Executives' Gender Pay Gap and Financing Constraints*

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Abstract

This paper investigates the effect of financing constraints following the 2008-9 financial crisis on executives' gender inequality. We use linked employer-employee data for the universe of private sector firms in Portugal, and exploit pre-crisis variation in external finance dependence across industries for identification. We find that the crisis had a positive effect on female executives' pay in exposed firms. Firms in financially more constrained industries reduce the gender pay gap and increase the share of females in executive positions after the crisis. At the worker-level, females in exposed industries are more likely to be promoted to executive and less likely to be demoted. We discuss channels and interpretations for the effects. Our results are consistent with female managerial characteristics, such as attitudes toward risk, being more valued after the crisis in exposed firms. A reduction in preference-based discrimination cannot be discounted.

Key Words: Executive Compensation, Gender Inequality, Gender Pay Gap, Financial Constraints, Financial Crisis

JEL Classification Numbers: J2, J41, J71, G01, M50

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1 Introduction

The pay of CEOs and other top executives has been in the center of academic and policy debates mainly due to the sharp rise in executive compensation in recent decades. The global financial crisis of 2008-9 has sparked renewed interest in executive compensation given evidence that pay arrangements, particularly for CEOs, contributed to excessive risk taking in the run-up to the financial crisis.[1]

Gender inequality in top corporate jobs is another issue that has been at the forefront of the global agenda. A body of research has documented the relative absence of females from top corporate jobs, and the fact that female executives are paid significantly less than their male counterparts.[2] Existing evidence showing that female leadership is positively related with firm performance (e.g. Dezso and Ross, 2012; Post and Byron, 2015; Flabbi et al., 2019) suggests that underrepresentation of women in executive positions may be associated with significant costs. It is therefore likely that the need to perform better after the crisis onset affected firms' decisions regarding male and female executive pay and employment shares, particularly for more financially constrained firms.

This paper addresses a gap in the literature by investigating the effect of financing constraints following the 2008-9 crisis on executive pay and the gender pay-gap of executives, as well as on the female executive share. We use employer-employee data for the universe of private sector firms and workers in Portugal, and exploit pre-crisis variation in external finance dependence across industries as a quasi-natural experiment. We obtain difference-in-differences estimates of the effect of the crisis for exposed firms, in more financially constrained industries, relative to other firms.

Firm performance became more important for firms' survival in the aftermath of the crisis given the negative shock to profit and increased uncertainty. It is therefore relevant to assess whether firms changed their attitudes about executive compensation and executive gender inequality as a result of financial constraints following the crisis.[3] This is an important question given evidence of a positive correlation between firm performance and the female share of executives.[4] Consistent with that evidence, we show that firms

[1] Executive compensation is one of the factors frequently cited as having contributed to the crisis (see e.g., Bebchuk et al., 2010; Balachandran et al., 2011; Bennett et al., 2015 and Bhagat and Bolton, 2014). Mehran et al. (2012) provide a review of the literature on the relation between corporate governance and risk taking by banks during the financial crisis.

[2] See, for example, Bertrand and Hallock (2001), Wolfers (2006) and Albanesi et al. (2015).

[3] Michelacci and Quadrini (2009) show that financial constraints affect the wage policy of the firm.

[4] This evidence is in line with a growing literature showing that executive characteristics, such as attitudes towards risk and management style can affect firm outcomes. Bertrand and Schoar (2003) and Bloom and Van Reenen (2007) are landmark contributions.

with a larger share of female managers performed better and were less negatively affected by the financial crisis. In particular, a larger share of female executives is associated with higher profit; firms with a higher female executive share experienced a lower reduction in profit after the crisis.

The financial crisis was a major shock to economies around the world, inducing many firms to reassess their decisions and operations. Existing evidence shows that financially constrained firms significantly reduced employment, average wages, technology spending, capital investment, and marketing expenditures after the crisis (see e.g., Popov and Rocholl, 2018; Campello et al., 2010; Greenstone et al., 2014 and Chodorow-Reich, 2014). As part of this reassessment, it is likely that attitudes about determining executive compensation would have changed.

We investigate how the financial crisis of 2008-9, and the resulting financing constraints imposed on firms, affected executives' gender pay-gap. We find that female executives' short-term compensation (salary and bonus) increased after the crisis in industries with higher pre-crisis dependence on external finance relative to less financially constrained industries, contributing to reduce the gender pay-gap. The reduction in the gender pay-gap is observed mostly for top executives, who are responsible for the firms' general policy and strategy.

In addition to the effect on executive pay, we also estimate the effect of the crisis on the share of females in executive positions at the firm-level, and on managers' probability of promotion and demotion. We find that firms in industries with higher financial constraints prior to the crisis increase the share of female executives following the crisis, relative to those in less financially vulnerable industries. These results control for firms' characteristics and for global trends. At the worker-level, females in exposed industries are more likely to be promoted to executive and less likely to be demoted. These findings show that the crisis also contributed to increase female representation in executive positions.

We investigate mechanisms for the effects of the crisis on the executive gender gap. Our specifications include worker-firm match fixed effects which account for gender differences in human capital and other supply-side sources as well as sorting of male and female workers across occupations, industries and firms. Our estimates thus capture the effects on the residual gender pay gap, often interpreted in the literature as the extent of employer discrimination (see e.g., Becker, 1957; Arrow 1973; Blau and Khan, 2017). We also show that the reduction in the gender gap is not driven by changes in rent shar-

ing across genders induced by the crisis. A reduction in preference-based discrimination cannot be ruled out as a channel for the effects on the gender gap. Specifically, exposed employers with a low share of females in the workforce (a common proxy for discrimination; e.g. Weber and Zulehner, 2014) exit the market at higher rates and reduce sales and employment by more after the crisis, relative to other employers. Theories of preference-based discrimination show that discriminatory behavior is costly, and as such is harder to sustain in a more challenging economic environment (Becker, 1957).

Some preliminary evidence shows that female representation in executive positions increased since 2008. For example, the percentage of women board directors in the Fortune 500 companies increased from 15.2% in 2008 to 20% in 2015, and the share of women CEOs from 2.4% to 4.8%.[5] However, more formal evidence of the effect of the crisis on the share of female executives and the gender pay-gap in executive jobs is scarce.

The linked employer-employee data (LEED) that we use has exceptionally detailed information for each executive, including gender, age, education, occupation, hours of work, earnings, hiring date and hierarchical position in the firm (e.g., top executive or intermediate executive), among other. The data also includes firm-level information, such as total sales, total employment, industry, location, number of establishments, legal and ownership structures and balance sheet information. Our specifications account for workers' observed and unobserved characteristics, for industry-specific trends and other exhaustive sets of fixed effects, which absorb any systematic differences across industries with different degree of financial dependence, among other factors. Specifications with worker-firm fixed effects identify the impacts from workers who stay in the same firm after the crisis, ensuring that the results are not driven by composition effects.

We identify credit supply effects using industry-level measures of financial vulnerability, which have been extensively employed in the literature: the Rajan and Zingales' (1998) external finance dependence measure and the Hadlock and Pierce (2010) size-age index of financial constraints. These measures are widely regarded as intrinsic characteristics of an industry and exogenously determined from the perspective of individual firms. We obtain these measures from firms' balance sheet and employer-employee data over the pre-crisis period, preventing changes in firm behavior after the crisis from affecting the measures of financial vulnerability. The results remain robust for the two alternative measures of financial constraints. Our identification exploits differences in pre-crisis financial vulnerability across industries. The use of exogenous measures of fin-

[5] Similarly, in the UK 11% of FTSE100 directors were women in 2008, rising to 23.5% in 2015 (Female FTSE Report, 2008, 2015).

ancial constraints allows us to cleanly estimate the effects arising from supply-side changes in the credit market following the crisis. We obtain results that are consistent with the role of shocks to credit supply, and firms' financial dependence, on the pay of executives and the gender pay-gap.

Our findings have important policy implications. They show that financing constraints and increased uncertainty following the 2008-9 financial crisis induced firms in more financially dependent industries to reduce the gender pay gap and increase the female share in executive positions. Our findings suggest that firms in more financially vulnerable industries, which needed to perform better, valued more highly female executive characteristics, such as attitudes towards risk, after the crisis. A reduction in costly discrimination induced by the challenging economic environment and increased uncertainty cannot be discounted.

The rest of the paper is organized as follows. The next section provides a review of the related literature. Section 3 describes the data used, the construction of the main variables and the empirical strategy. Section 4 presents and discusses the results on the effect of financing constraints on executives' gender pay gap, the female share of executives, worker transitions as well as potential channels for the effects. The last section concludes.

2 Related literature

This paper is related to recent studies on how financial shocks affect employment decisions of firms. A number of papers have studied the effects of the 2008-9 financial crisis on employment and wages. Notably, Chodorow-Reich (2014) using data from the U.S. shows that firms that borrowed from less healthy financial institutions before the crisis reduced employment by more relative to other firms. Bentolila et al. (2018) find consistent evidence for Spain. Greenstone et al. (2014) show that the withdrawal of lending to small firms accounted for significant negative effects on U.S. county-level employment. Fernandes and Ferreira (2017) find that firms in more financially constrained industries used fixed-term employment contracts disproportionately after the crisis, relative to other firms. Siemer (2019) and Duygan-Bump et al. (2015) use an identification strategy similar to the one we employ, exploiting differences across sectors in external finance dependence to study the differential effect of the crisis on employment growth and unemployment probability, respectively, in firms in sectors with high dependence on external finance,

relative to those in other industries.

Our paper also contributes to the broad literature that studies executive compensation (e.g., Jensen and Murphy, 1990; Hubbard and Palia, 1995; and Hall and Liebman, 1998). Fahlenbrach and Stulz (2011) and Bhagat and Bolton (2014) find that executive compensation structure is correlated with excessive risk-taking by banks during the credit crisis. Different from previous studies, we use the 2008-9 financial crisis as a quasi-natural experiment to estimate the relationship between firms' financing conditions prior to the crisis and executives' gender pay gap after its onset. This issue has received little attention in previous studies.

While a body of literature has studied gender gaps in the labor market, few studies have focussed on executives. Noteworthy exceptions include Bertrand and Hallock (2001), Gayle et al. (2012), Newton and Simutin (2015), Albanesi et al. (2015) and Keloharju et al. (2016). However, previous literature reports mixed findings; some studies find that female executives earn less than men (e.g., Bertrand and Hallock, 2001; Albanesi et al., 2015), while others find that female compensation is higher (Gayle et al., 2012).

Our paper is also related to the literature that studies the gender pay gap more generally (e.g., Blau and Kahn, 2000, 2017; Card et al., 2016). In preference-based discrimination theories employers pay female workers less than males as there is a disutility cost from employing females (Becker, 1957). Discrimination is harder to sustain in a competitive environment as prejudiced employers forgo profit to indulge their preferences.[6] The financial crisis implied a negative shock to firms' profit, particularly for more exposed firms, and as such could have similarly contributed to reduce costly discrimination if prejudiced employers exit at higher rates, or change their behavior. The literature also studied sorting of female and male workers across firms and differential bargaining power as sources of the gender pay gap, when firms have some wage-setting power.[7] Card et al. (2016) use the same data source from Portugal and show that sorting effects do not explain managers' gender pay gap, while the bargaining effect explains only 1% of the gap.

