution must be taken with 2013 coefficients, since data availability for that year is limited and in some cases provisional.

Table 5. Main regression, large and small firms

Dependent variable: log number of employees	Large companies (150+ employees)		Small companies (10-150 employees)	
RZ measure	RZ_eur	RZ_US	RZ_eur	RZ_US
Pre-crisis productivity *	0.0001012*** (0.00003)	0.000099*** (0.00003)	0.0000826*** (0.00002)	0.0000826*** (0.00002)
Pre-crisis RZ external dependence *	-0.0003755*** (0.00008)	-0.0001494* (0.00008)	-0.0001417*** (0.00005)	-0.000174*** (0.00004)
Pre-crisis indebtedness *	0.0000344*** (5.07e-6)	0.000033*** (4.5e-6)	-0.00000357*** (1.17e-6)	-0.00000357*** (1.17e-6)
Year 2005	0.048464*** (0.004)	0.0472898*** (0.004)	0.0418195*** (0.002)	0.0422472*** (0.001)
Year 2006	0.0970335*** (0.004)	0.0977771*** (0.004)	0.0780784*** (0.002)	0.0776263*** (0.002)
Year 2007	0.1687916*** (0.005)	0.1682157*** (0.005)	0.1312475*** (0.002)	0.1302932*** (0.002)
Year 2008	0.2139485*** (0.006)	0.2131201*** (0.005)	0.1798454*** (0.003)	0.1791782*** (0.002)
Year 2009	0.2167734*** (0.006)	0.2177575*** (0.006)	0.1785432*** (0.003)	0.179582*** (0.003)
Year 2010	0.2454604*** (0.006)	0.2478897*** (0.006)	0.2005456*** (0.003)	0.2020094*** (0.003)
Year 2011	0.2347438*** (0.006)	0.2374719*** (0.006)	0.1882018*** (0.003)	0.1900019*** (0.003)
Year 2012	0.2270153*** (0.006)	0.2289912*** (0.006)	0.1604976*** (0.003)	0.1623815*** (0.003)
Year 2013	0.2422487*** (0.008)	0.2430696*** (0.008)	0.1815711*** (0.003)	0.1831574*** (0.003)
Constant	5.49183*** (0.004)	5.475769*** (0.004)	3.205318*** (0.002)	3.197701*** (0.002)
Observations	195345 (23799 firms)	200703 (24468 firms)	899457 (106390 firms)	939016 (111032 firms)
F	232.11***	245.36***	1020.49***	1090.45***
R ²	0.0677	0.0678	0.0418	0.0431

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Special caution must be taken with 2013 coefficients, since data availability for that year is limited and in some cases provisional.

The coefficient of pre-crisis productivity is uniformly significant and positive in all the specifications. This indicates that, in some sense, (creative) destruction has been taking place. The more productive companies are the ones that have hired the most new workers: labour has been reallocated at a company level.

We can interpret the coefficient 0.0001012 on productivity of the RZ_eur specification for large companies as follows. I assume two companies, A and B, which have exactly the same characteristics but only differ in their productivity level, A having a productivity level of € 100,000 (2005 constant) per worker per year higher than B in the pre-crisis period. We expect company A to have on average 1.012 per cent more employees after the crisis stuck than B.

Even though the dimension of this coefficient is not very large, it is relevant to take into account that much of the effect of the crisis is being captured in the year fixed effects (which represent percentages with respect to 2004). Further, the significance of the positive coefficient is robust in all the specifications we have considered (considering the absolute number of employees, including other variables like sectorial competition or in general in most countries, as I analyse later), and does not depend on the sample choice with regards to the size of companies.

Therefore, at a company level and considering the EU15 as a whole, we do see evidence that successful innovators in a Schumpeterian sense indeed did better (positive evidence towards H1).

The coefficient of finance dependence that proxies the one used by Rajan and Zingales has a negative significant effect. This implies that finance had indeed an effect on the evolution of companies. Companies that had a structural need for more finance experienced more decreases (less increases) in their number of workers.

