Firms' Financial Policy and Labour Demand: Theory and Evidence*

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Abstract

We investigate the influence of financial leverage on firms' hiring decisions in the context of a hierarchy of finance model. The analysis is based on the Euler equation of employment in the presence of convex adjustment costs. We show the empirical implications of firms facing a hierarchy of financial costs, and estimate a linearised version of the model on a large panel of Swedish manufacturing firms. Bootstrap methods are utilised to alleviate some of the estimation problems involved. The empirical findings indicate that the influence of financial leverage on firms' hiring decisions differs significantly between firms in different financial regimes.

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1 Introduction

Over the past decade there has been a renewed interest among economists and policy makers in the influence of capital market imperfections on the operating behaviour of firms. Firms' investment and financial decisions will generally not be independent if the cost or availability of internal and external finance differ from each other. This is an important issue since the presence of a link between firms' real and financial activity may give rise to a financial propagation mechanism, amplifying the effects of business cycles and monetary policy, and hence having important policy implications.

The notion of such a real-financial link finds support in empirical research. There is a large body of microeconometric evidence, relating to capital investment, indicating that financial factors, such as the availability of internal funds or the debt position, are important for explaining variations in firms' capital expenditures. There is also evidence that this dependency varies over different groups of firms with different financial and institutional characteristics.[1] A more limited literature has directed attention towards firms' labour demand, reaching similar conclusions.[2]

[1] See, e.g., Fazzari, Hubbard & Petersen (1988), Whited (1992), Kashyap, Lamont & Stein (1994), and Hubbard, Kashyap & Whited (1995) for the United States; Devereux & Schiantarelli (1990), Blundell, Bond, Devereux & Schiantarelli (1992), and Bond & Meghir (1994) for the United Kingdom; Hoshi, Kashyap & Scharfstein (1991) for Japan; and Hansen & Lindberg (1997) for Sweden.

[2] See the contributions of, e.g., Nickell & Wadhwani (1991), Frisse, Funke & Lankes (1992), Sharpe (1994), and Nickell & Nicolitsas (1995).

In this paper, we provide further evidence for the influence of firms' financial policy on their employment decisions, using a large panel of Swedish manufacturing firms over the period 1979-88. While in previous studies financial factors have been included into traditional labour demand equations on an ad hoc basis, the aim of the current paper is to derive a model which is consistent with the endogenous nature of both the employment and the financial decision. To achieve this, we adopt the hierarchy of finance approach to corporate finance, and derive the set of Euler equations governing the optimal path of employment in the presence of convex adjustments costs of labour.

A hierarchy of finance may arise for several reasons, including tax discrimination, agency costs, asymmetric information, and costs of financial distress. It implies that firms face a hierarchy of financial costs associated with different sources of finance. For our purposes, we introduce corporate taxation and agency costs of debt into a standard dynamic model of labour demand. When the firm solves its intertemporal optimisation problem, it will acknowledge these distortions and take them into account accordingly. The firm's employment and financing decisions will hence be determined simultaneously, which, as we will show, has testable implications for the Euler equation. The analysis is confined to the choice between retained earnings and debt finance; thus, new equity financing is disregarded. This abstraction may be justified because debt is a more important source of incremental finance – in average, only 3.7 percent of Swedish corporate firms issued new equity over the period 1979-95.[3]

As noted by Bond & Meghir (1994), the theory of a hierarchy of finance predicts that some firms may in any period be in a regime in which operations are constrained by the availability of internal funds. Moreover, the probability to be in either regime is both time-varying and endogenous in the investment equation. These observations motivated Bond and Meghir to test for differences in the investment behaviour of firms across different financial regimes. We develop a similar test in this paper. Our model implies that if the firm has exhausted its retained earnings, the employment Euler equation will include a term measuring the degree of financial leverage. Financial leverage will hence only be important for those firms that do not have access to internally generated funds, and the hypothesis of a hierarchy of financial costs can be tested by comparing the coefficients on the debt ratio between these and other firms.

The Euler equation of employment is estimated using the Generalized Method of Moment estimator (GMM) proposed by Arellano & Bond (1991). Unfortunately, this estimator tends to perform poorly in finite samples. In particular, the asymptotic standard errors may be severely downward biased. As a remedy to this finite sample problem, however, several GMM-bootstrap procedures have been suggested[4]. Consequently, we assist our inference using the bootstrap procedure proposed by Brown & Newey (1995).

Our empirical findings suggest that the Euler equation of employment

[3] This average is obtained from the entire Costa data-base, described below.

[4] See, e.g, Brown & Newey (1995) and Hall & Horowitz (1996). For a comparison between these two, see Bergström, Dahlberg & Johansson (1997).

gives rise to a reasonably well specified model. Although the long-run properties of the model may be questionable, we find support for the hypothesis of a hierarchy of financial costs. There is a clear indication that the financial leverage capturing the agency costs exerts a significant influence on the labour demand for those firms that are in a regime in which they are liquidity constrained in the sense that internally generated funds are exhausted. However, because of the violation of the long-run properties of the model (which by no means is uncommon feature of empirical Euler equations) we thought it would be desirable to supplement the Euler equation analysis with an analysis of the labour demand relation in form of a behavioral equation. Failing to obtain a closed form solution of the labour demand relation from our model, we did this by estimating a "suggestive" labour demand equation, the properties of which can be intuitively motivated from our theory. This labour demand equation is similar in spirit to the model in Nickell & Nicolitsas (1995), and the results obtained confirm our previous findings on the implications of a hierarchy of financial costs.

The paper is organised as follows: The next section briefly reviews previous work in this field and outlines the theoretical foundation for our model. In section 3, we derive the Euler equation describing the optimal path of employment in the presence of capital market imperfections and convex adjustment costs. Section 4 describes the data and the sample selection procedure that we use. It also gives a brief account of the empirical procedures, including the bootstrap tests used. The econometric results are reported in section 5, while section 6 concludes.