Finally, our paper is also related to studies of the relationship between female leadership and firm performance. Existing evidence has shown that female leadership is positively related with firm performance (e.g. Dezso and Ross, 2012; Post and Byron,

[6]Empirical evidence on the effects of deregulation supports the prediction (e.g., Ashenfelter and Hannan, 1986; Black and Strahan, 2001; Cooke et al., 2019).

[7]Groshen (1991) and Bayard et al. (2003) show that between-firm sorting explains a fraction of the gender wage gap. Stuhlmacher and Walters (1999) show that women can have relatively lower bargaining power.

2015). Flabbi et al. (2019) find that female leadership increases performance in firms with a larger fraction of female workers. Papers on the introduction of gender quotas on firms' boards tend to find a negative effect on performance (e.g., Ahern and Dittmar, 2012; Matsa and Miller, 2013).[8] However, the imposition of quotas is a specific situation not necessarily generalizable when such constraint does not exist.

Our paper contributes to the literature in several respects. First, we present novel evidence that shocks to credit supply when firms face financial constraints can contribute to reduce executives' gender pay gap.[9] Reducing inefficiencies from gender inequality may have helped exposed firms to avoid more negative effects of the shock. Second, we provide evidence from the Great Recession, the largest financial shock in a generation, and thus exploit a clean natural experiment for identification, rather than relying on potentially endogenous measures. Third, we use exceptionally detailed data for the universe of firms and workers, while previous studies tend to focus on large, listed companies. Finally, we estimate the effects for managerial workers while previous papers have mostly focused on other employees. This is important as managers are the ones responsible for the firms' strategy, and also the gender pay gap has declined much more slowly at the top of the wage distribution (Blau and Khan, 2017).

3 Data and methodology

3.1 Employer-employee Data

To investigate the effect of the 2008-9 financial crisis on executive pay and gender inequality, this paper uses detailed linked employer-employee data from Portugal. The dataset, "Quadros de Pessoal" (QP), is collected annually by the Portuguese Ministry of Labor and Social Security as part of a mandatory survey to all private sector firms that employ at least one worker, all of their plants and all of their employees. The information in the data refers to the month when the survey is collected (October, since 1994). The legal requirement for firms to answer the survey and have it publicly available results in exceptional coverage and reliability of the data.[10] The same data has been used by e.g.,

[8] These papers study the introduction of quotas in Norway, which required that 40% of directors be women when only 9% were, and show that this led to younger and less experienced boards. In Portugal, corporate gender quotas were introduced in 2017, after the end of our sample period, and thus do not affect our outcomes.

[9] Previous studiers have shown that crises and other negative shocks can lead to economic restructuring that improves firms' and workers' outcomes (e.g., Aghion et al., 2021; Bloom et al., 2016).

[10] The legal requirement that the data is publicly available at the firm is to comply with monitoring by the Ministry of Labor that labor relations within the firm conform to the law.

Card et al. (2016) to study sorting and bargaining effects on the gender wage gap.

The data contains detailed information for each worker, including the gender, age, education, level of skill, occupation, monthly hours of work (normal and overtime), earnings, hiring date in the firm, date of the last promotion and type of employment contract. Information at the firm-level includes the year of creation, industry, region, employment, number of establishments, sales volume, legal structure and ownership type (domestic private, public or foreign).[11] Firms and workers can be traced over time through their unique registration number. Our analysis considers firms in the manufacturing and services sectors, covering 43 two-digit ISIC revision 3.1 industries. For this paper, since we study the effect of financing constraints after the financial crisis, we exclude finance sectors from the sample.[12] We also exclude micro firms, with less than 10 workers; this is appropriate in our context since managers in very small firms perform different roles than those in larger companies. Our analysis uses data for the period from 2004 to 2012.[13]

To investigate the effect of financial constraints on executives' gender gap, we exploit information on each worker's hierarchical level within the firm. Workers are classified into eight hierarchical or qualification levels, based on the complexity, responsibility, and skill requirement of the tasks they perform.[14] For our analysis, we consider executives, or managers, those in level 1 ("top executives") and those in level 2 ("intermediary executives") of the firms' hierarchy. We perform separate analysis for top executives and all executives. Our main focus is on top executives since they are the ones responsible for defining the firms' general policy and strategy. Table A.1 in the appendix shows the distribution of executives across years in our worker-level estimation sample, as well as the share of female executives in each year. Females are the minority in executive jobs representing about 40 percent on average over the sample years.

To study the effect of the crisis on the gender pay gap of executives, our main compensation dependent variable is the (log of) real monthly pay of the worker, obtained by

[11] The data excludes civil servants in public firms (those covered by the Labour Law on Civil Service), but it includes other workers, covered by the general Labour Law.

[12] Although the crisis started in the banking sector, it propagated across the economy as financial institutions were unable to supply credit to other firms, affecting firms and workers in all sectors of the economy.

[13] The full sample includes 46,423 distinct firms over the period, contributing 210,482 firm-year observations, and 286,483 workers, contributing 1,372,905 worker-year observations. There are 35,010 distinct firms in the period prior to the crisis, of which 25,835 are present after the crisis, implying a survival rate of 73.8%. The final estimation sample is smaller due to missing data for some variables.

[14] The levels of qualification are: 1 - Top executives (top management); 2 - Intermediary executives (middle management); 3 - Supervisors, team leaders and foremen; 4 - Higher-skilled professionals; 5 - Skilled professionals; 6 - Semi-skilled professionals; 7 - Non-skilled professionals; 8 - Apprentices, interns and trainees. Table A.1 in Cooke et al. (2019) shows a detailed description of the hierarchical levels and their skill content in accordance with the law (Law Decree 121/78 of July).

summing: (i) the base pay, or gross wage for the normal hours of work;[15] (ii) regular earnings supplements; and (iii) irregular bonuses.[16] We estimate separate specifications for total pay, wage and bonus. Our results are therefore interpreted as the effect of financing constraints after the crisis on executives' short-term compensation (salary and bonus).[17] Tables B.1 and B.2 in the online appendix report detailed summary statistics for the executive compensation variables, before and after the 2008-9 crisis. Female executives' pay is on average (and median) lower than their male counterparts'. The gender pay gap is on average lower in more financially dependent industries, and the median gap is lower after the crisis in those industries. Figure 1 shows the distribution of pay. The female pay distribution shifts very slightly to the right after the crisis, while both male and female distributions have higher concentration around the mean after the crisis. These simple summary statistics cannot account for differences across sectors, unobserved worker heterogeneity, composition effects or general trends. To take these factors into account, we conduct a more formal regression analysis which identifies the differential effect of the crisis on the pay gap of executives in firms more exposed to the credit shock.

[Figure 1 about here]

To study the effect of the crisis on the female executive share, we use as dependent variable the ratio of female to male executives within a firm. To investigate the effects on firm performance, we use firm's sales and annual accounting profit before tax. Profit data is from the "Sistema de Contas Integradas das Empresas" (SCIE; Enterprise Integrated Accounts System) dataset, collected annually by the Office for National Statistics (INE), with detailed balance sheet information for the universe of firms since 2004. We merge this data with the employer-employee data using the common firm identifier.

Our regressions control for observable characteristics of the worker, such as gender, age, tenure, type of contract of employment, and educational level.[18] We also control for firm characteristics: the log of size (number of employees), ownership status and whether

[15] This is the monthly base salary, before any contributions. Labor contracts in Portugal specify the normal hours of work (e.g. 40 hours per week).

[16] Regular earnings supplements include tenure related payments and other payments for the workers' normal hours of work, such as meal and transport allowances. Irregular bonuses are payments such as distribution of profits or dividends, awards for performance or other bonuses, not made on a regular basis. This variable captures any performance-related payments and bonuses made in the reference month of the data. This is used as the "bonus" dependent variable. The QP data do not include long term incentive plans (LTIP) or stock options since most firms are not publicly traded.

[17] Other studies have also used salary and bonus to study executives' compensation (e.g., Murphy, 1986; Hall and Liebman, 1998; and Aggarwal and Samwick, 1999).

[18] The level of education is recorded according to the UNESCO 1997 International Standard Classification of Education (ISCED).

the firm is multi-plant. Table 1 presents summary statistics for the variables used in our analysis, at the worker-level and firm-level.

[Table 1 about here]

To study the effects of financial constraints, we compute measures of financial dependence, from firms' balance sheet information in the SCIE dataset, described in detail below. We then merge the matched employer-employee data with the measures of financial dependence.

3.2 Measures of financial constraints

Our identification strategy exploits pre-crisis differences across industries in the dependence on external funds and uses the 2008-9 financial crisis as a shock to the supply of credit. We use two measures of financial dependence that have been extensively employed in the literature. First, Rajan and Zingales (1998; RZ henceforth) show that firms in some industries have significantly larger liquidity needs; this can be due to a larger initial investment, requirement for continued investment, or to the harvesting period. As they demonstrate, differences across industries in the reliance on external finance are the result of technological and other inherent characteristics of the industries and are exogenous for individual firms. The second proxy for financial vulnerability is the Hadlock and Pierce (2010; HP hereafter) size-age index, derived from the finding that firms' size and age are highly related to financial constraints, as young and small firms are more constrained.

The measures of financial vulnerability are widely considered intrinsic characteristics of a sector which are innate to the manufacturing process of the sector. This is corroborated by the fact that the measures display much greater variation across industries than among firms within a given industry, and are relatively stable over time. For this reason, and consistent with previous literature, we use the measures at the industry level.

The measures are computed using Portuguese firms' balance sheet and employer-employee data. The RZ external finance dependence ($Extfin$) measures the share of total capital expenditure not financed by internal cash flows from operations and is computed, as in previous literature, as capital expenditures minus cash flow from operations divided by capital expenditures. This is our preferred measure as it captures the reliance on external finance, our main interest to study the effects of the credit supply shock; it is also the measure more commonly used in the literature. The HP size-age index (SA

index) is computed, as in previous literature, by applying the Hadlock and Pierce (2010) coefficients to our sample of firms; size is the log of inflation adjusted book assets and age is the number of years of the firm.[19] The index captures the fact that financial constraints are reduced over a firm's life cycle, as young and small firms age and grow. By construction, financially more constrained firms have a higher $SA\ index$.

Following previous literature, to compute the industry-level measures of financial vulnerability, we first calculate the average of the measures at the firm-level; this is obtained over the pre-crisis period to avoid endogenous changes in financial vulnerability as a result of the crisis.[20] We then take the median across all firms within each 2-digit industry as the measure of financial dependence of the industry.[21] Therefore, the measures identify firms that were more exposed to the credit supply shock as those in industries that relied more on external finance. Figure 2 plots the distribution of firms according to the financial vulnerability measures; there is significant variation across firms, important for identification.[22] Our regressions exploit how increasing degree of financial vulnerability affects the outcomes.

[Figure 2 about here]

To estimate the effects of the crisis, we define the variable $Crisis_t$, which takes the value 1 from 2008 onwards and zero otherwise, to identify the global financial crisis period. This follows from the fact that September 2008 is generally considered the onset of the crisis. In March 2008, Bear Stearns was sold to J.P. Morgan after withdrawal of short-term financing. Financial conditions significantly worsened in September 2008, following the bankruptcy of Lehman Brothers. The global credit crunch escalated sharply with several other major financial institution failures and bailouts. As a result, the cost of interbank lending rocketed (see Chodorow-Reich, 2014, for more details).

