



Centre of Excellence  
for Science and Innovation Studies

**CESIS** Electronic Working Paper Series

**Paper No. 169**

## **Are there Financial Constraints for Firms Investing in Skilled Employees?**

**Gustav Martinsson**

(CESIS and Division of Economics, Royal Institute of Technology)

January 2009

The Royal Institute of technology  
Centre of Excellence for Science and Innovation Studies (CESIS)  
<http://www.cesis.se>

# Are there Financial Constraints For Firms Investing in Skilled Employees?

Gustav Martinsson<sup>\*</sup>

## Abstract

This paper explores how financial constraints affect intangible investment for knowledge intensive and less capital intensive firms. In this paper, a knowledge intensive firm implies a firm supplying knowledge intensive services which requires the firm to hire highly educated employees. In economics investment is defined as the act of incurring an immediate cost in the expectation of future reward, which also fits to the hiring of skilled employees. Drawing advantage of unique firm-level data comprising all Swedish knowledge intensive consulting firms I conclude that the accessibility to adequate collateral significantly affects the relationship between employment and internal funds at the firm level. The accessibility of adequate collateral is more important in an economic downturn than in an expansion and more important for highly knowledge intensive consulting firms. In this paper I make a novel attempt to incorporate knowledge intensive services firms into the financial constraints literature.

JEL Classification: D52, D82, L84, O16

Keywords: Incomplete markets, asymmetric information, knowledge intensive business services, economic development

---

<sup>\*</sup>Comments from participants at the RESER 2008 Services conference workshops in Stuttgart and at a seminar at the Royal Institute of Technology are gratefully acknowledged.

I gratefully acknowledge financial support from the Swedish Governmental agency for Innovation Systems, Vinnova.

CESIS - Centre of Excellence in Science and Innovation Studies, and the Economics Department, at the Royal Institute of Technology, e-mail: [gustav.martinsson@infra.kth.se](mailto:gustav.martinsson@infra.kth.se).

# I Introduction

In this paper I take a first step towards incorporating less capital intensive and knowledge intensive firms<sup>2</sup> into the financial constraints literature. The financial constraints literature mostly deals with capital investment for manufacturing firms (see e.g. Fazzari et al (1988), Bernanke et al (1996), Chirinko & Schaller (1995), Devereux & Schiantarelli (1989), Gertler & Gilchrist (1993, 1994), Hoshi et al (1991), Semenov (2006) for international evidence). This approach is not as relevant for knowledge intensive firms since capital investments are not their primary source in order to obtain future growth. A knowledge intensive firm implies a firm supplying services which requires the firm to hire highly educated employees. In this paper the hiring of skilled employees is considered an investment, an intangible investment. In economics investment is defined as the act of incurring an immediate cost in the expectation of future reward, which also fits to the hiring of skilled employees.

The basic idea behind the impact of firm financial constraints is that there exists a shadow cost of uncollateralized external financing which can lead to under-investment (Hubbard (1998)). This implies that firms identifying investment opportunities are unable to fully seize these opportunities. Translating this to the reality of knowledge intensive firms implies that they cannot invest in the type of skilled employees which they believe are required to meet the demand of the future.

## A. Literature review

Alemida & Carneiro (2006) discuss the relatively little attention that intangible investment has received in the literature. They further emphasize how important it is to gain knowledge on the impact which credit market imperfections has on intangible investment.

There are pioneering analyses on financial constraints and intangible investment (Aghion et al (2005, 2007a, 2007b) and Hall (1992, 2002)) but they utilize R&D investment data which limit the analysis to firms which actually have R&D departments. However, many firms do invest in intangibles without having an R&D department. Black & Lynch (1996) and Chang & Wang (1996) analyze the firm's decision to hire highly educated employees as a human capital

---

<sup>2</sup> Knowledge intensity is defined as the total number of employees with a university education exceeding three years divided by all employees at the firm. The median consulting firm of the sample has a knowledge intensity of 0.44.

investment. Put simply, firms choose the more expensive input, which a highly educated employee is compared to a less educated employee, based on the expectation that it will generate excess future revenue. But, it is difficult to evaluate the rate of return of this type of investment (see Blundell et al (1999)) as compared to capital investment.