2 Financial policy and labour demand

There is only a handful of empirical studies investigating the link between a firm's financial policy and its employment decisions, but the overall conclusion is that the firm's debt position seems to exert a substantial influence onto labour demand. Introducing various financial variables into a dynamic labour demand schedule given by a standard bargaining model, Nickell & Wadhwani (1991) find a significant impact of the debt to equity ratio for a panel of British firms. In a related study, Nickell & Nicolitsas (1995) find that an increase in interest payments relative to cash flow has a large negative effect on employment, and that this effect is greater for firms that are relatively smaller or relatively more highly leveraged. Frisse et al. (1992) obtains similar results for German firms, using a static model of labour demand. Finally, Sharpe (1994) finds a significant relationship between the financial leverage of U.S. firms and the cyclicality of their work forces over the 1959-85 period. This cyclicality was moreover inversely related to size of the firm. The results suggest that the macroeconomy becomes more sensitive to disturbances as financial leverage increases, and that smaller and more highly leveraged firms tend to be less prone to hoard labour.

The Sharpe (1994) study, in particular, touches on and lends direct support to the notion that financial leverage has an important role as a propagation mechanism in business cycles and in the transmission of monetary policy to the economy. Recent macroeconomic literature gives two complementary views on the operation of the financial propagation mechanism, both of which are based on problem of asymmetric information in financial markets.[5]

The first view is the credit view, which emphasises the availability of credit and the role played by banks as intermediaries. It is based on the presumption that banks play a special role in the financial system as they are especially well suited to solve asymmetric information problems in credit markets. Because of this special role of the banks, some borrowers will not have access to credit markets unless they borrow from banks. So if the funds available for bank lending (i.e., deposits less reserve holdings and operating costs) are reduced due to tighter monetary policy or some macroeconomic disturbance, investment spending will consequently decline. This effect will be further reinforced if banks react to the reduction of loanable funds by setting the interest rate below the market clearing level, thereby rationing credit.

The second view, the balance sheet view, stresses the creditworthiness of borrowers, suggesting that swings in the balance sheets will amplify swings in spending. The logic behind this is that a weaker balance sheet position of potential loan applicants will be perceived by creditors as a greater risk, for which they need to be compensated. The creditworthiness of borrowers, commonly measured as the level of net worth, is thus likely to affect the size of the agency costs associated with any financial arrangement. Since borrowers' net worth are likely to be procyclical, agency costs tend to decline in booms and rise in recessions. By the same reasoning, agency costs are also likely to

[5] For a comprehensive overview of the litterature on financial and real interaction, see Gertler (1988) and Kashyap & Stein (1993).

be higher whenever monetary policy is tight.

The aim of this paper is not to study the financial propagation mechanism over business cycles and various monetary regimes as such, but rather to investigate the influence of financial leverage on the employment decisions of individual firms, in the context of the hierarchy of finance model. However, since the analysis is based on credit market imperfections of the same type crucial to the operation of the balance sheet channel, our conclusions may also indirectly relate to the question of whether or not such a propagation mechanism indeed is in effect.

Our study extends previous research in this area by incorporating financial considerations explicitly into the firm's maximisation problem, and not just, ad hoc, adding financial variables to the labour demand relation. Except for the inclusion of capital market imperfections, the basic features of the model follow Machin, Manning & Meghir (1993), and the empirical analysis is based on the Euler equation governing the optimal path of employment in the presence of convex adjustment costs of labour.

We assume that the firm can finance employment and investment expenditures by internally generated funds or by debt, thus disregarding new equity finance. Debt finance is assumed to have a tax advantage to retained earnings, but to be associated with agency problems due to asymmetric information. Jensen & Meckling (1976) and Myers (1977) showed that the limited liability provision of debt contracts creates incentives for firm managers to act in defiance of the interest of creditors in order to increase the rate of return to the shareholder. Since potential creditors will acknowledge the incentive problem, as well as the risk of bankruptcy, they will demand either interest rate premiums or bond covenants to restrict the behaviour of the management with respect to new debt issues, dividends, and the maintenance of working capital. The costs that arise in these situations are commonly known as agency costs. These costs are likely to increase with the degree of leverage, since a greater debt to equity ratio means a greater incentive for managers to diverge. Debt finance will therefore become increasingly expensive as financial leverage rises, but still be the preferred source of funds at low levels of borrowing, because of the tax shield.

The firm will thus be facing a hierarchy of costs associated with the two sources of funds. Three financial regimes will emerge: In the first regime, the firm will finance investment spending solely by debt, up to the point where the marginal cost of debt equals the marginal cost of retained earnings. Any profits will be entirely distributed to the shareholders. In the second regime, marginal investments will be financed by internally generated funds at the expense of extra dividends. Finally, when retentions are fully exhausted, the firm will be in the third regime, and higher levels of investment must be financed by additional debt.

In reality, firms will never, or just rarely, be in the first regime. Less than one percent of the firms in the CoSta data-base[6] distribute their entire profits as dividends.[7] We will therefore in the empirical study focus only on the second and third regimes. It turns out that the financing hierarchy

[6]See below for a description.

[7]Calculating this ratio, we have corrected for the fact that firms are allowed to fund a certain share of their profits each year, thus postponing taxation of these funded profits.

implies that financial leverage, measured as the debt to capital ratio, will enter into the employment Euler equation only for those firms that are in the latter regime; i.e., firms who do not have access to internally generated funds. These firms can be identified as those not paying dividends in two consecutive periods, and the financial hierarchy hypothesis can be evaluated by testing for differences in the debt coefficients over firms in the two financial regimes. The formal model is developed in the following section.

3 The Model

3.1 Theoretical model

We consider a competitive firm operating in a world of imperfect capital markets. The managers and shareholders of the firm are assumed to be risk neutral. We also assume that the managers make their operating decisions in the beginning of each period, that they have rational expectations, and that they act on behalf of the shareholders in order to maximise the value of the firm. Labour and capital are assumed to be quasi-fixed input factors; hence, changes in these factors will entail positive adjustment costs. To focus on the employment decisions and to simplify the analysis, we assume that the adjustment cost function is additively separable in investment and hires, and we treat capital as predetermined.

