

# Credit Supply Shocks and Human Capital: Evidence from a Change in Accounting Norms\*

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## Abstract

This paper investigates the effect of an exogenous credit supply shock triggered by a change in accounting norms on firm accumulation of human capital. In 2005, the introduction of new reporting norms for defined-benefit pension plans in Portugal led to large increases in the accounting value of bank pension liabilities. Affected banks increased both direct contributions to their pension plans and prudential deductions from Tier 1 capital, subsequently reducing their supply of credit. Using bank-firm credit exposures matched with a census of Portuguese employees, we first document that firms in a relationship with affected banks do not perfectly substitute credit and hence borrow less. Second, we find that affected firms reduce employment. We show that these employment effects are stronger not only among unskilled workers but also among the highly educated ones. Workers holding a college degree, or occupying skill-intensive jobs - such as managers or specialists - are more likely to leave affected firms. These results suggest that credit supply shocks can affect firm accumulation of human capital, with implications for firm long-term productivity.

**Keywords:** Credit Frictions, Regulation, Employment, Human Capital

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# 1 Introduction

A recent literature shows that, when facing adverse credit supply shocks, firms tend to downscale investment, production and employment (Bentolila et al. 2015; Berton et al. 2016; Berg 2016; Hochfellner et al. 2015; Jiménez et al. 2016; Popov and Rocholl 2015; Siemer 2016). One important question is whether these negative shocks have long-run effects on firm productivity. Negative credit supply shocks could foster firm productivity if they offset existing labor market rigidities, leading to a more efficient matching between employee skills and occupations. Conversely, labor market rigidities may amplify the adverse effects of credit supply shocks if, for instance, only entrenched workers maintain their job, while high-skilled workers leave affected firms. Our objective is to address this question by investigating whether credit supply shocks affect firm ability to accumulate and retain human capital.

Measuring the effects of credit supply shocks on the accumulation of human capital is challenging. First, it requires a shock that is not only orthogonal to both bank and firm health, but also not contemporaneous to any important variation in labor market conditions. Second, we need bank, firm and employee data, as well as a way to link these three layers of information. Finally, detailed employee-level information on education, experience and occupation is necessary. Our paper exploits the introduction of new accounting norms for bank defined-benefit (DB) pension plans, in 2005 in Portugal, as an exogenous shock to credit supply.<sup>1</sup> We explore the effect of this shock by matching bank-firm credit exposures with a census of all private sector firms in Portugal.

We find that the negative effect of credit supply shocks on employment is concentrated among employees at the two extremes of the skill distribution: firms reduce employment of unskilled workers, but also of the highly-educated ones. We also show that workers holding a college degree and those occupying high-skilled jobs - such as managers and specialists - are more likely to leave firms affected by an adverse credit shock. These results suggest that credit supply shocks may have

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<sup>1</sup>In another context, Rauh (2006) exploits firm mandatory contributions to their pension funds as an exogenous shock to internal financial resources and investigates the effect on firm investment

long-run effects both on the productivity of firms, as their ability to accumulate human capital decreases, and on career outcomes.

To obtain our results, we exploit a credit supply shock triggered by new accounting norms for bank DB plans introduced in 2005 in Portugal - the *International Accounting Standard Nineteen* (or IAS 19). In a DB plan, the bank pledges retirement benefits to employees according to a formula that is a function of each employee's age, tenure and salary. Thus, the DB plan liabilities are equal to the discounted value of the payments pledged to retirees based on actuarial assumptions on discount rates, retirement age, wage growth and life expectancy. The introduction of IAS 19 resulted in large and heterogeneous increases in the accounting value of bank DB plan liabilities for two reasons. On the one hand, bank DB plans had to cover new types of benefits. Actuarial assumptions, on the other hand, changed significantly: discount rates decreased and life expectancy estimates were revised upwards, leading to large actuarial losses.

The large and heterogeneous increases in bank pension plan liabilities resulting from IAS19 led banks to both increase the direct contributions to their pension plans and to make prudential deductions from Tier 1 capital. In 2005, the total bank contributions to pension plans and the deductions for pensions from Tier 1 capital amounted, respectively, to 2.5 and 1.6 billion euros, or, in total, to almost 20% of their Tier 1 capital. These increases in prudential deductions and direct pension contributions are 1) *heterogeneous across banks*, as both the size of bank pension plans, and the magnitude of the effect on their funding status, vary across banks, 2) *orthogonal to bank health*, since they result from changes in the valuation norms for DB pension plans that are unrelated to bank financial characteristics, 3) *orthogonal to firm employment decisions*, because pension plans are mostly held by banks in Portugal 4) *not contemporaneous to any important variation in macroeconomic or labor market conditions* as the years 2004 and 2005 where years of steady growth in Portugal.<sup>2</sup>

We identify the effect of the introduction of IAS19 on firm employment by matching all bank-firm credit exposures with a census of Portuguese employees.

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<sup>2</sup>More than 80% of pension fund assets are held by banks

Bank-firm credit exposures come from the Portuguese Credit Register (CR), which covers the credit exposures of all banks and firms in Portugal since 1980. We combine the CR with data from bank, firm and DB plan financial statements. We then match this dataset with a census of all private sector firms in Portugal that includes detailed information on each employee career, education, occupation and earnings. This bank-firm-employee matched dataset allows us to measure the impact of our credit supply shock not only on firm employment but also on diverse other employment outcomes such as wages, career dynamics and talent allocation or retention.

Our analysis follows three steps. We first investigate the effect of the introduction of IAS19 on bank-firm credit exposures in a difference-in-differences setting at the loan level. Our measure of treatment intensity is the ratio of bank DB plan liabilities over bank total assets before the shock. Our specification controls for bank balance sheet and bank-firm relationship characteristics. In addition, because a large majority of firms are borrowing from several banks, we control for demand by including firm fixed effects (Khawaja and Mian 2008). In line with the existing literature (Aiyar et al. 2014; Behn et al. 2016; Fraisse et al. 2015; Jiménez et al. 2016), we find that banks facing a negative funding shock react by cutting credit more to the same firm than other banks. These findings hold both for the intensive and the extensive margins, and are stronger for banks with lower pre-existing capital buffers.

In a second step, we show firms that are associated to treated banks borrow less and reduce employment after the shock. To do so, we build a firm-level measure of treatment intensity, which is the weighted average of the treatment intensity across all the banks a firm is borrowing from in the pre-treatment period. A one standard deviation increase in the treatment intensity relatively cuts committed loan growth by 10 pp, and employment growth by 0.5 pp. These results are robust to the inclusion of industry and geography fixed effects, of multiple firm and bank controls and are stronger for small firms.

Finally, we further investigate the effect of the credit supply shock on employment, disentangling several compositional effects across worker characteristics. At

the firm level, we find that affected firms decrease employment relatively more among employees with low education. But the effect is also large on employees with a high level of education, and of comparable magnitude when we exclude micro firms - that is, firms with less than 10 employees. These results are confirmed at the individual level: highly educated workers are more likely to leave affected firms. When we investigate the effect of the credit supply shock across occupations, we find that both managers, and at the other extreme, unqualified workers, are more likely to leave firms affected by an adverse credit supply shock.

Our paper adds to the growing literature on the effects of bank financing constraints on lending (Paravisini 2008; Ivashina and Scharfstein 2010; Chava and Purnanandam 2011; Puri et al. 2011; Berg 2016) and firm employment (Benmelech et al. 2016; Bentolila et al. 2015; Berton et al. 2016; Acharya et al. 2015; Chodorow-Reich 2014; Popov and Rocholl 2015; Berg 2016; Hochfellner et al. 2015; Caggese et al. 2016; Siemer 2016). Our paper extends upon these studies in three ways. First, we focus on a credit supply shock triggered by a change in accounting norms and hence orthogonal to both bank and firm health. This credit supply shock occurs in good times, allowing us to better capture the effect of credit supply shocks on talent retention, and on the workforce composition. Second, we are able to differentiate the effect across a large set of employee characteristics, including occupation and education. Third, relying on our bank-firm-employee dataset, we aim at investigating the effect of credit supply shocks not only on the level and composition of employment at the firm level, but also on the allocation of workers across firms and on the career dynamics of each worker, controlling for employee characteristics.

Our paper also complements the literature that quantifies job reallocation effects *across firms*. Davis and Haltiwanger (1992) estimate that job creation and destruction account roughly for 20% of jobs, while Campbell and Kuttner (1996) find that reallocation shocks account for roughly half of the variance in total employment growth. Bai et al. (2015) find that the state-level deregulation of local U.S. banking markets lead to significant increases in the reallocation of labor within

local industries.<sup>3</sup> ? and Babina (2016) investigate the effects of firm financial distress on, respectively, individual earnings and transition to entrepreneurship.

Finally, the paper contributes to the labor literature on the allocation of workers *within firms*. By looking at a credit supply shock, we are able to examine how the pool of workers within the firm varies with firm access to external funds. Baghai et al. (2015) show that the pool of talented workers significantly deteriorates when firms are close to bankruptcy, and Brown and Matsa (2016) that talented workers tend to apply less to firms in financial distress.

The rest of the paper is organized as follows. Section 2 describes the institutional background of bank pension plans in Portugal and the related regulations. Sections 3 and 4 introduce respectively the data and the identification strategy. Section 5 presents and discusses the results. Section 6 concludes.

## **2 Institutional Background: Bank Pension Plans and the IAS19 Reform**

This section presents the institutional details of the functioning of bank pension plans in Portugal and describes the effects of the IAS19 accounting reform.

### **2.1 Bank DB Pension Plans in Portugal: an Overview**

In 2004, 13 out of the 22 major banking groups operating in Portugal provided DB pension coverage to their employees. Portuguese banks started offering pension plans in the late 1980s, following the adoption of the 1986 Social Security Act.<sup>4</sup> Bank DB plans were implemented through a nationwide sectoral labor agreement between banks and unions. One of the fundamental factors in the development of these pension funds was the tax incentives, as contributions can be tax-deducted. Banks offering private pension coverage have been coexisting with banks that do

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<sup>3</sup>Acharya et al. (2011) looks at the effect of state-level banking deregulation in the US on the allocation of output across sectors.

<sup>4</sup>Decreto-lei 396/86, de 25 de Novembro <https://dre.tretas.org/dre/8413/decreto-lei-396-86-de-25-de-novembro>

have pension obligations for their employees, such as foreign banks and some state-owned banks.

Due to their wide coverage - bank DB plans covered more than 180,000 employees in 2004 -, bank pension funds are sizable institutions.<sup>5</sup> At the end of 2005, total liabilities of the bank pension schemes amount to 12.3 billion euros, accounting for almost 8% of Portuguese GDP.

One unique specificity of the private pension sector in Portugal is that it mostly covers only two sectors: banking and telecommunications. For the rest of the population, pensions are paid by the National Social Security Pension Scheme. As a result, bank DB plans stand for more than 80% of the private pension plan assets under management in 2005.

The assets of bank DB plans are generally invested in a large range of financial securities. In 2005, 38% of total fund assets are invested in fixed income securities and 25% in equity.