Modigliani & Miller (1958) suggest that internal and external finance are perfect substitutes and therefore investment opportunities govern investment. In reality, this is rarely the truth and external finance is often more expensive than internal. The premium which firms have to pay on external finance is an increasing function of, among factors, information asymmetries (see Löfgren et al (2002) for a survey) and moral hazard-related issues. Problems regarding information asymmetries are exacerbated for intangible investment compared to capital investment which, all else equal, increases the cost of external finance. If external finance is fully collateralized, then external and internal finance are perfect substitutes (Bernanke et al (1996), Kiyotaki & Moore (1997)), implying that collateral mitigate the negative impact of information asymmetries.

There is also a size dimension which is relevant. Large firms tend to be less financially constrained than small firms (Gertler & Hubbard (1989), Gertler & Gilchrist (1994)). Knowledge intensive consulting firms are in general smaller than manufacturing firms.

They are also less capital intensive. Manufacturing firms are more capital intensive which make them more vulnerable to external credit access but they also possess collateralizable assets within its production which the less capital intensive knowledge intensive consulting firms do not. Therefore it is difficult to say if knowledge intensive consulting firms are more or less affected by financial constraints.

Hall et al (2000) analyze capital structure issues for small and medium sized unquoted UK firms. These firms, in general, only have two possible financing sources, internal equity or external debt (Internal equity in the shape of retained earnings and external debt through bank loans). The knowledge intensive firms of this paper are predominately small and therefore they are most likely restricted to these two types of funds.

Binks & Ennew (1996) discuss financial constraints for small firms. They highlight the importance of collateral as to mitigate information asymmetries alleviating the access to bank

debt. However, banks prefer private collateral over firm collateral, but most entrepreneurs are reluctant to post private collateral (see also Reid & Jacobsen (1988)). Binks & Ennew (1996) argue, based on the survey which their paper builds on, that machinery is not a preferred source of collateral (or that machinery is in many cases not even viable as collateral for small firms). The secondary market for machinery is illiquid and when banks need to liquidate collateral, mostly in recessions, from insolvent firms the demand for machinery is usually low or non-existent.

## **B. Outline of the paper**

Since the perspective of this paper is novel I present the course of action in bullet-form to give a clear view of what I actually do in this paper.

- In this paper I investigate the knowledge intensive consulting sector from a financial constraints perspective, viewing the hiring of skilled employees as an intangible investment, drawing advantage of unique firm-level data comprising all Swedish knowledge intensive consulting firms during 1997-2004.
- The firms analyzed are in general small (median employment of 1-99) which implies that the choice of financing source usually comprises internal equity and external bank debt.
- Firms with book value of real estate and/or land assets are considered as to possess adequate collateral. Firms with adequate collateral are assumed to be able to access external credit more favorably.
- In order to test if firms with and without adequate collateral differ in terms of employment development I view sales as a measure of the availability of internal funds at the individual firm. The employment-sales correlation is compared between firms with and without adequate collateral. Firms with adequate collateral are expected to be less dependent on business conditions in order to invest in skilled employees since they are considered to be able to compensate waning flows of internal funds with external credit.
- The empirical analysis tests if firms with and without collateral have different employment-sales correlations. The group of firms with the highest correlation is considered to be less financially constrained (see Kaplan & Zingales (1997) for the same interpretation but for capital investment and cash flow). To summarize, Kaplan & Zingales (1997) argue that

firms with high investment-cash flow correlation do not have as many previous liabilities, such as costly debt, to pay off before they can consider investing.

- The empirical analysis shows that firms with adequate collateral have about 60 percent higher employment-sales correlation than firms without.
- The result from above is stronger in an economic downturn and less pronounced in an expansion. The results are also more pronounced for the firms above the median in terms of knowledge intensity.
- The main contribution of this paper is the application of the financial constraints literature by treating the hiring of skilled employees as an investment, to a knowledge intensive sector, a segment of the economy which is up to this point omitted from this literature.
- The paper is organized as follows. Section II presents the unique data set and some preliminary estimation. Section III describes the estimation strategy and how the results are interpreted drawing advantage of the implications of Kaplan & Zingales (1997). Section IV comprises the empirical results and all robustness checks. Section V concludes.

## II Data

In A the data and subsequently the sample of the paper is presented. In B I present a comparison of the results of the analysis in Martinsson (2008) obtained on manufacturing firms, where I explore the impact of firm collateral on the firm's knowledge intensity, to the knowledge intensive consulting sample of this paper. This was my initial test I conducted and which made me intrigued to pursue the approach of firm financial constraints for knowledge intensive firms.