This is coherent with a situation of difficulties in international financial markets in which banks are unwilling to lend money, regardless of the situation of the specific company. In the context of the Aghion-Howitt Schumpeterian model with financial system, this is equivalent to the screening cost f being higher and affecting particularly these sectors, which have therefore lower growth rates and generate less employment.

This conclusion agrees with Aghion, Hemous and Kharroubi (2014), who find that sectors that strongly rely on external finance are those who can gain the most from policy interventions in recessions.

Furthermore, results go in the same line as those of Dell’Ariccia, Detragiache and Rajan (2008) or Kroszner, Laeven and Klingebiel (2007).

This result is robust towards calculating the RZ_eur measure with current US data (2004-2007), for all three sets of companies. The use of the original RZ coefficient (Appendix A, Table A.1) yields different results. The differences with RZ_eur and RZ_US are not due to the use of only manufacturing companies (results above are robust towards that selection), but probably to the outdated nature of the coefficient.

The economic significance of this coefficient is not so straightforward to analyse. In the next section I consider an alternative specification with dummy variables that represent financial dependence deciles in order to get an understanding of the dimensions that this effect may have.

The coefficient for the variable that proxies indebtedness does not have a consistent sign. It is negative for small companies and positive for large companies. Overall, the coefficient is negative.

Therefore, being more indebted in the period 2004 to 2007 implied more hirings after the crisis for large companies, while for smaller companies it implied less hirings.

A hypothesis that might explain why this is happening for large companies is that more indebtedness is related to having more profitable investments (Barlevy, 2003). It can be also related to the fact that these companies have a better access to the financial system due to their size, their internationalisation or interconnections with banks.

Another, from Nickell, Wadhani and Wall (1992), is the so-called “discipline of debt”: high debt levels force managers to be more dynamic (seek new opportunities, expand markets), thus improving the overall performance of the company. The same argument appears in Aghion et al. (2005): firms with a higher debt ratio will try to innovate more to escape the possibility of bankruptcy.

For the whole population of firms, the negative coefficient is possibly related to the intuitive prediction: an indebted firm suffers more during the crisis because it needs to repay its debt. Furthermore, during the crisis it might not obtain a refinancing of the amounts due while in an expansion context it would.

For the overall sample, an increase of 10 percentage points of the indebtedness ratio (as defined above) is correlated with a 0.36 per cent lower number of workers during the crisis (3 per cent higher for large firms).

The differences between large and small companies can also be related to an argument proposed by Dell’Ariccia, Detragiache and Rajan (2008): small

companies rely more on banks situated on their same country, while large companies can get financing abroad or in securities markets.

4.2. Financial dependence deciles

As we anticipated earlier, we have run a regression exactly identical to the one earlier, just substituting the RZ component for decile dummies interacting with a crisis dummy, in order to more deeply understand the effect of belonging to a financially-dependent sector. The results of the regression (for large firms) are in Appendix A (Table A.2).

On average, a company in the most financially dependent decile, *ceteris paribus*, employs 1.48 per cent fewer people during the crisis than a company in the least financially dependent quartile. In terms of the dimensions of the other coefficients that we are considering, this effect is quite relevant (although in the specification proposed the effect fails to be significant at the 10 per cent level); however, coefficients for the deciles do not show a homogeneous pattern.

4.3. Other explanatory variables: sectorial competition

Apart from the variables in the main model specification, I have also derived the same model including a measure of sectorial competition following Aghion et al. (2005), calculated for European data in the period 2004 to 2007 to avoid endogeneity issues, as earlier. Results are in Appendix A (Table A.3).

The result of this coefficient is uniformly positive, significant overall and for large firms, but not for the smaller ones. This indicates that firms in sectors with a higher level of competition, overall, have performed better since the onset of the financial crisis than sectors with a lower level of competition.

This evidence is consistent with the “escape competition” effect as described by Aghion et al. (2005): higher sectorial competition (in the context of the current crisis) implies that companies are more incentivised to innovate to escape competition. This implies, in terms of the framework in this paper, that they grow more on average.