In the absence of price bubbles, i.e. $\lim_{T\to\infty} E_t\left[\prod_{k=0}^{T}\beta_{t+k-1}V_T\right] = 0$, the value of the firm at the beginning of period t is given by the expected present value of all future dividend payouts:

$$V_{it} = E\left[\sum_{j=0}^{\infty}\left(\prod_{k=0}^{j}\beta_{t+k-1}\right)D_{i,t+j}\,\Big|\,\Omega_t\right]; \qquad (1)$$

where D_{it} is the dividends paid in period t and β_t represents the firm's one-period discount factor. The discount factor is defined as $\beta_{t+k-1} = 1$ for $k = 0$ and $\beta_{t+k-1} = (1 + r_{t+k-1})^{-1}$ for $k = 1, 2, \ldots, \infty$, where r_t is the shareholders' required nominal rate of return between periods t and $t+1$. Finally, $E[\cdot|\Omega_t] = E_t[\cdot]$ denotes the expectations operator conditional on information available in period t.[8]

The dividends are defined by the identity of sources and uses of funds which states that cash inflows must equal cash outflows:

$$\begin{aligned} D_{it} = {} & (1-\tau)[F(N_{it}, K_{it}, X_{it}) - G(H_{it}) - W_{it}N_{it} - i_{t-1}B_{i,t-1} \\ & - A(B_{i,t-1}, K_{i,t-1})] + B_{it} - (1-\pi_t)B_{i,t-1}. \end{aligned} \qquad (2)$$

Here $F(N_{it}, K_{it}, X_{it})$ denotes the real revenue function (denominated in terms of the output price), where N_{it} is labour, K_{it} is capital, and X_{it} is all other types of input factors. Revenues are assumed to be increasing at a decreasing rate with labour. $G(H_{it})$ is the real adjustment cost function, assumed to be increasing and convex in hires, H_{it}, which is defined as

$$H_{it} = N_{it} - (1-\delta)N_{i,t-1}. \qquad (3)$$

[8] Uncertainty may come from a number of factors, such as future interest rates, input/output prices, and technologies.

where $0 \leq \delta \leq 1$ is the voluntary quit rate. $A(B_{i,t-1}; K_{i,t-1})$ is the agency cost function, where $B_{i,t-1}$ is the amount of one-period real debt issued in the previous period and $K_{i,t-1}$ is the capital stock, here representing collateral. The agency costs are assumed to be increasing at an increasing rate in the level of debt, but decreasing in the level of capital. Finally, W_{it} is the real wage cost, i_{t-1} the nominal interest rate paid on loans taken in period $t-1$, τ the corporate tax-rate, and π_t the rate of product price inflation between period $t-1$ and t.

Thus, equation (2) states that the dividend payouts must be equal to the sum of after-tax profits and the change in the stock of debt. In addition, dividends are restricted to be non-negative:

$$D_{it} \geq 0. \tag{4}$$

Now, the firm's objective is to choose the levels of employment and debt so as to maximize its value, equation (1), subject to the constraints (2), (3), and (4). To solve this problem, form the Lagrangian function, letting λ_{it} be the series of (current value) Kuhn-Tucker multipliers associated with (4) and substituting for D_{it} and H_{it} using (2) and (3). The first order conditions for labour and debt can then be derived as

$$\frac{\partial F_{it}}{\partial N_{it}} - \frac{\partial G_{it}}{\partial H_{it}} - W_{it} = -\beta_t E_t \left[\frac{1+\lambda_{i,t+1}}{1+\lambda_{it}} (1-\delta) \frac{\partial G_{i,t+1}}{\partial H_{i,t+1}} \right]; \tag{5}$$

$$(1+\lambda_{it}) = \beta_t E_t\left[(1+\lambda_{i,t+1})\left(1+(1-\tau)\left(i_t+\frac{\partial A_{i,t+1}}{\partial B_{it}}\right)-\pi_{t+1}\right)\right]; \qquad (6)$$

for any period $t = 0, 1, \ldots, \infty$. Equation (5) is the Euler equation, characterising the optimal path of hirings along which the firm will be indifferent between hiring someone today and postponing the hire until tomorrow. This equation may be more easily interpreted if we rearrange it slightly:

$$\frac{\partial F_{it}}{\partial N_{it}} - W_{it} = \frac{\partial G_{it}}{\partial H_{it}} - \beta_t E_t\left[\frac{1+\lambda_{i,t+1}}{1+\lambda_{it}}(1-\delta)\frac{\partial G_{i,t+1}}{\partial H_{i,t+1}}\right]. \qquad (7)$$

First consider the case where the firm pays positive dividends, i.e. $\lambda_{i,t+1} = \lambda_{it} = 0$. On the left hand side of equation (7) is the net contribution to cash flow in period t from adding a new worker to the labour force. It includes the real marginal revenue product less the real wage cost. On the right hand side is the marginal net hiring cost, comprising the difference between the marginal hiring cost incurred in period t and the discounted expected value of the marginal hiring cost to be recovered in period $t+1$. The latter arises since the firm has to incur less expenses in period $t+1$ in order to obtain the same number of employees in the subsequent period and onwards. Equation (7) thus tells us that the marginal benefit of a new worker should be equal to the marginal net hiring cost.

Next consider the case when either of the non-negativity constraints on dividends is binding. The Kuhn-Tucker multiplier associated with the binding constraint will then take on a positive value, and the term

$(1+\lambda_{i,t+1})/(1+\lambda_{it})$ will work as an additional weight on the right hand side expression. This means that if the constraint is binding in period t, the hiring costs to be recovered in $t+1$ will be discounted more heavily. The marginal net hiring cost will hence be perceived by the firm as higher, and hirings will be reduced in accordance with that. Consequently, a firm that is financially constrained in the sense that it has fully exhausted its retentions will hire fewer workers than a firm that has not, everything else equal.