### A. The sample

This paper utilizes data collected from two datasets provided by Statistics Sweden. The firm level database (FS), which is balance sheet data, is used to collect information on firm characteristics such as sales, capital, collateralizable assets, equity and debt. Information on knowledge intensity and employment is collected from the Swedish firm level employment database (RAMS). These two databases contain all Swedish firms during the period 1997-2004.

The sample comprises the consulting sector (SIC 72 and 74) which is the largest segment of the knowledge intensive business services (KIBS)-sector. The knowledge intensive consulting sector is the least capital intensive and the most knowledge intensive segment of the KIBS-sector.

The sample selection procedure is conducted identically as in Martinsson (2008) where manufacturing firms with and without adequate collateral is compared. Designing the sample here identically to the sample of Martinsson (2008) enables me to compare the results of the knowledge intensive consulting firms to the manufacturing sample.

The first step of the sample selection procedure is that median employment must be at least one but may not exceed 99. The firm must have had at least one employee with a university education exceeding three years. The sample is also corrected for statistical and economical outliers. The final sample contains about 23,500 firms and a total of about 100,000 observations which are compiled in table 1.

The indicator variable of adequate collateral is designed as a binary variable assigning 1 if the firm has had at least half of its observations reporting book value of real estate and/or land assets (See Gan (2007) for a discussion on land and real estate as the primary source of collateral).

[Table 1 about here]

The distribution of firms with collateralizable assets is evenly distributed across sub-sectors (at the SIC 5-digit level) within the consulting sector implying that the results are not biased toward a specific segment of consulting firms.<sup>3</sup> Based on table 1 there are no clear distinctions between firm-year observations with and without adequate collateral. The firms analyzed are small, the average firm has sales of SEK 7,151,000 and between 6 and 7 employees, with about half of the employees having a university education exceeding three years.

By looking at the median firm of the knowledge intensive consulting sector and the manufacturing sector and then taking the average over the sample period I can present a preliminary view of the differences of the typical firm of each sector. In terms of knowledge intensity, the consulting sector has a 0.44 intensity compared to 0 for the typical manufacturing firm. The typical consulting firm has a capital intensity of SEK 32,000 compared to SEK 58,000 for its manufacturing counterpart.<sup>4</sup>

Capital structure plays an important role. The average median manufacturing firm across the sample period has a 0.70 leverage<sup>5</sup> ratio, with a short debt-long debt ratio of about 3. The same for the whole knowledge intensive consulting sector is leverage of 0.60 and short debt-long debt ratio of about 2.5. By exploring consulting firms with and without adequate collateral there is some difference. The leverage ratio is unchanged around 0.60 for firms with and without collateral. In terms of debt composition firms with adequate collateral have short debt-long debt ratio of about 2.5 whereas firms without collateral have a corresponding ratio of 250. The comparison of debt structure suggests that firms with adequate collateral can access credit more favorably than firms without. It seems unlikely that firms without adequate collateral simply prefer short-term debt over long-term debt. Gan (2007) argue that collateral is the key decider if firms are to obtain long-term, or relational, debt from banks. He further refers to long-term debt as cheaper based on the lower interest rates cost attached to them. This is some preliminary evidence of the financial constraints of consulting firms lacking adequate collateral.

## **B. Manufacturing firms vs. consulting firms**

First of all, is adequate collateral more important for manufacturing firms or for consulting firms? At a first glance there are two factors where one of them speaks in favor of manufacturing

---

<sup>3</sup> The list of consulting sub-sectors at the 5-digit level is available upon request.

<sup>4</sup> These capital intensities converted into US dollars at a spot rate of 8 SEK/\$ is \$4,000 for knowledge intensive consulting firms and subsequently \$7,250 for manufacturing firms.

<sup>5</sup> Leverage is defined as short debt plus long debt divided by total assets (Rajan & Zingales (1995)).



firms and one in favor of consulting firms. (1) The more capital intensive nature of manufacturing firms which in general make them more likely to require external capital, which in turn increase their need of adequate collateral in order to lower the external finance premium. (2) But on the other hand manufacturing firms possess more tangible assets as a result of their capital intensive nature compared to knowledge intensive consulting firms. Another aspect which most likely increase the need for adequate collateral for consulting firms is the information aspect. It is probably a greater risk that the lenders do not fully grasp the business idea for which the consulting firm seeks financing for as compared to the investment in new plant or machinery.