## 2.2 The Accounting of Bank DB Plans

In a DB pension plan, the bank pledges retirement benefits to employees according to a formula that is a function of each employee's age, tenure and salary. Thus, a bank sponsoring a DB pension plan has a financial liability equal to the present discounted value of the payments pledged to retirees. The bank has to fund pension liabilities with dedicated assets.

The calculation of the accounting value a DB plan assets and liabilities is based on actuarial assumptions, which, when they vary, lead to *actuarial gains or losses*. There are two primary sets of actuarial assumptions. Economic assumptions deal with the discount rate, wage growth, inflation and the expected long-term rate of returns on assets. Demographic assumptions, on the other hand, include life expectancy, retirement age, and rate of employment termination before retirement. The level of discount rate is the actuarial assumption which, if revised, can lead to the highest *actuarial losses*.

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<sup>5</sup>Estatísticas de Fundos de Pensões - [http : //www.asf.com.pt/NR/exeres/21E954ED - 7325 - 4CE6 - 8626 - 11AFE2245D5A.htm](http://www.asf.com.pt/NR/exeres/21E954ED-7325-4CE6-8626-11AFE2245D5A.htm)

The financial situation of a DB pension plan can affect the sponsor bank lending activity through two channels: the *funding* channel - when the sponsor has to make direct cash contributions to the pension fund - and the *accounting* channel - when the sponsor has to recognize *actuarial losses* in its balance sheet and make prudential deductions from Tier 1 capital.

The sponsor of a DB plan is required to make cash contributions to the pension plan when the pension plan is “underfunded”. A pension plan is considered underfunded when the market value of the plan assets is less than the present discounted value of the pension liabilities, which may result from *actuarial losses*. Required contributions are defined by a legally specified formula.

Prudential deductions to Tier 1 capital were introduced in 2002 by the Bank of Portugal to shield bank capital from deferred actuarial losses.<sup>6</sup> Actuarial losses are amortized over the service period of employees and only the amortization amounts are deducted each year from revenues in the income statement.<sup>7</sup> The losses that still have to be recognized - or the deferred actuarial losses - are reported in the bank balance sheet and deducted from Tier 1 capital. Thus, banks anticipating an increase in actuarial losses have to monitor closely their capital levels to remain compliant.

Figure 2 illustrates how a 50 million Euros increase in the accounting value of a bank DB plan liabilities can lead to contributions and prudential deductions. The technical annex provides more details on the exact accounting rules that drive contributions and prudential deductions.

#### INSERT FIGURE 2

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<sup>6</sup>Notice 12/2001 of Bank of Portugal. Prudential deductions were included along with the “corridor rule” that requires disclosure of actuarial gains/losses only if gains or losses exceed the greater of 10% of the value of the DB plan assets or liabilities

<sup>7</sup>Pension expenses on the income statements are calculated as the sum of the forecasted annual pension commitments (also known as the “service cost” of the plan) and the interest cost of the plan and amortization amounts, net of the expected return on the plan’s assets.

## 2.3 The Introduction of IAS19 as a source of Variations in Regulatory Capital and Internal Financial Resources

The introduction of IAS19 in 2005 led both to large bank contributions to their DB funds and to prudential deductions from Tier 1 capital.

### *The introduction of IAS19 in 2005*

In 2005, in the context of the implementation of the IFRS norms in Portugal, Portuguese banks had to adopt the IAS19 regarding employee benefits. Figure 3 illustrates the effect of the adoption of IAS19 on the financial situation of bank DB plans. At the end of 2005, the total liabilities of Portuguese bank DB pension plans increased by around 3 billion euros.<sup>8</sup>

#### INSERT FIGURE 3

The increase in bank DB plan liabilities resulted from two major changes. First, the benefits covered by bank pension plans were extended to include post-employment medical care and life insurance. The extension accounted for about 50% in the increase in the value of bank DB plan liabilities.

Second, actuarial assumptions were revised. The discount rate used to calculate the present value of bank DB fund liabilities was revised downwards - to take into account the very long maturities of the obligations -, accounting for approximately 25% of the effect of IAS19 on pension fund liabilities. The life expectancy of female workers, on the other hand, was revised upwards, accounting for the remaining 25% of the effect.<sup>9</sup> The second part of the technical annex shows extract from the main Portuguese bank 10-K financial statements about pension benefits, and how the accounting value of the liabilities have been affected.

#### INSERT FIGURE 3

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<sup>8</sup>The changes introduced by IAS accounting and their effects are described in Bank of Portugal 2005 Financial Stability Report.

<sup>9</sup>Before the introduction of the IAS standards, actuaries used one single mortality table for both male and female employees. The new rules required gender-specific tables, adjusting for the higher life expectancy of female employees.

### ***Bank Mandatory Contributions***

Following the substantial actuarial losses resulting from the adoption of IAS19 in 2005, banks were required to increase their contributions their pension plans. Figure 4 shows bank contributions to their pension plans from 2002 to 2010. The effect of the introduction of IAS19 is large: bank contributions to their pension plans spike in 2005, amounting to 2.345 billion euros.

INSERT FIGURE 4

### ***Prudential Deductions***

Figure 5 shows, in aggregate terms, the deductions applied on the regulated capital of the banks running pension schemes. Visibly, the most substantial constraints on regulated capital are imposed in 2005. Figure 2 and the technical annex provide a stylized example describing the mechanism through which the IAS accounting reform resulted in contributions and prudential deductions.

INSERT FIGURE 5

The richness of our institutional setting allows us to exploit cross-bank heterogeneity in their financing constraints, driven by the substantial ex-ante heterogeneity in the coverage of the pension plans. Figure 6 shows the distribution of prudential deductions across banks in 2005, scaled by pre-existing levels of Tier 1 capital. We observe that, first, deductions are very large for some of the banks, amounting to 50% of their Tier 1 capital. Second, banks are almost uniformly distributed. We will exploit this dimension in the identification strategy, by relying on specifications based on heterogeneous treatment intensity across banks.

INSERT FIGURE 6

## 3 Data

### 3.1 Loan Level Data and Bank Characteristics

We collect bank-firm credit exposures using the Portuguese Credit Registry (CR). The CR is held by the Bank of Portugal, and covers *all bank loans* above 50 euros granted to firms from 1980 to present. The CR collects from financial institutions their credit liabilities, as well as amounts in default, on a monthly basis.

The main sample of our analysis covers 165,085 firms borrowing from 59 banks belonging to 22 banking groups over the 2004-2007 period. We obtain this final sample by keeping only non-financial, private firms, and banks for which we have balance sheet information, representing more than 90% of the total credit in Portugal.<sup>10</sup> We then aggregate the different outstanding loans into monthly bank-firm credit exposures. This results in a dataset of over 20 million monthly credit exposures. In addition, we extract for each firm its full credit history since 1995.

We then match our database on credit exposures with annual financial information on bank DB pension plans, bank balance sheets as well as regulatory information on bank capital levels. This data covers bank exposure to their pension plans, any prudential deduction from Tier 1 capital and bank direct contributions to their pension schemes over the 2004-2012 period. Prudential deductions and contributions are at the banking group level, covering 22 banking groups. Bank financial characteristics are at the bank level and are available for the 59 banks belonging to these 22 banking groups.

For each bank, we construct a *TreatmentDummy*, indicating whether a bank is treated or not, and the variable *TreatmentIntensity* measuring the intensity of the treatment. Our *TreatmentIntensity* variable is the ratio of the banking group total pension liabilities over banking assets in the pre-treatment period, i.e. the year 2004. Table 1 shows that our variable *TreatmentIntensity* - bank pension plan exposure - varies significantly across banks: the average is 15%, the median is 9%, the 10<sup>th</sup> percentile 1% and the 90<sup>th</sup> percentile 25%. In order to obtain

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<sup>10</sup>We drop financial firms, state-owned companies and entrepreneurs.

balanced treated and control groups, we then define as *not treated* both banks with no pension funds, and banks with a fund exposure in the lowest quartile of the distribution.

### 3.2 Firm Level Data

For each firm, we use data from the CR to build the total credit exposure, as well as indicators of financial health - debt to income ratio, total credit, the number of bank relationships and indicators for non performing loans.

In 2004, Portuguese firms deal with several banks, 3.02 banks on average. This multiplicity of bank relationships allows us to include firm fixed effects, thereby neatly distinguishing demand and supply factors when explaining bank lending behavior.

We then build a variable *WeightedTreatment* measuring treatment intensity at the firm level as the average of the treatment intensity across all the banks lending to firm weighted by their relative credit exposures during the pre-treatment period. Table 1 shows that at the firm level, the weighted exposure to bank DB plans, measured by *WeightedTreatmentIntensity* is 0.1 on average, with a standard deviation of 0.09.

### 3.3 Employee Level Data

To investigate the effects of our credit supply shock on labor market outcomes we use the Quadros de Pessoal (QP) database, a census of all private sector firms in Portugal that employ at least one worker. The census is conducted each October by the Portuguese Ministry of Employment. Each firm and each worker entering the database are assigned a unique, time-invariant identifying number allowing us to follow firms and workers over time. Over our 2004-2007 sample period, we have information on 350,000 firms and on the complete career history of 3 million workers.

The QP asks employers to report each employee's socio-demographic characteristics, employment start and end dates, as well as an extensive set of job characteristics such as the type of employment, job title, wage, hours worked per

year (normal and overtime).<sup>11</sup> Socio-demographic characteristics include years of experience, level of education, year of last promotion, age, gender and nationality. Information is also collected on the industry, location, and founding date of the firm, as well as gross sales in the preceding calendar year.

The QP database also includes key firm level data such as accounting information - total sales, starting capital, age, number of employees - and detailed industry geographical dummies, as well as unique firm identifiers. We use these unique firm identifiers to match the QP database with the CR.

### **3.4 Balance Analysis: Treated versus Non-treated**

Table 1 shows that treated and non-treated banks are broadly similar across many dimensions, such as credit exposures and financial characteristics. The wide range of available bank characteristics will also allow us to control for observable differences among treated and non treated banks in our specifications.

INCLUDE TABLE 1

### **3.5 External Validity**

Portugal offers an ideal experimental setting for our identification; not only because of the policy experiment and the access to unique data, but also because the Portuguese economy has some unique characteristics that are useful for our analysis.

First, Portugal is a bank-based economy. We therefore measure the cost of banking frictions through the lending channel in a country where firm main source of funds are banks. Hence, in 2004, Portuguese banks held more than 70 per cent of total financial system's assets, in line with other EU countries, and bank loans correspond to more than 120% of GDP (Constancio et al. (2009), see Figure X in the online appendix).

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<sup>11</sup>The information on earnings includes the base wage (gross pay for normal hours of work), seniority-indexed components of pay, other regularly paid components, overtime work, and irregularly paid components.

