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LIQUIDITY CONSTRAINTS FACED BY FIRMS AND EMPLOYMENT

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ABSTRACT: We examine the role of liquidity constraints in a study on labour input and wage formation in Finland covering the period of the deep 1990's recession. Financial solvency problems are shown to lead to a reduction in labour input, potentially explaining one third of the 16% peak rate of unemployment. Wage moderation is absent and liquidity costraints raise wages in the largest firms. The link between leverage and "real-side" behaviour of firms is, hence, clearest in labour input decision. The large impact of high leverage on employment can be explained by the adjustment of factor inputs, as a result from bargaining between firms and financers under financial distress. Labour hoarding and fixed costs in recruitment raise the long run effects, but also explain the weaker immediate effect as the level of liquidity constraints go up.

KEY WORDS: Labour Demand, Labour Union, Financial Constraints, Firm Indebtedness.
JEL-code: J23, C33, G32, E24

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TIIVISTELMÄ: Tutkimus tarkastelee rahoitustekijöiden vaikutusta työvoiman kysyntään ja palkanmuodostukseen Suomessa 1990-luvun lamassa. Likviditeettirajoitukset vähensivät työvoiman kysyntää, selittäen potentiaalisesti puolet 16 prosentin työttömyysasteesta. Palkkamaltti on sen sijaan ollut vähäistä. Suurissa yrityksissä rahoitusongelmat ovat jopa lisänneet palkkavaatimuksia. Siten likviditeettiongelmilla on selvin vaikutus työvoiman kysyntään. Tätä selittää etenkin 1990-luvun alun lama ja pankkien vaatimukset kustannusten karsimisesta yrityksissä. Työvoiman kysynnän joustamattomuus on sen sijaan voinut hillitä työvoiman vähentämistä silloin kun likviditeettiongelmat ovet olleet hyvin suuria.

1 Introduction

Empirical research shows that even in highly developed financial markets in the United States a majority of firms are faced with liquidity constraints. (See Hubbard, 1990, Carpenter, Fazzar and Petersen, 1994, and Hubbard, Kashyap and Whited, 1995.) Financial constraints are also typical for Finland, not least due to the relatively late capital market liberalization and high leverage of firms: until recently both taxation and financial market constraints favored debt finance. The Finnish economy was hit by a deep recession in the early 1990's, with a 14% drop in GDP in the years 1991-1993. In addition, the tight monetary policy and relatively high interest rate level from the March 1989 revaluation of the Finnish mark until the shift to the floating exchange rate in September 1992 imposed fiscal restraint on firms, along with external shocks that hit Finland, including the drop in trade with Russia (see Honkapohja, Koskela 1999).

We explain financial constraints in a Nash bargaining context, where, similar to Bronars and Deere (1991), bankruptcy occurs when the stochastic cash flow is not enough to finance debt. Liquidity constraints are measured by borrowing ratio, interest expenses divided by cash flow analogously to Nickell and Nicolitsas (1995), but we also provide a theoretical argument for it. The firms and organised employees bargain over the wages in the imperfectly competitive labour market.[2] Under financial

[2]The paper originates from Piekkola (1998), which examines the corporate financial position and

distress the union may not settle for a smaller payoff. Credit market loan contracts are negotiated between firms and financers, both having bargaining power. Bargaining between firms and financers explains the elastic supply curve of debt finance increasing in leverage, or in the debt-equity ratio as in Funke, Maurer and Strulik (1999).

Besides varying over time, financial constraints do not affect all firms equally. Carpenter, Fazzari and Petersen (1990, p.82) list the two most obvious reasons why financing constraints can be more severe for small firms.[3] To begin with, public information is less available and the possibility of asymmetric information between managers, the owners of firms and lenders is greater. Second, small firms rely more heavily on bank debt than large firms and international finance opportunities are scarcer. Hubbard, Kashyap and Whited (1995) find, however, that the empirical evidence is mixed and emphasize the low-dividends-payout and the low profitability of the smaller firms in explaining the incidence of borrowing constraints.

In the empirical analysis, we use ETLA's (The Research Institute of the Finnish Economy) panel data of the five hundred biggest firms in 1986-98. The firms in ETLA's data employ on average 532 000 people, one third of the total employment in

the role of labour union behavior for employment and wage formation in Finland, financed by the Ministry of Trade.

[3]For theoretical studies on financial constraints and corporate behaviour, see Myers and Majulis (1984), Stiglitz and Weiss (1981), Jensen (1986), Devereux and Schiantarelli (1990), Strong and Meyers (1990) and Oliner and Rudebusch (1992).

the private sector. The firm-size effect is controlled by examining liquidity constraints separately for the second-largest and the largest firms. Piekkola (1998) uses a similar framework in a study of small and medium-sized firms (SMEs) in the 1990's using another data set.

We show that financial constraints substantially contributed to the rise in the unemployment rate up to 16 percent. The approximately 7 percent reduction of employed personnel in surviving firms results in 140 000 unemployed in the private sector. At the same time, the doubling of the number of bankruptcies on average from 2 to over 4 percent of firms caused 70 000 fired employees (bankruptcies increased by 8000 firms in the years 1991-1994). If half of this lead to unemployment, jobs lost through financial constraints explain half of all the jobs lost and one third of the rise in unemployment up to a 400,000 persons in private sector. Pohjola et al. (1998) similarly finds that the rise of the interest rate up to 7 percent for four years explains half of the mass unemployment. The magnitude of the employment effect of the rise in the real interest rate has been found to be even higher in Sweden in Holmlund (1997). This study confirms the devastating effects of the higher interest rates from 1989 until the 1992 devaluation.

We stress the effects to be especially strong when combined with the deteriorating cash flow of firms. The direct effect of interest rate hike may be moderate compared to the accompanying worsening of cash flow. The dependance of opportunity income

and financial contracts on borrowing ratio are unique features of the model that change the employment effects from findings in other papers. In our Nash bargaining model liquidity constraint effects on employment may relate to (i) the demand shocks, (ii) the adjustment in either opportunity incomes or wages under no employment negotiations, (iii) to non-competitive financial markets with negotiation power of the financers and/or with the cut in investment and employment when financers and firms negotiate on investment finance or on the cost of capital (under financial distress). It is shown, like in Koskela and Stenbacka (2001), that in not perfectly competitive labour markets financers with market power have incentive to increase rent sharing. In Koskela and Stenbacka (2001) the outside options are also reduced and this wage moderation improves employment. This result requires a framework where rents are shared between employees and firms.[4] It is evident here that lower rent splitting induced by liquidity constraint may explain some wage moderation when the level of quasi rents is high. Rent sharing is, however, not very general in Finland, where it is shown that approximately no more than 2% of rents is distributed to workers.

We argue that the negative employment effects result from tighter cash-flow constraints in bargaining between firms and banks. Due to large fixed costs in adjusting labour input, the magnitude of liquidity constraints also decrease as liquidity con-

[4]Rent-sharing studies include Blanchflower, Oswald and Garret (1990), Christofides and Oswald (1992) and Van Reenen (1996).

straints become more severe (for fixed costs in adjusting labour, see Hamermesh and Pfann, 1996).

Despite the better access to capital markets of largest firms, the relative decrease in labour input is of the same magnitude in the largest and the second-largest firms. Differences in wage formation between small and large firms can explain this. Our explanation is that in large firms employees require a compensation for bankruptcy risk, increasing wage costs. This is also in line with the finding that the wage rise is particularly severe when borrowing ratio is high enough.

In addition to our model, institutional factors such as centralised wage negotiations can also be more binding for largest firms, creating wage compression and increased job turnover. Following Lazear (1995), largest firms can also pay higher wages and reward risky workers with good performance. In recession this lead to firing of bad workers.

The paper is organized as follows. Section 2 lays out the Nash bargaining equilibrium between workers, employers and lenders and presents the labour demand, wage and productivity equations in the model. The empirical results are presented in Section 3. Section 4 concludes and summarizes the main findings.