In Martinsson (2008) manufacturing firms with collateral display a counter-cyclical response to sales variation (i.e.  $(\beta^{KI} + \gamma^{KI})$  is negative) whereas firms without collateral display a pro-cyclical response ( $\beta^{KI}$ -estimate positive). These results imply that firms with collateral can borrow externally, as earnings are reduced by declining sales, which enables the counter-cyclical response. These results corroborate with previous results obtained on R&D investment, see e.g. Aghion et al (2005, 2007a). Below is the specification submitted for estimation:<sup>6</sup>

$$K.I_{i,t} = \zeta + \phi^{KI,1} K.I_{i,t-1} + \phi^{KI,2} K.I_{i,t-2} + \beta^{KI} \ln(Sales_{i,t}) + \gamma^{KI} \ln(Sales_{i,t}) * \\ \bullet \text{ Collateral} + \mu_t + v_i + \varepsilon_{i,t}$$

The above specification is run with ordinary least squares (OLS), within, and “Difference” and “System” general methods of moments (GMM) estimation.

[Table 2 about here]

As Arellano & Bond (1991) suggest I use the one-step estimates for inference since it controls for heteroscedasticity and also that they are not plagued with finites sample bias which potentially could be the case with the two-step estimates. A similar pattern as for the manufacturing firms is present for the knowledge intensive consulting firms as suggested by both “difference” and “system” GMM. The “system” GMM estimates display a positive correlation between sales and knowledge intensity for firms without collateral. Whereas  $\gamma^{KI}$  turns the overall effect for firms with collateral negative thus suggesting that sales and knowledge intensity is negatively correlated.

---

<sup>6</sup> The specification has been run without lags of the dependent variable and with one lag but it was not until two lags of the dependent variable that the specification became clear of autocorrelation.

The conclusion of Martinsson (2008) builds on the fact that the different pattern, as presented above, of firms with and without adequate collateral come from their different access to external credit. A firm more reliant on that its sales generate sufficient funds to finance its operations is more likely to display a pro-cyclical knowledge intensity-sales relationship. Whereas firms which are able to keep their more expensive employees when sales wane, i.e. displaying a counter-cyclical knowledge intensity-sales relationship, can do that based on their better access to credit.

Based on the similar results between consulting and manufacturing firms indicate that adequate collateral is important for less capital intensive firms as well.

### III Estimation strategy and interpretations

In A I give a brief description on the choice of estimation method. I present how the results of the estimation is interpreted drawing advantage of the seminal paper by Kaplan & Zingales (1997).

#### A. Dynamic panel data estimation

It is not straightforward to estimate a regression with firm-level data in a dynamic context. In this paper employment serves as dependent variable, and Arellano & Bond (1991) point to the persistence of employment and how that could create problems in terms of estimation.

When a time series is persistent it probably needs to be modeled as an autoregressive series. In order to illustrate and explain the estimation strategy of this paper, consider the following simple autoregressive series with additional covariates:

- $Y_{i,t} = \delta Y_{i,t-1} + \theta X_{i,t} + \eta_{i,t}$
- $\eta_{i,t} = \xi_i + \varepsilon_{i,t}$

The error term  $\eta$  comprises a time invariant and a time variant component.

Applying ordinary least squares (OLS) estimation provides inconsistent estimates because of the negative correlation between  $Y_{i,t-1}$  and the time invariant component of the error term. Within estimation may be consistent if the sample covers a long time period. As Nickel (1981) shows, if the panel contains many observations but covers few time periods, a so called “small T, large N” panel, the fixed effects component is positively correlated with  $Y_{i,t-1}$  and thus yields biased estimates. Another problem of utilizing within estimation is that it requires strictly exogenous covariates, and it is not likely to find strictly exogenous covariates when using economic firm-level data (Bond (2002)).

Generalized method of moments (GMM) estimation is supposed to correct for the biases which arise from applying OLS or within estimation to dynamic panels. Arellano & Bond (1991) develop and test “difference” GMM which transforms the specification above through differencing which wipes out the time invariant component of the error term. Estimation is performed instrumenting the dependent variable and the predetermined variables with lagged

levels, and instrumenting the strictly exogenous variables with differences. The instrumentation procedure is conducted in order to deal with endogeneity and simultaneity biases. There are however a drawback with “difference” GMM. If the panel is unbalanced with gaps (as the sample of this paper is) the differencing procedure reduces the sample size and potentially important information is lost.