Second, in 2004, the development and integration of the Portuguese financial system are close to the EU average. Since the 1980s, the liberalisation of the economy, coupled with the participation in the Euro area, have fostered the growth of the financial sector. The privatisation of the Portuguese public banks, which started in 1989, was virtually completed in 1995.<sup>12</sup> Private banks started to operate in late 1984, and, during the 1990s some foreign groups were already operating in Portugal, with a total market share of more than 10 per cent in 2004.<sup>13</sup>

Another interesting feature about the Portuguese economy is its labour market. While the structure of the labour market is close to the one of other OECD countries in terms of sectoral composition and firm size (see Figures A and B in the online appendix), its rigidity is relatively high, which ensures that any effect we observe on worker flows might only be biased downwards (Blanchard and Portugal 2001).<sup>14</sup>

While job flows are much lower in Portugal than in the US, wages are relatively flexible, which allows us to investigate the effect of the credit supply shock on wages and the cost for worker of job displacement. The average wage spell in Portugal is 13 months, about 2 months less than in the Euro Area (Druant et al. 2009). Despite the rigidity imposed by the existence of mandatory minimum wages and the presence of binding wage floors determined by collective agreements the firms still retain the ability to circumvent wage agreements to absorb demand shocks (Constancio et al. 2009).<sup>15</sup>

Finally, in 2005, Portugal was in the fourth consecutive year of relatively low growth following the 1995-2001 boom, with no major changes in the dynamics of its labour market (see Figure X).

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<sup>12</sup>The market shares of the State-owned banks (in terms of the banking system's assets) decreased from more than 74 per cent in 1990 to around 24 per cent in 1996, remaining stable from then on. The market share of the public banking group that still prevails corresponds to that of Caixa Geral de Depositos.

<sup>13</sup>The increase in the market share of foreign banks in 2000 was largely due to the acquisition of a large domestic bank - Banco Totta & Acores - by a foreign bank - Santander.

<sup>14</sup>Despite an unemployment rate of only 6.1 per cent, very similar to the US one in 2004, flows of workers into unemployment are indeed three times lower in Portugal than in the US. These lower flows come from both lower job creation and destruction, and from lower worker flows given job creation and destruction.

<sup>15</sup>? claims that wage flexibility might be limited in Portugal in 2006 since this wage cushion has been partly used by firms from 2000 to 2005

## 4 Identification

We exploit the heterogeneous exposure of banks to the introduction of the new accounting norms on pension plan liabilities as a shock to credit supply. We then investigate the heterogeneous effect of this credit supply shock on firm employment and career outcomes across skills and occupations.

### 4.1 Loan Level Analysis

#### *Overall Effect*

We investigate the effect of the new accounting norms on bank lending to firms using a difference-in-differences analysis.

We first build a balanced panel of bank-firm pairs over the 2004-2006 period. For each bank-firm pair that appears at least once in the CR over the period, we fill all months for which the pair is not in the CR with a zero exposure. Hence, if a bank  $b$  lends to a firm  $f$  and the loan is repaid within three months, the  $bf$  pair will be in our data every month during the entire sample period, even though the bank-firm exposure will be equal to zero most of the time.

We then collapse our panel into two sub-periods, one pre-treatment period and one post-treatment period. Because IAS19 was introduced on January 1, 2005, we use 2004 as the pre-treatment period and the two subsequent years, 2005 to 2006, as the post-treatment period. For each bank-firm pair, we take the average exposure in each sub-period, as in Bertrand et al. (2004). For all firm and bank controls, as well as the bank pension plan exposure, we take the values *ex-ante*, at the end of the pre-treatment period.

Our difference-in-differences estimation compares the change in the loan exposure of treated banks to the change in the loan exposure of non-treated banks with the following model:

$$\begin{aligned} \Delta \text{LogExposure}_{b,i} = & \alpha \text{Firm}_i + \beta * \text{Treatment}_{b,pre} + \\ & + \alpha * \text{BankControls}_{b,pre} + \gamma * \text{RelationshipControls}_{b,i,pre} + e_{b,i} \end{aligned} \tag{1}$$

The dependent variable  $\Delta \text{LogExposure}_{b,i}$  is the change in the logarithm of lending exposure of bank  $b$  to firm  $i$  between the pre- and the post-treatment periods. The independent variable  $\text{Treatment}$  is either our treatment dummy indicating whether the bank is treated or not, or our measure of treatment intensity, i.e. the ratio of the bank pension plan liabilities over the bank assets.  $\text{Firm}_i$  is either a vector of firm characteristics or, in the most restrictive specifications, firm fixed effects to capture loan demand at the firm level (Khwaja and Mian 2008).

Finally,  $\text{BankControls}_{b,pre}$  is an extensive range of bank controls, extracted from detailed bank financial statements, in the pre-treatment period. These bank controls include total assets, Tier 1 capital ratio, liquidity ratios, the loan to asset ratio, the short term liabilities to asset ratio, and the ratio of non-performing loans to total assets. All ratios are winsorized at the lowest and highest fifth percentile. Firm controls include the logarithm of total credit and the logarithm of the number of banks a firm borrowed from in the pre-treatment period. Relationship controls include the logarithm of total credit a firm borrowed from a given bank.

### ***Effect on Intensive Margins***

We investigate to which extent changes in bank-firm exposures come from the intensive margin - that is, from a decrease in volume within existing bank-firm relationships - by estimating our model on the subsample of bank-firm exposures that are strictly positive in the pre-treatment period. We analyze how these exposures change over the post-treatment period.

### ***Effect on Extensive Margins***

We then analyze the effect on the extensive margin of credit by looking at new

lending relationships. In this case, the dependent variable is a dummy that equals one if a new loan is granted in the post-treatment period to a firm that had a zero-exposure in the pre-treatment period. The variable is zero otherwise. The controls are the same as in Model 1. Thus, we estimate the following logit model:

$$\begin{aligned}
 NewLoan_{bi,post} = & \beta * TreatmentDummy_b * + \gamma * BankControls_{b,pre} + \\
 & + FirmControls_i + e_{bi}
 \end{aligned} \tag{2}$$

### ***Restricting the sample to banks running pension plans***

At this point, there might be lingering concerns that the group of banks running pension plans vary significantly from those banks that do not offer pension coverage. To alleviate these concerns, we run our main specification on the subset of banks that offer pension plans. Thus, we restrict the sample to a plausibly more homogeneous group of banks, within which we exploit different treatment intensities.

### ***Sensitivity to Bank Capital Buffers***

Finally, we investigate whether bank capital buffers partly offset the effects of the shocks. We explore whether the treated banks that had accumulated higher capital buffers above regulatory requirements prior to the shocks react differently from less well-capitalized banks. Since the shocks reduced bank Tier 1 capital, we would expect any negative effects on lending to be less pronounced when capital buffers are larger. To this end, we add to our dataset bank Tier 1 capital during the pre-treatment period. We estimate the following specification, with the coefficient of interest being  $\mu$ :

$$\begin{aligned} \Delta \text{LogExposure}_{bi,post} = & \text{Firm}_i + \beta * \text{TreatmentIntensity}_b + \eta * \text{Tier1Capital}_b + \\ & + \mu * \text{Tier1Capital}_b * \text{TreatmentIntensity}_b + \gamma * \text{BankControls}_{b,pre} + e_{bi} \end{aligned} \quad (3)$$

## 4.2 Firm-Level Analysis of Labor Outcomes

We first investigate whether firms are able to substitute across loan providers when their bank is affected by the shock. Second, we compare variations in the level of employment among firms that are differentially affected by the shock. We finally explore whether the effect varies across both levels of education and occupations.

### *Firm Access to Credit*

To measure the impact of the treatment on firm-level credit growth, we aggregate firms' credit exposures across banks and examine their change between the pre and post-treatment periods. We follow the specification below:

$$\begin{aligned} \Delta \text{LogTotalCredit}_{i,post} = & \text{Industry}_j + \text{Geography}_k + \beta * \text{WeightedTreatment}_{i,pre} + \\ & + \gamma * \text{Controls}_{i,pre} + e_i \end{aligned} \quad (4)$$

where  $\Delta \text{LogTotalCredit}_{i,post}$  is the change in the logarithm of strictly positive credit exposure by all banks to firm  $i$ .  $\text{Industry}_j$  and  $\text{Geography}_k$  are 52 and, respectively, 28 industrial sector and geography dummies.  $\text{WeightedTreatment}_{i,pre}$  is a differential treatment measure calculated as the average of the treatment intensity across all the banks lending to firm  $i$ , weighted by their relative credit exposures during the pre-treatment period.  $\text{Controls}_{i,pre}$  include a wide range of firm variables - total sales, total credit, the number of bank relationships, indicators for bad credit history, starting capital, age, number of employees and debt to income ratios - and, in some specifications, bank characteristics averaged similarly

to the treatment variable. Finally, we disaggregate the analysis by firm size.

### ***Firm Employment***

We examine, in a panel analysis over the 2004-2007 period, how firm employment varies across firms following the introduction of IAS19. The model we estimate is the following:

$$\begin{aligned} \Delta \text{LogTotalEmployment}_{i,t} = & \text{Firm}_i + \text{Year}_t + \\ & + \beta \text{Post}_t \text{WeightedTreatment}_{i,\text{pre}} + e_i \end{aligned}$$

We then split the sample of workers into three groups by level of education. We estimate the effect of the treatment on firm total number of employees with no high school degree, with only a high school degree and with college education.

Finally, in order to investigate more precisely the effect on the more educated workers, we distinguish firms with more than 10 employees from firms with less than 10 employees. Because small firms employ on average less than one educated worker, we expect the flows of talent in and out these firms to be rather limited.

### **4.3 Worker-Level Analysis**

In the last part of our empirical analysis, we further exploit the granularity of the data by investigating the effect of the credit supply shock at the worker level.

We first estimate whether the probability of a worker to be displaced after the credit supply shock increases with the intensity of the treatment. To do so, we estimate the following panel model over the 2002-2007 period:

$$\begin{aligned} \text{Pr}(\text{Leavingthe firm})_{i,j,t} = & \text{Firm}_j + \text{Year}_t + \beta \text{Post}_t \times \text{WeightedTreatment}_j \\ & + \text{Controls}_{i,t} + e_{i,j,t} \end{aligned}$$

where  $\text{Pr}(\text{Leavingthe firm})_{i,j,t}$  is a dummy variable indicating whether worker  $i$  leaves firm  $j$  in year  $t$ ,  $\text{Firm}_j$  is a vector of firm fixed effects,  $\text{Year}_t$  a vector of

year fixed effects, and  $Post_t \times WeightedTreatment_j$  takes for value the intensity of the treatment over the 2005-2007 period, 0 otherwise.  $Controls_{i,t}$  is a vector of worker characteristics that includes a polynomial of age, gender, education and job title.

We first estimate our model on our full sample of Portuguese employees. We then estimate the same model across levels of education, occupations and wage quartiles in 2004. We use wage quartiles in 2004 as a proxy for workers' skills.

## 5 Results

### 5.1 Bank-Firm Credit Exposures

INCLUDE FIGURE 7

Figure 7 plots the evolution of credit for treated and control banks from January 2004 to January 2007. The two lines represent the percentage growth in credit since 2004 in a monthly basis. While credit granted by the two groups of banks evolves in parallel until 2005, treated banks experience lower credit growth from then on. The lag we observe is driven by the fact that part of the bank-firm exposures come from revolving lines of credit, which are negotiated ex-ante for a given period of time, and by the fact that some banks incorporated the IAS 19 rules in the second semester of 2005, because they reported pension liabilities only once a year, at the end of the year.