2 Bargaining Model

We consider bargaining over labour and capital input encompassing elements from trade union approaches (starting from Dunlop 1944). The negotiations on wages take place at the firm-level and employees may negotiate directly or the system is based on labour unions and union representatives in firms. The negotiations on labour input may especially take place when the firm is shedding labour (for the differences in shedding or hiring workers, see Layard R., Nickell S. and R. Jackman). At second stage, we include in the bargaining between banks and firms over loan contracts under financial stress so that financers have bargaining power and the adjustment of employment to the renegotiated loan contract. These short-terms contracts are also in practise negotiated separately with each firm.

The employees (and a bank) bargain with a profit-maximizing firm with a standard neoclassical production function $F(K, L)$, where all capital is borrowed. Letting w denote wages, L labour input, r the interest rate on loans, K capital input, γ demand shock and $CF \equiv \gamma F(K, L) - wL$ the cash flow, the profits condition of the firm not to fail is that the expected cash-flow is enough to finance the investment $\varepsilon[CF] - rK > 0$, where ε is stochastic.[5] If the firm goes bankrupt, bank bears all the

[5]Liquidity constraint are presumably differently affected by interest rates, the general tightness of monetary policy and profitability, as found in the adjustment of firms' stocks in Carpenter, Fazzari and Petersen (1994). In their study the interest rate level was an insignificant factor whereas the

costs which may be positive or negative depending on ε. We assume that ε follows a uniform distribution $\varepsilon \sim U[\underline{\varepsilon}, \bar{\varepsilon}]$, $\bar{\varepsilon} > 0, \underline{\varepsilon} = 0$. It depends on asymmetric information problem of banks not knowing the true cash flow of the firm and on the fact that in the event of bankruptcy the bank bears all the losses. The uncertainty is resolved after the wage and financing decisions are made. The probability that the firm runs into bankruptcy is then $p\left\{\varepsilon < \frac{rK}{CF}\right\} \equiv B$, where $B \equiv \frac{rK - \underline{\varepsilon} CF}{\bar{\varepsilon} CF - \underline{\varepsilon} CF} = \frac{rK}{\bar{\varepsilon} CF}$ when $\underline{\varepsilon}$ is set at zero. Firm owners are assumed risk neutral. The expected profits of the firm are $(1-B)PR + B * 0 \equiv (1-B)(CF - rK) = (1-B)(1 - \bar{\varepsilon}B)CF$, where profits are cash flow less payments on debt. Infinitely high value of $\bar{\varepsilon}$ gives no bankruptcy risk $B = 0$ and thus an indication of the market equilibirum with no financial distress.

If no agreement is reached the workers have to find employment elsewhere and we assume that they search for jobs in the same industry. Let $(1-B)\bar{w} + BU$ denote the opportunity income of employed and $x \equiv (1-u)\bar{w} + uU$ the opportunity income of not accepting the wage offer and continuing to search the job in the industry, where $\bar{w}$ is industry average wages and u is the probability of staying unemployed and U is unemployment benefits. Let $a = (1-u)\bar{w} + uU - (1-B)\bar{w} - BU = (B-u)(\bar{w} - U)$ the difference in the opportunity income for those searching new jobs and for those accepting the wage offer. a is positive if the probability for bankruptcy is greater than the probability for unemployment when not accepting the job offer. Hence, in

tightness of monetary policy, in particular, explained the cyclical adjustments of firms' stocks.

firms not performing well opportunity income is lower and a is positive. On the other hand, in recession period the probability for unemployment is high. Unemployment spells are longer and benefits are decreasing over time. a can be negative.[6] Many recent job search models also assume reservation wages of employed to be higher than unemployed, see Burdett and Mortensen (1999) and Acemogly and Shimer (2000). However, for a sufficiently financially constrained firm a is positive.

If the firm is shedding labour then $L < \overline{L}$, where $\overline{L}$ is the number of workers in the firm at the beginning of the negotiations and L is the number of workers actually employed in the firm in the current period. Employer is responsible to justify the dismissals that must be based on restructuring of the firm's activities and preceded by joint negotiations between employers and employees or their representatives. If the firm is hiring labour then $L > \overline{L}$ (e.g. positive demand shock). Then all jobs are secure and it can be possible that employees are only interested in bargaining over wages. The solution with no employment negotiation is also shown. Irrespective of employment negotiations, employees' expected income if an agreement is reached in negotiations is $wL(1-B) + (1-a)xLB + x\left(\bar{L} - L\right)$, where a shows the relative opportunity income of employed versus outsiders. In this formula the expected wage income if the firm does not run into bankruptcy is $w(1-B)$. If the firm runs into

[6] Cahuc and Lehmann (1999) indeed compare the wage pressures generated by higher benefits from short time employment with the positive job research incentives when unemployment benefits are decreasing with the unemployment spell.

bankruptcy employees in second period earn their reservation wages $(1-a)x$. The reservation wage for those who stay unemployed already in the first period, $\bar{L}-L$, is $x \equiv (1-u)\bar{w}+uU$. The employee surplus from the agreement is $wL(1-B)+(1-a)xLB+x\left(\bar{L}-L\right)-x\bar{L} = \ (w-\hat{x})\,L\,(1-B)$, where $\hat{x} \equiv (1-(1-a)B)/(1-B)$ measures the real opportunity cost of income in wage negotiation.

2.1 Bargaining over Wages and Employment

In this section, investment and interest rate are predetermined by long-term contracts between financers and firms. When banks are maximizing rents the objective function is $Kr\,(1-B)+(\bar{K}-K)\rho$ in the individual loan contracts, where $\bar{K}$ is total capital stock yielding ρ in alternative investment and $Kr\,(1-B)$ is the expected capital income accruing to the bank (assuming that all capital is borrowed, for simplicity). The threat point for banks is the value of alternative investment $\bar{K}\rho$. Assume that in long-term contracts financial markets are competitive and the firm decide the optimal investment level to satisfy $r=\rho/(1-B)$, i.e. the bank fully receives the opportunity income, taking bankruptcy risk as given. The model also includes the effects of the bargaining between employees and firm on the welfare of bank so that the bargaining power of banks β also affects the outcome. This shows the interests of the bank in wage setting (amended by the negotiations over investment in the next section). The

Nash bargaining solution is obtained by maximizing the following:

$$\max_{w,\,L} \quad (1-B)[wL-\hat{x}L]^{\alpha} \qquad (1)$$
$$[Kr-K\rho/(1-B)]^{\beta}\,(PR)^{1-\alpha-\beta}\,,$$

where α is the bargaining power of the employees, β is the bargaining power of banks and under no employment negotiations employment L is maximized over profits PR only. Defining $QR \equiv \gamma F(K,L) - rK - \hat{x}L$ as the quasi rent the first-order-conditions for wages and employment are from Appendix A written as:

$$w = \hat{\alpha}\left(\frac{QR}{L} - \hat{a}BA\right) + (1-\hat{\alpha})\hat{x}\,; \qquad (2)$$

$$\gamma F_L = \hat{x} \quad \text{under employment negotiations}\,; \qquad (3)$$

$$\gamma F_L = w \quad \text{under no employment negotiations}\,, \text{ where} \qquad (4)$$

$$\hat{\alpha} \equiv \frac{\alpha}{1-\beta+BA\left(1-\frac{\beta\delta}{r(1-B)-\delta}\right)}\,,\ \hat{x} \equiv x\frac{1-(1-a)B}{1-B}, \qquad (5)$$

$$\hat{a} \equiv \frac{(\bar{w}-U)x}{1-B}\left(B-\frac{u-B}{1-B}\right),\ A \equiv \frac{CF-rK}{CF-rK/\bar{\varepsilon}}. \qquad (6)$$

Wages depend on quasi rent QR and opportunity income $\hat{x}$ using the rent splitting parameter $\hat{\alpha}$ as the weight. The threat of bankruptcy (higher B) increases wage demands through higher relative value of opportunity income since $a = (B-u)(\bar{w}-$

$U) \uparrow$. Lower rent sharing via $\hat{\alpha}$ and $\hat{a}$ works in the opposite direction. Liquidity constraints have no unambiguous effect on wages.