Equation (6) is the first-order condition for debt, stating that the firm should borrow up to the point where it is indifferent between one additional unit of debt and one additional unit of retentions. Assuming that the firm pays positive dividends in both periods, the marginal benefit of issuing one unit of new debt to finance dividend payments must be equal to the present value of repaying the debt plus interest. However, if the dividend constraint is binding in period t, the marginal cost of new debt will exceed the marginal benefits, implying that the discount factor in equation (7) reads

$$\beta_t E_t\left[\frac{1+\lambda_{i,t+1}}{1+\lambda_{it}}\right] = \frac{1}{1+(1-\tau)(i_t+A_{Bit})-\pi^e_{t+1}}. \qquad (8)$$

Equations (7) and (8) form the theoretical basis for our empirical investigation in section 5. The empirical specification of the model is derived below.

3.2 Empirical specification

In order to get a specification that can be estimated, we need a few further assumptions on explicit functional forms of the revenues, as well as the adjustment and agency costs. Following Machin et al. (1993), we assume that the revenue and adjustment cost functions are given by

$$F(N_{it}; K_{it}; X_{it}) = f(K_{it}; X_{it}) N_{it}^{\alpha}; \tag{9}$$

$$G(H_{it}) = \frac{\gamma}{2} H_{it}^{2}; \tag{10}$$

where α and γ are greater than zero[9]. For the agency cost function, we assume the following form:

$$A(B_{i;t-1}; K_{i;t-1}) = \frac{\phi}{2} \frac{B_{i;t-1}^{2}}{K_{i;t-1}}; \tag{11}$$

for positive values of $B_{i;t-1}$, and zero otherwise. ϕ is the agency cost parameter assumed to be greater than zero.

Differentiating (9), (10), and (11) with respect to N_{it}, H_{it}, and B_{it}, we insert the result into (7) and (8). Under the assumption of constant conditional covariance between $(\theta + \lambda_{i;t+1}) = (\theta + \lambda_{it})$ and other time $t+1$ variables, (8) can then be substituted into (7). Using the assumption of rational expectations on the resulting expression and rearranging yields:

[9] We use quadratic adjustment costs for mathematical convenience. However, we acknowledge that there is limited empirical support for this assumption. (See, e.g., Hamermesh (1993)).

$$\frac{\gamma(1-\delta)}{1+(1-\tau)i_t+\phi\left(\frac{B}{K}\right)_{it}-\pi^e_{t+1}}\left(N_{i,t+1}-(1-\delta)N_{it}\right)=$$
$$\gamma\left(N_{it}-(1-\delta)N_{i,t-1}\right)+W_{it}-\alpha\left(\frac{Q}{N}\right)_{it}+f_i+s_{t+1}+\varepsilon_{i,t+1};\quad (12)$$

where $Q = f(K;X)N^{\alpha}$ denotes real sales, f_i is a firm-specific fixed effect, s_{t+1} is a time-specific fixed effect, and $\varepsilon_{i,t+1}$ is the forecast error, serially uncorrelated and orthogonal to any information in period t. The firm-specific effect is included to allow for heterogeneity among firms due to differences in, e.g., growth opportunities or the skill of the management. The time-specific effect will capture macroeconomic shocks that are common to all firms.

Finally, Taylor expanding (12) about the individual mean of the variables yields the Euler equation for employment to be estimated:

$$N_{i,t+1}\simeq\beta_1 N_{it}+\beta_2 N_{i,t-1}+\beta_3 W_{it}+\beta_4\left(\frac{Q}{N}\right)_{it}+\beta_5\left(\frac{B}{K}\right)_{it}+f_i^*+s_{t+1}^*+\varepsilon^*_{i,t+1};\quad (13)$$

where f_i^*, s_{t+1}^*, and $\varepsilon^*_{i,t+1}$ differ only proportionally from f_i, s_{t+1}, and $\varepsilon_{i,t+1}$.[10] The reduced form parameters β_i are related to the structural parameters as follows:

[10] Note that the inflation rate and the interest rate are subsumed by the time-specific effect.

$$\beta_1 = \frac{(1-\delta)^2 + \Psi}{(1-\delta)} \qquad \beta_2 = -\Psi$$

$$\beta_3 = \frac{\Psi}{\gamma(1-\delta)} \qquad \beta_4 = -\frac{\alpha\Psi}{\gamma(1-\delta)}$$

$$\beta_5 = \frac{\phi\delta\bar{N}(1-\tau)}{\Psi}$$

with $\Psi = 1 + (1-\tau)\left(i + \phi\left(\overline{B/K}\right) - \pi\right)$.

The model is clearly overidentified in terms of the structural parameters, but we can still say something about the reduced form parameters.. The model predicts that $\beta_1 > 2$, $\beta_2 < -1$, $\beta_3 > 0$, $\beta_4 < 0$, and $\beta_5 > 0$. Note that the sum of β_1 and β_2 will be greater than one, implying that the signs of the coefficients on Q/N, W, and B/K must be reversed in the long run. This implies, in particular, that an increase in the debt ratio will have a negative long-run effect on employment. Note also that the debt to equity ratio is only expected to enter the equation if the firm has exhausted all of its retentions.

4 Estimation and Data

4.1 Methodological considerations

We estimate equation (13) using the Generalized Method of Moments estimator (GMM) developed by Arellano & Bond (1991). This estimator exploits the linear moment conditions implied by the model. The individual effects are removed by first-differencing the model and the resulting endogeneity problem is handled by using appropriate instruments.