INCLUDE TABLE 3

Tables 3 shows the effect of the introduction of IAS 19 on bank-firm credit exposures. Column (1) compares bank-firm credit exposures of treated versus control banks. The coefficient suggests that variations in credit exposures are 65 percentage points lower for treated versus control banks. The coefficients in columns (2) and (3) indicate that bank-firm credit exposure decreases with the intensity of the treatment. One standard deviation increase in the intensity of the treatment leads to a 21 pp decrease in credit growth. In other words, banks with

a large pension plan relative to their size tend to reduce their credit exposure to firms more after the introduction of IAS19. Including firm fixed effect to control for demand even increases the magnitude of the effect (column (3)).

The coefficients in columns (5) and (6) suggest that the effect is both at the intensive and extensive margins: firms that are already borrowing from treated banks see their credit exposure growing less than control firms (column (5)), and treated banks are less likely to initiate new loans (column (6)). Column (6) provides additional robustness for the possibility that firms dealing with non-treated banks might be systematically different from firms related to treated banks. We restrict the sample only to treated banks, and we find that the magnitude of the effect is even amplified. Finally, column (7) presents the results when we include the effect of banks' actual capital buffers in the regressions. The coefficient suggest that treated banks with lower capital buffers tend to cut lending more than highly capitalized banks.

## 5.2 Firm Borrowing

We now focus on the effect of the introduction of IAS 19 on firm total credit exposure.

INCLUDE TABLE 4

The coefficients in Table 4 suggest that firm total credit exposures decline substantially when they are exposed to treated banks. We find that credit growth is 10 percentage points lower for treated firms relatively to non-treated firms. The results are robust to including different combinations of controls. At the firm level, we control for total sales, initial capital, profitability, credit exposures, historical defaults, age and size (column (1)). The specification in column (2) is saturated with 52 industry and 28 geography fixed effects. In column (3), we add average bank characteristics along the same dimensions as for the bank-firm analysis, but weighted by ex-ante relative credit exposures. Columns (4) to (6) shows the same specifications with the treatment intensity as an independent variable. A one standard deviation in the intensity of the treatment leads to 7 percentage points

decrease in credit growth. Finally, columns (7) and (8) show the results across firm size. Consistent with the hypothesis that it is more costly for a small firm to substitute credit, we find that the effect is larger on firms with less than 10 employees.

### 5.3 Labor Outcomes

INCLUDE TABLE 5

Table 5 offers evidence that firms reduce employment after facing an adverse credit supply shock. Column (1) first indicates the effect of the treatment on employment growth. We find that increasing the intensity of the treatment by one standard deviation leads to a 0.5 percentage point decrease in employment growth. Column (2) shows that the effect is even larger on the less educated: one standard deviation increase in the treatment intensity leads to a 1 percentage point decrease in employment of the workers with no high school degree. While we do not find any effect on the employees with a high school education but no college degree, the effect is also negative on employees with a college degree.

INCLUDE TABLE 6

In Table 6, we refine our analysis by separating micro-firms - i.e. firms with less than 10 employees - from the other firms. The objective is to better identify the effect on the most talented: because micro-firms are less likely to employ highly-skilled workers, including them in the estimation might reduce the precision of our results. We find that the effect on the most educated is much larger when we focus on firms with more than 10 employees (column (6)) and of similar magnitude than on the less educated.

Finally, employee-level regressions confirm our results. In Table 7, we look at the effect of the treatment on the probability that a worker leaves the firm over the subsequent three years. After controlling for a large set of individual characteristics, we find that the probability that a worker leaves a firm is 0.5 percentage point larger for a one standard deviation increase in the intensity of the

treatment (Column 1). When decomposing the effect across levels of education, we find that most of the effect is driven by highly-educated workers, that is, workers holding at least a college degree (Columns 2 to 6). This result suggests that the net effect on firm employment is driven by lower inflows for the less educated, and larger outflows for the more educated.

INCLUDE TABLE 7

Table 8 shows a similar decomposition of our results across occupations. Workers occupying skill-intensive jobs - such as managers, specialists and technicians - are more likely to leave a firm that is affected by the credit supply shock. While we do not observe the exact reason for the separations - whether the separation is driven by firm job destruction or by individuals finding better outside opportunities -, the loss of highly skilled workers is likely to negatively impact firm productivity over the long run.

INCLUDE TABLE 8

Finally, when using wages in 2004 as a proxy for workers' skills, we find that workers in the top quartile of the wage distribution are more likely to leave affected firms after the credit supply shock (Table 9)

## 6 Conclusion

We exploit the introduction of new accounting norms that mechanically increase the liabilities of bank DB pension plan as an exogenous shock to credit supply. We first confirm that firms in a relationship with treated banks borrow less and reduce employment. Then, we investigate which workers are the most affected and we find a U-shaped relationship between the size of the effect and human capital. Less-educated workers and workers with a college degree are the most affected. This result suggests that credit supply shocks might reduce firm long-term productivity by affecting human capital accumulation.

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# A. FIGURES

**Pension Fund Balance Sheet (31 December 2005)**

Assets	Liabilities
100	100+50
50	Transition liability in 2005
Sponsor contribution to cover the transition liability	

Note: Assuming funding requirements of 100% of the PBO and following an increase of 50 due to incorporating the transitional liability to the PBO, plan sponsors need to increase contributions by 50.

**Sponsor Bank Balance Sheet (31 December 2005)**

Assets	Liabilities
100 Cash	200 Equity
100 Loans	-1.75 Annual P&L
-50	-48.25
Δ due to contribution to the pension plan	Δ in the funding status of the bank pension plan

Note: Assuming funding requirements of 100% of the PBO and following an increase of 50 due to incorporating the transitional liability to the PBO, plan sponsors need to increase contributions by 50.

**Bank Profit and Loss Statement (P&L, 2005)**

Income	Expenses
	1.75
	Annual amortisation of deferred costs

Note: Assuming no past deferred costs, the value of the corridor at 31 December 2005 is equal to 15 = 10%\*max(Pension Assets, Pension Liabilities). After incorporating the transition liability, deferred costs amount to 35=50-15. Assuming an amortisation horizon of 20 years, the annual amortisation of deferred costs equals 1.75=35/20.

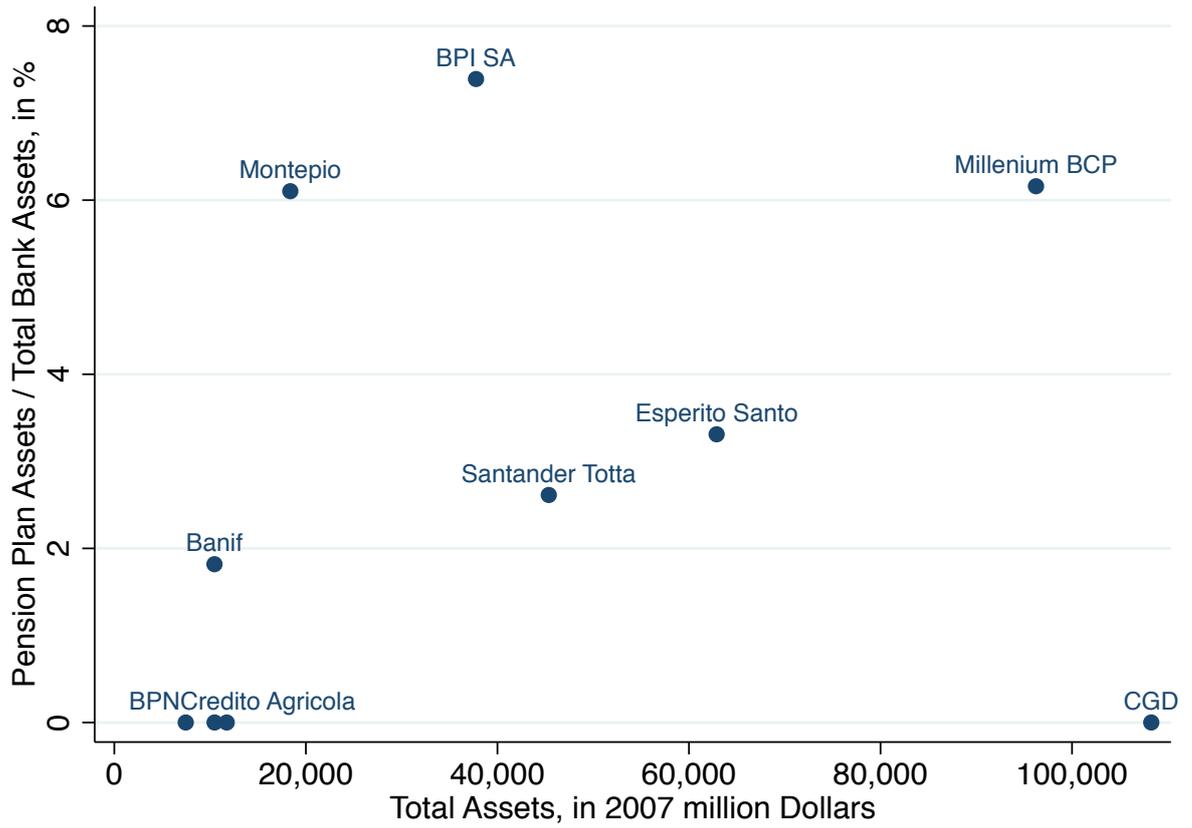
**Bank Tier 1 Regulated Capital (31 December 2005)**

Equity	200
Annual P&L	-1.75
Prudential Deduction	-33.25
Total Tier 1 Capital	165

Note: According to Portuguese prudential regulation, the calculation of bank Tier 1 Capital should take into account the whole amount of deferred costs corresponding to the transitional liability. However, in practice, transitioning to IAS 19 would have imposed huge prudential deductions, which is why banks were given several years to split the deductions.

**Figure 1. The Impact of an Increase in the Accounting Value of Bank DB Plan Liabilities on Bank Financial Situation**

This figure uses stylised numbers to show how, based on the IAS 19 accounting standards, an increase of 50 million Euros of a bank DB-plan liabilities will affect the bank balance sheet, its income statement and its regulated capital.