Instead, “System” GMM has some advantages over the “difference” GMM procedure. “System” GMM proposed by Arellano & Bover (1995) and Blundell & Bond (1998) utilizes another type of transformation, the so called “forward orthogonal deviations” transformation. The transformation of “System” GMM subtracts the averages of all future observations of the variable instead of subtracting the previous observation from the contemporaneous as in “differencing” GMM. “System” GMM also allows for additional instruments since it builds on the assumption that first differences of instruments are uncorrelated with the fixed effects. Therefore “System” GMM builds a system containing both the original level equation and a differenced equation.

## **B. How to interpret the estimation results**

Kaplan & Zingales (1997) re-estimate the capital investment-cash flow relationship for US manufacturing firms first estimated in Fazzari et al (1988). In Fazzari et al (1988) a firm’s likelihood of being financially constrained is based on their dividend policy. Fazzari et al (1988) conclude that firms less likely to be financially constrained have a low capital investment-cash flow correlation (or sensitivity as they call it). They argue that it is a plausible conclusion since the low correlation implies that since they are not financially constrained, they are not as dependent of current business conditions. Subsequently, firms with a high capital investment-cash flow correlation are considered more financially constrained.

Kaplan & Zingales (1997) criticize the results obtained by Fazzari et al (1988).<sup>7</sup> They argue that the results should be interpreted the other way around. Kaplan & Zingales (1997) use the sample of financially constrained firms from Fazzari et al (1988) and estimate the capital investment-cash flow correlations. Their estimation suggests that the firms suggested by Fazzari et al (1988) to be most likely financially constrained displayed the highest capital investment-cash flow correlations. Kaplan & Zingales (1997) complement their regression results by examining each of

---

<sup>7</sup> They do not just simply criticize the interpretation of the results they are also critical of how they actually analyze financial constraints. I omit that part of Kaplan & Zingales (1997). The latter critique is controversial and in Fazzari et al (2000) they counter the critique received in Kaplan & Zingales (1997, 2000).

their firm-year observations' annual reports and they draw the conclusion that firms with high capital investment-cash flow correlations are less financially constrained. They argue that if a firm displaying a high correlation between capital investment and cash-flow implies that the firm is not plagued by too many troublesome liabilities and bad debt. Since debt financing implies giving up cash flow rights, having too much debt payments seriously dampens the cash flow to capital investment channel.

As suggested in the introduction section it is not as relevant to examine capital investment for knowledge intensive consulting firms, instead this paper focuses on the hiring of highly educated employees.

Firms without adequate collateral are more likely to face a higher shadow cost of external finance since adequate collateral lowers this cost. Therefore firms without collateral are more likely to be plagued by bad debt repayments as a consequence. Based on this, the estimation carried out in section IV tests if the possession of adequate collateral yields the same difference of correlations as in Kaplan & Zingales (1997), but for employment and sales.

## IV Employment-sales specification

### A. Specification

The following specification is used in order to calculate employment-sales correlations.<sup>8</sup>

$$\ln(E_{i,t}) = \alpha + \phi \ln(E_{i,t-1}) + \beta \ln(Sales_{i,t}) + \gamma \ln(Sales_{i,t}) * Collateral + \mu_i + u_i + \varepsilon_{i,t}$$

I wish to capture the effect of sales on employment; additionally I want to test if the employment-sales correlation for firms with adequate collateral is different. In order to properly capture these effects I apply a dynamic specification with lagged employment as explanatory variable, firm fixed effects, and a full set of time dummies. The  $\gamma$ -parameter corresponding to the interaction term tests formally if firms with or without collateral have a different employment-sales correlation. The interpretation of  $\gamma$  is how much does the employment-sales correlation of firms with collateral deviate from  $\beta$ , i.e. the response for firms without collateral.

Bond (2002) and Roodman (2006) propose a way to draw advantage of the inconsistent estimates of OLS and within estimation. Since OLS provides upward biased estimates of the lagged dependent variable and within estimation with downward biased estimates, a good benchmark for a consistent specification is to fall in between the OLS and within estimates.

The GMM estimation procedures presented in section III rests on the assumption that the idiosyncratic errors are uncorrelated and for that reason it is recommended to include time dummies (Roodman (2006)).