The timing of the crisis in Portugal coincided with the events in 2008. GDP fell by 3% between 2008 and 2009. A short temporary recovery in 2010 was followed by new declines

[19] The index is obtained as -0.737×Size + 0.043×Size^2 - 0.040×Age. Size is capped at \$4.1 billion, and age at 37 years to capture a flat relation between financial constraints and these variables for very large and mature firms.

[20] We use the period from 1997-2006 for the *extfin* measure. Restricting to 2004-2006 generates similar results, consistent with the finding in the literature that these measures are stable over time. Due to larger data coverage for the HP SA index from 2002, this measure is computed over the 2002-2006 period.

[21] Previous studies that use the same methodology include, among many others, Duygan-Bump et al. (2015) and Siemer (2019), who study unemployment dynamics during the 2008-9 crisis; and Chava and Purnanandam (2011), who study the effect of shocks to the U.S. banking system.

[22] A small fraction of firms have very low financing constraints (longer left-tail), but a larger mass of firms have significant financing constraints.

in GDP between 2011 and 2012, by 3% on average (World Bank, World Development Indicators). Figure A.1 in the appendix plots these trends. As shown, the Portuguese economy followed the same trajectory as the EU and USA until 2011. After 2011, the European economies experienced the second dip of the so called "double-dip" recession, but the slump in Portugal started earlier, and was significantly more pronounced than in the rest of the EU.

3.3 Empirical strategy

The aim of this paper is to investigate the relationship between financing constraints and the gender pay-gap of executives, exploiting the 2008-9 crisis as a shock to credit supply. To that end, we implement a difference-in-differences approach to estimate the differential effect of the crisis on the pay of executives in firms with high financial vulnerability, relative to those in firms with low financial vulnerability. We estimate specifications of the form:

$$\begin{aligned} \ln w_{ijsrt} &= \beta_1(FinVuln_s \times Crisis_t \times Fem_i) + \beta_2(FinVuln_s \times Crisis_t) \\ &+\beta_3(Fem_i \times Crisis_t) + \beta_4(FinVuln_s \times Fem_i) + \theta X'_{it} + \delta Z'_{jt} \\ &+\{FE\} + \epsilon_{ijsrt}. \end{aligned} \tag{1}$$

The dependent variable is the log of real monthly pay, wage or bonus, of worker i, in firm j, industry s, region r, and year t. $Crisis_t$ is the indicator variable for the crisis period, which takes the value 1 from 2008 onwards, and 0 otherwise. September 2008 is generally considered the onset of the crisis, as discussed above, and the data refers to the month of October in each year. $FinVuln_s$ is one of the measures of financial constraints for industry s: external finance dependence ($Extfin$) or the Hadlock and Pierce (2010) size-age index of financial constraints ($SA\ index$). We use continuous measures, which exploit how increasing degrees of financial vulnerability affect the outcomes.[23] We also verify that the results remain robust to using a dichotomous treatment variable, taking the value 1 for industries with above-median financial vulnerability, and zero for those below-median. Fem_i is a dummy for whether worker i is a female, to capture the differential pay for female executives.

X'_{it} is a matrix of individual characteristics, including education, quadratic in age

[23] Conceptually, the identification strategy compares the outcomes for workers in industries with high financial dependence to those in industries with low financial dependence, after the crisis. The results remain robust if we drop outliers, with the highest and lowest 1% of the measures of financial constraints.

and in tenure, type of employment contract, whether the worker is a foreign national, and dummies for past managerial experience and past sector experience. Z'_{jt} is a matrix of firm characteristics, including the log of size (employment), EU class size dummies, year of creation, type of instrument of collective regulation (IRCT), ownership structure (domestic private, public or foreign), and whether the firm is multi-plant. Controlling for firm size is important because it has been extensively shown that executive pay is positively correlated with firm size (see, for example, Kostiuk, 1990; and Baker and Hall, 2004). We include an exhaustive set of fixed effects $\{FE\}$, such as industry (d_s), region (d_r) and year (d_t), to absorb unobserved industry and regional characteristics that may affect compensation, particularly the gender pay differential, and global shocks that affect all firms and workers. We also include worker-firm match (d_{ij}) fixed effects, which control for any unobserved individual heterogeneity, including differences between males and females in talent or motivation, management styles, attitudes towards risk, as well as selection across firms and industries, which could affect gender differences in compensation.[24] We saturate the model further with industry-specific linear trends, $d_s \times t$, to absorb any potential trends in wages at the industry level, particularly differential trends for exposed industries, and female-specific trends in pay, $Fem_i \times t$.[25] ϵ_{ijsrt} is a random disturbance term. We cluster the standard errors at the firm-level.

The coefficient of main interest is β_1, on the triple interaction term between the female dummy, the crisis variable and the financial constraints measure, $FinVuln_s \times Crisis_t \times Fem_i$. It is interpreted as the differential effect of the crisis on the pay of female executives in firms with higher financial dependence, relative to those in other firms. We expect β_1 to be positive if the crisis had a positive differential effect on female executive pay in firms that rely more heavily on external funds, thus contributing to reduce the gender pay-gap of executives. The term $FinVuln_s \times Crisis_t$ captures the baseline effect of the crisis on executive pay, and the effect on male executives' compensation.

An extensive literature has documented the relative absence of females from top corporate jobs, a phenomenon termed "glass ceiling". We also investigate whether the crisis has led to a relative increase in the share of female executives in firms in more financially dependent sectors, which were more exposed to the shock. We estimate the following

[24] Since both firm and worker fixed effects are constant within a match, these specifications are close to the two-way fixed-effects regressions in Abowd, Kramarz and Margolis (1999).

[25] The lower-order terms of the triple interaction of main interest in Equation (1) are explicitly estimated or are absorbed by the sets of fixed effects included.

firm-level specification:

$$femsh_{jsrt} = \beta_1(FinVuln_s \times Crisis_t) + \delta Z'_{jt} + \{FE\} + \epsilon_{jsrt}. \quad (2)$$

Here, the dependent variable, $femsh_{jsrt}$, is the ratio of female to male employment in executive positions in firm j, industry s, region r, in year t. In this specification, the interaction term of interest, $FinVuln_s \times Crisis_t$, captures the differential effect of the crisis on the share of female executives in firms with higher financial constraints, relative to other firms. We continue to include industry (d_s), region (d_r) and year (d_t) fixed effects (in $\{FE\}$) to absorb time-invariant industry and regional characteristics that may affect the female share of executives, and global trends across all firms. Z'_{jt} is a matrix that includes the firm characteristics discussed above.[26]

4 Results

4.1 Executive gender pay-gap

Before we study the effects of the crisis and financial constraints on the gender pay-gap of executives, this section begins by documenting the gender pay gap in managerial jobs in Portugal prior to the crisis. This is also a point of comparison with previous studies. To that end, we estimate the following compensation specification:

$$\ln w_{ijsrt} = \alpha + \beta_1 Fem_i + \beta_2(Fem_i \times FinVuln_s) + \gamma X'_{it} + \lambda Z'_{jt} + \{FE\} + \epsilon_{ijsrt} \quad (3)$$

The dependent variable is the natural log of either real pay, wage or bonus of worker i in firm j, industry s, region r, in year t, and Fem_i is a female dummy. As above, X'_{it} includes the worker's education, quadratic in age and in tenure, type of employment contract, whether foreign national, and dummies for past managerial and past sector experience. Z'_{jt} includes the firm's characteristics described in the previous section. We also include industry (d_s), region (d_r), and year (d_t) fixed effects ($\{FE\}$) as well as industry-specific time trends ($d_s \times t$). Since we control for a comprehensive set of workers' background characteristics, which account for differences in productivity and other supply-side factors, the estimated coefficient on the female dummy captures the unexplained pay-gap between male and female executives in our sample. The $Fem_i \times FinVuln_s$ interaction estimates the differential gender gap according to financial vulnerability of the industry, if any.

[26] Figure A.2 plots the female top managerial share over time, by financial vulnerability.

[Table 2 about here]

The estimation results are reported in Table 2. The sample period for this table is the period preceding the crisis, from 2004 to 2007. In Panel A we use the sample of top managers ("top executives" in the data), while Panel B uses the sample of all managers ("top executives" and "intermediary executives"). The estimates show that executives' gender pay-gap is sizeable. After controlling for executives' background characteristics and for firm characteristics, we find that female executive pay is on average 17 to 18 percent lower than their male counterparts' (column (1)). The gap is of the same magnitude if we consider hourly pay instead of monthly pay (column (4)). The gender gap is significantly larger for bonus than for salary, reaching 24 percent on average for top managers and 28 percent in the sample of all managers (column (3)). The estimate of the interaction term is positive and significant for top managers' monthly salary, suggesting a somewhat lower gender pay gap in more financially constrained industries, relative to other industries,[27] but there is no statistically significant difference for the other compensation variables or in the sample of all managers.

The results in this section are in line with previous literature and are consistent with male and female executives with equal characteristics not sharing equal pay. The unexplained differential in pay between male and female workers with the same qualifications, skills and other observable characteristics is often interpreted in the literature as an estimate of employer discrimination (see e.g., Becker, 1957). The next section investigates the effect of the crisis on the gender pay-gap of executives.

4.2 Effect of the crisis on executives' gender pay-gap

This section investigates the effect of financial constraints on the pay of executives following the financial crisis of 2008-9, particularly on the gender pay gap at the top of a corporation. We assess whether there is a differential effect of the crisis on the pay of female executives in industries with intrinsically higher external finance dependence or size-age (SA) index, the measures of financial vulnerability, relative to those in other industries following the crisis. Workers and firms in industries that rely more on external finance are more exposed to the negative shock to credit supply and are thus the treatment group. We estimate Equation (1), for the compensation dependent variables.

[27] If the unexplained gender gap is a measure of employer discrimination, as discussed in previous literature, an intuition would be that financially constrained firms are less able to engage in costly discrimination, even before the crisis, as they require higher productivity to increase the value of internally generated funds.

Table 3 reports the results for the sample of top executives, for log pay (columns (1) to (3)), log wage (columns (4) to (6)) and log bonus (columns (7) to (9)) as the dependent variables. Panel A uses the RZ external finance dependence measure of financial vulnerability ($Extfin$), while Panel B uses the HP size-age index ($SA\ index$). We include exhaustive sets of fixed effects, as discussed in previous sections. For each dependent variable, we start by estimating a specification with just the $Crisis$ variable. The positive and significant coefficient shows that executive salaries continued to grow after the crisis and are about 5% higher on average in the five years since the crisis onset, relative to pre-crisis years. This is consistent with extensive evidence that despite the shock, executive pay continued to rise after the crisis (e.g., Bebchuk et al., 2010; Bowie, 2012). In the second column for each dependent variable, we estimate a specification with a $Fem \times FinVuln$ interaction and lower order Fem term.[28] The estimates show that female executive pay is lower on average than male's over the sample period, and that the gap in pay is lower in more financially dependent sectors, though not significantly different for bonus, confirming the findings in Table 2 above. However, to estimate the lower-order terms, these specifications do not account for worker heterogeneity, selection, or general trends in female pay.