In the rent sharing, term A measures the effects of profits relative to the profit requirement. This depends on expected cash flow $\bar{\varepsilon}CF$. Profit requirements are likely to increase under financial distress; hence A increases in value with higher profit margin $\bar{\varepsilon} \downarrow$. Higher unemployment lowers the opportunity income. It is seen that in recessions, unemployment and high profit requirement both moderate wages. It is concluded that high borrowing ratio increasing the riskyness of the job relative to job offers in other firms through higher $\hat{x}$ is the only reason for liquidity constraints to raise wages (as found in the empirical part of the study). This becomes more likely the dominating factor the lower is rent sharing, expected cash flow requirements and unemployment rate.

The model also includes the interests of financers in wage settlements. It is seen that the negotiation power of banks β increases the rent splitting parameter (5). Banks want higher share of wage expense to fluctuate according to the performance of the firm. Thereby intensified credit market competition lowers rent splitting and increases wage moderation.

The employment effect of bankruptcy crises are seen from (3) and (4). When there is no bargain on employment, employment is settled by employers according to (4) so that employment adjusts to the negotiated wage level. When employees and

employers negotiate over employment, the marginal product of labour depends on opportunity wages from (3). The cost of employment is lower than when no negotiations take place for $\hat{\alpha}\left(\frac{QR}{L} - \hat{a}BA\right) + (1-\hat{\alpha})\hat{x} > \hat{x}$. It is not excluded that equilibrium level of employment is instead higher with no employment negotiations if employees require compensations for increased bankruptcy probability. Finally, employment depends on demand shocks γ, often accompanied by the liquidity constraints.

2.2 Bargaining over Investment and Employment

Consider next the pressures created by the suppliers of capital, the banks. There is no standard way to model imperfect competition. One way to approach the issue is to analyse the effects of increasing number of competing lenders, and another increasing product differentiation, following Hotelling type models of horizontal product differentiation. The Nash bargaining approach is taken here which gives monopoly (bank has all bargaining power) and perfect competition (bank has no bargaining power) as special cases. It is convenient to assume that here we deal with short-term commitments, allowing now the bankruptcy risk to depend on the amount borrowed. The wage negotiations are also considered as long-term compensation contracts, and short-term debt contracts in the finance affect only employment. The sequence of negotiations is hence: long-term financial contract, wages, employment under no financial contracts, short-term financial contract, employment under short-term fi-

nancial contract. Assume that after the short-term financial contract the firm is no more willing to negotiate over employment, since liquidity constraints, the cause for financial negotiations, are adequate reasons for dismissals.

Bank may practise negotiation power either in the setting of borrowing cost r or the level of investment K (see discussion below). The maximization problem in finance becomes:

$$\max_{r \text{ or } K} \quad (1-B)\left[Kr - K\rho/(1-B)\right]^{\beta} PR^{1-\beta} \,. \tag{7}$$

where wage and employment level is given by the first stage negotiations. First order conditions for negotiated interest rate and investment are from appendix given by:

$$r \quad : \quad r = \frac{\delta}{1-B} + \frac{\beta(1-\varepsilon_r^B/(1-B))}{(1-\beta)K/PR + \varepsilon_r^B} \,; \tag{8}$$

$$K \quad : \quad r = \frac{\delta}{1-B} + \frac{\beta}{(1-\beta)\Psi K/PR + \varepsilon_K^B/(r-\varepsilon_K^B\delta)} \,; \tag{9}$$

$$\Psi \quad \equiv \quad \frac{\partial PR}{\partial K} \Big/ \frac{\partial\left(Kr - K\frac{\delta}{1-B}\right)}{\partial K} = \frac{r-\gamma F_K}{r-\varepsilon_K^B\delta} \tag{10}$$

where $\varepsilon_r^B = \frac{\partial B}{\partial r}\frac{r}{1-B} = \frac{rK}{\bar{\varepsilon}PR}$, $\varepsilon_K^B = \frac{\partial B}{\partial K}\frac{K}{1-B} = \frac{rK-\bar{\varepsilon}\gamma F_K KB}{\bar{\varepsilon}PR}$. It is first seen that the negotiated equilibrium is ambiguous if bank and firm negotiate both over interest rate and capital. In fact, at the negotiated level of interest rate, the bank is interested to borrow to the firm until profits cover profit expectations $\bar{\varepsilon} < 1$ (yielding zero profits if $\bar{\varepsilon} = 1$). The only other viable solution is to agree either on the rate of interest or

on capital as given by equations (8) and (9).

It is seen that negotiations over interest rate with monopoly power of the bank always leads to higher cost of capital than the long-term commitment with fixed bankrutpcy risk, $r = \frac{\delta}{1-B}$, since $1 - \varepsilon_r^B/(1-B) = (1+B-B^2)/(1-B) > 0$ with $B < 1$. In negotiations over investment the cost of capital is also increased since investments imply an increase in borrowing cost, $\varepsilon_K^B > 0$, as long as the firms is making positive profits. It is also seen that the difference between long-term contract, $r = \frac{\delta}{1-B}$, and short-term contract narrows the higher is the level of borrowing ratio. In this sense, the negative effects on investment are decreasing in the level of borrowing ratio. The competitive capital market, lower β, has a positive effect on investment. In earlier chapter, competitive financial market also lead to wage moderation because of lower rent splitting.

At the final stage, employment level is set to maximize profits $PR = \gamma F(\hat{K}, L) - \hat{w}L - \hat{r}\hat{K}$, where $\hat{w}$, $\hat{r}$ and $\hat{K}$ are given from the Nash bargaining or market equilibrium. It is then clear that starting from the negotiated levels of capital and employment, the lower level of capital or higher level of interest rate has a negative effect on employment.

2.3 Empirical Formulation

In the empirical study, the quasi rent for firm i at time t is estimated in the form

$$QR_{it} \equiv Y_{it} - x_{jt}L_{it} - 0.3K_{it}, \tag{11}$$

where Y_{it} is real output of firm i, L_{it} is employment, x_{jt} is average wages in the industry j and the cost of capital K_{it} is set fixed at 3 percent. Adding dynamics and liquidity constraints, we analyse the following labour input equation:

$$\begin{aligned} l_{it} &= \mu_i + \eta_1 l_{it-1} + \eta_2 l_{it-2} + \mu_1 k_{it} - \mu_2 w_{jt} \\ &\quad -\mu_3 B_{it-1} - \mu_4 B_{it-1}(B_{it-1} - \overline{B}_{t-1}) + \mu_5 d_{it} + \varepsilon_{it} \ , \end{aligned} \tag{12}$$

where index i refers to the firm, index j to the industry and t to time and small capital refers to logarithmic values. In addition, μ_i = firm factor, w_{jt}= wages, B_{it-1}= bankruptcy risks, $\overline{B}$ = average value for B over the years and d_{it}= demand shocks (wages w are deflated by consumer prices and rents QR deflated by producer prices). Bankruptcy risks B_{it-1} are measured by financial expenses per cash-flow $\frac{rK_{it}}{CF_{it}}$. The firm runs into bankruptcy if payments on capital exceed cash flow. We also analyse the effects of a deviation from the average level of borrowing ratio $B_{it-1}(B_{it-1}-\overline{B}_{t-1})$. This reduces the estimation error of assuming a fixed coefficient for all firms when the true coefficient μ follows a linear approximation $\mu = \mu_5 + \mu_6(B_{it} - \overline{B}_t)$.[7] We have also estimated B differently for the second-largest and largest firms.

[7] Abowd and Lemieux (1993) similarly analysed the deviation of quasi-rents from their average level.

The variable μ_i contains all the firm's characteristics that remain stable over time. Under constant returns to scale $\mu_1 = 1 - \eta_1 - \eta_2$, which is not tested. The wage equation is (without lags) of the form:

$$\begin{aligned} w_{it} - w_t &= \vartheta_o + \vartheta_1 C_{it} + \vartheta_2 QR_{it}/L_{it} - \vartheta_3 B_{it} \\ &\quad -\vartheta_4 B_{it-1}(B_{it-1} - \overline{B}_{t-1}) + \mu_5 d_{it} + \eta_{jt}\,, \end{aligned} \tag{13}$$

where QR_{it}/L_{it} is quasi rent per worker. We follow Nickell and Nicolitsas (1999) in focusing on wage increases in a firm in exceeds of the average level of wage increase.