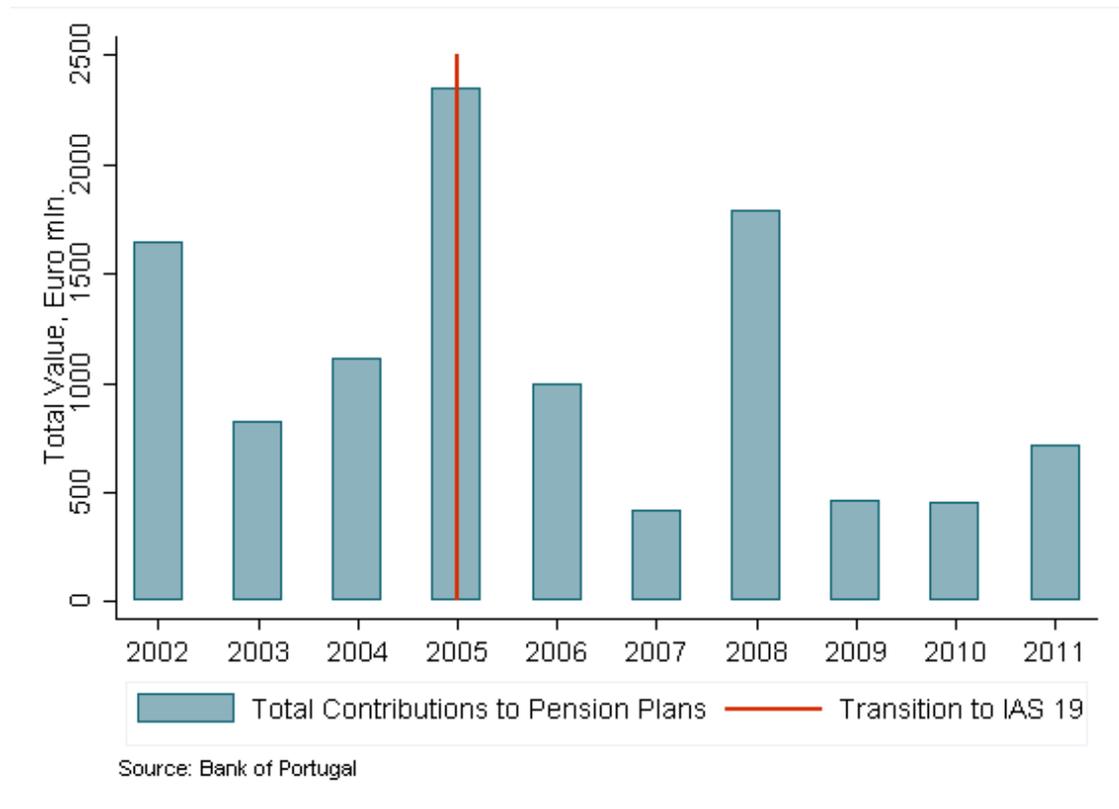
**Figure 2. Bank Exposure to Pension Plans**

This figure shows bank exposure to pension plans - measures as the ratio of the pension plan assets to bank total assets - for the 10 main Portuguese banks in 2004. These 10 banks represent 98% of total bank assets in Portugal.



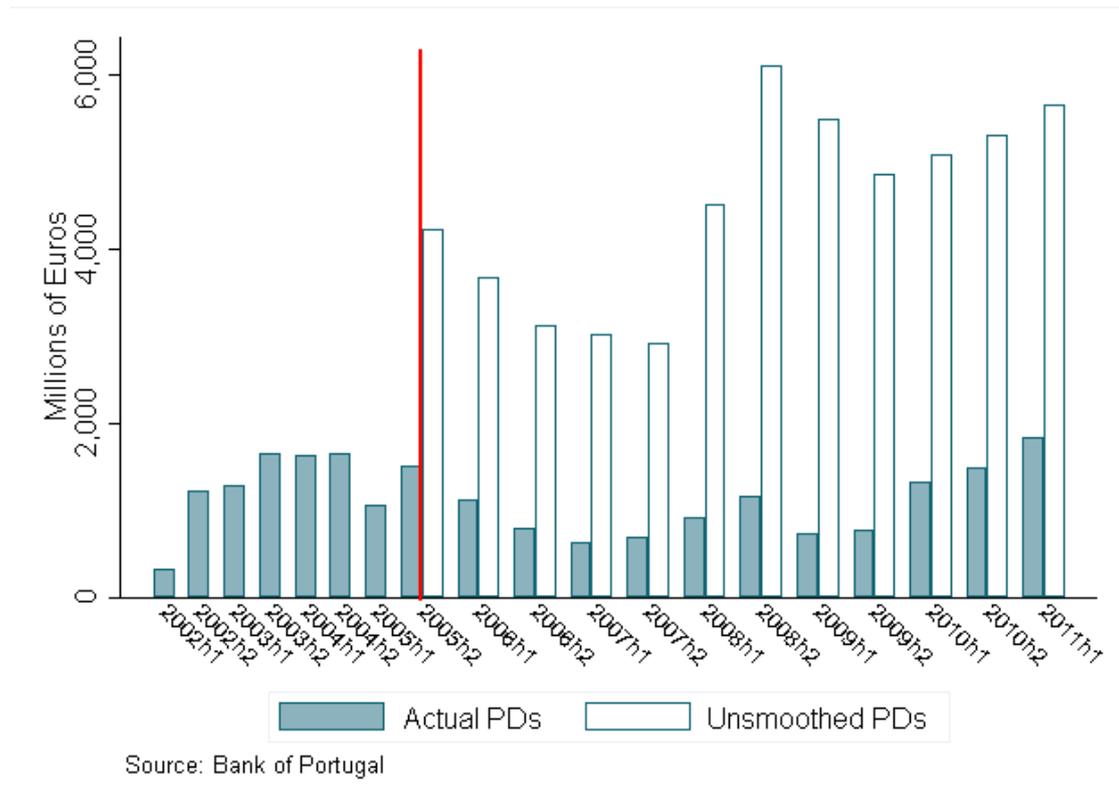
**Figure 3. Aggregate Variations in Bank DB Plan Assets and Liabilities over the 2002-2010 Period**

This figure shows the actuarial variations in the value of bank DB plan assets and liabilities over the 2002-2011 period, as well as the increase in liabilities due to the extension of coverage following the introduction of IAS 19. Any negative variation in liabilities in excess of the “corridor” is fully discounted from bank Tier 1 regulated capital as prudential deductions. Increases in liabilities may also require bank direct contributions to their pension plans.



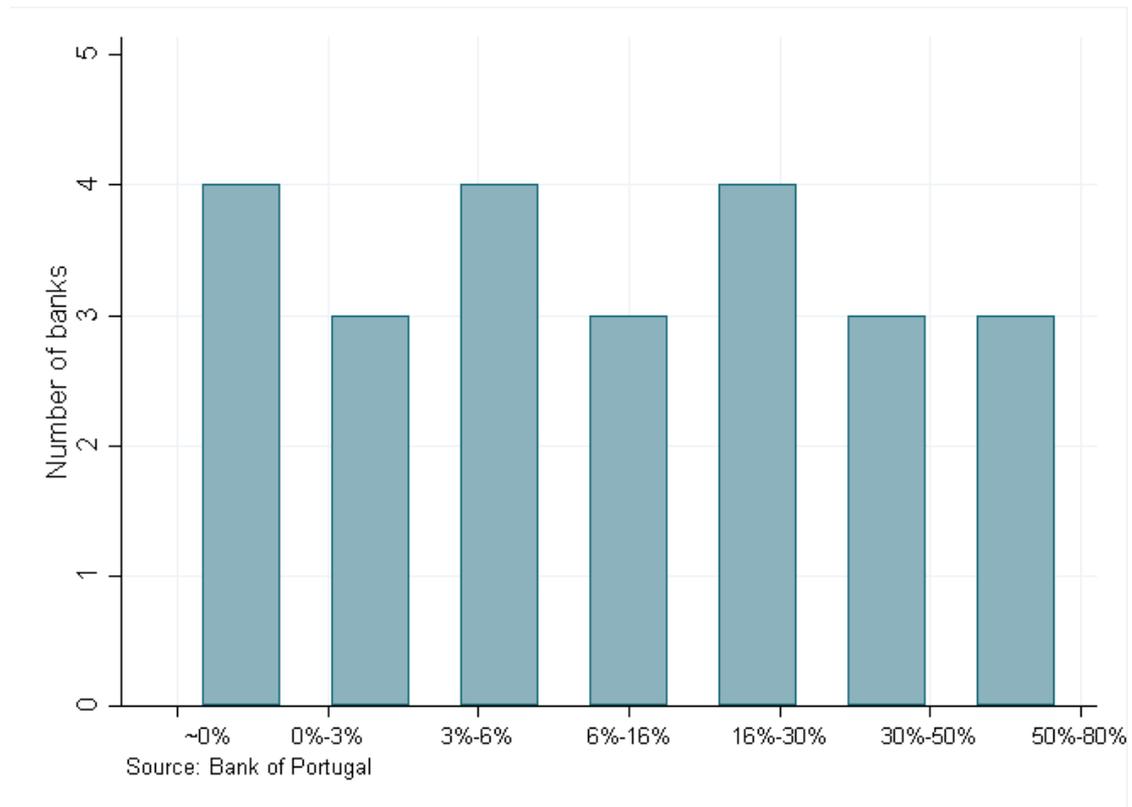
**Figure 4. Bank Contributions to their DB Pension Plans (2002-2011)**

This figure shows the aggregate value of bank annual contributions to their DB pension plans over the 2002-2010 period. Legislation on privately funded pension plans in Portugal requires the pension benefit obligations to be funded at 100% for pensions in payment and at 95% for employees in service. As a result, negative variations in the funding status of the pension schemes are met with increasing contributions. The large contributions in 2005 correspond to the increase in pension liabilities caused by the introduction of IAS 19.



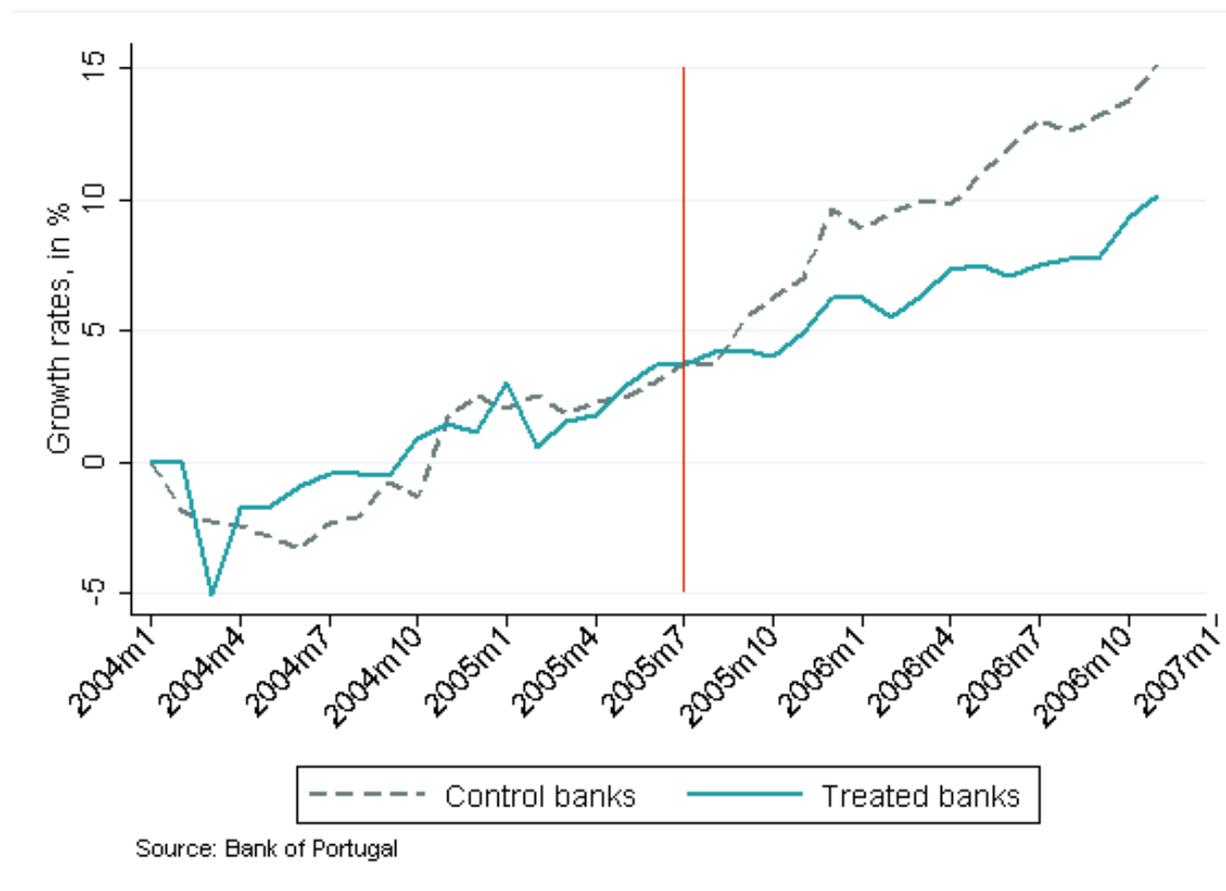
**Figure 5. Bank Prudential Deductions to Tier 1 Capital (2002-2011)**

This figure captures the aggregated bi-annual prudential deductions from Tier 1 capital over the 2002-2012 period. The blue bars show the actual deductions that banks applied before each regulatory review of capital ratios (usually, at the end of June and December of each year). Due to the high level of excessive variations (i.e., deferred costs in excess of the accounting corridor), special regulations allowed banks to smooth the impact on prudential deductions. The white bars show what the prudential deductions would have been in the absence of smoothing (according to calculations by the authors).