[Table 3 about here]

Our main results are presented in columns (3), (6) and (9), which estimate Equation (1) and include worker-firm match fixed effects. These absorb time-invariant characteristics of the executive and the firm and account for differential sorting of male and female workers across firms and industries, ensuring that the effects are not due to composition effects. This specification thus estimates the effects from workers that remain in the same firm after the crisis, confirming that the results are not driven by movements across firms, which could pay higher wages. The estimates of main interest here are those on the triple interaction term $FinVuln_s \times Crisis_t \times Fem_i$. We obtain a positive and statistically significant coefficient for all compensation dependent variables in Panel A. These results imply that the crisis had a positive differential effect on the pay of female executives in more financially dependent sectors, contributing to reduce the gender pay-gap in exposed sectors.[29] Specifically, the estimates in column (3) imply that the pay of female executives in industries with external finance dependence one standard deviation above the sample mean (0.91) increased by an additional 1.3% following the crisis. The

[28] The lower-order $FinVuln_s$ term is absorbed by the industry fixed effects.

[29] We obtain almost identical results if worker fixed effects are included instead of worker-firm.

coefficients for the wage regression are similar (column (6)), while the effects on bonuses are significantly larger, implying a 12.5% increase for females in industries with financial dependence one-standard deviation above the average (column (9)). The coefficients on the lower-order terms of the main interaction are mostly statistically insignificant, suggesting that the crisis did not have a significant effect on the pay of males in financially vulnerable industries, or of females in unconstrained industries, supporting the role of the credit shock in reducing the gender gap in exposed firms.

The results in Panel B of Table 3, for the HP size-age index of financial constraints, remain robust for pay and wages: the coefficients of the triple interaction of main interest remain positive and highly significant, showing that female executive pay increased in financially dependent industries, relative to other industries. The coefficients are insignificant for bonus when using the SA index; however, the measure of bonus has the caveat of including only bonuses paid in October.[30]

Table A.2 in the appendix reports results for the same specifications but for the sample of all managers. The results using the $Extfin$ measure (Panel A) tend to be insignificant. Since top managers determine the firm's strategy and thus contribute more to profit, it is expected that their pay is more significantly affected by the crisis than that of middle managers, as e.g., demand for female top executives' styles may have increased as a result of the crisis (see Bertrand and Schoar, 2003).[31] When using the HP size-age index to measure financial vulnerability (Panel B), we continue to find a positive differential effect of the crisis on female executive pay in financially vulnerable industries. The estimates for bonus continue to be insignificant.

We verify the robustness of our results to alternative specifications. Specifically, our results above use continuous measures of financial vulnerability, which have the advantage of exploiting how increasing degrees of financial dependence affect the outcomes. We verify that the results remain robust to using a dichotomous treatment variable ($D_{FinVuln}$), taking the value 1 for industries with above-median financial vulnerability, and zero for those below the median. The results, reported in Table A.3, remain robust in sign, magnitude and statistical significance. Our benchmark results use monthly pay and wages, for comparison with the results for bonus, which do not dependent directly on hours worked.[32] As another check, Table B.3 in the online appendix reports results

[30] Moreover, our preferred measure of financial vulnerability is the pre-crisis reliance on external funds.

[31] The description of tasks in the law states that top managers are responsible for "defining the firm's general policy and strategy", while middle-managers' tasks involve "adaptation of the guidelines established by the superiors" (see also Fernandes et al., 2014, 2018).

[32] Bonuses may depend on an indirect measure of effort; however, they do not depend on hours directly

using hourly pay and hourly wages as the dependent variables. The results remain robust; we continue to find that there is a positive and significant differential effect of the crisis on the pay of female top managers in more financially dependent industries, for both measures of financing constraints. In the sample of all managers the effects continue to be generally insignificant.

The results above show that the crisis had a positive differential effect on female executives' pay in financially constrained industries, thus contributing to reduce the gender pay gap. Our specifications account for prior trends in pay at the industry level. As a further test of our identification of the impact of the credit supply shock following the 2008-9 crisis, we use the 2001 recession, which resulted from the bursting of the information and communications technology (ICT) bubble, as a placebo test. Since the 2001 recession did not affect firms' access to credit, it serves as a placebo test of our main results if changes in female pay after the 2001 crisis are not related to financial dependence across industries. Therefore, we estimate the same specifications for managerial compensation, but for the period of the 2001 crisis: from 1999 through to 2003.[33] The post-shock dummy variable, $Crisis^{2001}$, now takes the value 1 in 2002 and 2003, after the ICT recession, and zero in 1999 and 2000.[34]

[Table 4 about here]

The estimation results are presented in Table 4, for top managers (columns (1) to (3)) and all managerial workers (columns (4) to (6)). We find that the coefficient on the triple interaction term of main interest, between the post-2001 crisis dummy, the financial vulnerability measure and the female dummy ($FinVuln_s \times Crisis_t^{2001} \times Fem_i$) is statistically insignificant for all dependent variables and for both measures of financial dependence (Panels A and B). Financing constraints are thus insignificant in explaining changes in female pay after the ICT crisis. This supports our identification of the effects of the shock to credit supply after the 2008-9 crisis, and the role of financing constraints in reducing the executive gender pay-gap in financially vulnerable firms.

Next, we investigate the role of female firm leadership on the estimates of the impact of the crisis on the executive gender pay gap. Previous literature has found that the gender pay gap is affected by whether the firm is female-led or male-led (e.g., Cardoso

to allow the computation of an hourly bonus measure.

[33]For the placebo test, we consider the same groups identified for the main period for the financial vulnerability measures to assess the effects for the same group of firms.

[34]The data was not collected in 2001 and our sample period for the main analysis starts in 2004, so we use the period from 1999 to 2003 for the placebo test.

and Winter-Ebmer, 2010; Flabbi et al., 2019). To investigate this, we identify the top executive as the top earner (as in e.g., Flabbi et at., 2019) and estimate separate specifications for female-led and for male-led firms. The results, presented in Table 5, show that the effect of the crisis on the pay of female executives in exposed industries is positive and statistically significant in both female-led and male-led firms, and of similar magnitude (though slightly larger in female-led firms).[35] The estimates imply that female top executive pay increased by an additional 2.1% in female-led firms and 1.5% in male-led firms with external finance dependence one standard deviation above the mean.[36] For the sample of all managers (Panel B), as above, the effects tend to be insignificant. Table B.4 in the online appendix uses as alternative definition of female leadership the share of female top executives in the firm.[37] The main interaction with this measure confirms that the positive effect of the crisis on the pay of female executives in exposed firms is increasing in the measure of female leadership. In sum, the crisis increased female managers' pay in exposed firms, and the effects are not driven solely by female leadership.

[Table 5 about here]

In our benchmark specifications, the main interaction captures the effects of financing constraints on the unexplained gender gap. This is a clean way to estimate the effects which controls for executives' observed and unobserved characteristics, but in Table B.5 in the online appendix we also perform a Oaxaca-Blinder decomposition of the gender pay-gap into differences in characteristics and an unexplained component (as in e.g., Blau and Khan, 2017), before and after the crisis (for 2005 and 2010).[38] More important for our setting is the contribution of $Extfin$; for top managers, while in 2005 external finance dependence has a positive contribution to the pay-gap, by 2010, after the crisis, it has a negative entry showing that it raised females' relative pay and thus contributed to narrow the gender gap (though modestly).[39] Although this analysis does not allow controlling for executives' unobserved heterogeneity, or industry trends, the findings are consistent with a reduction in the gender gap in exposed industries after the crisis.

[35] There is an exception of a large and significant coefficient for bonus in male-led firms. This could be related to the fact that most firms are male-led and the number of observations for bonus in female-led firms is significantly lower to identify the effects.

[36] We use external finance dependence to measure financial vulnerability in Table 5. The results remain robust to using the alternative proxy.

[37] We obtain similar results if using the share of all executives.

[38] Entries are the male-female differences in the means of each variable multiplied by the corresponding coefficients from a pooled model (see Blau and Khan, 2017, for more details). Executive's age has a significant contribution to the gap, while women's higher level of education raised their relative wage and thus has a negative entry.

[39] For all managers the contribution to the gap also decreases after the crisis, but it remains positive.

In sum, the results in this section show that the crisis led to a relative increase in female executive pay in financially constrained sectors, thus contributing to reduce the gender pay-gap. We investigate potential channels for the effects in Section 4.4.

4.3 Effect of the crisis on the share of female executives and worker transitions

In this section, we investigate whether there is a differential effect of the crisis on the share of female executives in firms with higher financial vulnerability; as well as on the probability of promotion, demotion or exit. To study the effects on female representation in executive positions, we estimate Equation (2) above at the firm-level, where the dependent variable is the ratio of the number of female to the number of male executives in the firm. We include industry fixed effects, to estimate the effect across firms within an industry, and control for region and year effects. The coefficient of main interest is on the $FinVuln_s \times Crisis_t$ interaction, which captures the differential effect of the crisis on the share of female executives in firms more exposed to the shock.

Table 6 presents the estimations for the ratio of females in top executive jobs in columns (1) and (2), and for the ratio in all managerial jobs in columns (3) and (4). We report results for the two measures of financial vulnerability: external finance dependence (columns (1) and (3)) and size-age index (columns (2) and (4)). The results show that the share of females in executive positions increased following the crisis in more financially dependent firms. The estimates using the $Extfin$ measure imply that a one standard deviation increase in financial vulnerability above the sample mean is associated with a 12.7% increase in the ratio of female top executives, relative to the mean ratio in the sample, and a 6% increase in the ratio of all female executives. The estimates remain similar for the $SA\ index$. These results provide evidence that the crisis and the financial constraints imposed on firms contributed to increase firms' share of female executives.[40]

[Table 6 about here]

Next, we study worker-level transitions. We measure individual-level promotions, demotions, and exit rates for workers whose firms were more exposed to the recession, compared to other workers. We estimate specifications of the form of Equation (1) for the

[40] Table A.4 in the appendix reports results for a placebo test, using the 2001 ICT-driven recession. As shown, the coefficient of interest tends to be insignificant or negative, supporting the role of financing constraints in the increase in the female manager share in financially vulnerable firms.

probability of promotion, demotion, and exit as the outcome variables. The $FinVuln \times Crisis \times Female$ interaction estimates how changes in these probabilities after the crisis are related to gender and financial constraints of the firm. We control for managers' characteristics and for exhaustive sets of fixed effects, as discussed in Section 3.3. We estimate linear probability models.[41] Table 7 presents the results. Columns (1) and (2) are for the probability of promotion to top executive, for all workers and for those that move to another firm, respectively. Although the probability of promotion to top executive is on average lower after the crisis in affected industries for both genders, among those that move to another firm, females in affected industries are more likely to be promoted to top executive (column (2)). The effect is not significant among all workers (column (1)).