Since the errors in levels are serially uncorrelated, as implied by rational expectations, the errors in first-differences will follow a first-order MA-process. This implies that values of the dependent variable (in levels) and other right-hand side variables must be lagged at least two time-periods in order to be uncorrelated with the differenced error term and, thereby, valid as instruments in the transformed model. As the consistency of the GMM estimates critically hinges on the validity of the instruments, we test for this assertion, using the Sargan-test and the Arellano-Bond m_2-criterion. The Sargan-test tests for the null of no correlation between the instruments and the residuals, while the m_2-test tests for the lack of second-order correlation. A corresponding m_1-test tests for the lack of first-order correlation. Estimation is carried out using the DPD program for Ox 1.20.[11]

Unfortunately, there is a tendency for the asymptotic standard errors of the second-step Arellano-Bond estimator to be downward biased in small samples. There are two ways of handling this. One could either stick to the consistent first-step estimates, which have better finite sample properties but are potentially inefficient; or one could go for the efficient second-step estimates and employ a bootstrap t-test, which has better size properties[12], for inference. We make use of both approaches and report the first- and second-step asymptotic tests together with the bootstrap tests.

The idea of the bootstrap test is simple. It amounts to estimating the distribution of the test statistic by resampling the data. When performing an asymptotic t-test, the null hypothesis is rejected if the test statistic is

[11] For a description of the programs, see Doornik (1996) and Arellano, Bond & Doornik (1997).

[12] See the Monte Carlo evidence in Bergström (1997).

unlikely to have come from a t-distribution. When performing a bootstrap test, we first need to estimate the distribution of the test statistic. This is done by treating the data as the population and the estimated parameter value, say $\hat{\beta}$, as the true value. From this "fake" population, we then create a large number of samples by randomly drawing observations with replacement, and reestimate the β-parameter for each of the new samples (using the same method as before). The logic of a bootstrap test is that the reestimated values, say $\tilde{\beta}$, will on average be equal to the "true" value, $\hat{\beta}$. So by constructing t-tests of the null $\tilde{\beta} = \hat{\beta}$ (which we know will be true in repeated resampling) for all new samples, we may in this way simulate the distribution of the t-statistic under the true null. This distribution will not only reflect the characteristics of the DGP (data generating process), but also the size of the original sample.

Forming tests based on the bootstrap distribution has proved to be at least as reliable as using the asymptotic distribution, and, in most cases, considerably more reliable.[13] GMM-bootstrapping involves a few other technical obstacles that must be overcome. We do not want go into these issues here, and refer the reader to Brown & Newey (1995) for a rigorous treatment of the issues involved.

4.2 Data and sample selection

The data we use is a sample from the CoS ta-base which contains annual income statements and balance sheets of Swedish firms over the years 1979-

[13] See e.g. Davidson & MacKinnon (1996).

1994.[14] The data material is collected by Statistics Sweden and includes all manufacturing firms with more than 20 employees. At times, firms leave the sample, either due to bankruptcies or mergers or because they have "contracted" themselves out from this class of firms. Since we cannot identify the cause of why a firm leaves the sample, we need to restrict our analysis to those firms that remain in the sample over the entire period, which would give us a balanced panel of 16 years. There is, however, a self selection problem with this approach. By discarding firms that have "contracted" themselves out of the sample, factors with a negative influence on employment will be underestimated. To cope with this, we use the following sample selection procedure:

1. Include in the sample only those firms that have sufficiently many employees in the first year (1979) to allow the firms to contract over the time-period without leaving the sample.

2. Inspect the number of employees for the last observation of each firm sampled. If this is less than some critical value, label the firm "doubtful".

3. Select the length of the panel as long as possible, but make sure that no "doubtful" firms are thrown away.

In order to keep as many observations as possible, we choose a design in which the required number of employees in the first year is 50, the critical

[14] For a thorough description of the CoSta-database, see Hansen (1997).

number of employees is 30, and the length of the panel is 10 years. This leaves us with a panel of 479 firms over the period 1979-1988. Out of the firms discarded, three firms were labelled "doubtful"; i.e., they had less than 30 employees as their final observation. The exclusion of these three will hardly cause any significant self-selection bias.

The variables used in the empirical analysis include labour, N, real wage costs, W, productivity, Q/N, and the debt to equity ratio, B/E. Note that we use the debt to equity ratio instead of the debt to capital ratio, as in the derivation of the model. This avoids the problems associated with measuring the value of the capital stock. It may also constitute a better measure of the firm's financial strenght, if the firm has other assets than capital.[15]

N is measured as the average number of full time employees, which is roughly the total number of hours worked divided by the working time considered as standard hours at each firm. W is obtained by dividing total wage costs by the number of employees and Q/N is measured as real sales divided by the number of employees, both of which are deflated using the Producer Price Index at a two digit (SNI) industry level. B/E is calculated using the book values of debt and equity in accordance with the recommendations of the Swedish Association of Financial Analysts. The use of book values was necessary since we have no access to market information. However, if we want to make a virtue out of this necessity, we could argue that the book values are more appropriate to use, as those are the figures that bankers gen-

[15] For a firm with no other assets than capital, B/E is simply be a monotonic transformation of B/K: $B/E = (B/K)/(1 - (B/K))$.

erally would audit. A more detailed description of the variables and some descriptive statistics are given in the data appendix.

5 Results

5.1 Euler equation estimates

We start by estimating equation (13) without allowing for financial regimes.[16] The results are reported in the first three columns of Table 1. As can bee seen, the specification tests do not indicate any problems that would affect the consistency of the estimates. Even though the test for first-order serial correlation does not indicate a significantly negative correlation as is expected, both the Sargan and the m_2 tests suggest that the instruments are valid and that the specification is acceptable. The set of instruments includes values of all variables in levels, lagged up to three periods. While the inclusion of further lags as instruments increases the efficiency of estimation, it also leads the Sargan test to emphatically reject the specification.

All coefficients have the signs that we would expect from the theoretical model, with one important exception: the coefficient on the debt ratio is negative. Before we address this issue, we may first note that the first-step estimates in the first column suggest that only the lagged dependent variables exert any explanatory power in the Euler equation; none of the other

[16] All estimations in this section have been performed both with and without time-specific fixed effects with virtually the same results. As the time effect in most cases were individually significant and always jointly significant, we have choosen to present the estimations including these effects.

estimates are significantly different from zero. However, considering the fact that the first-step estimates are inefficient, this result should not be all that surprising, and it does not persist in the second-step of estimation. On the contrary, in some cases the t-statistics associated with the second-step estimates are remarkably high, which makes us suspect that these standard errors may be estimated with a severe downward bias. This suspicion is supported by the high bootstrap p-values reported in the third column, although one should bear in mind that the bootstrap procedure we used itself have a tendency to under-reject the null hypothesis. (See Bergström (1997) for Monte Carlo evidence). Taken together, the evidence seem to suggest that the variables included do exert some influence upon employment, even though the significance of the wage costs and the productivity measure are somewhat ambiguous.