3 Results

The data relating to the analysis of the 500 biggest firms in Finland are described in Appendix B. The panel includes all sectors in the period 1986-1998. First differences are used to eliminate firm-specific effects. The endogeneity problem is solved by using instrument variables that should correlate with the firm's quasi-rents and liquidity but not with the dependent variable. Most of the variables are treated as endogenous with lagged values from period $t-2$ onwards used as instruments. The time lag is sufficient for current labour demand or wage formation to be insensitive to the instruments. Despite using a lagged borrowing ratio B, the error in difference estimation may still contain positive shocks both on employment and reduced borrowing costs creating a negative bias. A positive bias can emerge from adjustments related to recruiting

that temporarily raises financial expenses. To reduce the biases, the instruments also include industry export and import prices and their second power.[8] These are erroneous to the extent that export and import prices correlate with productivity and the skill level of employees and hence correlate with wages rather than exhibit pure demand shocks. It is noteworthy that especially the largest firms have globalized by increasing foreign direct investment, which shows as a negative relation between borrowing and domestic size of personnel. However, the inclusion of foreign staff in the number of employed here avoids the data problem in this respect.

Since wage settlements last for 1-2 years, it is found convenient to analyse quasi-rent and the borrowing ratio with one period lag. The rest of the variables are as shown earlier. The estimation uses the Arrelano and Bond (1991) IV(GMM) method or alternatively the Arellano and Bover (1995) and Blundell and Bond (1998) GMM-SYS estimator. The latter results in the use of lagged first-differences as instruments for equations with levels that are stacked on top the transformed equations. We have time dummies and firm type dummies as shown in the Appendix. (See table A.2.) The number of observations is around 2700 in GMM and 3130 in GMM-SYS in the period 1990-1998 (with a two-period lag).

[8] Abowd and Lemieux (1993) use as the instrument the prices of exports and imports and Van reenen (1996) the number of major innovations made by the company.

3.1 Labour Input

The R squared in regressing 48 instruments (excluding wages) on endogenous variables are successively in OLS estimation, $labour_{it}$ $R^2 = 0.19$, $wages_{it}$ $R^2 = 0.38$, $capital_{it}$ $R^2 = 0.44$, $borrowing\,ratio_{it-1}$ $R^2 = 0.35$. It can be seen that in wage formation the level instruments are more valid than in labour input. Explaining labour input by lagged values gives the coefficient 0.98. This shows persistence of labour input with significant value for lagged values of labour input. Hence, we rely especially on the GMM-SYS estimator. In Table 1, GMM estimation is shown in column 3 and the rest of the table uses the GMM-SYS estimator. Liquidity constraints in the 250 second-largest and 250 largest firms, divided according to average real sales, are analysed separately in column 2. The quadratic borrowing ratio term measures how the deviation of liquidity constraints from average affect employment (so that the linear term gives an estimate of the average effect of liguidity constraints). In the last column, the real interest rate instead of the liquidity effects is used. Sales and the time dummies also control for the demand factors.

It is seen that the firm's financial liquidity has a notable permament negative effect on labour input. The borrowing ratio variable is significant with a coefficient of -0.07 for all the firms in column 1. Interest rate measures the service cost of the debt for each individual firm and turns out to be insignificant. Hence, the variation in borrowing expenses relative to cash flow rather than the rise in the rate of return

Table 1. Employment

Variable	Basic SYS		Firm Size SYS		GMM		Real Interest Rate SYS	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
$Labour_{it-1}$	1.03	**(9.7)**	0.95	**(10.8)**	0.53	**(8.7)**	1.16	**(10.0)**
$Labour_{it-2}$	-0.08	(0.8)	-0.01	(0.1)	-0.05	**(1.9)**	-0.19	**(1.7)**
$Capital_{it}$	0.01	(1.6)	0.01	(1.7)	0.10	**(3.8)**	0.01	(1.1)
$Wages_{it}$	-0.02	(1.2)	-0.03	**(1.3)**	-0.04	**(2.8)**	-0.01	(0.2)
Borrowing $Ratio_{it-1}$ (or Real Interest $Rate_{it-1)}$	-0.07	**(2.6)**			-0.04	**(1.9)**	0.00	(0.2)
Borrowing Ratio Medium-$Sized_{it-1}$			-0.09	**(2.9)**				
Borrowing Ratio Large $Firms_{it-1}$			-0.06	**(2.3)**				
Borrowing Ratio $Quadratic_{it-1}$	0.01	(1.5)			0.01	**(1.9)**		
Borrowing Ratio Quadratic Medium-$Sized_{it-1}$			0.02	**(1.9)**				
Borrowing Ratio Quadratic $Large_{it-1}$			0.01	(0.9)				
$Sales_{it}$	0.27	**(3.5)**	0.33	**(4.2)**	0.31	**(5.5)**	0.23	**(2.6)**
$Sales_{it-1}$	-0.24	**(3.1)**	-0.30	**(3.8)**	-0.10	**(1.8)**	-0.21	**(2.4)**
$Bankruptcies_{it-1}$	0.10	(0.5)	0.09	(0.5)	-0.15	(0.5)	0.14	(0.7)
Export Share	0.01	(0.6)	0.02	(0.7)	-0.03	(0.4)	0.02	(1.1)
Standard Error (in Levels in SYS)	0.003		0.003		0.004		0.003	
Serial Correlation AR1 (N(0,1))	-4.034		-4.369		-4.804		-4.144	
Serial Correlation AR2 (N(0,1))	-0.120		-0.871		-0.259		-0.233	
Wald test of joint significance	X^2 (10) =173500		X^2 (105) = 141.3		X^2 (10) = 284.1		X^2 (11) =167800	
Instrument validity	X^2 (85) =116.9				X^2 (340) =366		X^2 (81) =109.5	

(i) Equations include 16 industry dummies and time dummies. There are 2701 observations in GMM and 3131 observations in SYS estimation (3132 in last column).

(ii) All variables are treated as endogenous. Instruments include $labour_{it-x}$, $capital_{it-y}$, $wages_{it-y}$, borrowing $ratio_{it-y}$, borrowing ratio $squared_{it-y}$, $bankruptcies_{it-y}$, export shareit-y, where x=3,...,6, y=2,...,6 and non-gmm type instruments as export $price_{it-1}$, export $price_{it-2}$, import $price_{it-1}$, import $price_{it-2}$ and their squares.

(iii) The quadratic term is the product of borrowing ratio and the deviation of it from its mean.

alone explains a large share of the liquidity constraint effect. The average borrowing ratio rose from 0.62 in 1989 to 1.33 in 1991, see table B.2 in appendix (the average real interest rate on borrowed capital rose from 4.7 percent to 8.7 percent in the firms studied). The rise in borrowing ratio causes employment to decrease on average by 4 percent (0.07*0.71, where 0.71 is the change in borrowing ratio). The total long-run effect is double, 7 percent.

The variable *bankruptcy* measures the number of people losing jobs in the industry through bankruptcy relative to the total number of job losses through bankruptcies in all industries (on average 5 percent of the total job losses). The number of industry bankruptcies rose by around 8,000 in four years, raising unemployment by 70,000. The relative magnitude of bankrupties turns out insignificant. Bankrupties do not have large spillovers to continuing firms.

It is seen that the labour demand effect is of lower size than that found in Nickell and Nicolitsas for England.[9] But the increase in the borrowing ratio was more severe, especially for large firms (up to 1.40). At the same time, from column 2 the negative labour input effect is somewhat stronger for the second-largest firms.

Our theoretical model explains labour input by (i) the demand shocks, (ii) the adjustment in either opportunity incomes or wages under no employment negotiations,

[9]Nickell and Nicolitsas (1995) also concentrate on British manufacturing companies in an earlier period, 1972-86.

(iii) to non-competitive financial markets with negotiation power of the financers and/or with the cut in investment and employment when financers and firms negotiate on investment finance or on the cost of capital. It can be seen from Table 1 that demand shocks, via sales, have less permanent effects on employment. The second-period adjustment offsets the direct negative effect. Due to time dummies and sales as explanatory variables, other variables show the ceteris paribus consequences of financial constraints rather than over the business cycle. As discussed, from the last column the rise in the rate of return has no strong direct effect. It is indeed more likely that under financial distress bank and the firm especially negotiate over the level of investment. The average expenses on borrowing are determined by the market rate of returns and borrowing may be restricted by lower expected cash flow. A substantial part of unemployment is then explained by tighter cash-flow constraints and the lower level of investment. The firms have to restructure employment to the lower investment level. The adverse effect on smaller firms can especially be explained by higher negotiation power of the banks. Small firms rely more heavily on bank debt than large firms and international finance opportunities are scarcer.