[Table 7 about here]

Columns (3) and (4) estimate the probability of promotion from non-executive to executive, either top or middle executive. We find a positive and significant coefficient on the interaction term of interest, implying that females in affected firms are more likely to be promoted to executive, both within and across firms. Specifically, females have a 5.7 percentage-point higher probability of being promoted to manager after the crisis. These results are consistent with an increased female share, reported in Table 6. Columns (5) and (6) look at the probability of demotion, from top to middle executive, and from executive to non-executive, respectively. Female managers in financially vulnerable industries have a slightly lower probability of being demoted from top to middle executive. In column (7), we find that the crisis led to increased exit from the sample for both genders, with a slightly higher exit probability for females in more affected industries. In sum, the results suggest that females in exposed industries have higher promotion probability after the crisis and lower probability of demotion, consistent with a lower gender pay differential.

4.4 Mechanisms for the effects on the gender gap

This section investigates the role of alternative mechanisms in explaining our main findings of a reduction in the gender pay-gap and increase in the female share of executives in more exposed firms after the crisis. The sources for the gender pay gap discussed in

[41] Estimates can thus be directly interpreted as average marginal effects. It has been shown that average marginal effects from probit estimates are usually very close to the linear estimate (see e.g., Wooldridge, 2002; Angrist and Pischke, 2009).

the literature, in addition to supply-side factors, include differential sorting of male and female workers across high and low wage paying firms, different bargaining or rent sharing across genders, and employer discrimination. The detailed employer-employee data that we use has the advantage of allowing us to include firm-worker match fixed effects, which control for worker characteristics and sorting of male and female workers across firms and industries, among other factors. This is the cleanest way to account for these potential sources of the gender-gap when estimating the impact of the crisis.

The literature has studied as another source of the gender wage-gap whether women are offered worse wage bargains, or firms share rents disproportionately with men (Card et al., 2014, 2016; Guiso et al., 2005; Black and Strahan, 2001). To investigate this potential channel for the effects on the gender pay gap, we estimate a rent sharing model (as e.g. Card et al., 2014), relating individual managers' pay to measures of surplus per worker and interactions to capture differential effects of the crisis on rent sharing for females in exposed sectors. We measure rents or surplus per worker ($\ln surpw$) by (log) sales per worker, or alternatively (log) value added per worker at the firm-year level, as in e.g. Card et al. (2014, 2016). We continue to include the sets of fixed effects and controls as in the benchmark specifications.[42]

The estimation results are reported in Table 8. Consistent with previous literature, increases in surplus are associated with higher pay: the coefficient on $\ln surpw$ is positive and significant for top managers. The $Female \times \ln surpw$ interaction is negative, suggesting lower rent sharing with female managers, though the estimate is of small magnitude. Importantly, the interaction of main interest ($Female \times FinVuln \times Crisis \times \ln surpw$) is not statistically significant, showing that the crisis did not contribute to changes in the rent sharing coefficient of females in exposed industries, relative to other workers. Moreover, the main effect of financial constraints and the crisis on female top managers' pay continues to be positive, significant and of similar magnitude. These results suggest that the reduction in the gender pay-gap is not driven by changes in rent sharing induced by the crisis.

[Table 8 about here]

The unexplained difference in pay between genders, for workers with the same skills, productivity and other characteristics is often interpreted in the literature as a measure of discrimination. Discrimination is costly and thus prejudiced employers are less efficient

[42] Industry-specific time trends control for average wage in an industry, a measure of workers' alternative or opportunity wage.

(e.g., Becker, 1957). It is therefore possible that inefficient discriminatory firms more exposed to the credit crisis exit the market at higher rates or reduce employment by more, relative to non-prejudiced employers. This substitution would contribute to increase the share of female managers and reduce the managerial gender pay-gap. To investigate this as a potential mechanism for the effects, we estimate a specification of the relationship between firms' size and survival, financial constraints and the level of discrimination:

$$\begin{aligned} \ln Y_{jst} &= \beta_1(FinVuln_s \times Crisis_t \times Femsh_j) + \beta_2(FinVuln_s \times Crisis_t) \\ &\quad \beta_3(Crisis_t \times Femsh_j) + \delta Z'_{jt} + \{FE\} + \epsilon_{jst}, \end{aligned} \tag{4}$$

The dependent variable, Y_{jst}, is either firm employment, sales or the probability that firm j exits the market in t.[43] $Femsh_j$ is the share of females in the workforce relative to the industry average, the proxy for discrimination, as in previous literature (e.g. Weber and Zulehner, 2014).[44] We expect β_1 to be positive for firm size and negative for exit if firms in exposed industries with a lower female share reduce size by more and exit at higher rates after the crisis, relative to other firms.

Table 9 shows that the crisis reduced employment and sales, and increased the probability of exit by more for firms in more exposed industries: the $FinVuln \times Crisis$ coefficient is negative for firm size and positive for exit. Importantly, the interaction with the discrimination proxy ($Femsh$) is positive and significant for size, showing that firms with a lower female employment share reduce size by more after the crisis than those with a higher share. The estimates imply that firms with financial dependence one standard deviation above the mean and average $Femsh$ reduce sales by 21% after the crisis, but those with $Femsh$ one standard deviation below the average reduce sales by a larger 31% (column (2)). Regarding exit (column (3)), firms with a low female share exit the marker at higher rates than other firms. In sum, these findings show that the shock contributed to reduce the size and increase exit rates by more for exposed employers with a low female share. This suggests that a reduction in preference-based discrimination cannot be ruled out as a channel for the reduction in the unexplained gender gap.

[Table 9 about here]

The results are also consistent with firms in more financially constrained sectors,

[43] The exit dependent variable takes the value 1 if the firm exits the market in year t and zero if it survives.

[44] This is measured as the average over the pre-crisis period to prevent endogenous changes due to the crisis from affecting the estimates.

which needed to perform better, valuing female managerial styles more highly after the crisis. This is in line with evidence that female leadership is positively related with firm performance, and with results showing that risk taking behavior of (male) managers was a contributing factor leading to the crisis (e.g., Balachandran et al., 2011; Bhagat and Bolton, 2014). We investigate whether the share of female executives affects the impact of the crisis on firm performance in more exposed firms. The results, presented in Table 10, show that firms with a higher share of female managers experienced a lower reduction in profit than other firms (the interaction $FinVuln \times Crisis \times Fem\text{-}mng\text{-}sh$ is positive and significant), thus avoiding sharper negative impacts of the crisis. The positive correlation between the female managerial share and firm performance after the crisis is consistent with firms seeking to increase the female share and reduce the gender pay gap of executives.

[Table 10 about here]

5 Conclusion

This paper investigates how the financial crisis of 2008-9, and the resulting financing constraints imposed on firms, affected executives' gender gap. We exploit the crisis, which affected firms differently according to their prior dependence on external finance, as a quasi-natural experiment. We study the link between financing constraints and executive gender inequality. To estimate the effects, we use employer-employee data for the universe of private sector firms and workers in Portugal, with exceptionally detailed information for each executive, including gender, age, education, occupation, hours of work, earnings, hiring date in the firm, and the hierarchical position in the firm (e.g. top executive or intermediate executive), among other. The data also includes firm-level information, such as sales, employment, industry, and location, among other.

Following previous literature on the effects of financing constraints, we use industry-level measures of financial dependence to identify credit supply effects. We use external finance dependence, following Rajan and Zingales (1998), and the Hadlock and Pierce (2010) size-age index of financial constraints. We compute these measures for the firms in our sample over the pre-crisis period, thus avoiding potential changes in firm behavior after the crisis from affecting the measures of financial vulnerability. These measures are widely regarded as intrinsic characteristics of an industry and exogenous for individual firms.

We find that after the crisis short-term compensation (salary and bonus) of female executives in exposed industries increased relative to males' and those in less financially constrained industries. The crisis thus contributed to reduce the executive gender pay-gap in exposed industries. We control for workers' observed and unobserved characteristics and for industry-specific trends and other exhaustive sets of fixed effects. Worker-firm match fixed effects account for sorting of workers across firms and industries, among other factors.

We also find that firms in industries with higher dependence on external finance increase the share of female executives following the crisis, relative to firms in less financially vulnerable industries. At the worker-level, females in exposed industries are more likely to be promoted to executive both within and across firms, and to top executive in other firms after the crisis. Female executives are also less likely to be demoted. These findings show that the crisis contributed to increase female representation in executive positions.

We investigate potential mechanisms for the effects of the crisis on the gender gap of executives. Our specifications account for supply-side factors and sorting of workers across firms, and we do not find evidence of changes in bargaining or rent sharing as sources of the effects on the gender gap. A reduction in preference-based discrimination cannot be ruled out as a channel for the effects of the crisis on the gender gap (Becker, 1957). Specifically, employers with a low share of females in the workforce reduce size by more and exit at higher rates after the crisis. We also find that firms that increased the female managerial share performed better after the crisis, consistent with female executive characteristics, such as attitudes towards risk, being more valued after the shock.

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6 Tables

Table 1: Descriptive statistics

Panel A: Worker level	(1) Top managers Male	(2) Top managers Female	(3) All managers Male	(4) All managers Female
ln(monthly pay)	7.766	7.412	7.617	7.314
ln(monthly wage)	7.696	7.367	7.542	7.268
ln(bonus)	5.824	5.331	5.766	5.295
ln(hourly pay)	2.711	2.434	2.553	2.318
ln(hourly wage)	2.642	2.388	2.477	2.272
ln(hours)	5.055	4.982	5.065	5.000
Crisis	0.585	0.620	0.578	0.597
Tenure	9.937	8.772	9.639	8.406
Age	41.745	38.408	40.856	37.275
Educational level (baseline: primary)				
secondary	0.061	0.032	0.090	0.043
high school	0.149	0.099	0.199	0.124
university	0.746	0.849	0.636	0.808
Fixed-term contract	0.106	0.159	0.126	0.1672
Foreign worker	0.024	0.020	0.022	0.019
Part-time	0.032	0.055	0.028	0.046

Panel B: Firm level	No. Obs	Mean	Median	Std dev.
Extfin	210,482	0.369	0.407	0.538
SA-Index	210,482	-7.327	-7.329	0.419
ln(employment)	210,482	3.409	3.178	0.948
ln(sales)	210,250	13.388	14.184	3.988
Profit$\times 10^5$ euros	151,619	0.474	0.204	1.221
Firm exit	210,482	0.037	0	0.188
Female-led firm	210,482	0.350	0	0.477
Female ratio, all managers	163,750	0.659	0	1.556
Female ratio, top managers	113,696	0.568	0	1.248
Female share relative to industry mean (pre-crisis)	186,343	1.052	1.002	0.721
Categories of firm size (baseline: small)				
medium	210,482	0.215		
large	210,482	0.034		
Multiestablishment firm	210,482	0.247		
Ownership (baseline: private national)				
public	210,482	0.012		
foreign	210,482	0.068		
Legal nature (baseline: quota society)				
individual name	210,482	0.012		
uniperson quota society	210,482	0.016		
anonymous society	210,482	0.228		
other	210,482	0.136		

Own calculations based on Portugal's linked employer-employee data, Ministry of Labor and Social Solidarity (MTSS), 2004-2012. Statistics in Panel A are for the worker-level estimation sample, and those in Panel B for the firm-level estimation sample.