As we noted above, the negative coefficient on the debt to equity ratio (-0.12) is not consistent with the theoretical model. Therefore, following our precedent line of arguments, we reestimate the model, now allowing for the presence of financial regimes, with the debt to equity coefficients varying over these. This is done simply by creating two dummy variables which are interacted with the debt ratio, the first picking out those firms that do not pay positive dividends in two consecutive years and the second picking out the remaining firms. As a direct implication of the theoretical model, we should expect the debt ratio to be statistically significant only for the subset of firms that are not paying positive dividends in two consecutive periods. Since these firms are, in some sense, liquidity constrained, their employment decisions are likely to be influenced by their financial status. The results are presented in the last three columns of Table 1.

As can be seen, the specification is not rejected by the specifications tests, and the coefficients on all variables other than the debt to equity ratio remain practically the same. In contrast, the debt coefficient changes substantially. For those firms that are not paying dividends, the debt coefficient is now positive (0.12) as implied by theory, whereas the coefficient for dividend-paying firms is no longer significantly different from zero. This supports the hypothesis of a hierarchy of finance and suggests that financial leverage will only be important in a regime in which internally generated funds are exhausted.

It should be noted that the bootstrap t-test of the debt coefficient associated with the group of non-dividend paying firms ($p = 0.11$) does cast some doubts on its level of significance. Nonetheless, bearing in mind the potential size distortion of the bootstrap test and also being reassured by the small difference between the first and second step estimates, we are inclined to believe that this does not contradict the hypotheses of a hierarchy of finance.

5.2 Labour demand relation

The main source of disappointment in our empirical model is the violation of the long run properties suggested by theory: the coefficients on lagged employment do not sum to a value greater than unity. This result, which by no means is uncommon for empirical Euler equations of this type, makes the parameter estimates obtained somewhat less clear-cut to interpret. It

Table 1: Euler Equation of Employment

	I. Original Specification			II. Financial regimes		
Var	1-step	2-step	Boot p	1-step	2-step	Boot p
N_{it}	0.4949	0.4940		0.4951	0.4949	
	(3.53)	(410)	0.000	(3.54)	(377)	0.000
$N_{i,t-1}$	0.0821	0.0831		0.0821	0.0832	
	(2.63)	(385)	0.000	(2.63)	(329)	0.000
W_{it}	0.7170	0.2465		0.7614	0.2625	
	(1.56)	(5.08)	0.119	(1.54)	(4.91)	0.100
Q/N_{it}	-0.0231	-0.0095		-0.0236	-0.0101	
	(-0.48)	(-1.76)	0.443	(-0.48)	(-1.78)	0.438
B/E_{it}	-0.1110	-0.1211				
	(-0.62)	(-8.19)	0.010			
B/E_{it}^{nodiv}				0.1175	0.1218	0.114
				(0.42)	(6.54)	
B/E_{it}^{div}				-8.6383	-4.8117	0.632
				(-0.76)	(-1.61)	
	m_1: -1.07	S_1(65):	0.000	m_1: -1.07	S_1(64):	0.000
	m_2: -1.23	S_2(65):	0.149	m_2: -1.23	S_2(64):	0.163
		Wald (7):	0.000		Wald (7):	0.000

Notes:
(i) GMM estimates, obtained using DPD for Ox 1.20. For a description of the programs, see Doornik (1996) and Arellano et al. (1997).
(ii) t-statistics are reported in parentheses. They are computed using the asymptotic standard errors, which are obtained using a heteoscedasticity-robust variance-covariance matrix. Boot p gives the p-values of the corresponding bootstrap t-test. Throughout 400 bootstrap replications have been used.
(iii) All regressions include time dummies. Wald gives the p-value of an asymptotic Wald-test of the joint significance of the dummies. Under the null of no relationship, the Wald statistic is asymptotically distributed as $\chi^2(k)$, where k is the number of coefficients tested.
(iv) m_1 and m_2 are test statistics for first- and second-order serial correlation in residuals in first differences. Both are asymptotically standard normal under the nulls of, respectively, no first- and second-order correlation.
(v) S_1 (S_2) gives the p-value of the asymptotic first (second) step Sargan test of the over-identifying restrictions (validity of instruments). Under the null of valid restrictions, the Sargan statistic is asymptotically distributed as $\chi^2(p-k)$, where p is the number of moment conditions and k is the number of coefficients estimated. The set of instruments includes N and Q/N lagged 2 and 3 years, B/E and W lagged 1, 2, and 3 years, and all time dummies.

would therefore be desirable to estimate the labour demand relation in the form of a behavioural function, as a complement to the Euler equation analysis. Because of the involved structure of the model, we have not come up with a closed form solution for such a labour demand relation. Instead, we have estimated a bare-bones log-linear labour demand equation to which we have added our financial variables ad hoc, in the same manner as in e.g. Nickell & Nicolitsas (1994). Following their line of arguments, we should expect financial leverage of the previous period to exert a negative influence on labour demand, something which also is intuitively consistent with our previous model.

Allowing for financial regimes in the same manner as before, the empirical model we estimate is based on the equation

$$n_{it} = \alpha_1 n_{it-1} + \beta_1 w_{it} + \gamma_1 B/E^{nodiv}_{i,t-1} + \gamma_2 B/E^{div}_{i,t-1} + f_i + s_t + \varepsilon_{it}$$

where lower case letters indicate logs[17]. We then add sufficient dynamics to the equation, in order to obtain a valid specification, and estimate the resulting equation in first differences as previously[18]. The main difference between this specification and the Euler equation representation, is the introduction of contemporaneous wage costs.