I estimate and report both one-step and two-step GMM estimation. The one-step estimation uses robust standard errors which controls for heteroscedasticity, as compared to two-step estimation which only deals with the homoscedasticity case resulting in downward biased standard errors. For this reason Arellano & Bond (1991) recommend one-step estimation for inference. The two-step estimates are run mainly because it enables me to test the validity of the instruments using the Sargan test of over-identification of Sargan (1958) which is only available

---

<sup>8</sup> The  $\ln(\text{sales})$  variable is treated as predetermined. If  $E[x_{i,t} \varepsilon_{i,s}] \neq 0$  for  $s < t$  but  $E[x_{i,t} \varepsilon_{i,s}] = 0$  for all  $s \geq t$ , the variable is considered predetermined. In other words,  $\ln(\text{sales})$  may be correlated with previous realizations of the idiosyncratic error term.

for the homoscedasticity case. The one-step estimates are also preferred over the two-step estimates since they are less likely to be plagued with finite-sample bias.

## B. Results

Table 3 provides the regression results. This specification was also run with two lags of the dependent variable. The second lag turned out to be non-significant and it did not improve the test statistics which made me choose the one lag structure for the dependent variable.<sup>9</sup>

[Table 3 about here]

The results from the “system” GMM considering the lagged dependent variable falls in between the OLS and within estimates as it should. The “difference” GMM estimate is almost identical to the within estimate implying downward biased results. However, the “difference” GMM does not reject the null hypothesis of autocorrelation while “system” GMM does so.

The  $\beta$ -estimate is as expected positive and rather large. The robust one-step “system” GMM estimate of  $\beta$  is 0.383. Interestingly the  $\gamma$ -estimate is as large as 0.219. These results suggest that firms with collateral have an employment-sales correlation of 0.60 while firms without adequate collateral have a corresponding correlation of 0.383. Since the median firm of the two sub-samples, presented in table 1, appear to be identical the magnitude of the difference in terms of employment-sales correlation is somewhat surprising.

The specification above was also run with different controls in order to check the sensitivity of the obtained estimation results.

The estimation was also considered in difference form. Differencing, however, further add to the small T problem mentioned in section III. Switching the level values of the above specification to first differences of the same variables yielded qualitatively similar results.

The choice to utilize sales as a measure of the availability of internal funds is forced by the dataset. A proper cash flow variable is not available. However, I constructed a gross profit

---

<sup>9</sup> The results from the regressions with two lags of the dependent variable are not included in the paper due to space limitation but they are available upon request.

variable via subtracting wage expenditure from value added. Substituting the sales variable with the gross profit variable lead to almost identical results.<sup>10</sup>

I considered a lag structure of sales (and gross profit) but it did not alter the results either. In order to rule out that it is not actually capital intensity of the individual firm that really drive the results I controlled for capital intensity. The firm's capital stock was added as contemporaneous and first lag of capital and capital per employee which left the results unchanged. I conducted the same procedure with total assets also, contemporaneous and lagged, not altering the results either.

The employment-sales correlations are further evaluated in C.

## C. Sample splits

I further check the estimation via four sample splits. I split based on time (i.e. business conditions), investment opportunities, knowledge intensity, and leverage respectively. The last three sample splits are made based on locating the median firm and splitting the sample in half.

### C.1 The impact of business conditions

The Swedish economy has grown rapidly during the first half of the sample period, 1997-2000, but growth slowed down after the burst of the dot-com bubble. Therefore the employment-sales correlation can be explored by dividing the sample into one ranging from 1997-2000, and the other sub-sample subsequently from 2001-2004. This procedure enables me to explore the importance of collateral in an expanding economy versus a considerably slower growing economy.

In this section I build upon the discussion of Hubbard (1998, pp. 195-198). In an environment with information asymmetries there is a shadow cost of uncollateralized external financing which could lead to under-investment. I argue that in a growing economy investment opportunities govern the allocation of capital which mitigate the shadow cost of uncollateralized external financing. Therefore I expect that the employment-sales correlation difference to be less pronounced in the sample containing the 1997-2000 observations.

---

<sup>10</sup> The correlation of sales and gross profit is 0.85, so it is not very surprising.



In an economy of less growth there are fewer investment opportunities and the risk for lenders such as banks increases. This leads to the shadow cost of external financing increasing. Therefore I predict the employment-sales correlation to be more pronounced in the 2001-2004 sample.