Another explanation for the negative effects of liquidity constraints is the inflexibility of wages or, even higher wages to compensate higher bankruptcy risk. In second-largest firms, rent sharing is more common, see Piekkola (2001), and wage moderation can be more common. In column 1, the short run coefficient on wages

of around -2 percent implies very inelastic labour demand on average. The industry wage elasticity is below the industry labour demand elasticity in Holm, Koskela and Honkapohja (1996), where its value is around -0.3. The wage elasticity is more negative for the largest firms (not shown), while the average wage levels are rather similar in the second-largest and largest firms.[10]

For second–largest firms in column 2 the negative effect of the borrowing ratio decreases as the deviation from the industry average rises. One reason is that the negative investment effects are decreasing in the level of borrowing ratio. In the base model in column 1 the quadratic term is instead insignificant. This suggest that the adjustment costs in managing labour are higher for the second-largest firms. In the largest firms the negotiations between financers and firms has less dampening effect on investment and employment. Wage demands, on the other hand, should be decreasing in the level of borrowing ratio.

The approximately 7 percent reduction of employed personnel results in 140 000 unemployed in the private sector out of the 2 million working in the private section. Job destruction of 140,000 due to liquidity constraints in continuing firms should be amended by permanent jobs lost through closures, perhaps half of of the 70,000

[10]The usual finding of the higher wage level in big firms in other countries, and also in plant-level studies in manufacturing in Finland, has been explained by more demanding production technology, by schumpeterian innovation and by higher capital intensity with the stronger complementarity of capital and labour of large firms.

jobs lost. The figures are consistent with the finding that on average one fourth of job destruction takes place through firm closures, see Böckerman and Piekkola (2001). Between the end of 1991 and 1993 job destruction was 630,000 in firms where employment decreased and job creation was 340,000 in firms where employment rose. Employment change is the difference 290,000, while unemployment rose up to 400,000. Financial constraints explain then around 170,000 (140,000 + 30,000) of unemployment, and half of all the jobs lost. In addition, time dummies indicate that employment was around 4 percent lower in recession years 1991-1994 leading to 40,000 less jobs (not reported). Substantial share of the remaining part of total unemployment, 150,000 of 400,000, emerges from the lenghtening of unemployment period. Finally, if labour demand dispersion is four times the standard deviation, the variation of the firm's liquidity over the whole period alone similalry explains around 30% of the variation in labour demand.[11]

3.2 Wage Formation

The standard deviation of log real wages across firms has increased over time as well as the average wage level, which can be explained by the increase in labour productivity (see Table B.1 in Appendix B). In the fourth column, the liquidity effects are analysed in the three time periods 1986-90, 1991-94 and 1995-98. The periods are chosen on

[11] From 0.82*0.11*4*(1.178/0.82), where 0.11 is the elasticity coefficient (average borrowing ratio is 0.92 and employment 1730) and 1.178 is the standard deviation of the borrowing ratio.

the basis of the deep recession in the middle period with a 14 percent drop in GDP and on the basis of tight monetary policy and high interest rates leading up to the devaluation in 1991 and the currency floating regime in 1992. Wage deviations from yearly average is considered. Therefore the model does not explain all the adjustment to aggregate shocks in the recession time. Table 2 shows that wages adjust quickly, i.e. there is little difference between short- and long-term wage adjustment.

It is seen that the coefficient on quasi rent is significant yielding average elasticity of 1.3 (average quasi rent is 151 FIM thousand). Using level of wages instead of log wages as dependent variable yields an elasticity of around 2 percent, close to that obtained in Piekkola (1999). The effect does not substantially vary between firms of different size nor on instrumenting (not shown). The rent splitting of 1.3-2 percent is rather moderate, which gives indication of low wage flexibility. From Table B.1 in appendix it is seen that average real quasi rent decreased from 90,000 FIM to 45,000 FIM in recession. Even this drastic decrease lead only to about 2 percent decrease in wages.

The borrowing ratio has, on average, a positive effect on wages. The coefficient attached to the quadratic borrowing ratio term (deviation from average) is negative. Wage moderation dominates for liquidity constraints high enough. The second column shows that liquidity constraints have no effect on second-largest firms. Last column 5 shows results for the 250 largest firms, and includes an interaction term with quasi rent and liquidity constraints.

The theoretical model shows that liquidity constraints raise opportunity income if the job in the firm is riskier than in the industry in general, the latter measured by the probability for staying unemployed in job search. As seen from columns 1, 2 and 5 wages in the largest firms indeed tend to increase to compensate for the bankruptcy risk. These findings contrast the view by Bronars and Deere (1991) that leverage can be used to control for the union bargaining power. Column 4 shows that in recession period 1992-94 this is less clear. Union bargaining power is mitigated by high probability of unemployment if not accepting the job.

The negative sign of the interaction term between quasi rent and borrowing ratio in the last column shows that if the large firm is earning high quasi rents, borrowing ratio leads to wage moderation. Bankrutpcy risk is less likely than that implied by borrowing ratio and wage compensations to compensate the risk are lowered. In addition, borrowing ratio lowers the rent splitting parameter and rent sharing. Lower share of quasi rents are distributed to the employees.

Table 2. Wages Dependent Variable: Wage Deviation from Yearly Average

	GMM		Firm Size GMM		SYS		Year Effects SYS		GMM	
Variable	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**	**Coefficient**	**t-value**
$Wages_{it-1}$ - $Wages_{t-1}$	0.151	**(3.1)**	0.138	**(3.0)**	0.921	**(54.6)**	0.151	**(5.2)**	0.873	**(24.6)**
Quasi-Rent/L_{it-1}	0.00009	**(2.1)**	0.00007	**(1.9)**	0.00006	(1.1)	0.00009	**(4.7)**	0.00012	(1.3)
Quasi-Rent Quadratic/L_{it-1}	-8.793	(0.2)	-9.412	(0.3)	-6.584	(0.9)	-9.389	(0.5)	0.000	(0.2)
Borrowing $Ratio_{it-1}$	0.04	**(2.1)**			0.13	(1.5)	86-90 -0.007	(1.2)		
Borrowing Ratio Medium-$Sized_{it-1}$			0.00	(0.0)			91-94 -0.002	(0.5)		
Borrowing Ratio Large $Firms_{it-1}$			0.06	**(3.0)**			95-98 -0.005	(0.6)	0.17	**(1.9)**
Borrowing $Ratio_{it-2}$	0.02	(1.0)			-0.07	(1.4)				
Borrowing Ratio Medium-$Sized_{it-2}$			-0.03	(1.4)						
Borrowing Ratio Large $Firms_{it-2}$			0.05	**(2.1)**					-0.08	(1.7)
Borrowing Ratio $Quadratic_{it-1}$	-0.01	**(2.6)**			-0.04	(1.6)	86-90 -0.012	**(2.7)**		
Borrowing Ratio Quadratic Medium-$Sized_{it-1}$			0.00	(0.5)			91-94 -0.002	(0.4)		
Borrowing Ratio Quadratic $Large_{it-1}$			-0.02	**(3.1)**			95-98 0.002	(0.3)	-0.04	**(1.8)**
Borrowing Ratio $Quadratic_{it-2}$	-0.01	(1.4)			0.02	(1.5)				
Borrowing Ratio Quadratic Medium-$Sized_{it-2}$			0.01	(1.1)						
Borrowing Ratio Quadratic $Large_{it-2}$			-0.02	**(2.3)**					0.02152	**(1.8)**
Borrowing Ratio * Quasi-Rent/Li_{t-1}									-0.00007	**(2.0)**
Borrowing Ratio * Quasi-Rent/Li_{t-2}									0.00004	(1.3)
$Sales_{it}$	0.03	(0.7)	0.06	(1.5)	-0.03	(0.3)	0.030	(0.7)	0.06069	(0.6)
$Sales_{it-1}$	0.00	(0.1)	-0.01	(0.2)	0.03	(0.3)	0.030	(0.8)	-0.06000	(0.6)
Current $Ratio_{it-1}$	0.00	(0.0)	0.00	(0.3)	0.00	(0.9)	0.000	(0.4)	-0.00006	(0.1)
$Bankrupties_{it-1}$	0.20	(0.9)	0.18	(0.8)	-0.16	(1.1)	0.232	(1.1)	-0.09754	(0.5)
Standard Error (in Levels in SYS)	0.0033		0.0032		0.0028		0.0033		0.0033	
Serial Correlation AR1 (N(0,1))	-6.476		-6.3750		-5.2160		-6.5820		-6.5820	
Serial Correlation AR2 (N(0,1))	0.0490		-0.0564		2.1000		-0.0490		-0.0490	
Wald test of joint significance	X^2 (11) =36.41		X^2 (13) =38.12		X^2 (9) =21.25		X^2 (13) =28.07		X^2 (13) =1662	
Instrument validity	X^2 (295) =306.9		X^2 (379) =391.0		X^2 (73) =86.31		X^2 (82) =109.5		X^2 (71) =86.1	

(i) Equations include 16 industry dummies and time dummies. There are 2704 observations in GMM and 3132 observations in SYS.

