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# Financial constraints in search equilibrium: Mortensen Pissarides meet Holmstrom and Tirole

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## ABSTRACT

A key lesson from the Great Recession is that firms' leverage and access to finance are important for hiring and firing decisions. It is now empirically established that bank lending is correlated with employment losses when credit conditions deteriorate. We provide further evidence of this and make causal inferences on the effect of leverage on job losses drawing on a new firm-level dataset that we assembled on employment and financial positions of European firms. Yet, in the Diamond Mortensen Pissarides (DMP) model there is no role for finance. All projects that display positive net present values are realized and financial markets are assumed to be perfect. What if financial markets are not perfect? Does a different access to finance influence the firm's hiring and firing decisions? The paper uses the concept of limited pledgeability proposed by Holmstrom and Tirole to integrate financial imperfections and labor market imperfections. A negative shock wipes out the firm's physical capital and leads to job destruction unless internal cash was accumulated by firms. If firms hold liquid assets they may thus protect their *search capital*, defined as the cost of attracting and hiring workers. The paper explores the trade-off between size and precautionary cash holdings in both partial and general equilibrium. We find that if labor market frictions disappear, so does the motive for firms to hold liquidity. This suggests a fundamental complementarity between labor market frictions and holding of liquid assets by firms.

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## 1. Introduction

The 2008 financial crisis and the associated increase in unemployment on both sides of the Atlantic sparked a new interest in the relationship between financial imperfections and labor market dynamics. In the aftermath of the crisis, a growing empirical literature studied the links between financial conditions and employment adjustment. A key lesson that we have learned from this flourishing literature is that firms' leverage and access to finance are strongly and significantly correlated to hiring and firing decisions. More specifically, it is now empirically accepted that frictions in bank lending are correlated to employment losses when credit conditions deteriorate. It is more difficult to draw causal inferences as to the relationship between financial conditions of firms and employment adjustment. Yet studies reviewed below drawing on exogenous variation in financial conditions of firms and the additional evidence produced in this paper suggest that leverage induces more downsizing during a financial recession. In particular, we assemble a new dataset on firm-level adjustment and financial conditions of firms throughout the Great Recession and implement a new identifica-

tion strategy based on the involvement of firms in consortia offering third party collateral. We find a sizeable and negative effect of leverage on employment adjustment throughout the Great Recession, mainly operated via the downsizing of firms rather than a slower growth of expanding units.

These documented links between finance and employment adjustment can be better understood in a framework combining financial market and labor market imperfections. The Diamond Mortensen Pissarides (DMP) model is the main paradigm for addressing imperfect labor markets. In the baseline framework, there is no role for finance. All projects that display positive net present values are realized and financial markets are assumed to be perfect. What if financial markets are not perfect? Does a different access to finance influence the firm hiring and firing decisions? These basic questions call for a deeper understanding of the relationship between labor and finance. Among the financial frictions addressed by the literature and reviewed below, this paper exploits the concept of limited pledgeability proposed by Holmstrom and Tirole (2011). The idea is that only part of the entrepreneur's income is pledgeable and can be borrowed upon, either because part of the in-

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come is private benefit or because the entrepreneur needs incentives. By adding financial imperfections and borrowing constraints into an otherwise standard equilibrium unemployment model, the paper contributes to the building of an archetype and flexible model of labor and finance.

In our model, firms are financially constrained by limited pledgeability and invest in physical capital within an imperfect labor market. Entering firms attract workers by posting vacancies with wages attached to them and hire up to an endogenously determined size level that depends on the firms' access to finance. Firms anticipate the possibility that new funding will be needed over the lifetime, and that refinancing may not be available in those times. If that happens, the firm must rely on liquid assets for financing the rebuilding of its physical capital. In the absence of such funds, the firm is forced to fire workers and close down its operations. When workers are fired, the firm loses its *search capital*, defined as the cost of attracting and hiring workers. *Ex ante*, firms therefore face a trade-off between investing their limited funds in liquid assets to protect their search capital, or to invest in more capacity and more employees.

Our theoretical model shows that if labor market frictions disappear, so does the motive for firms to hold liquid assets. This implies a fundamental complementarity between labor market frictions and holding of liquid assets by firms that is novel in the literature. In this sense, the paper brings together the work on liquidity by [Holmstrom and Tirole \(2011\)](#) with the traditional ([Mortensen and Pissarides, 1994; 1999](#)) model of equilibrium unemployment.

In [Section 2](#) we position our contribution with respect to the earlier theoretical literature and the more recent empirical literature since the Great Recession. In [Section 3](#), we present new causal inferences based some on an unexploited data set of European firms. [Section 4](#) presents the environment of our theoretical perspective, the financial contracts and the asset equations. [Section 5](#) derives and solves for the general equilibrium. In [Section 6](#) we extend the basic model to allow for heterogeneous firms and we reconcile our theory with recent work and evidence on employment and liquidity ([Bacchetta et al., 2016](#)). [Section 7](#) discusses our more general implications and reconcile them with the evidence summarized in [Section 2](#), and provided in [Section 3](#). [Section 8](#) concludes.