As can be seen from the results in Table 2, this specification is approved

[17] For a discussion on the endogeneity problem which makes it necessary to use lags of the financial variable, see Nickell & Nicolitsas (1994).

[18] Introducing the productivity measure or industry specific trends did not change the results substantially. We therefore report the results from the more parsimonious model in which these regressors are omitted.

Table 2: Labour Demand Equation

	I. Financial Regimes		
Var	1-step	2-step	Boot p
$n_{i,t-1}$	0.7715	0.7470	
	(11.76)	(32.3)	0.000
$n_{i,t-2}$	-0.1841	-0.1652	
	(-5.34)	(-12.4)	0.000
$n_{i,t-3}$	0.1097	0.0916	
	(3.55)	(8.10)	0.005
w_{it}	-0.2036	-0.1584	
	(-0.02)	(-5.53)	0.030
$w_{i,t-1}$	0.0978	0.0470	
	(2.14)	(1.96)	0.468
$w_{i,t-2}$	-0.0892	-0.0988	
	(-3.89)	(-6.29)	0.000
$B/E^{nodiv}_{i,t-1}$	-0.0008	-0.0009	
	(-2.71)	(-15.1)	0.030
$B/E^{nodiv}_{i,t-2}$	-0.0001	-0.0001	
	(-0.24)	(-2.31)	0.562
$B/E^{div}_{i,t-1}$	0.0126	0.0112	
	(3.23)	(4.85)	0.095
$B/E^{div}_{i,t-2}$	0.008	0.0098	
	(2.33)	(6.42)	0.085
	m_1: -3.96	S_1(128): 0.000	
	m_2: 0.93	S_2(128): 0.416	
		Wald (7): 0.000	

Notes:
(i) GMM estimates, obtained using DPD for Ox 1.20.
(ii) The set of instruments includes all lags available from period t-2 for n, w, and q/n, and all lags available from period t-1 for B/E, as well as all time dummies.
(iii) See the notes in table 1 for further explanations.

by all tests performed. Note that the m_1 now indicates a significant negative first-order serial correlation, as one would expect from taking first differences. Looking at the parameter estimates, they do resemble those of a labour demand relation with a fairly low short run employment-wage elasticity and with a long run elasticity at roughly -0.6, which seems rather reasonable. Furthermore, the negative signs of the debt coefficients of non-dividend paying firms are consistent with the findings of Nickell & Nicolitsas (1994), although the magnitude of the coefficients may appear to be rather small. However, the summary statistics in the data appendix tell us that the variable we have chosen to capture the agency costs may potentially increase quite drastically for individual firms; an increase of one standard deviation, starting out from the mean, implies a 400 per cent increase of this ratio. The actual effects from changes in this ratio onto employment may hence be substantial even though the coefficients appear small.

The evidence on statistical significance of the debt to equity ratio of dividend paying firms is ambiguous. On the one hand, the first and second step asymptotic t-tests suggest that the coefficients are statistically significant. On the other hand, the bootstrap t-test suggests they are not. In view of our earlier result and the potential size distortion of the bootstrap test, we are in this case inclined to believe that some effects are actually present. This result is, of course, not consistent with the theory of financial regimes, which predicts that financial leverage should be irrelevant for the employment decision of dividend paying firms. But even so, there is a clear difference between the two subsets of firms. The debt-coefficient of non-dividend paying firms is negative in coherence with our a priori belief, whereas the debt coefficient of dividend paying firms is positive, a result which fits badly into the theoretical framework of agency costs. We make no attempts trying to interpret this result, but just note that there are important differences in the influence of financial leverage between firms in different financial regimes.

6 Conclusions

Using the hierarchy of finance approach, we have derived an Euler equation model of employment suggesting a mechanism through which the financial policy of firms may affect their hiring decisions and, thus, their labour demand. This model was estimated using a large panel of Swedish manufacturing firms over the years 1979-88. A few points are worth stressing:

- In accordance with earlier studies, we find that financial leverage exert an important influence on the hiring decisions of firms. The main conclusion is that this effect is related to which financial regime the firm finds itself in. Financial leverage only appears to be important for those firms that are in a regime in which retentions have been fully exhausted.

- The Euler equation of employment gives rise to a reasonably well specified model, although the long-run properties of the model may be questionable. However, estimating a bare-bones log-linear labour demand relation as a complement to the Euler equation analysis, we get qualitatively similar results, giving some support for the hierarchy of finance hypothesis.

- The bootstrap procedure we have used here confirms that the downward bias of the second-step estimates might be an important problem. However, as the bootstrap t-test itself appears to be somewhat undersized, inference may still not be clear-cut. Nevertheless, we believe that bootstrap tests are useful and essential complements to asymptotic tests in applications of this type.

References

Arellano, M., Bond, S. & Doornik, J. A. (1997). Dynamic panel data estimation using DPD for Ox. Nuffield College, Oxford, available at http://hicks.nuff.ox.ac.uk/Users/Doornik/.

Arellano, M. & Bond, S. R. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, Review of Economic Studies 58: 277–297.

Bergström, P. (1997). On bootstrap standard errors in dynamic panel data models., Working paper 23, Department of Economics Uppsala University.

Bergström, P., Dahlberg, M. & Johansson, E. (1997). GMM bootstrapping and testing in dynamic panels, Working paper 10, Department of Economics Uppsala University.

Blundell, R., Bond, S., Devereux, M. & Schiantarelli, F. (1992). Investment and Tobin's Q, Journal of Econometrics 51(1-2): 233–57.

Bond, S. & Meghir, C. (1994). Dynamic investment models and the firm's financial policy., Review of Economic Studies 61: 197–222.

Brown, B. & Newey, W. (1995). Bootstrapping for GMM, Mimeo, MIT.

Davidson, R. & MacKinnon, J. G. (1996). The size distortion of bootstrap tests, Discussion Paper 937, Queen's Institute for Economic Research.