In this section I just present the one-step system GMM estimation results.

[Table 4 about here]

The results fall in line with predictions. During 1997-2000 there is a statistically significant estimate for the interaction between sales and collateral but the low z-value is too low to gain economic significance from when the sample is large. On the other hand the overall employment-sales correlation is 0.466, which is substantially higher than for the full sample.

In the 2001-2004 sample the employment-sales correlation is heavily pronounced as compared to the overall sample results in A. In the full sample the employment-sales correlation of firms without collateral is 0.383. In the 2001-2004 sample the corresponding estimate is 0.347. The additional estimate for the firms with collateral is 0.256, which is higher than for the full sample. This leads to the difference between firms with and without collateral diverging. Firms with collateral have employment-sales correlation of 0.603 which translates into 74 percent higher correlation than firms without collateral.

## **C.2 Investment opportunities**

This sample split is based on a measure proposed in Griliches (1969). It is called the gross rate of return on capital (GRR). GRR is calculated as the gross profit of the firm, expressed as value added minus its payroll, divided by the capital stock, i.e. the ratio of gross profit per unit of capital.

Q is usually utilized to measure firm investment opportunities, but q is not a feasible option when dealing with non-publicly traded firms. Left out to book value entities I argue in favor of the GRR measure as a proxy for investment opportunities, implying that firms with a high GRR ratio are facing investment opportunities to a greater extent than firms with a low GRR. From a lender's point of view a firm with high GRR is more likely to be able to repay its debt since it is profitable in relation to its capital.

I predict that firms above the median in terms of GRR are not in need of collateral to the same extent as firms in the below median sample since funds are supposed to be channeled to firms with investment opportunities.

Table 5 contains the results from the sample splits. The results displayed in table 5 are the one-step “system” GMM estimates.

[Table 5 about here]

The above GRR sub-sample estimated  $\gamma^{A.GRR}$  at -0.014<sup>11</sup>, but it is only significant at below 10 percent with a z-value of -2. This cannot be considered an overwhelming result based on the large sample. On the other hand the below median GRR sub-sample provides a strongly significant parameter estimate of  $\gamma^{B.GRR}$ , at 0.216.

The above median GRR sub-sample displays surprisingly different results than for the full sample. The low value of the estimate of the lagged dependent variable is particularly surprising suggesting that firms with high GRR are less persistent in terms of employment. The low z-value of  $\gamma^{A.GRR}$  is inline with expectations.

The firms of the above median sample share similar employment-sales correlation regardless collateral. Firms in the below median sample appear to face a similar impact of collateral as for the full sample.

### C.3 Knowledge intensity

It is interesting to explore if firms with more expensive and educated employees display different employment-sales correlations.

The above median sub-sample has a smaller  $\beta^{A.KI}$ -estimate than the firms of the below median sub-sample.<sup>12</sup> Highly knowledge intensive firms without collateral have a employment-sales correlation of 0.311 (see table 5). The highly knowledge intensive firms has a greater difference

---

<sup>11</sup> The notation A.GRR and B.GRR indicate that the estimate is from either the above or below median sample split based on GRR.

<sup>12</sup> The notation for knowledge intensity is identical as in the GRR sample split.

between firms with and without collateral. The employment-sales correlation for firms with collateral is 0.462 (0.311+0.151), implying that the employment-sales correlation for firms with collateral is 49 percent higher than for firms without collateral. For the below median sample in terms of knowledge intensity the  $\gamma^{B.KI}$ -estimate is again displaying a small z-value of only 3. However, the  $\beta^{B.KI}$ -estimate is as large as 0.443.

Based on splitting the sample on knowledge intensity the conclusion is that highly knowledge intensive firms have lower employment-sales correlation than less knowledge intensive firms. On the other hand if highly knowledge intensive firms have collateral they display similar employment-sales correlation as the less knowledge intensive firms.

#### C.4 Leverage

Finally the sample is split based on firm leverage. Firms with high leverage are considered to have better access to external credit than firms with a low leverage ratio. Of course, a too levered firm could be a case of an insolvent or unsuccessful firm.