4.4. Cross-country interaction terms

In order to perform a country-level analysis of how the crisis affected the overall level of productivity, I have repeated the panel data fixed-effect estimation with log specification, as described above, including country-variable interaction terms. There are only three EU-15 countries for which I do not report coefficients: Greece, Netherlands and Denmark. This is due to the fact that companies in these countries did not fulfil the requirements set in terms of availability of data (particularly, of value added).

For ease of interpretation of coefficients, they do not reflect country differences with respect to a benchmark country, but the effect that each of the variables had in each specific country. The results are summarised (in terms of signs, by country and company size) in Table 6 below and reported in detail in Appendix A (Tables A.4, A.5, A.6).

Table 6. Cross-country effects, signs

Specification	Productivity			Indebtedness			RZ		
Country	All	L	S	All	L	S	All	L	S
Austria		-	+		+				-
Belgium	+		+	-	+	-		-	
Finland			+	+	+				
France	+	+	+	-	-	-			
Germany	+	+		+	+	+		-	
Ireland		+		+	-	+		+	
Italy	+	+	+					-	
Luxembourg									
Portugal	+		+	+	+	+	-	-	
Spain	+	+	+		+		-		-
Sweden	+	+	+						
UK	+	+	+				-	-	-

This table summarises the results of Tables A4, A5 and A6. L are large firms and S are small firms, as defined in general for this section. + indicates positive significance and – indicates negative significance. No sign indicates no significance.

These results show, first of all, that there is in general a positive evidence for H1 (“creative destruction hypothesis”) in most of the European countries, and particularly in all of the larger ones, where the coefficient is significantly positive regardless of company size.

However, magnitudes are quite different. For instance, considering the results for all companies, in Spain a much more productive company (€ 100,000 constant 2005 per worker per year more) is *ceteris paribus* related with a number of workers nearly 3 per cent higher than a less productive one (in France the value is similar). In the Spanish case, as pointed out earlier, flows out of the construction sector can be a good part of the explanation for the relevance of this phenomenon.

On the other hand, the percentage drops to 0.7 in the case of the UK or Germany, countries in which labour productivity did not improve significantly (Germany) or decreased (UK) since the beginning of the crisis.

The French case is more puzzling, since it shows a strong effect of creative destruction, while labour productivity performance did not improve much during the crisis period.

In Ireland creative destruction was only prevalent for large firms. For the overall sample of firms, the effect fails to be significant at 10 per cent level.

Portugal, another country that was particularly affected by the crisis, shows a very small coefficient. In terms of magnitude, it is around 20-30 times lower than the Spanish, even lower than the German. However, overall Portuguese labour productivity did increase; these two observations together seem to indicate that this productivity improvement took place inside firms (possibly through reduction of the number of workers, particularly in temporal contracts, that were the main source of adjustment of employment in Portugal (Carneiro, Portugal and Varejão 2014). This effect is likely to have happened as well in other European countries.

Second, it is clear that the effect of finance dependence (as measured by the RZ_eur coefficient) is of particular significance in dimension in southern European countries like Spain or Portugal, that suffered trouble in their financial systems (and thus companies had to face higher screening costs) and a sovereign debt crisis (that generated further tensions in the financial system, increasing borrowing costs). In the same line, the coefficient is also negative for large firms in Italy and Belgium, countries that endured similar situations.

This is also the case of the UK (for both subsamples of companies) and might be one of the relevant reasons that could explain the decrease in overall labour productivity. The negative coefficient on the RZ measure for the United Kingdom is the largest amongst all the studied countries, reflecting a particularly negative effect of finance dependence for British companies.

In all of these cases the magnitude of the RZ coefficient is similar to the one analysed earlier for large firms at an EU-15 level.

Third, the overall negative effect of indebtedness, which I have analysed to be the result of two very different effects (positive for large companies and negative for smaller ones), is less homogeneous. It seems that in countries like France or Belgium the negative effect of debt is significant, while the arguments for the positive effect of debt seem to apply particularly to Portugal, Germany, Finland or Ireland.