(ii) All variables are treated as endogenous. Instruments include $labour_{it-x}$, $capital_{it-y}$, $wages_{it-y}$-$wages_{t-1}$, borrowing $ratio_{it-y}$, borrowing ratio $squared_{it-y}$, current $ratio_{it-y}$, $bankrupties_{it-v}$, where x=3,...,6, y=2,...,6 and non-gmm type instruments: export $price_{it-1}$, export $price_{it-2}$, import $price_{it-1}$, import $price_{it-2}$ and their squares.
(iii) The quadratic term is the product of borrowing ratio and the deviation of it from its mean.

Overall, it is seen that wages are not very flexible downwards when the firm face liquidity constraints. In large firms, employees have negotiation power and employers should compensate for the increase in bankruptcy risk. In the second-largest firms employees have, however, less negotiation power. But liquidity constraints do not lead to wage moderation, either. It is instead possible that wage moderation is more common in UK as found in Nickell and Nicolitsas (1999).

The different implications of profits and liquidity on wages depending on firm-size could, in principal, explain part of the greater wage dispersion in Finland than in Sweden, as found in Vainiomäki and Laaksonen (1995). Wage variation is significant in small firms, while largest firms take more prominent role in Swedish industry. However, it is also claimed that the wage variation between firms is high in all the Nordic countries (see Westergard-Nielsen and Pingley, 1998) and wage dispersion has particularly increased after the recession.

3.3 Productivity

Firms under financial pressure may be induced to improve profitability and productivity. In the empirical analysis, we measure productivity by total factor productivity relative to the average in the industry. The log of relative total factor productivity is measured by

$$\ln TFP = \ln\left(\frac{Y_{it}/L_{it}}{\bar{Y}/\bar{L}}\right) - 0.4\ln\left(\frac{K_{it}/L_{it}}{\bar{K}/\bar{L}}\right) \tag{14}$$

where Y_{it} is value added, L_{it} labor input, and K_{it} capital input in plant i in year t, and 0.4 approximates the cost share of the capital input. $\bar{Y}$, $\bar{L}$ and $\bar{K}$ are the geometric means of value added, labor and capital, respectively, in each industry. Table 3 examines the factors explaining total factor productivity. We use SYS estimation given the persistence of the productivity measure indicated by a lagged coefficient value of 0.94 in OLS estimation.

In Table 3 lagged productivity receives a large value reflecting the long-run adjustments. Column 1 shows that the borrowing ratio has a negative effect on productivity, albeit the quadratic term is positive. From Table 3 it is seen that the return on investment and total factor productivity are also not strongly related. The differences between export and non-export firms are not significant either. This goes against the usual finding in Finland that export share is an important factor for efficiency. All this shows an adjustment in investment and labour that may result not only from profix maximization but from negotiations over the investment level between firms and banks. It is not necessary that productivity thereby improves. Productivity might also have been affected by the two devaluations in 1991 and 1992, but profitability implications are ambiguous if the firm has borrowed a large share of funds in foreign currencies (see Ilmakunnas and Topi, 1996).

Table 3. Total Factor Productivity

Variable	Basic SYS		Firm Size SYS		GMM	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
$Log(TFP)_{it-1}$	0.88	**(4.5)**	0.67	**(5.0)**	0.15	**(2.8)**
$Log(TFP)_{it-2}$	-0.20	(1.5)	-0.03	(0.3)	-0.04	(1.4)
Borrowing $Ratio_{it-1}$	-0.03	**(2.5)**			0.01	(1.6)
Borrowing Ratio $Medium\text{-}Sized_{it-1}$			-0.03	**(2.2)**		
Borrowing Ratio $Large\ Firms_{it-1}$			-0.03	**(2.5)**		
Borrowing Ratio $Quadratic_{it-1}/100$	0.94	**(2.5)**			-0.42	**(2.0)**
Borrowing Ratio Quadratic $Medium\text{-}Sized_{it-1}$ /100			1.0	**(2.5)**		
Borrowing Ratio $Quadratic\ Large_{it-1}/100$			0.8	**(2.6)**		
Return on $Investment_{it-1}$	1.95	(0.7)	1.9	(0.8)	1.88	**(2.2)**
Export Share	-0.54	(0.1)	-1.1	(1.3)	7.47	**(3.1)**
Standard Error	0.0013		0.0012		0.0015	
Serial Correlation AR1 (N(0,1))	-3.283		-3.646		-3.880	
Serial Correlation AR2 (N(0,1))	1.731		1.113		0.792	
Wald test of joint significance	X^2 (6) =364.5		X^2 (8) =325.90		X^2 (6) = 44.24	
Instrument validity	X^2 (56) =49.19		X^2 (87) =110.3		X^2 (256) = 235.7	

(i) Equations include 16 industry dummies and time dummies. There are 1660 observations in GMM and 2017 observations in SYS estimation.

(ii) All variables are treated as endogenous. Instruments include labourit-x, capitalit-y, wagesit-y, borrowing ratioit-y, borrowing ratio squaredit-y, where x=3,...,6, y=2,...,6, and non-gmm type instrument indclude export $price_{it-1}$, export $price_{it-2}$, import $price_{it-1}$, import $price_{it-2}$ and their squares.

(iii) The quadratic term is the product of borrowing ratio and the deviation of it from its mean.

4 Conclusions

We show evidence that liquidity constraints forced firms to cut employment and not necessarily in a way raising productivity. Wages do not adjust as rent sharing is relatively unimportant, a direct outcome of centralised wage bargaining. Liquidity constraints have not resulted in wage moderation, but liquidity constraints are the most important explanation for employment cuts. They explain one third to half of the mass unemployment during the recession. The deterioration of financial condition is explained by the worsening of cash flow and the cut down in investment induced by negotiations between banks and firms, and to lesser extent directly from the rise in interest paid on debt. Possible additional explanations for employment adjustment is labour hoarding and large cost in adjusting labour. But this also implies that very large cuts in employment are costly. Hence, the relation between employment and liquidity constraints become weaker as the level of liquidity constraints go up.

It is evident that despite the productivity increase, firms continue to stay after recession susceptible to financial constraints that affect the firm's performance and employment. The shock sensitivity of firms is measured in Table B.3 in Appendix B by the change in the number of firms, where value added covers wages, when wages are increased by 20%. It shows a value after the recession similar to before the recession. Quasi rent per labour is also at a lower level than before the recession, although net profits have improved, see Table B.1. However, better access to capital markets and

severe competition between banks limit the chance of controlling investment.