Table 2: Pre-crisis executive gender pay-gap

	(1)	(2)	(3)	(4)	(5)
Dependent variable:	ln(pay)	ln(wage)	ln(bonus)	ln(hr pay)	ln(hr wage)
Sample:			Top managers		
Panel A					
$Female$	-0.176***	-0.162***	-0.243***	-0.166***	-0.153***
	(0.008)	(0.008)	(0.029)	(0.008)	(0.008)
$Female \times FinVuln$	0.032**	0.033**	-0.019	0.022	0.023
	(0.015)	(0.015)	(0.041)	(0.016)	(0.016)
R^2	0.469	0.484	0.183	0.425	0.448
No. Obs.	314,595	314,595	80,932	314,595	314,595
Sample:			All managers		
Panel B					
$Female$	-0.174***	-0.159***	-0.283***	-0.164***	-0.148***
	(0.006)	(0.006)	(0.026)	(0.006)	(0.006)
$Female \times FinVuln$	0.018	0.017	0.012	0.003	0.002
	(0.015)	(0.015)	(0.035)	(0.015)	(0.015)
R^2	0.462	0.480	0.147	0.430	0.459
No. Obs.	568,852	568,852	140,384	568,852	568,852
Industry fixed effects	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes
Industry-year trends	yes	yes	yes	yes	yes

The sample is for the pre-crisis period, 2004-2007. Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is a foreign national, and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, year of creation, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. Financial vulnerability ($FinVuln$) is measured by external finance dependence (Extfin). A constant term is included in all specifications. The number of observations is the number of worker-years. Standard errors, clustered at the firm level, are reported in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

Table 3: Effect of the crisis on top executive pay and gender pay-gap

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		ln(pay)			ln(wage)			ln(bonus)	
Fin. vuln. measure:					Extfin				
Panel A									
$FinVuln \times Crisis \times Female$			0.014***			0.010**			0.137***
			(0.004)			(0.004)			(0.045)
$FinVuln \times Crisis$			-0.012*			-0.004			-0.081
			(0.007)			(0.004)			(0.074)
$Female \times Crisis$			-0.007*			-0.002			-0.035
			(0.004)			(0.003)			(0.035)
$FinVuln \times Female$		0.045***			0.046***			0.042	
		(0.012)			(0.012)			(0.039)	
$Crisis$	0.054***			0.045***			0.120*		
	(0.006)			(0.004)			(0.062)		
$Female$		-0.187***			-0.174***			-0.284***	
		(0.007)			(0.007)			(0.026)	
R^2	0.435	0.447	0.052	0.454	0.465	0.072	0.137	0.143	0.046
No. Obs.	785,210	785,210	785,210	784,882	784,882	784,882	184,101	184,101	184,101
Fin. vuln. measure:					SA index				
Panel B									
$FinVuln \times Crisis \times Female$			0.005**			0.005***			-0.011
			(0.002)			(0.002)			(0.018)
$FinVuln \times Crisis$			-0.006*			-0.006***			0.035
			(0.003)			(0.002)			(0.047)
$Female \times Crisis$			0.036**			0.041***			-0.054
			(0.014)			(0.013)			(0.138)
$FinVuln \times Female$		0.028*			0.030*			0.000	
		(0.016)			(0.016)			(0.020)	
$Crisis$	0.054***			0.045***			0.120*		
	(0.006)			(0.004)			(0.062)		
$Female$		0.043			0.067			-0.260	
		(0.113)			(0.113)			(0.160)	
R^2	0.435	0.447	0.052	0.454	0.465	0.072	0.137	0.143	0.045
No. Obs.	785,210	785,210	785,210	784,882	784,882	784,882	184,101	184,101	184,101
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry-time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes
Female-time trends			yes			yes			yes
Match fixed effects			yes			yes			yes

Crisis takes the value 1 from 2008 onwards, and zero otherwise. Extfin measures the dependence on external finance and is the share of total capital expenditure not financed by internal cash flows from operations (Rajan and Zingales, 1998). SA index is the Hadlock & Pierce (2010) size-age index where size is the firm's inflation-adjusted book assets (winsorized at 4.1 billion euro) and age is the number of years of existence of the firm (winsorized at 37). Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is a foreign national, and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, year of creation, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. The sample includes workers that are observed both before and after the crisis. A constant term is included in all specifications. The number of observations is the number of worker-years. Standard errors, clustered at the firm level, are reported in parentheses. * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 4: Placebo - effect of the 2001 ICT crisis on executive pay and gender pay gap

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	ln(pay)	ln(wage)	ln(bonus)	ln(pay)	ln(wage)	ln(bonus)
Sample:	Top managers			All managers		
Fin. vuln. measure:	Extfin					
Panel A						
$FinVuln \times Crisis \times Female$	0.013	0.012	0.197	-0.007	-0.007	0.054
	(0.013)	(0.009)	(0.146)	(0.010)	(0.007)	(0.114)
$FinVuln \times Crisis$	-0.074**	-0.039	-0.831	-0.052**	-0.029	-0.346
	(0.032)	(0.026)	(0.520)	(0.024)	(0.020)	(0.406)
$Female \times Crisis$	0.002	0.002	-0.116	0.014	0.016	0.207**
	(0.019)	(0.017)	(0.137)	(0.015)	(0.014)	(0.104)
R^2	0.080	0.085	0.164	0.075	0.083	0.112
No. Obs.	150,569	150,569	35,149	265,068	265,068	60,026
Fin. vuln. measure:	SA index					
Panel B						
$FinVuln \times Crisis \times Female$	0.003	-0.003	0.048	-0.000	0.000	0.013
	(0.007)	(0.005)	(0.085)	(0.004)	(0.004)	(0.055)
$FinVuln \times Crisis$	0.004	-0.001	0.630**	0.007	0.002	0.507*
	(0.026)	(0.013)	(0.314)	(0.017)	(0.010)	(0.298)
$Female \times Crisis$	0.033	-0.013	0.300	0.014	0.017	0.283
	(0.053)	(0.042)	(0.703)	(0.033)	(0.029)	(0.467)
R^2	0.079	0.085	0.173	0.075	0.083	0.121
No. Obs.	150,569	150,569	35,149	265,068	265,068	60,026
Industry fixed effects	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes
Industry-time trends	yes	yes	yes	yes	yes	yes
Female-time trends	yes	yes	yes	yes	yes	yes
Match fixed effects	yes	yes	yes	yes	yes	yes

Crisis takes the value 1 from 2001 to 2003, and zero for 1999 and 2000. Extfin measures the dependence on external finance and SA index is the Hadlock & Pierce (2010) size-age index of financial constraints. Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is a foreign national and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. The sample includes workers that are observed both before and after the crisis. A constant term is included in all specifications. Standard errors, clustered at the firm level, are reported in parentheses. * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 5: Effect of the crisis on executive gender pay-gap, by gender of the top executive

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	ln(pay)		ln(wage)		ln(bonus)	
Top executive:	Female	Male	Female	Male	Female	Male
Sample:	Top managers					
Panel A						
$FinVuln \times Crisis \times Female$	0.023***	0.017***	0.016***	0.012**	0.016	0.119**
	(0.008)	(0.005)	(0.006)	(0.005)	(0.062)	(0.051)
$FinVuln \times Crisis$	-0.023*	-0.007	-0.013*	0.001	0.180**	-0.140*
	(0.012)	(0.008)	(0.007)	(0.006)	(0.074)	(0.080)
$Female \times Crisis$	-0.014	-0.008	-0.008	-0.003	-0.132*	-0.074*
	(0.009)	(0.005)	(0.006)	(0.004)	(0.076)	(0.044)
R^2	0.058	0.053	0.060	0.079	0.033	0.058
No. Obs.	206,574	578,636	206,494	578,388	35,991	148,110
Sample:	All managers					
Panel B						
$FinVuln \times Crisis \times Female$	0.012*	0.011	0.005	0.005	-0.092*	0.118*
	(0.007)	(0.007)	(0.005)	(0.008)	(0.051)	(0.071)
$FinVuln \times Crisis$	-0.014	-0.002	-0.006	0.005	0.267***	-0.077
	(0.018)	(0.008)	(0.006)	(0.008)	(0.065)	(0.087)
$Female \times Crisis$	-0.001	-0.010	0.001	-0.003	0.008	-0.090*
	(0.007)	(0.006)	(0.004)	(0.006)	(0.048)	(0.049)
R^2	0.067	0.057	0.060	0.078	0.020	0.038
No. Obs.	382,559	990,346	382,414	989,902	70,614	256,900
Industry fixed effects	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes
Industry-time trends	yes	yes	yes	yes	yes	yes
Female-time trends	yes	yes	yes	yes	yes	yes
Match fixed effects	yes	yes	yes	yes	yes	yes

Financial vulnerability is measured by external finance dependence (Extfin). Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is a foreign national and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. The sample includes workers that are observed both before and after the crisis. A constant term is included in all specifications. Standard errors, clustered at the firm level, are reported in parentheses. * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 6: Effect of the crisis on the share of female managers

	(1)	(2)	(3)	(4)
Dependent variable:	no. female managers/no. male managers			
Sample:	Top managers		All managers	
Fin. vuln. measure:	Extfin	SA	Extfin	SA
$FinVuln \times Crisis$	0.079***	0.088***	0.040*	0.033***
	(0.023)	(0.013)	(0.024)	(0.011)
R^2	0.018	0.018	0.024	0.024
No. Obs.	113,573	113,573	163,576	163,576
Industry fixed effects	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes

Extfin measures the dependence on external finance and SA index is the Hadlock & Pierce (2010) size-age index of financial constraints. Specifications include ln(sales in real terms), ownership type, whether the firm is multi-establishment, and legal nature. A constant term is included in all specifications. The number of observations is the number of firm-years. Standard errors, clustered at the firm level, are reported in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

Table 7: Worker transitions and the crisis

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent variable:	Pr(promoted to top exec.)		Pr(promoted to exec.)		Pr(demoted)		Pr(exit)
Sample:	All	Movers	All	Movers	to mid-exec	to non-exec	
$FinVuln \times Crisis \times Female$	-0.002	0.026**	0.057***	0.035*	-0.007***	-0.002	0.006***
	(0.007)	(0.013)	(0.011)	(0.019)	(0.002)	(0.002)	(0.002)
$FinVuln \times Crisis$	-0.048***	-0.047**	0.015	-0.022	0.011**	0.002	0.031***
	(0.013)	(0.020)	(0.023)	(0.029)	(0.005)	(0.004)	(0.005)
$Female \times Crisis$	-0.004	-0.012	-0.025***	-0.005	0.009***	0.003*	-0.004***
	(0.004)	(0.010)	(0.008)	(0.013)	(0.002)	(0.002)	(0.001)
$FinVuln \times Female$	-0.000	-0.004	-0.047***	-0.049***	0.002	0.007**	-0.004***
	(0.006)	(0.009)	(0.009)	(0.014)	(0.002)	(0.003)	(0.001)
$Female$	-0.018***	-0.030***	-0.011**	-0.028***	-0.003*	0.008***	0.002***
	(0.004)	(0.006)	(0.006)	(0.010)	(0.001)	(0.002)	(0.000)
R^2	0.072	0.097	0.135	0.234	0.030	0.045	0.057
No. Obs.	1,187,386	150,587	663,408	105,871	811,168	1,441,057	1,828,283
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes
Industry-time trends	yes	yes	yes	yes	yes	yes	yes

Financial vulnerability is measured by the external finance dependence (Extfin). Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is a foreign national and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, year of creation, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. A constant term is included in all specifications. The regressions are linear probability models. Standard errors, clustered at the firm level, are reported in parentheses. The number of observations is the number of worker-years. * p<0.10; ** p<0.05; *** p<0.01.