The positive effect of debt for large companies is shown to be much more consistent across countries than the negative effect for small companies is. The only exception for this is France, where coefficients are significantly negative for all company sizes.

On the other hand, Germany and Portugal do show a positive effect of debt for all company sizes, which is particularly striking in the Portuguese case, where the dimension of the coefficient is considerable (an increase of 1 percentage point on indebtedness is related with having a 3 per cent higher number of workers after the crisis).

In contrast with the significantly negative effect of finance dependence for the UK, indebtedness fails to be a relevant variable in order to explain the performance of British companies in the post-crisis period.

5. Conclusions

I have studied the main determinants of company performance in the context of the current financial crisis in order to understand the transmission channels through which it impacted on productivity.

The results I obtain explain some of the remarkable findings in the stylised facts. Spain, the country where productivity improved the most, was the one with the largest effect of “creative destruction” (even though finance also played a role). The UK, on the other hand, where productivity actually decreased, shows the largest effect of finance dependence on the evolution of companies.

Policy implications are, therefore, heterogeneous amongst countries and companies. On the one hand, the existence of a consistent creative destruction effect (even though limited in dimension) suggests that recessions do help to reorganise the economy. This would imply that policy intervention to support companies during a recession would be negative in the long run.

On the other hand, however, financially dependent companies suffer more during a recession, independently of their indebtedness level. This provides a further justification for policy intervention to stabilise the financial system or to help financially dependent companies by offering them the loans they cannot secure in the private sector.

Moreover, results show that fostering sectorial competition would help companies to survive in the context of a crisis. With regards to indebtedness, the effect is heterogeneous and dependent on company size. While so-called “discipline of debt” remains a good explanation in theory, the fact that indebtedness is a positive predictor for company performance during a crisis only if the company is large might be pointing out that indebtedness is proxying other unobservable company

characteristics (good relations with financial sector, bargaining power...) that can also be very related with resistance in a crisis context.

There are many future possibilities for research on this topic. Following the same methodological approach, other explanatory variables could be included in the analysis (both at a sectorial and company level) of post-crisis performance determinants. This could offer a solution for some of the countries whose evolution is not well explained by this framework (France or Ireland, for instance).

An aspect that has not been considered is the analysis of opening and closing companies, where part of the creative destruction process is taking place.

It would also be informative to repeat this kind of analysis for other recessions or financial crises, be it in a different time frame or in a different geographical area. This would help to compare the current crisis with other past recessions and to draw conclusions with more general validity.

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Appendix A. Tables.

Table A.1. Other functional specifications for the main regression: RZ coefficient, absolute values.

Specification (dependent variable: log number of employees)	All companies	Small companies	Larger companies	All companies (considering absolute value of employees)
Measure	RZ	RZ	RZ	RZ_eur
Pre-crisis productivity * crisis	0.000787*** (0.00002)	0.000191 (0.0002)	0.0000688*** (0.00001)	0.0206754*** (0.008)
RZ external dependence * crisis	0.038832*** (0.005)	0.0375329*** (0.006)	0.0373786*** (0.01)	-0.021964 (0.125)
Pre-crisis indebtedness * crisis	0.0004638*** (0.0001)	0.0003801*** (0.0001)	0.0005149*** (0.0002)	-0.0004457 (0.0007)
Year 2005	0.233758*** (0.002)	0.0227549*** (0.002)	0.0274249*** (0.005)	5.175511** (2.61)
Year 2006	0.0395673*** (0.002)	0.0366141*** (0.002)	0.0522684*** (0.006)	15.6772*** (3.84)
Year 2007	0.0780634*** (0.002)	0.0726387*** (0.003)	0.1027773*** (0.006)	26.59072*** (4.232)
Year 2008	0.0908126*** (0.003)	0.0819294*** (0.01)	0.1049978*** (0.008)	34.40845*** (4.65)
Year 2009	0.0654195*** (0.003)	0.0556513*** (0.01)	0.0838619*** (0.008)	32.36799*** (4.95)
Year 2010	0.0758409*** (0.003)	0.0659838*** (0.01)	0.0948655*** (0.008)	35.18816*** (5.05)
Year 2011	0.0776454*** (0.003)	0.0676491*** (0.01)	0.0973285*** (0.009)	41.15221*** (5.338)
Year 2012	0.0661422*** (0.004)	0.0545099*** (0.01)	0.0935452*** (0.009)	45.34283*** (5.95)
Year 2013	0.0708986*** (0.004)	0.0606266*** (0.01)	0.0914669*** (0.01)	58.79747*** (8.65)
Constant	3.812305*** (0.002)	3.425448*** (0.002)	5.657646*** (0.006)	299.6515*** (4.20)
Observations	448156 (52684 firms)	370296 (43381 firms)	77369 (9245 firms)	1096350 (130320 firms)
F	252.18***	219.73***	43.20***	10.82***
R ²	0.0232	0.0185	0.0471	0.0006