A Appendix A

We show the proof for the case where the firm is shedding labour. The proof for the case where the firm is hiring labour is analogous. $(u-B)(\bar{w}-U)$ Proceeding from the maximization of (1) shown in the text the FOC for wages w reduces to

$$\begin{aligned} 0 &= \alpha L\left(1-B\right)\left(1+x\frac{\partial B}{\partial w}\frac{a}{(1-B)^2}\right)\left[L(w-\hat{x})\right]^{-1} \qquad \text{(A. 1)} \\ &\quad -(1-\alpha-\beta)\left(1-B\right)\,LPR^{-1} \\ &\quad +\beta(1-B)\,\frac{\partial B}{\partial w}\,\frac{\delta K}{\left(1-B\right)^2}\left[Kr-K\frac{\delta}{1-B}\right]^{-1}-\frac{\partial B}{\partial w}\;\Leftrightarrow \\ 0 &= \alpha\frac{PR}{L}+\alpha\hat{a}BA \qquad \text{(A. 2)} \\ &\quad -(1-\alpha-\beta)\,\left(w-\hat{x}\right) \\ &\quad +\beta AB\,\frac{\delta}{r(1-B)-\delta}\left(w-\hat{x}\right)-AB\left(w-\hat{x}\right) \end{aligned}$$

where $\hat{x}\equiv x\frac{1-(1+a)B}{1-B}$, $\hat{a}=(\bar{w}-U)x\left(\frac{u-B}{1-B}-B\right)$ and the second equality emerges from multiplying by $\frac{PR}{1-B}(w-\hat{x})$ using $\frac{\partial B}{\partial w}\frac{PR}{1-B}=BL\frac{PR}{CF(1-B)}=BLA$, $A\equiv\frac{CF-rK}{CF-rK/\bar{\varepsilon}}$, since $\frac{\partial B}{\partial w}=\frac{BL}{CF}$ and $PR=\,CF(1-rK/CF)$. Substituting in (A. 2) $\frac{PR}{L}=\frac{\gamma F}{L}-w-r\frac{K}{L}$ gives (2) in the text. The FOC for labor input L reduces to

$$\begin{aligned} 0 &= \alpha\left(1-B\right)\left[w-\hat{x}+x\frac{\partial B}{\partial L}\frac{a}{(1-B)^2}\right]\left[L(w-\hat{x})\right]^{-1} \qquad \text{(A. 3)} \\ &\quad +(1-\alpha-\beta)\left(1-B\right)\,(\gamma F_L-w)PR^{-1} \\ &\quad +\beta\left(1-B\right)\frac{\partial B}{\partial L}\frac{\delta K}{\left(1-B\right)^2}\left[Kr-K\frac{\delta}{1-B}\right]^{-1}-\frac{\partial B}{\partial L}\;\Leftrightarrow \end{aligned}$$

$$
\begin{aligned}
0 &= \alpha\frac{PR}{L} - \alpha\hat{a}BA\frac{\gamma F_L - w}{w - \hat{x}} && \text{(A. 4)}\\
&\quad +(1-\alpha-\beta)\left(\gamma F_L - w\right)\\
&\quad -\beta BA\frac{\delta}{r(1-B)-\delta}(\gamma F_L - w) + BA\left(\gamma F_L - w\right)
\end{aligned}
$$

where the second equality emerges from multiplying by $\frac{\partial B}{\partial L}\frac{PR}{1-B} = -BA(\gamma F_L - w)$ using $\frac{\partial B}{\partial L} = -\frac{B(\gamma F_L - w)}{CF}$. The FOC for r is given by

$$
\begin{aligned}
&-(1-\beta)(1-B)K\,PR^{-1} - \frac{\partial B}{\partial r} && \text{(A. 5)}\\
&+\beta(1-B)\left(K - \frac{\partial B}{\partial r}\frac{\delta K}{(1-B)^2}\right)\left[Kr - K\frac{\delta}{1-B}\right]^{-1} = 0\\
&\quad \Leftrightarrow && \text{(A. 6)}\\
&-(1-\beta) - \varepsilon_r^B PR/rK + \beta\frac{PR/K\left(1 - B - \varepsilon_r^B\delta\right)}{r(1-B)-\delta} = 0 && \text{(A. 7)}
\end{aligned}
$$

where $\varepsilon_r^B = \frac{\partial B}{\partial r}\frac{r}{1-B} = \frac{K}{\bar{\varepsilon}CF}\frac{r}{1-B} = \frac{rK}{\bar{\varepsilon}PR}$ and the second equality emerges from multiplying by $\frac{PR}{1-B}\frac{1}{K} = A\frac{CF}{K}$. The FOC for capital input K reduces to

$$
\begin{aligned}
0 &= -(1-\beta)\left(1-B\right)\frac{\partial PR}{\partial K}PR^{-1} - \frac{\partial B}{\partial K} && \text{(A. 8)}\\
&\quad +\beta\left(1-B\right)\left[r - \frac{\partial B}{\partial K}\frac{\delta K}{(1-B)^2}\right]\left[Kr - K\frac{\delta}{1-B}\right]^{-1}\\
&= -(1-\beta)PR_K - \frac{\partial PR}{\partial K} && \text{(A. 9)}\\
&\quad +\beta(1-B)\frac{\partial\left[Kr - K\frac{\delta}{1-B}\right]/\partial K\; PR/K}{r(1-B)-\delta} && \text{(A. 10)}
\end{aligned}
$$

where $\varepsilon_K^B = \frac{\partial B}{\partial K}\frac{K}{1-B} = \frac{r-\bar{\varepsilon}\gamma F_K B}{\bar{\varepsilon}CF}\frac{K}{1-B} = \frac{rK-\bar{\varepsilon}\gamma F_K KB}{\bar{\varepsilon}PR}$, $\frac{\partial PR}{\partial K} = r - \gamma F_K B$, $\partial\left[Kr - K\frac{\delta}{1-B}\right]$ $/\partial K = r - \varepsilon_K^B \delta$ and the second equality emerges from multiplying by $\frac{PR}{1-B} = ACF$.

B Appendix B

Firm-level data

The data bank consists of the 500 biggest firms in sales and their balancing of their accounts in the years 1986-98. It was collected by Talouselämä magazine and maintained by ETLA (see Aalto 1993). Consistency and the requirement of information on firms for five successive years has reduced the maximum number of firms to 428. The number of firms in the unbalanced panel varies from a low of 218 in 1986 to a high of 370 in 1991. In the sample, the median output is 575 million markkas in 1995. (The lowest is 155 million markkas.) The border for middle-sized firms is below 40 million Ecus according to EU recommendations (240 million marks), and 55 of the 250 second-largest firms satisfy this requirement. Personnel in the second-largest firms (an average of 329) is around one-tenth of that in bigger firms (an average of 2917). The original division into 20 industries is reduced to 16 industries, combining textile and furniture industries, engineering (electronic and information technology industry), advertising and all service and keeping 14 multi-industry firms not allocated to other industries. Manufacturing firms total 47% of all firms, and 70% of all workers (the average of yearly total employment is 532 000). The value added per

capita and annual wages (in ten thousand markkas FIM90), quasi rent and capital per capita (in thousand markkas FIM90) are given in the following table.