Table 8: Rent-sharing, executive gender pay-gap and the crisis

	(1)	(3)	(5)	(7)
Dependent variable:	ln(pay)			
Sample:	Top managers		All managers	
Surplus measure (*surpw*):	sales/emp.	v. added/emp.	sales/emp.	v. added/emp.
$FinVuln \times Crisis \times Female \times \ln(surpw)$	0.000	-0.001	0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$FinVuln \times Crisis \times Female$	0.012***	0.016***	0.000	0.005
	(0.004)	(0.005)	(0.005)	(0.006)
$Female \times Crisis$	-0.005	-0.008	0.005	0.002
	(0.004)	(0.006)	(0.007)	(0.006)
$FinVuln \times Crisis$	-0.012*	-0.010	-0.005	-0.006
	(0.007)	(0.007)	(0.010)	(0.006)
$\ln(surpw)$	0.002**	0.002**	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$Female \times \ln(surpw)$	-0.001	-0.002**	-0.001	-0.002
	(0.001)	(0.001)	(0.001)	(0.001)
$Crisis \times \ln(surpw)$	0.000	-0.000	0.001*	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$Crisis \times Female \times \ln(surpw)$	0.000	0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.000)	(0.001)
$FinVuln \times \ln(surpw)$	-0.000	-0.001	0.000	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$FinVuln \times Female \times \ln(surpw)$	0.000	0.002	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
$FinVuln \times Crisis \times \ln(surpw)$	-0.001*	0.000	-0.002***	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.052	0.052	0.055	0.058
No. Obs.	776,215	665,084	1,360,313	1,133,9850
Industry fixed effects	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes
Industry-time trends	yes	yes	yes	yes
Female-time trends	yes	yes	yes	yes
Match fixed effects	yes	yes	yes	yes

Financial vulnerability is measured by external finance dependence (Extfin). Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is a foreign national and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, year of creation, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. The sample includes workers that are observed both before and after the crisis. A constant term is included in all specifications. Standard errors, clustered at the firm level, are reported in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

Table 9: Firm size and exit, gender discrimination and the crisis

	(1)	(2)	(3)
Dependent variable:	ln(employm)	ln(sales)	Pr(exit)
$FinVuln \times Crisis$	-0.031***	-0.397***	0.042***
	(0.009)	(0.082)	(0.004)
$FinVuln \times Crisis \times Femsh$	0.016**	0.153**	-0.015***
	(0.008)	(0.067)	(0.003)
$Crisis \times Femsh$	-0.006*	-0.065**	-0.000
	(0.004)	(0.031)	(0.002)
R^2	0.029	0.036	0.049
No. obs.	186,343	186,158	186,343
Firm fixed effects	yes	yes	yes
Year fixed effects	yes	yes	yes

The dependent variable is the natural log of employment at the firm level in column (1), the natural log of real sales' volume in column (2), and the probability of the firm exiting the market in column (3). *Femsh* is the pre-crisis average share of females in the workforce relative to the industry average. Financial vulnerability is measured by external finance dependence (Extfin). Specifications include controls for the ownership type, whether the firm is multi-establishment, and legal nature. Standard errors, clustered at the firm level, are reported in parentheses. * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 10: Firm performance, share of female managers and the crisis

	(1)	(2)
Dependent variable:	profit	
Female share:	Top managers	All managers
$FinVuln \times Crisis \times Fem\text{-}mng\text{-}sh$	0.026**	0.027**
	(0.013)	(0.011)
$FinVuln \times Crisis$	-0.069**	-0.076***
	(0.028)	(0.022)
$Crisis \times Fem\text{-}mng\text{-}sh$	0.004	0.002
	(0.013)	(0.010)
$FinVuln \times Fem\text{-}mng\text{-}sh$	-0.012	-0.012
	(0.015)	(0.015)
$Fem\text{-}mng\text{-}sh$	-0.003	-0.002
	(0.015)	(0.011)
R^2	0.039	0.042
No. Obs.	78,642	121,289
Firm fixed effects	yes	yes
Year fixed effects	yes	yes

The dependent variable is firm profit (in 10^5 euros). Financial vulnerability is measured by the dependence on external finance (Extfin). Specifications include controls for the ownership type, whether the firm is multi-establishment, and legal nature. A constant term is included in all specifications. Standard errors, clustered at the firm level, are reported in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

7 Figures

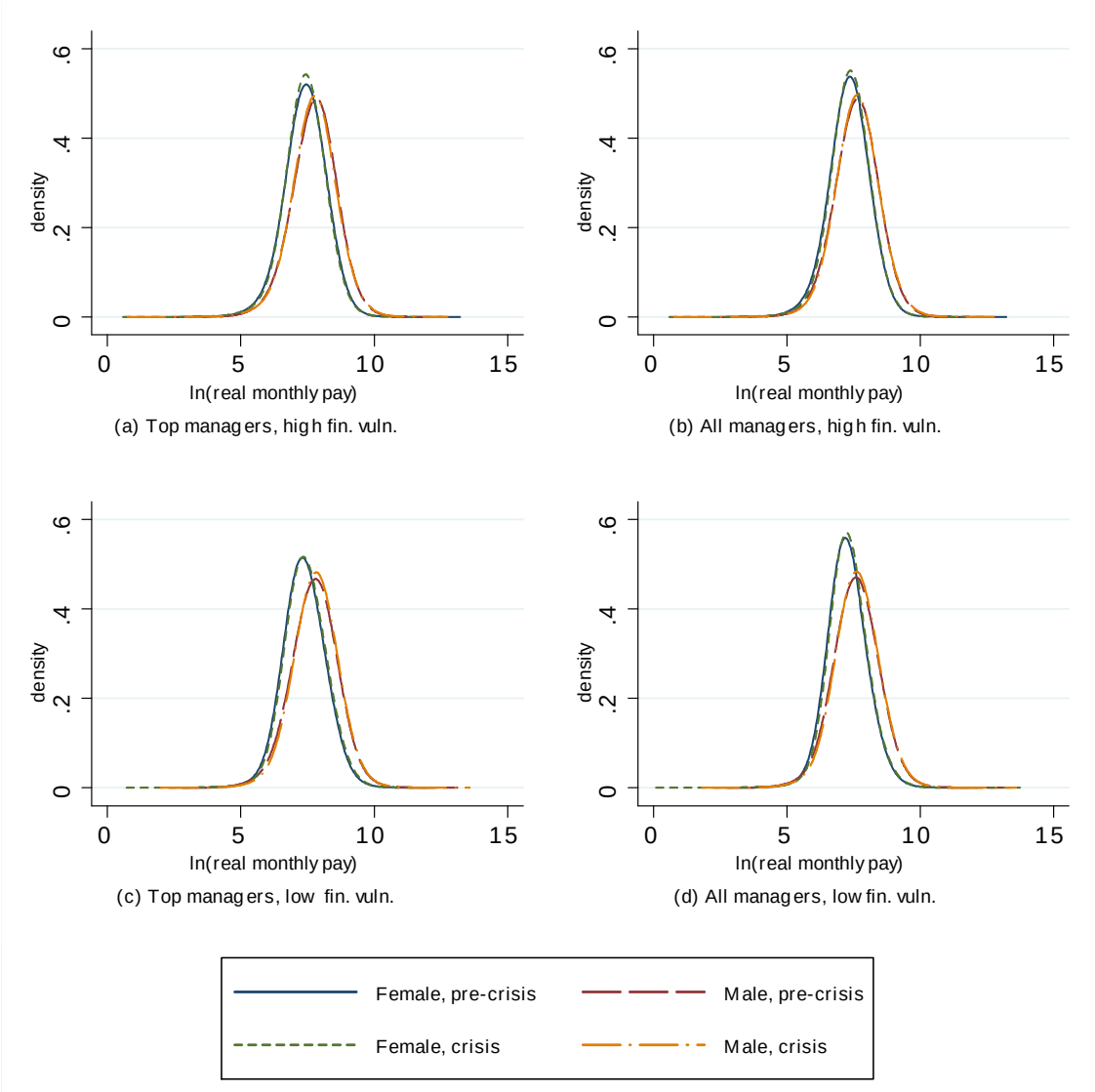

Figure 1: Distribution of pay of top and all executives, by financial vulnerability

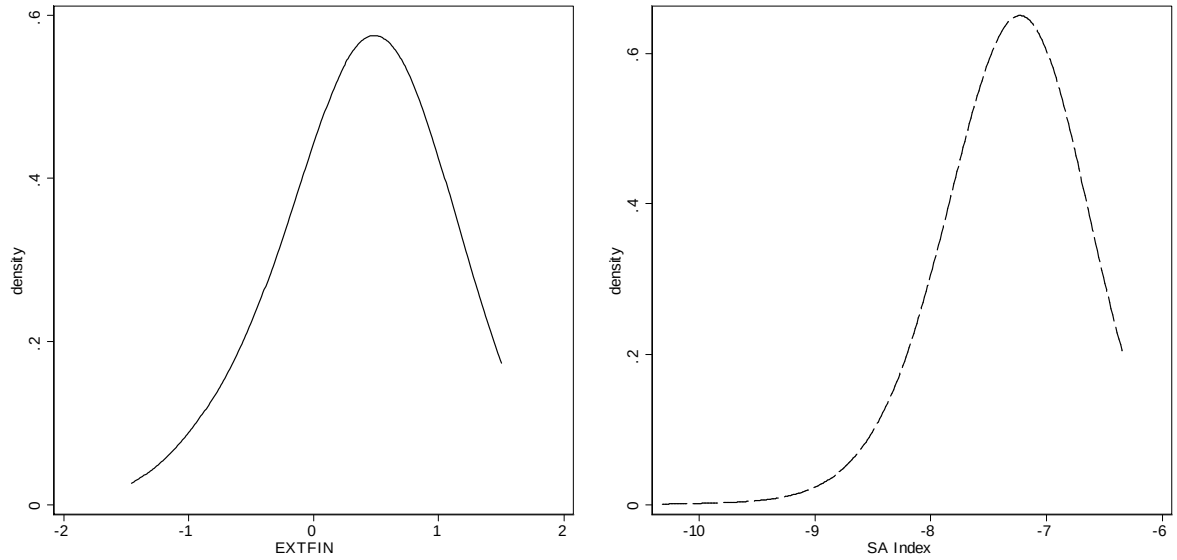

Figure 2: Distribution of firms according to financial vulnerability

A Appendix

Table A.1: Sample size

	(1)	(2)	(3)	(4)
	Top managers		All managerial workers	
	Number	% Female	Number	% Female
2004	63,977	35.17	114,701	38.45
2005	71,420	36.61	133,779	40.28
2006	79,979	37.81	150,799	41.90
2007	99,219	42.06	169,573	43.03
2008	103,408	42.29	175,782	43.14
2009	97,864	42.05	166,745	43.16
2010	93,672	41.19	159,168	42.39
2011	89,856	41.85	155,427	43.13
2012	85,815	41.82	146,931	43.68
Total	785,210	40.44	1,372.905	42.29

The statistics are for the worker-level estimation sample. Own calculations based on Portugal, MTSS (2004-2012).