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Special caution must be taken with 2013 coefficients, since data availability for that year is limited and in some cases provisional.

Table A.2. Results with decile dummies.

Specification (dependent variable: log number of employees)	Large companies
Measure	RZ_eur
Pre-crisis productivity * crisis	0.0001013*** (0.00003)
Pre-crisis indebtedness * crisis	0.0000345*** (5e-6)
Decile 2	-0.0454783*** (0.015)
Decile 3	-0.0278186** (0.013)
Decile 4	-0.0280597 (0.017)
Decile 5	-0.0013969 (0.014)
Decile 6	-0.0243156* (0.014)
Decile 7	0.0141897 (0.016)
Decile 8	0.0045195 (0.013)
Decile 9	-0.0032661 (0.015)
Decile 10	-0.0147987 (0.016)
Constant	5.491495*** (0.004)
Observations	195345 (23799 firms)
F	141.71***
R ²	0.0681

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Year fixed effects are included but not reported. Deciles are ordered from less financial dependence to more financial dependence, with coefficients being relative towards the lowest decile (least financially-dependent companies)

Table A.3. Results including sectorial competition

Specification (dependent variable: log number of employees)	All companies	Small companies	Larger companies
Pre-crisis productivity * crisis	0.0000912*** (0.00002)	0.0000826*** (0.00002)	0.0001012*** (0.00003)
RZ external dependence * crisis	-0.0001844*** (0.00005)	-0.0001422*** (0.0000519)	-0.000379*** (0.00008)
Pre-crisis indebtedness * crisis	-0.0000034** (1.44e-6)	-0.00000357*** (1e-6)	0.0000344*** (5e-6)
Sectorial competition* Crisis	0.0000425*** (0.00001)	0.0000233 (0.00002)	0.0001329*** (0.00003)
Constant	3.614075*** (0.0016)	3.20522*** (0.0018)	5.491749*** (0.004)
Observations	1095627 (130291 firms)	899260 (106367 firms)	195297 (23793 firms)
F	1141.66***	942.10***	214.44***
R ²	0.0464	0.0418	0.0678

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Year fixed effects are included but not reported

Table A.4. Cross-country effects (all companies)

Specification	All companies		
Country	Productivity*crisis	Indebtedness*crisis	RZ eur * crisis
Austria	0.0000608 (0.00006)	0.0051556 (0.003)	0.0025071 (0.0033)
Belgium	0.0000571** (0.00002)	-0.000003*** (9.9e-7)	-0.0002017 (0.0002)
Finland	0.0001785 (0.0001)	0.0019087** (0.0008)	-0.0002199 (0.003)
France	0.0002657*** (0.00009)	-0.0000399*** (0.0001)	-0.0004387 (0.0004)
Germany	0.00007*** (0.00001)	0.0001227*** (0.00004)	-0.0001074 (0.00008)
Ireland	0.0000628 (0.00005)	0.00000676* (3.7e-6)	0.0003986 (0.0014)
Italy	0.0002119*** (0.00005)	0.000127 (0.00008)	-0.0000855 (0.00006)
Luxembourg	-0.0000214 (0.000307)	0.003082 (0.001)	0.008684 (0.009)
Portugal	0.0000115* (6.56e-6)	0.0003118*** (0.00007)	-0.0002609** (0.0001)
Spain	0.0002921*** (0.00005)	0.00000357 (3e-6)	-0.0002309** (0.00009)
Sweden	0.0005777*** (0.0002)	0.0000736 (0.0001)	-0.0001457 (0.0002)
United Kingdom	0.0000659*** (0.00001)	0.0000306 (0.00003)	-0.0003876*** (0.0001)