**Figure 6. Distribution of Banks across the Ratio of Prudential Deductions to Tier 1 Capital (2005)**

This figure groups banks running pension schemes according to the value of the ratio of applied prudential deductions in December 2005 to bank Tier 1 capital the year before. It documents the heterogeneous impact of adopting the IAS 19 standards in 2005, and supports our identification strategy exploiting differing treatment intensity.



**Figure 7. Evolution of Credit: Treated versus Control Banks**

This figure captures the evolution of credit for treated and non-treated banks from January 2004 to January 2007. The two lines represent the percentage growth in credit since 2004 on a monthly basis. While credit granted by the two groups of banks evolves in parallel until 2005, treated banks experience visibly lower credit growth from then on.

## B. TABLES

Table 1. Summary Statistics

	Mean (1)	SD (2)	P10 (3)	P90 (4)
<i>Bank DB Plan Characteristics</i>				
Ratio of Bank DB Plan Assets to total Bank Assets	0.15	0.09	0.01	0.25
<i>Bank-Firm Exposure (EUR 00,000)</i>				
From Treated Banks	1.80	30.24	0	1.58
From Control Group	1.96	28.30	0	1.86
All	1.87	29.44	0	1.69
<i>Bank Characteristics - Treated Banks</i>				
Log(Total Assets) (EUR 000)	14.98	1.75	12.46	17.16
Capital Ratio	0.09	0.06	0.05	0.14
Liquidity Ratio	0.16	0.12	0.04	0.29
Loans to Assets	0.72	0.20	0.36	0.90
Short Term Liabilities to Assets	0.52	0.24	0.18	0.83
Doubtful Ratio	0.01	0.01	0	0.03
<i>Bank Characteristics - Control Group</i>				
Log(Total Assets) (EUR 000)	13.19	1.91	11.01	15.64
Capital Ratio	0.13	0.13	0.00	0.30
Liquidity Ratio	0.19	0.19	0.02	0.47
Loans to Assets	0.78	0.18	0.46	0.96
Short Term Liabilities to Assets	0.64	0.25	0.28	0.97
Doubtful Ratio	0.02	0.03	0	0.01
<i>Bank-firm Relationship Characteristics</i>				
Total Credit Exposure (EUR mln.)	9.71	159.17	0	8.12
# of Banks	3.02	2.31	1	6
<i>Firm characteristics</i>				
Total Credit (EUR mln.)	81.57	1047.01	0	68.83
Total Sales (EUR mln.)	1.69	23.4	0.02	2.06
Initial Capital (EUR mln.)	0.4	9.4	0.01	0.3
Number Employees	16.4	109.72	2	27
Debt to Revenue Ratio	3.45	4.72	0.13	9.50
Bad Loan Indicator (current)	0.05	0.22	0	0
Bad Credit History	0.11	0.32	0	1
<i>Employee Characteristics</i>				
Probability of Leaving a Firm (unconditional)	0.13	0.34	0	1
Age	38.12	11.27	24	54
Gender (1 Male, 2 Female)	1.41	0.49	1	2
Real Hourly Wage	5.62	10.68	2.45	10.12
Average Tenure	7.62	8.45	0.5	20.25
Fraction with Low Education	0.77	0.35	0	1
Fraction with Middle Education	0.16	0.29	0	0.66
Fraction with High Education	0.05	0.17	0	0.13

This table reports summary statistics for all bank-firm credit exposures, bank and pension plan data as well as firm and worker characteristics in 2004, the year before the shock.

**Table 2. The Introduction of IAS 19: Description of the Treatment**

<i>Timeline</i>	
Implementation of IAS19	January-June 2005
Pre-treatment Period	Year 2004
Post-treatment Period	Year 2005-2006
<i>The Effect on Banks</i>	
<b>Treated Banks</b>	
Number	13
% of Total Credit	56
<b>Control Banks</b>	
Number	46
% of Total Credit	44
<b>Effect on Bank Fundings</b>	
2005 Contribution to DB plans	
2005 Total Amount, bln euros	2.3
Percentage of Tier 1 Capital	14.5
2005 Prudential Deductions	
Total Amount, bln euros	1.5
Percentage of Tier 1 Capital	9.3
<b>Treatment Variables</b>	
Treatment Dummy (Average)	0.56
Treatment Intensity (Average)	0.15
Treatment Intensity (Standard Deviation)	0.09
<b>Main Effect on Bank-Firm Credit Exposure</b>	
Reduction in credit growth for treated banks	-65 pp
– for one standard deviation increase in treatment intensity	-21 pp
<i>The Effect on Firms</i>	
<b>Treatment Variables</b>	
Treatment Dummy (Average)	0.5
Weighted Treatment Intensity (Average)	0.13
Weighted Treatment Intensity (Standard Deviation)	0.1
<b>Main Effect on Credit Growth</b>	
Reduction in credit growth for treated firms	-12 pp
– for one standard deviation increase in treatment intensity	-8 pp
<b>Main Effect on Employment</b>	
Variation in Total Employment Growth for one standard deviation increase in treatment intensity	-0.5 pp
Inferred effect on Total Employment Growth of a 10 pp decrease in credit growth	- 0.6 pp%

This table summarizes the characteristics and the main effects of the 2005 credit supply shock triggered by the introduction of IAS 19. Effects are computed using the estimation results in Table 3 (columns 1 and 3), Table 4 (columns 3 and 6) and Table 5 (column 1).

**Table 3. The Impact of the Introduction of IAS 19 and Bank-Firm Credit Exposures**

Dependent variable	$\Delta \log(\text{Loan Exposure})$				New Loan Dummy	$\Delta \log(\text{Loan Exposure})$	
	(1)	(2)	(3)	<i>Intensive Margin</i> (4)	<i>Extensive Margin</i> (5)	Treated only (6)	Robustness (7)
Treatment dummy	-0.654*** (0.083)						
Treatment intensity (I)		-1.397*** (0.429)	-2.319*** (0.414)	-0.723** (0.293)	-1.939*** (0.332)		- 13.269*** (0.501)
Treatment intensity (non-zero treatment)						-4.397*** (0.540)	
Tier 1 Capital (II)							6.952*** (0.896)
Interaction (I*II)							0.304*** (0.162)
Firm Fixed Effects	Yes	-	Yes	Yes	-	Yes	Yes
Firm Characteristics	-	Yes	-	-	Yes	-	-
Bank Char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relationship Char.	Yes	Yes	Yes	Yes	-	Yes	Yes
Observations	275,856	352,815	275,856	182,860	352,815	196,075	275,111
R <sup>2</sup>	0.763	0.529	0.763	0.449	-	0.776	0.464

This table reports the coefficients of OLS and Logit estimations. The unit of observation is the loan exposure at bank-firm level. The dependent variable is the change in the log of bank-firm loan exposure, except in column (5) where the dependent variable is a dummy variable that is equal to one if a new loan is granted to a firm with currently zero exposure to the credit granting bank and is equal to zero otherwise. The independent variable *Treatment intensity* is the ratio of the bank DB plan liabilities to the bank total assets in the *pre-period*, and it measures bank initial exposure to the shock. *Treatment dummy* allocates banks into treatment and control groups. Control banks include banks with no DB pension plans or banks in the lowest quartile of the treatment intensity. The initial sample comprises the universe of bank-firm exposures. In columns (1) and (3) the sample is restricted to firms that borrow from several banks. In column (4), the sample is restricted to bank-firm exposures that involve relationship firms, i.e., firms with a strictly positive exposure in the *pre-period*. In column (6), the sample is restricted to bank-firm exposures that involve treated banks. Bank controls include the logarithm of assets, capital ratios, liquidity ratios, loans to assets, securities to assets, short-term liabilities to assets and doubtful ratios. Firm controls include the logarithm of total credit and the number of bank relationships. We control for the strength of the bank-firm relationship by including the logarithm of the total credit exposure between a firm and its bank. Standard errors are clustered at banking group\*industry levels and are reported in brackets, \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

**Table 4. The Impact of the Introduction of IAS 19 on Firm Total Credit Exposure**

<i>Sample</i>	$\Delta \text{Log}(\text{Total Credit Exposure})$							
	<i>All Firms</i>						<i>By Firm Size</i>	
	(1)	(2)	(3)	(4)	(5)	(6)	<10 Employees (7)	$\geq 10$ employees (8)
Treatment Dummy	-0.099*** (0.030)	-0.095*** (0.025)	-0.124*** (0.021)					
Weighted Treatment				-0.674*** (0.179)	-0.651*** (0.153)	-0.781*** (0.137)	-0.866*** (0.159)	-0.448*** (0.157)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average Bank Char.	-	-	Yes	-	-	Yes	Yes	Yes
Industry FE	-	Yes	Yes	-	Yes	Yes	Yes	Yes
Geography FE	-	Yes	Yes	-	Yes	Yes	Yes	Yes
Observations	149,073	149,072	149,072	149,073	149,072	149,072	110,239	36,166
R <sup>2</sup>	0.039	0.044	0.044	0.039	0.044	0.045	0.049	0.051

This table reports the coefficients of OLS regressions where the dependent variable is the change in the log of firm total loan exposure. The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-period, weighted by their relative share in the firm's total credit exposure over the same period. The independent variable *Treatment dummy* separates firms into treated or control groups, depending on whether they are below or above the median of the weighted treatment index. Firm controls include 52 dummies for 2-digit industrial sectors and 28 geographical dummies, corresponding to districts in Portugal, as well as measures of total sales, total credit, the number of bank relationships, indicators for past defaults, starting capital, age, number of employees and debt to income ratios. Columns (3) and (6) include controls for the "average" bank - i.e. the logarithm of assets, capital ratios, liquidity ratios, loans to assets, securities to assets, short-term liabilities to assets and doubtful ratios - weighted by their ex-ante credit exposure in a firm's total credit. Model (7) restricts the sample to microfirms (with 10 employees or less) while Model (8) includes all firms with more than 10 employees. Standard errors are clustered at main banking group\*industry levels and reported in brackets, \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$

**Table 5. Labor Market Outcomes Following the IAS 19 Shock: Total Effect on Employment and Across Levels of Education**

<i>Sample</i>	$\Delta$ (Log Number of Employees)			
	<i>All</i> (1)	<i>with Elementary Edu- cation</i> (2)	<i>with High School Edu- cation</i> (3)	<i>with College Education</i> (4)
Weighted Treatment	-0.047*** (0.004)	-0.100*** (0.004)	0.001 (0.004)	-0.020*** (0.003)
Firm Fixed Effects	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes
Observations	624,221	624,221	624,221	624,221
R <sup>2</sup>	0.03	0.02	0.01	0.01

This table reports the coefficients of panel regressions over the 2002-2007 period. The dependent variable is the delta log total number of employees in column (1), the total number of employees with less than a high school degree (column (2)), with at least a high school degree but no college degree (column (3)) and a college degree (column (4)). The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. Standard errors are clustered at the firm level and reported in brackets.