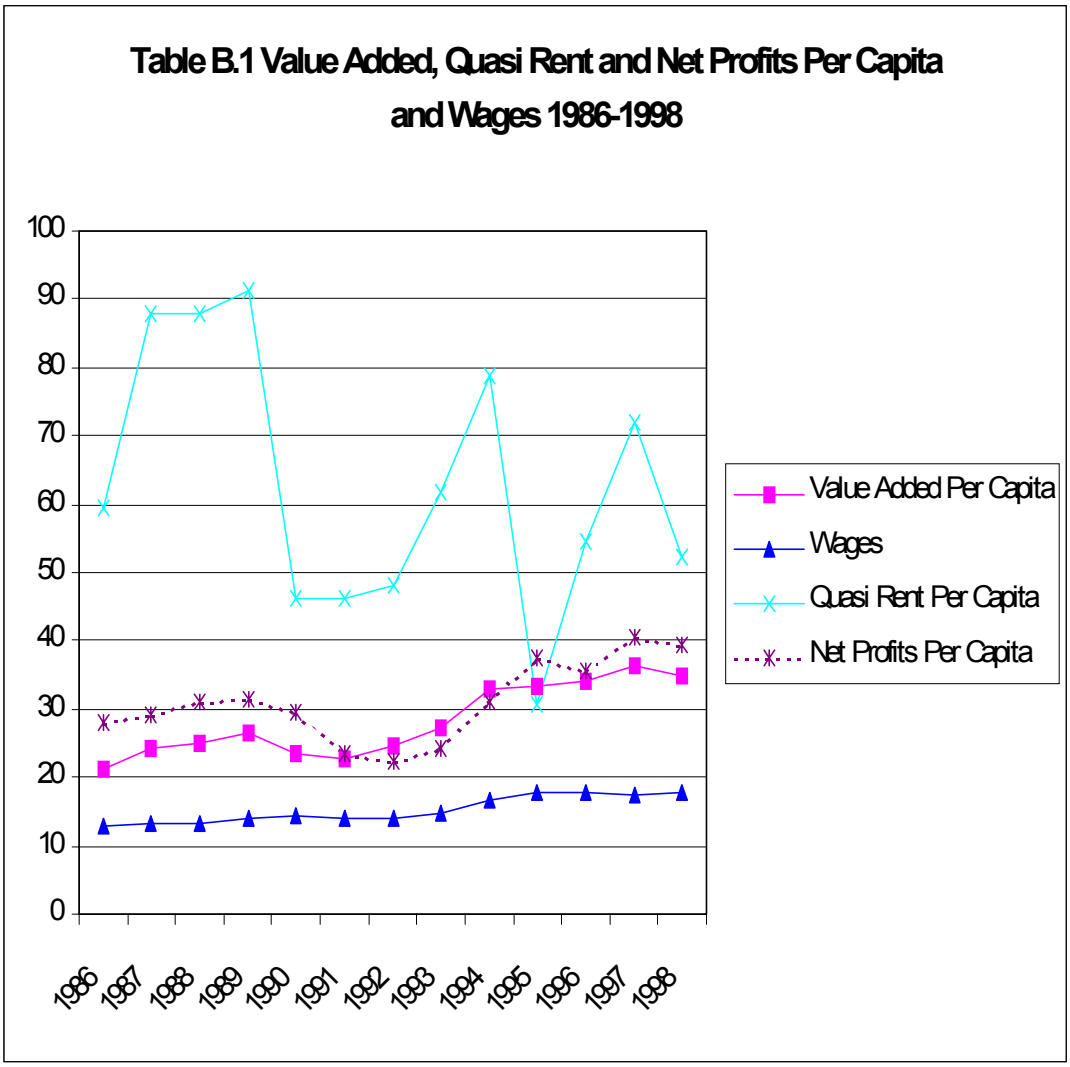
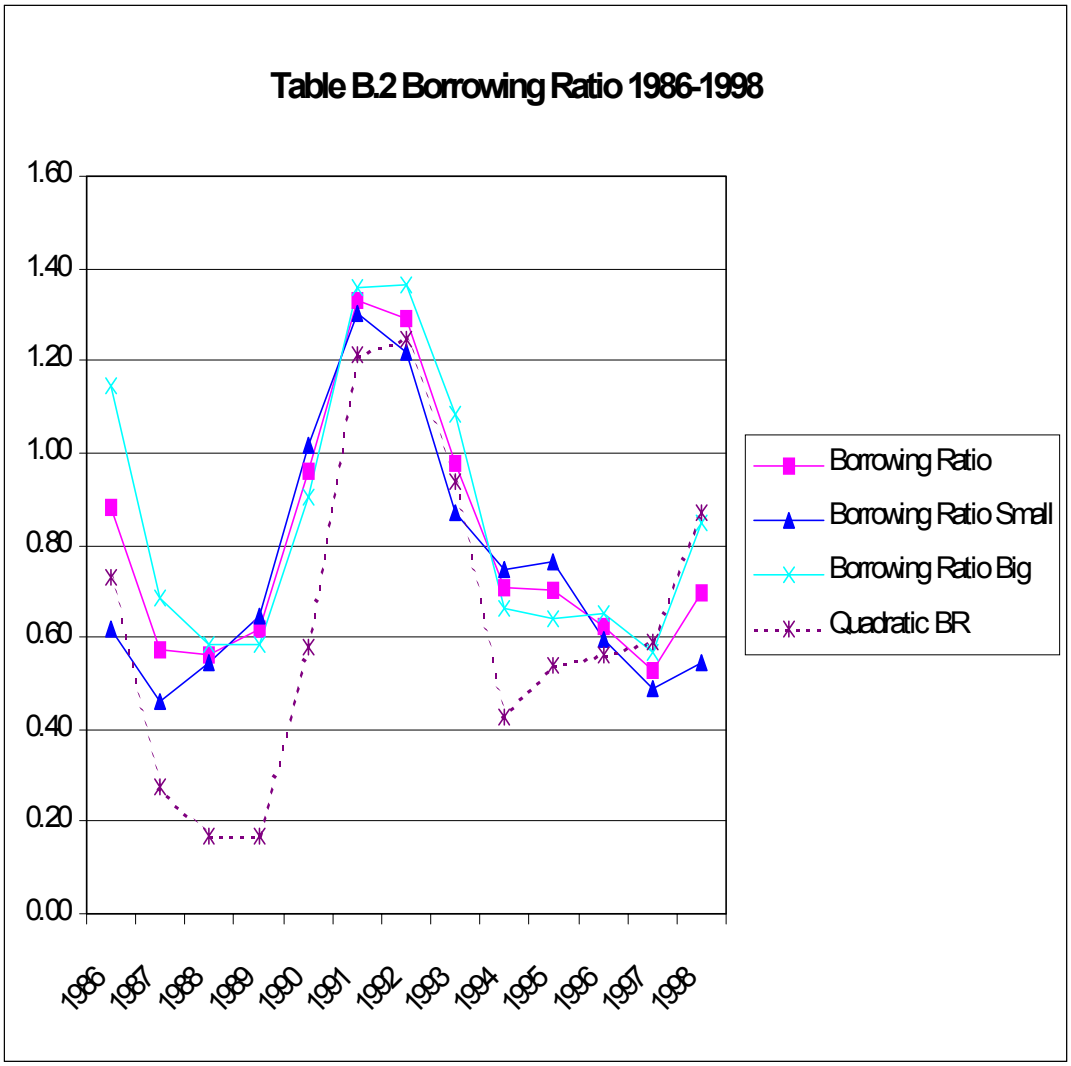


Table B.1 Value Added, Quasi Rent and Net Profits Per Capita and Wages 1986-1998
100
90
80
70
60
50
40
30
20
10
0
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
Value Added Per Capita
Wages
Quasi Rent Per Capita
Net Profits Per Capita

Figure 1:

The borrowing ratio, also depending on firm size, and the quadratic borrowing ratio term, showing deviation of borrowing ratio from overall average, are given by



The wage variable is wage expenses divided by the number of employees. The cash flow is the real profit plus assessed taxes. Capital stock k_{it} is obtained by using the working capital at the beginning of a period and then cumulating net investment using true economic depreciation and normalizing using the price index for plant

and machinery. Borrowing ratio uses the information available on average interest payments on interest bearing debt. This is usually missing in the first observation year so that the development of financial expenses per all debt is used to assess this. Market share $mksh_{it}$ is derived as in Nickell and Nicolitsas (1995). Return on investment RA_{it} is net profits plus net interest expenses divided by the firm's balance sheet less interest-free debt. (The balance sheet is the end-of-year figure and not the average, as usual.)

Industry level variables

Bankruptcy risk is the ratio of jobs lost through bankrupties in the industry to all jobs lost through bankruptcy in the year, Source: Enterprises, Statistics Finland. The producer prices are two-digit GDP deflators from the industry and wages are deflated by consumer prices, Source: Bulletin of Statistics, Statistics Finland.

Shock sensitivity

The shock sensitivity shows the percentage decline in firms for which value added covers wage expenses if wages are increased by 20%.

Table B.3 The Share of Firms where Valued Added Cover Wages

Year	1986	1987	1988	1989	1990	1991	1992
Wages	96	98	97	97	95	93	94
Wages up 20%	89	93	93	91	86	81	84
Difference	7	5	4	6	8	12	10
Year	1993	1994	1995	1996	1997	1998	
Wages	94	96	93	94	95	94	
Wages up 20%	89	92	87	89	92	88	
Difference	6	5	7	5	3	6	

The shock absorption measure is over 10 percentage points during the deepest recession of 1991-1992 and 3-7 percentage points thereafter which is fairly similar level to the level prevailing before recession.

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