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Year fixed effects are included but not reported. Sample: all companies >10 workers.

Table A.5. Cross-country effects (large companies)

Specification	Large companies (>150 employees)		
Country	Productivity*crisis	Indebtedness*crisis	RZ_eur * crisis
Austria	-0.0000993* (0.00006)	0.098242*** (0.014)	-0.0018293 (0.004)
Belgium	-0.000113 (0.00015)	0.0010556*** (0.0004)	-0.0007397*** (0.0002)
Finland	-0.000084 (0.00006)	0.003328*** (0.0002)	0.0002542 (0.0005)
France	0.0005744*** (0.00017)	-0.000038*** (5e-6)	-0.0023801 (0.002)
Germany	0.0000743*** (0.000017)	0.0003514** (0.0002)	-0.0002428* (0.0001)
Ireland	0.0003226*** (0.0001)	-0.0004037* (0.0002)	0.0014643* (0.0009)
Italy	0.0001381*** (0.00004)	0.0004487 (0.0004)	-0.0003791** (0.0002)
Luxembourg	-0.0002139 (0.0002)	-0.0138419 (0.033)	-0.000368 (0.0058)
Portugal	-0.0002336 (0.0002)	0.0024675*** (0.0003)	-0.0004822*** (0.0002)
Spain	0.0003826*** (0.00014)	0.0000326*** (2e-6)	-0.0002151 (0.00024)
Sweden	0.0007177*** (0.0002)	0.0042386 (0.003)	-0.0008262 (0.0007)
United Kingdom	0.0001954*** (0.00008)	0.0000221 (0.00002)	-0.0003483* (0.00021)

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Year fixed effects are included but not reported

Table A.6. Cross-country effects (small companies)

Specification	Small companies (<150 employees)		
Country	Productivity*crisis	Indebtedness*crisis	RZ_eur * crisis
Austria	0.0002439** (0.0001)	0.0017293 (0.0016)	-0.000216** (0.000097)
Belgium	0.0000592** (0.00002)	-0.00000322*** (1e-6)	0.0000604 (0.0002)
Finland	0.0004548*** (0.00015)	-0.0004037 (0.0005)	-0.0004428 (0.00034)
France	0.000163** (0.000074)	-0.0000251** (0.00001)	-0.0003021 (0.0004)
Germany	0.0000435 (0.00003)	0.0001027** (0.00004)	-0.0000287 (0.0001)
Ireland	0.0000237 (0.00002)	0.0000093*** (2.5e-6)	-0.0064138 (0.004)
Italy	0.0003906*** (0.00014)	0.0000997 (0.00007)	-0.0000712 (0.000062)
Luxembourg	-0.0000349 (0.00004)	0.0004389 (0.00097)	0.0160682 (0.014)
Portugal	0.000012* (7e-6)	0.000268*** (0.00003)	-0.0001917 (0.00013)
Spain	0.0002647*** (0.00005)	0.000000605 (1e-6)	-0.000216** (0.0000964)
Sweden	0.0005633*** (0.00017)	0.0000645 (0.0001)	-0.0000766 (0.000246)
United Kingdom	0.0000554*** (5e-6)	-0.00000197 (0.00001)	-0.0003854*** (0.0002)

*** significant to 1% level, ** significant to 5% level *significant to 10% level. Year fixed effects are included but not reported. Only companies with at least 10 employees are included.