**Table 6. Labor Market Outcomes Following the IAS 19 Shock: Composition Effects by Firm Size and Level of Education**

<i>Sample</i>	Log Number of Employees					
	Employees with Low Education		Employees with Middle Education		Employees with High Education	
	<10 employees (1)	≥10 employees (2)	<10 employees (3)	≥10 employees (4)	<10 employees (5)	≥10 employees (6)
Weighted Treatment	-0.071*** (0.011)	-0.113*** (0.023)	-0.013 (0.010)	-0.026 (0.027)	-0.000 (0.006)	-0.068*** (0.021)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	579,823	206,533	579,823	206,533	579,823	206,533
R <sup>2</sup>	0.82	0.91	0.77	0.90	0.79	0.93

This table reports the coefficients of panel regressions over the 2002-2007 period. The dependent variable is the total number of employees with less than a high school degree (columns (1) and (2)), with at least a high school degree but no college degree (column (3) and (4)), and a college degree (column (5) and (6)). For each specification, we separate microfirms - i.e., firms with less than 10 employees - in (columns (1), (3) and (5)) from firms with 10 employees or more (columns (2), (4) and (6)). The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. Standard errors are clustered at the firm level and reported in brackets, \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

**Table 7. Labor Market Outcomes Following the IAS 19 Shock: Employee-Level Regressions by Years of Education**

<i>Sample - Years of Education</i>	=1 if the Employee Leaves their Firm, 0 if not					
	All (1)	≤ 4 (2)	6 years (3)	9 years (4)	High School (5)	College (6)
Weighted Treatment	0.055* (0.032)	0.034 (0.036)	0.004 (0.026)	0.043 (0.031)	0.094 (0.077)	0.140* (0.084)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,501,752	2,662,958	2,065,966	1,943,982	1,831,660	941,501
R <sup>2</sup>	0.19	0.21	0.21	0.20	0.21	0.17

This table reports the coefficients of a linear probability model over the 2002-2007 period. The dependent variable is a dummy variable equal to 1 when a worker leaves the firm they were working for in the previous year and 0 if the worker stays with the same firm. The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. We saturate the models with firm and year fixed effects and we control for individual characteristics - age, age squared, gender and job level (Columns (2) to (5)) as well as education (Column (1)). Standard errors are clustered at firm level and reported in brackets, \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

**Table 8. Labor Market Outcomes Following the IAS 19 Shock: Employee-Level Regressions across Occupations**

<i>Sample</i>	=1 if the Employee Leaves their Firm, 0 if not					
	All Employees (1)	Managers, Specialists and Technicians (2)	Administrators (3)	Service Providers (4)	Qualified Workers (5)	Unqualified Workers (6)
Weighted Treatment	0.055* (0.032)	0.112* (0.062)	0.130 (0.096)	0.031 (0.031)	-0.026 (0.034)	0.083* (0.049)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,501,752	1,776,096	1,445,586	1,346,814	2,271,300	2,516,017
R-squared	0.19	0.17	0.21	0.20	0.21	0.21

This table reports the coefficients of a linear probability model over the 2002-2007 period. The dependent variable is a dummy variable equal to 1 when a worker leaves the firm they were working for in the previous year and 0 if the worker stays with the same firm. The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. We saturate the models with firm and year fixed effects and we control for individual characteristics - age, age squared, gender and job level (Columns (2) to (5)) as well as education (Column (1)). Standard errors are clustered at firm level and reported in brackets, \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

**Table 9. Labor Market Outcomes Following the IAS 19 Shock: Employee-Level Regressions across Ex-ante Wages**

<i>Sample</i>	=1 if the Employee Leaves their Firm, 0 if not					
	Up to 10th percentile (1)	10 to 25th percentile (2)	25 to 50th percentile (3)	50 to 75th percentile (4)	75 to 90th percentile (5)	90 to 100th percentile (6)
Weighted Treatment	-0.080*** (0.011)	-0.052*** (0.008)	-0.003 (0.006)	0.011* (0.006)	0.077*** (0.007)	0.229*** (0.009)
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	624,198	1,006,896	1,787,911	1,850,986	1,151,962	777,557
R-squared	0.32	0.29	0.27	0.26	0.25	0.23

This table reports the coefficients of a linear probability model over the 2002-2007 period. The dependent variable is a dummy variable equal to 1 when a worker leaves the firm they were working for in the previous year and 0 if the worker stays with the same firm. Workers are grouped according to the level of their wage in 2004. The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. We saturate the models with firm and year fixed effects and we control for individual characteristics - age, age squared, gender, education and job level. Standard errors are clustered at firm level and reported in brackets, \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

# For Online Publication

## A Tables

**Table A.1. Main Portuguese Banks in 2004**

Name	Market Share	Total Assets (Mn 2007 \$)	Equity Ratio	Loan to Asset Ratio	Pension Plan	
					Assets 2007 \$)	(Mn Assets to Total Bank Assets
	(1)	(2)	(3)	(4)	(5)	(6)
Caixa Geral de Depositos	25.7%	108,279	5.0%	57.8%	0	0.0%
Millenium BCP	22.8%	96,242	6.0%	68.8%	5,928	6.2%
Banco Espirito Santo SA	14.9%	62,895	6.0%	61.4%	2,082	3.3%
Santander Totta SGPS	10.8%	45,367	6.2%	75.2%	1,185	2.6%
Banco BPI SA	9.0%	37,769	4.9%	69.5%	2,791	7.4%
Montepio Geral	4.4%	18,374	4.1%	84.6%	1,121	6.1%
Credito Agricola	2.8%	11,734	8.2%	68.4%	0	0.0%
Rentipar Financiera - SGPS, SA	2.5%	10,472	5.5%	73.5%	0	0.0%
BANIF SGPS SA	2.5%	10,462	5.7%	73.7%	190	1.8%
Banco Internacional do Funchal	1.8%	7,461	4.7%	77.6%	0	0.0%

This table reports the market share (% of total bank assets in Portugal in 2004), total assets, equity and loan to asset ratios, pension plan assets and ratio of pension plan assets to total assets of the main Portuguese banks in 2004.

**Table A.2. Labor Market Outcomes Following the IAS 19 Shock: Employee-Level Regressions by Years of Education**

<i>Sample - Years of Education</i>	=1 if the Employee Switches to a Different Firm, 0 if Not					
	All (1)	$\leq 4$ (2)	6 years (3)	9 years (4)	High School (5)	College (6)
Weighted Treatment	-0.032*** (0.001)	-0.027*** (0.002)	-0.036*** (0.002)	-0.054*** (0.003)	-0.033*** (0.003)	0.012*** (0.003)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,129,568	2,438,536	1,978,640	1,881,690	1,810,384	961,600
R <sup>2</sup>	0.04	0.05	0.04	0.05	0.04	0.03

This table reports the coefficients of a linear probability model over the 2002-2007 period. The dependent variable is a dummy variable equal to 1 when a worker switches to a new employer and 0 otherwise. The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. We saturate the models with firm and year fixed effects and we control for individual characteristics - age, age squared and gender. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

**Table A.3. Labor Market Outcomes Following the IAS 19 Shock: Employee-Level Regressions across Occupations**

<i>Sample</i>	=1 if the Employee Switches to a Different Firm, 0 if Not					
	All Employees (1)	Managers, Specialists and Technicians (2)	Administrators (3)	Service Providers (4)	Qualified Workers (5)	Unqualified Workers (6)
Weighted Treatment	-0.032*** (0.001)	0.020*** (0.002)	-0.006** (0.003)	0.007** (0.003)	-0.043*** (0.002)	-0.081*** (0.002)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	9,129,568	1,803,623	1,431,583	1,267,907	2,156,669	2,335,216
R-squared	0.04	0.03	0.05	0.08	0.04	0.06

This table reports the coefficients of a linear probability model over the 2002-2007 period. The dependent variable is a dummy variable equal to 1 when a worker switches to a new employer and 0 otherwise. The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. We saturate the models with firm and year fixed effects and we control for individual characteristics - age, age squared and gender. \* $p < 0.10$ , \*\* $p < 0.05$ , \*\*\* $p < 0.01$ .

**Table A.4. Labor Market Outcomes Following the IAS 19 Shock: Employee-Level Regressions across Ex-ante Wages**

<i>Sample</i>	=1 if the Employee Switches to a Different Firm, 0 if Not					
	Up to 10th percentile (1)	10 to 25th percentile (2)	25 to 50th percentile (3)	50 to 75th percentile (4)	75 to 90th percentile (5)	90 to 100th percentile (6)
Weighted Treatment	-0.012*** (0.011)	-0.009*** (0.008)	-0.030*** (0.006)	-0.036*** (0.006)	0.003 (0.007)	0.093*** (0.009)
Industry Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	430,158	706,208	1,267,597	1,336,471	835,583	551,529
R-squared	0.04	0.04	0.04	0.03	0.03	0.03

This table reports the coefficients of a linear probability model over the 2002-2007 period. The dependent variable is a dummy variable equal to 1 when a worker switches to a new employer and 0 otherwise. The independent variable *Weighted Treatment* is the average treatment intensity across all the banks a firm borrows from in the pre-treatment period, weighted by their relative share in the firm's total credit exposure over the same period. We saturate the models with firm and year fixed effects and we control for individual characteristics - age, age squared and gender.  $*p < 0.10$ ,  $**p < 0.05$ ,  $***p < 0.01$ .

## **B Technical Note: The regulatory treatment of bank pension plans in Portugal and its implications for regulated capital**

### *1. The regulation of bank pension schemes prior to IAS 19*

In 1995, Bank of Portugal issues its first specific regulation covering bank DB pension plans. While pension liabilities are a historical feature of the Portuguese banking system, it is with Notice No. 6/1995<sup>16</sup> that Bank of Portugal requires those banking groups sponsoring pension coverage to formalise the set-up of the plans. As a result, pension schemes become separated financial institutions comprising all committed pensions obligations as liabilities and the assets dedicated to their funding. The same regulation defines strict coverage rules to ensure that the plans are sufficiently funded. According to the rules, by the closing of each accounting year on 31 December, the Pension Benefit Obligation (PBO) should be funded at 100% for pensions in payment and at 95% for employees in service. As a result, if a pension plan becomes underfunded in a given year, the sponsoring bank has to step up its contributions so as to comply with the regulatory standards.