Table A.2: Effect of the crisis on executive pay and gender pay-gap; all executives

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Dependent variable:		ln(pay)			ln(wage)			ln(bonus)	
Fin. vuln. measure:					Extfin				
Panel A									
$FinVuln \times Crisis \times Female$			0.005			-0.001			0.087
			(0.005)			(0.005)			(0.057)
$FinVuln \times Crisis$			-0.006			0.002			-0.064
			(0.009)			(0.006)			(0.083)
$Female \times Crisis$			0.001			0.004			0.011
			(0.006)			(0.003)			(0.052)
$FinVuln \times Female$		0.021			0.019			0.050	
		(0.015)			(0.015)			(0.031)	
$Crisis$	0.057***			0.050***			0.094**		
	(0.005)			(0.004)			(0.047)		
$Female$		-0.183***			-0.167***			-0.309***	
		(0.006)			(0.006)			(0.021)	
R^2	0.419	0.433	0.054	0.442	0.454	0.071	0.111	0.118	0.029
No. Obs.	1,372,905	1,372,905	1,372,905	1,372,316	1,372,316	1,372,316	327,514	327,514	327,514
Fin. vuln. measure:					SA index				
Panel B									
$FinVuln \times Crisis \times Female$			0.009**			0.009*			-0.018
			(0.004)			(0.005)			(0.021)
$FinVuln \times Crisis$			-0.004			-0.007***			0.032
			(0.003)			(0.003)			(0.042)
$Female \times Crisis$			0.068**			0.073*			-0.090
			(0.029)			(0.040)			(0.159)
$FinVuln \times Female$		0.038*			0.039*			0.015	
		(0.021)			(0.021)			(0.027)	
$Crisis$	0.057***			0.050***			0.094**		
	(0.005)			(0.004)			(0.047)		
$Female$		0.106			0.132			-0.177	
		(0.150)			(0.149)			(0.199)	
R^2	0.419	0.433	0.055	0.442	0.455	0.071	0.111	0.118	0.029
No. Obs.	1,372,905	1,372,905	1,372,905	1,372,316	1,372,316	1,372,316	327,514	327,514	327,514
Industry fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Industry-time trends	yes	yes	yes	yes	yes	yes	yes	yes	yes
Female-time trends			yes			yes			yes
Match fixed effects			yes			yes			yes

Crisis takes the value 1 from 2008 onwards, and zero otherwise. Extfin measures external finance dependence and SA index is the Hadlock & Pierce (2010) size-age index of financial constraints. Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is a foreign national, and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, year of creation, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. The sample includes workers that are observed both before and after the crisis. A constant term is included in all specifications. Standard errors, clustered at the firm level, are reported in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

Table A.3: Effect of the crisis on executive pay and gender pay-gap, dichotomous treatment

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable:	ln(pay)	ln(wage)	ln(bonus)	ln(pay)	ln(wage)	ln(bonus)
Fin. vuln. measure:			Extfin			
Sample:		Top managers			All managers	
Panel A						
$D_{FinVuln} \times Crisis \times Female$	0.011**	0.013***	0.134***	0.006	0.003	0.101**
	(0.005)	(0.004)	(0.045)	(0.006)	(0.005)	(0.051)
$D_{FinVuln} \times Crisis$	-0.012	-0.006	-0.014	-0.006	-0.001	-0.006
	(0.008)	(0.004)	(0.102)	(0.008)	(0.004)	(0.088)
$Female \times Crisis$	-0.005	-0.004	-0.033	0.001	0.002	0.008
	(0.004)	(0.003)	(0.035)	(0.008)	(0.004)	(0.056)
R^2	0.052	0.072	0.045	0.054	0.071	0.029
No. Obs.	785,210	784,882	184,101	1,372,905	1,372,316	327,514
Fin. vuln. measure:			SA index			
Sample:		Top managers			All managers	
Panel B						
$D_{FinVuln} \times Crisis \times Female$	0.008*	0.012***	0.005	0.013**	0.016***	0.021
	(0.005)	(0.004)	(0.046)	(0.005)	(0.005)	(0.047)
$D_{FinVuln} \times Crisis$	-0.011	-0.010**	0.155	-0.005	-0.009**	0.135
	(0.007)	(0.004)	(0.116)	(0.007)	(0.004)	(0.083)
$Female \times Crisis$	-0.004	-0.005	0.007	-0.006	-0.007*	0.021
	(0.005)	(0.004)	(0.041)	(0.005)	(0.004)	(0.043)
R^2	0.051	0.072	0.046	0.054	0.071	0.030
No. Obs.	785,210	784,882	184,101	1,372,905	1,372,316	327,514
Industry fixed effects	yes	yes	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes	yes
Industry-time trends	yes	yes	yes	yes	yes	yes
Female-time trends	yes	yes	yes	yes	yes	yes
Match fixed effects	yes	yes	yes	yes	yes	yes

Crisis takes the value 1 from 2008 onwards, and zero otherwise. Extfin measures the dependence on external finance and SA index is the Hadlock & Pierce (2010) size-age index. $D_{FinVuln}$ takes the value 1 for industries with above-median financial vulnerability, and zero otherwise. Specifications include quadratic in age and in tenure, education, type of contract, whether the worker is foreign national, and dummies for past managerial and past sector experience. Firm level covariates include ln(firm size), EU size dummies, type of instrument of collective regulation of labour, ownership type, whether the firm is multi-establishment, and legal nature. The sample includes workers that are observed both before and after the crisis. A constant term is included in all specifications. Standard errors, clustered at the firm level, are reported in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

Table A.4: Placebo - effect of the 2001 ICT crisis on the share of female managers

	(1)	(2)	(3)	(4)
Dependent variable:	no. female managers/no. male managers			
Sample:	Top managers		All managers	
Fin. vuln. measure:	Extfin	SA index	Extfin	SA index
$FinVuln \times Crisis$	0.037	-0.040**	0.052*	-0.028*
	(0.026)	(0.017)	(0.031)	(0.016)
R^2	0.016	0.017	0.020	0.020
No. Obs.	27,482	27,482	37,692	37,692
Industry fixed effects	yes	yes	yes	yes
Region fixed effects	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes

Crisis takes the value 1 for 2002 and 2003, and zero for 1999 and 2000. Extfin measures the dependence on external finance and SA index is the Hadlock & Pierce (2010) size-age index of financial constraints. Specifications include ln(sales in real terms), ownership type, whether the firm is multi-establishment, and legal nature. A constant term is included in all specifications. The number of observations is the number of firm-years. Standard errors, clustered at the firm level, are reported in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

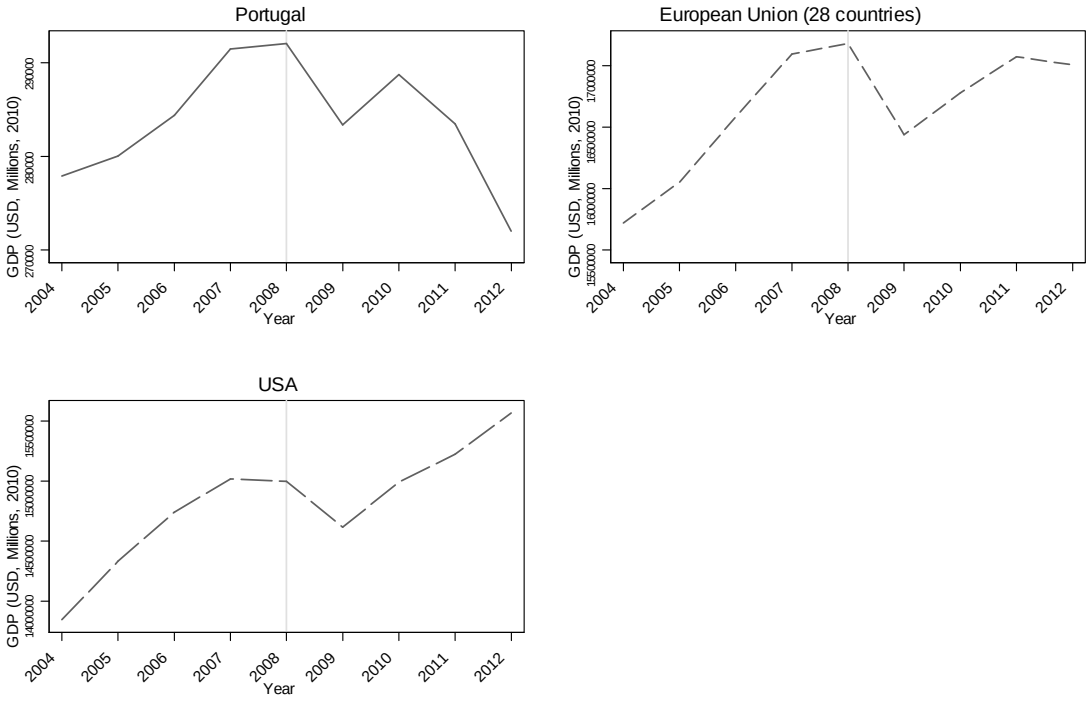

Figure A.1: GDP series for Portugal, EU-28 and USA, 2004-2012

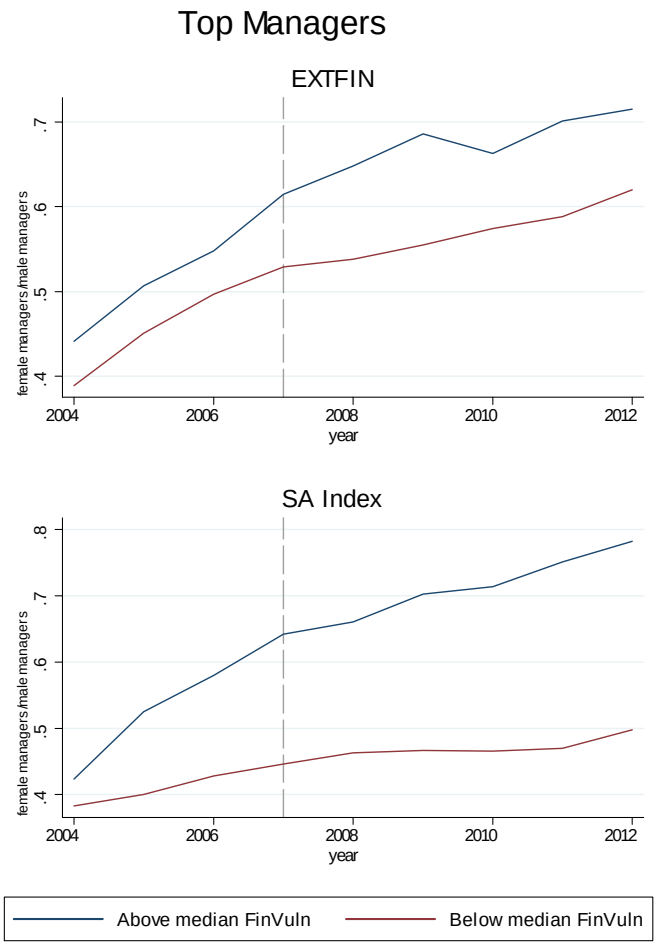

Figure A.2: Female top managerial share over time, by financial vulnerability