Devereux, M. & Schiantarelli, F. (1990). Investment, financial factors, and cash flow: Evidence from U.K. panel data, in G. R. Hubbard (ed.), Asymmetric Information, Corporate Finance and Investment, University of Chicago Press, Chicago, pp. 279–306.

Doornik, J. A. (1996). Object-oriented Matrix Programming Using Ox', Thomson Business Press, London.

Fazzari, S., Hubbard, R. & Petersen, B. (1988). Financing constraints and corporate investment, Brookings Papers on Economic Activity (1): 141–95.

Frisse, K., Funke, M. & Lankes, F. (1992). Financial structure and labour demand of West German industrial and commercial companies: A study with longitudinal data, Jahrb. für Nationalökonomie und Statistik 209: 106–118.

Gertler, M. (1988). Financial structure and aggregate economic activity: An overview, Journal of Money, Credit and Banking 20(3): 559–88.

Hall, P. & Horowitz, J. L. (1996). Bootstrap critical values for tests based on Generalized-Method-of-Moments estimators, Econometrica 64: 891–916.

Hamermesh, D. S. (1993). Labor Demand, Princeton University Press.

Hansen, S. (1997). CoSta - Corporate Statistics. Uppsala University, Dept of Economics.

Hansen, S. & Lindberg, S. (1997). Agency costs, financial deregulation, and corporate investment. An Euler equation approach to panel data for Swedish firms, Working paper 20, Department of Economics Uppsala University.

Hoshi, T., Kashyap, A. & Scharfstein, D. (1991). Corporate structure, liquidity and investment: Evidence from Japanese industrial groups, Quarterly Journal of Economics 106(1): 33–60.

Hubbard, G. R., Kashyap, A. K. & Whited, T. M. (1995). Internal finance and firm investment, Journal of Money, Credit, and Banking 27(3): 683–701.

Jensen, M. & Meckling, W. (1976). Theory of the firm: Managerial behavior, agency costs, and ownership structure, Journal of Financial Economics 3(4): 305–60.

Kashyap, A. K., Lamont, O. A. & Stein, J. C. (1994). Credit conditions and the cyclical behavior of inventories, Quarterly Journal of Economics 109(3): 565–92.

Kashyap, A. K. & Stein, J. C. (1993). Monetary policy and bank lending, NBER Working Paper 4317.

Machin, S., Manning, A. & Meghir, C. (1993). Dynamic models of employment based on firm-level panel data, in J. Van Ours, G. Pfann

& G. Ridder (eds), Labor Demand and Equilibrium Wage Formation, North-Holland, Amsterdam, pp. 167–195.

Myers, S. (1977). Determinants of corporate borrowing, Journal of Financial Economics 5(2): 147–75.

Nickell, S. & Nicolitsas, D. (1994). Wages, restrictive practices and productivity, Working paper 219, Centre for Economic Performance, LSE.

Nickell, S. & Nicolitsas, D. (1995). How does financial pressure affect firms?, Discussion Paper 170, Institute of Economics and Statistics, University of Oxford.

Nickell, S. & Wadhwani, S. (1991). Employment determination in British industry: Investigations using Micro-Data, Review of Economic Studies 58(5): 955–69.

Sharpe, S.A. (1994). Financial market imperfections, firm leverage, and the cyclicality of employment, American Economic Review 84: 1060–1074.

Whited, T.M. (1992). Debt, liquidity constraints, and corporate investment: Evidence from panel data, Journal of Finance 47(4): 1425–60.

A Data Appendix

A.1 The Sample

The sample we use consists of 479 Swedish companies observed over the years 1979 – 1988 and is drawn from the CoSta base, which contains annual income statements and balance sheet for a large number of firms. It was selected according to the following criteria, upon which our results are conditional:

- Only firms in the manufacturing industry is included, i.e., those belonging to SNI categories 31–38.
- Only firms with more than 50 employees are included. This is due to the sample selection problem which is thoroughly described in section 4.3 of this paper.
- Firms must have strictly positive wages and sales. This criterion is applied in order to exclude obviously erroneous data.
- Employment must not fluctuate with more than a factor of 3 between two consecutive years. This requirement is used to eliminate changes in employment which is due to restructuring of companies, rather than to the factors that we seek to study. This restriction, however, proved to be non-restrictive in the sample selection.

A.2 Definitions of Variables

The variables used in this paper are the following.

- Employment (N_{it}) is expressed as the number of "effective" workers according to the definition of the Central Swedish Accounting Board (Bokföringsnämnden), BFN

R4. It is calculated as total hours worked divided by the "normal" working time of an employee. CoSta: Var001 Mean: 424.3 Std dev: 1661

- Wage costs (W_{it}) is total wage costs, including payroll taxes, divided by the number of employees. It is expressed in real terms using the Producer Price Index at a two digit (SNI) industry level. CoSta: Var004/(Var001 £ PPI_{jt}) Mean: 148.9 Std dev: 24.46

- Sales (Q_{it}) includes both domestic and international sales. It is expressed in real terms using the Producer Price Index at a two digit industry level. CoSta: Var005/PPI_{jt} Mean: 662.3 Std dev: 579.3

- Debt (B_{it}) is computed as the sum of current payables and long-term liabilities to corporate group members, current loan liabilities, and other long-term liabilities. Costa: Var078+Var084+Var081+Var086. Mean: 87660.16 Std dev: 668932.7

- Adjusted equity (E_{it}) is computed as the sum of book-value of equity and tax adjusted value of untaxed reserves less the dividends declared. The corporate tax rate used in calculations was set to 0.5. A few observations (eight) quoted negative equity, but rather than deleting the entire time series of these …rms, we imputed these observations by the value of equity per employee in the lowest percentile observed, times the number of employees. Costa: Var108+(1-¿)Var103-Var110. Mean: 91181.2 Std dev: 506053.6

- Debt to equity rato(B_{it}=E_{it}) Mean: 1.579276 Std dev: 4.435337

- Producer Price Index (P_{jt}) at a two digit industry level. Source: Statistics Sweden