Pension plans are reported off the balance sheet of the sponsoring banks. Until the introduction of the International Accounting Standards (IAS 19) in 2005, the financial reporting of the pension plans followed the generally accepted accounting principles in Portugal for the banking sector (“Local GAAP”). According to these rules, changes in the value of the pension plans are reflected in the income statement and the balance sheet of the sponsor through two main concepts. The annual cost of the plan appears in the income statement of the bank. It is calculated as the sum of the forecasted annual pension commitments (also known as the “service cost” of the plan), the interest cost of the plan and amortization amounts, net of the expected return on the plan’s assets. Other variations in the funding status of the pension plans are recorded as direct adjustments in the balance sheet of the plan sponsors. This concept includes deferred costs, such as changes in the coverage of the pension plans or unrecognized gains or losses. Deferred costs have little immediate impact on the income statement because they can be amortised over a long period (typically coinciding with the average remaining service period of the participants in the pension plan).

The financial reporting of bank pension funded evolved further with Notice 12/2001 and Notice 7/2002 of Bank of Portugal<sup>17</sup>. These regulations brought about three refinements to the existing methodologies: regulated limits on the actuarial assumptions, a “corridor approach” for deferring actuarial losses and other unforecasted liabilities as well as the deduction of deferred costs from prudential bank capital. We explain the working of each of the three elements below.

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<sup>16</sup>Available in Portuguese at: <http://www.bportugal.pt/sibap/application/app1/docs1/avisos/textos/6-95a.pdf>

<sup>17</sup>The two notices are available at: <http://www.bportugal.pt/sibap/application/app1/docs1/avisos/textos/12-2001a.pdf> and <http://www.bportugal.pt/sibap/application/app1/docs1/avisos/textos/7-2002a.pdf>

First, Notices 12/2001 and 7/2002 imposed bounds on the actuarial assumptions that pension sponsors use in the valuations of the schemes. Examples of actuarial assumptions are the discount rate used to calculate the net present value of the pension PBO, the expected growth rate of wages, the expectation for future inflation as well as the rate of growth of the plan assets. Prior to the two regulations, Portuguese banks were left with more discretion in choosing the value of the assumptions used in valuation. With the new requirements, the level of discretion declines. At the closing of the fiscal year in 2002, banks recalculate the obligations and the assets of their pension schemes using bounded actuarial assumptions. This results in large actuarial losses. The losses have two effects. On the one hand, the increase in liabilities means that plan sponsors need to make substantial contributions to the pension schemes to satisfy the funding rules. On the other hand, the actuarial losses have to be recognised in banks' income statements and prudential capital. As we explain below, the former can be done over a long horizon, while the prudential regulation has a more immediate effect.

Also since 2002, bank pension plans reporting in Portugal use the "corridor method" of accounting. This implies that large actuarial variations (gains or losses) do not have to be immediately recognised in banks' financial statements. In exchange, they can be amortised over 15 or 20 years, depending on the average remaining service period of plan participants. In practice, this means that only costs due to the yearly amortisation of the actuarial losses reported at the end of 2002 were reflected in banks' income statements. The remainder was collected as deferred costs. On the contrary, the balance sheet of the sponsoring banks reflected the total change in the funding status of the pension scheme (that is, actuarial variations and new contributions) through compensating accounts.

Finally, deferred costs are immediately recognised through prudential regulation. Due to the long-term amortisation of actuarial losses in the income statement and to reporting through compensating accounts in the balance sheet, actuarial losses risked undermining bank capital regulation. Because large actuarial losses were deferred, their impact in bank capital would have been limited only to their yearly amortisation. Therefore, to protect the integrity of bank capital from deferred costs, Bank of Portugal decided that actuarial losses and other unfunded liabilities - in excess of the corridor - be deducted from the periodical calculation of bank Tier 1 capital. As a result, since 2002 we observe prudential deductions from bank Tier 1 capital due to variations in the valuation of pension funds.

## *2. The regulation of bank pension schemes after adopting IAS 19*

Transitioning to IAS 19 on 1 January 2005 brings about substantial changes in the valuation of pension plans. On the asset side of the balance sheet, fair value becomes prevalent for measuring the securities. This leaves the assets of the plans vulnerable to fluctuations in their market value. On the liability side, the coverage of the plans is broadened and there are several adjustments in the actuarial assumptions used in valuation.

Adopting the new standards generates an immediate impact on financial statements due to the changes in liabilities. New employee obligations are added to the PBO from 1 January 2005. These include post-retirement health care ben-

efits, through contributions to the Social Health Assistance Service for Banking Sector Employees (SAMS), and benefits from life insurance. In addition, there are important changes in the actuarial assumptions about the discount rate and the projected life expectancy of the plan participants.

In pension accounting, the level of the discount rate is the actuarial assumption with the largest impact in calculating the PBO. Prior to IAS 19, actuaries could select any discount rate, as long as it fell inside pre-specified bounds. The new standards specifically require that the discount rate employed be equal to the rate of return on high-quality corporate debt with maturity approximating the duration of the plan's liabilities. In practical terms, this implies a downward revision of the discount rates previously employed by the banks.<sup>18</sup>

IAS 19 also requires the revision of mortality tables employed by actuaries. Prior to 2005, the valuation of bank pension funds relied on a single mortality table for both men and women. The table was based on the estimated life expectancy of male employees. The new standard introduces a separate mortality table for female employees, taking into account their longer life expectancy.<sup>19</sup>

Due to their broader coverage and the change in actuarial assumptions, the liabilities of the pension plans increase significantly during 2005 (leading to what we call "transition liability"). The impact on the asset side is modest. Because financial markets are stable in that period, transitioning to market based valuation does not impose major shifts in the value of securities. The resulting mismatch between assets and liabilities gives rise to a large funding gap. This requires new contributions from the banks, mainly to cover the transition liability.

The increase in contribution was matched by an almost equal growth in prudential deductions. As explained above, introducing the "corridor method" in 2002 implied an adjustment in the measurement of pension schemes that led to actuarial losses outside the corridor. By 2005, most of these actuarial losses have not been amortised, meaning that the transition liability resulting from adopting IAS 19 cannot be absorbed within the corridor. The effect is an increase in deferred costs up the value of the transition liability (net of the corresponding amortisations).

Prudential regulation requires that deferred costs be deducted from bank Tier 1 capital, which means that the value of the transition liability should have been deducted from banks' capital. However, incorporating the whole transition liability in one go would have crippled banks' capital levels. In response, Notice No. 2/2005 of Bank of Portugal<sup>20</sup> establishes a smoothing period for recognising the impact of transition liability in regulated capital. The amount above the corridor is split across 5 or 7 years, depending on the type of liability. Even so, banks still have

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<sup>18</sup>The 2005 Annual Financial Reports of BPI mentions a change in the discount rate from 7% to 5.25%. Similarly, the discount rate used by BCP changed from 5.25% at the end of 2004 to 4.75% at the end of 2005. The 2005 BPI report is available at: <http://bpi.bancobpi.pt/storage/download/ficheiro.54C95FF4-1295-42C6-A4F3-BBC3C15A35F2.1.pt.asp?id=9AC48705-CEF6-4B63-9D4C-650C29126FA0>. The 2005 BCP report is available at <http://ind.millenniumbcp.pt/en/Institucional/investidores/Pages/RelatorioContas.aspx>

<sup>19</sup>Again, banks' Annual Financial Reports mention the change from using a single mortality table for both genders, TV73/77, to using the table TV73/77 for male employees and a second table, TV88/90, for female employees. (please refer to Footnote 11 for the exact references).

<sup>20</sup><http://www.bportugal.pt/sibap/application/app1/docs1/avisos/textos/2-2005a.pdf>

to make significant deductions from their Tier 1 capital in 2005. Figure 1 uses stylised numbers to illustrate the impact of a large pension transition liability across banks' financial statements and prudential reports.

Table 7 below illustrates step by step the mechanics of the “corridor approach” and the impact of the transition liability in 2005 by means of another stylised example. Here, the increase in liabilities in 2005 is matched by an almost equal spike in annual deferred costs, because past deferred costs are already larger than the corridor. To keep the story tractable, in this example we do not apply the smoothing of the transition liability. In practice, that reduced prudential deductions in 2005 to 25% of their total impact.<sup>21</sup>

Finally, the last years included in Table 7 provide an illustration of the transmission of actuarial losses through the corridor in the case of a decline in the market value of the pension assets. This generates actuarial losses on the asset side, which are added to any pre-existing deferred costs. Subsequently, the excessive deferred costs generate large prudential deductions from regulated capital, while being amortised gradually in the income statement. We use this empirical setting to study how large prudential deductions compensating losses in pension assets during the financial crisis of 2007-08 and the sovereign debt crisis in 2010-11 impact bank lending behaviour.

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<sup>21</sup>While Notice No. 2/2005 of Bank of Portugal allowed smoothing over several years, 25% of the transition liability had to be recognised in the first year.

**Table B.1. Illustrative example of the “corridor approach”**

Concept/Year	2002	2003	2004	2005	2006	2007	2008
Assets (Expected Evolution)	100	160	170	180	210	220	230
Assets (Actual Evolution)	100	160	170	180	210	220	180
Actuarial Variations (Asset Side)	0	0	0	0	0	0	50
Liabilities	150	150	150	200	200	200	200
Transition Liability(*)	50	0	0	50	0	0	0
Contribution	50	0	0	20	0	0	20
Corridor	15	16	17	20	21	22	20
Variation in Corridor	0	1	1	3	1	1	-2
Past Deferred Costs	0	33.3	30.6	28.2	71.4	66.9	62.6
Deferred Costs of the Year	35.0	32.3	29.6	75.2	70.4	65.9	114.6
Horizon for Amortisation through P&L (yrs.)	20	20	20	20	20	20	20
Annual Amortisation of Deferred Costs	1.8	1.6	1.5	3.8	3.5	3.3	5.7
Applied Prudential Deductions	33.3	30.6	28.2	71.4	66.9	62.6	108.9

(\*) Transition Liability = Actuarial Variations in Liability + Changes in Coverage. This table relies on stylised numbers to re-create the mechanics of the “corridor approach” for reporting variations in the value of bank pension funds over the period 2002-2008. We use stylised numbers for two reasons. First, not all the concepts outlined above are disclosed through banks’ statements. Second, this is a simplified version of pension fund measurements, in order to make it more tractable. Starting with 2002, the introduction of the corridor approach promoted the re-measurement of the pension plans, generating a large transition liability. The part of the transition liability that exceeds the corridor is recorded as deferred costs and amortised over an average of 20 years. Deferred costs net of the annual amortisation are discounted from bank capital as prudential deductions. Past deferred costs are carried over in time, but they decrease both because of an increase in the corridor and due to new rounds of amortisation. However, adopting the IAS 19 standards in 2005 imposes a large transition liability, which gets incorporated in the corridor approach. Because, at that point in time, past deferred costs are still substantially larger than the corridor, the transition liability cannot be absorbed and, consequently, it is charged as a prudential deduction. 2008 illustrates what happens when there are substantial actuarial losses on the asset side. Similarly to 2005, when above the corridor, the actuarial losses get incorporated as deferred costs and deducted from regulated capital as prudential deductions.