## 2. Relationship to the existing literature

In this section we relate our theoretical and empirical contributions to the existing literature.

### 2.1. Earlier (mostly theoretical) literature

There exists a substantial literature on financial frictions. The early literature, predating the Great Recession, identified different sources of frictions. In particular, ([Greenwald and Stiglitz, 1993](#)) looked at the risk aversion of firms, ([Farmer, 1985](#)) studied the financing of quasi-fixed costs, and ([Townsend, 1979](#)) proposed the costly verification model. Sticky bank borrower relationships were also emerging in this early literature as a result of asymmetric information with moral hazard ([Holmstrom and Tirole, 1997](#)) and adverse selection ([Sharpe, 1990](#)). [Kiyotaki and Moore \(1997\)](#) studied the role of capital as collateral. Within a more DMP labor finance literature, the pioneer work was ([Wasmer and Weil, 2004](#)) investigation of the interplay between matching frictions in labor and financial markets. [Merz and Yashiv \(2007\)](#) discussed the relationship between adjustment costs of labor and the value of the firm.

In order to position our contribution within this literature, we need to characterize in some detail the main theories of financial frictions, and their relevant applications. In Townsend's costly verification model ([Townsend, 1979](#)), the income of the borrower is private information, and the lender has to incur a cost in order to observe the income. It follows that the cost of borrowing is increasing in the amount borrowed, as it increases the probability that costly verification will take place.

In [Holmstrom and Tirole's](#) model ([Holmstrom and Tirole, 1997](#)), the entrepreneur can only borrow on a share (less than one unit) of a non-stochastic income flow.<sup>1</sup> This setup fits very well into the Diamond–Mortensen–Pissarides model as the (non-pledgeable) component of income firms cannot borrow upon is simply subtracted from output period by period.

[Bernanke and Gertler \(1989\)](#) analyze an economy in which financial frictions are modeled by Townsend's costly verification framework. In their model, aggregate output is assumed to be stochastic. The impetus for financial fluctuations is linked to individual savings. If the economy is hit by a positive shock, entrepreneurs accumulate more wealth before investing, and this increases the fraction of entrepreneurs who invest. This initial effect persists because the increased investments lead to higher income in the next period, and hence also higher wealth. We study a model without anticipated aggregate shock, hence the effect through initial wealth is absent. Our focus is on the multiplier effect of job creation: more job creation gives more pledgeable income, which in turn allows for more job creation. This mechanism is absent in [Bernanke and Gertler](#), as the size of the projects (*ex ante*) is exogenous in their model.

In [Kiyotaki and Moore \(1997\)](#), entrepreneurs can only borrow on collateral, not on future income as such. Collateral (land in their setting) is also an input in the production process. A one-period increase in productivity gives rise to multiplier effects as it increases the present and future values of land, relaxing the borrowing constraint of investors (farmers). As already commented upon, firms borrow on future income in our setup, collateral plays no direct role as such. Hence changes in future income flows influence the borrowing constraint directly, not only indirectly as in [Kiyotaki and Moore](#).<sup>2</sup> Our assumption is convenient within a search setting, as physical capital is downplayed in these models. Furthermore, in search models, a part of the investment is upfront investment in search capital, i.e. costs associated with acquiring workers. The search capital per worker hired is endogenously determined in search equilibrium, and it is not clear whether search capital can be used as collateral. This is particularly important in our set-up, as it is the protection of the search capital that motivates firms to hold cash.

### 2.2. The (mostly theoretical) literature after the Great Recession

After the great recession, a literature on the interplay between financial frictions, liquidity, and employment has developed. A seminal paper is [Jermann and Quadrini \(2012\)](#), who first observe that dividends are pro-cyclical while debt is counter-cyclical, and then construct a model that delivers these facts as an equilibrium outcome. In their model, firms prefer debt financing to equity financing because debt is more favorably treated by the tax system. In addition to long-term financing, firms also have a short-term need for funding of running expenses, including wages. Finally, short-run changes in dividend payments entail convex adjustment costs. Due to financial frictions of the Kiyotaki-Moore type, the firms' total debt cannot exceed a fraction less than one of the value of the firms capital next period, and this fraction is subject to shocks, referred to as financial shocks. A negative financial shock will be partly mitigated through adjustments of the dividend payments. However, due to the convex cost of adjusting dividends, negative shocks also lead to reduced hiring in order to reduce the total wage bill, and hence also the need for borrowing. Finally, [Boeri et al. \(2016\)](#) study the interplay between limited pledgeability, job creation and business cycle volatility within the DMP framework. In that paper there is no role for liquidity and firms can only invest in capacity.

<sup>1</sup> The underlying information friction is that the entrepreneur must have a sufficiently large stake in the project to be willing to exert effort, and part of the income flow the project generates is therefore non-pledgeable.

<sup>2</sup> [Zheng et al. \(2013\)](#) argue that there is a positive co-movement between land prices and business investments, and suggest that this may drive the land-price dynamics over the cycle.

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