For the above median leverage sub-sample the  $\beta^{A.Lev}$ -estimate is 0.478 (see table 5). The  $\gamma^{A.Lev}$ -estimate is significant but with a low z-value, below 3. For the below median sub-sample the  $\beta^{B.Lev}$ -estimate is small at 0.285 implying that firms with poor credit market access have a lower employment-sales correlation. However firms with collateral in the below median sub-sample have a significantly higher employment-sales correlation. The  $\gamma^{B.Lev}$ -estimate is estimated at 0.17 (with a z-value of 9) suggesting that firms with collateral in this sub-sample have a employment-sales correlation of 0.455.

Consulting firms with high leverage and with low leverage and collateral have similar employment-sales correlation.

## V Conclusion

In this paper I examine financial constraints for knowledge intensive and less capital intensive firms. There exist a clear difference in terms of employment-sales correlation between knowledge intensive consulting firms possessing adequate collateral and those which do not. This difference is exacerbated in a slow growing economy compared to a fast growing economy which is probable. In a growing economy, lenders seek more aggressively to gain return on their capital and there are also more investment opportunities. When the economy slows down the lenders become more reluctant to lend. Also, the risk of default is higher in a slowing economy.

The difference is also higher when comparing highly knowledge intensive firms to the less knowledge intensive ones. These results are in line with the literature which emphasize the need to hold tangible assets in order to mitigate information asymmetries when investing in intangibles.

This paper suggests a way to examine for financial frictions in the context of knowledge intensive firms. I differentiate based on collateral and argue that adequate collateral is important since it leads to more favorable debt contracts which enables a higher correlation between the internal funds measure and employment (the intangible investment). The results obtained are validated via numerous robustness and sensitivity checks.

The financial constraints literature needs to expand and consider more than manufacturing firms and firms with an R&D department, this is my contribution.

## References

- [1] Aghion, P., Angeletos, G-M., Banerjee, A. & Manova, K. (2005). "Volatility and Growth: Credit Constraints and Productivity-Enhancing Investment", NBER Working Papers 11349.
- [2] Aghion, P., Askenazy, P., Berman, N., Cetto, G. & Eymard, L. (2007a). "Credit Constraints and the Cyclicalitv of R&D Investment: Evidence from France", Working Paper 2007-4, Weatherhead Center of International Affairs.
- [3] Aghion, P., Fally, T. & Scarpetta, S. (2007b). "Credit Constraints as a Barrier to the Entry and Post-entry Growth of Firms, *Econ Policy*, Vol. 22, pp. 731-779.
- [4] Almeida, R. & Carneiro, P. (2006). "The Return to Firm Investment in Human Capital", World Bank Policy Research Working Paper 3851.
- [5] Arellano, M. & Bond, S. (1991). "Some tests of specification of panel data: Monte Carlo evidence and an application to employment equations", *Review of Economic Studies*, Vol. 58, pp. 277-297.
- [6] Arellano, M. & Bover, O. (1995). "Another look at the instrumental variables estimation of error-components models", *Journal of Econometrics*, Vol. 68, pp. 29-51.
- [7] Bernanke, B., Gertler, M. & Gilchrist, S. (1996). "The Financial Accelerator and the Flight to Quality", *Review of Economics and Statistics*, No. 78, pp. 1-15.
- [8] Binks, M. R. & Ennew, C. T. (1996). "Growing Firms and the Credit Constraint", *Small Business Economics*, Vol. 8, pp. 17-25.
- [9] Black, S.E. & Lynch, L.M. (1996). "Human-Capital Investments and Productivity", *American Economic Review*, Vol. 86, No 2, pp. 263-267.
- [10] Blundell, R. & Bond, S. (1998). "Initial Conditions and Moment Restrictions in Dynamic Panel Data Models", *Journal of Econometrics*, Vol. 87, pp. 115-143.
- [11] Blundell, R., Dearden, L., Meghir, C. & Sianesi, B. (1999). "Human Capital Investment: The Returns from Education and Training to the Individual, the Firm and the Economy", *Fiscal Studies*, Vol. 20, No 1, pp. 1-23.

- [12] Bond, S. (2002). "Dynamic panel data models: A guide to micro data methods and practice", Portuguese Economic Journal, Vol. 1, pp. 141-162.
- [13] Bond, S. Harhoff, D. & Van Reenen, J. (2003). "Investment, R&D and financial constraints in Britain and Germany", LSE Research Online, <http://eprints.lse.ac.uk/771/>.
- [14] Chang, C. & Wang, Y. (1996). "Human Capital Investment and Asymmetric Information: The Pigovian Conjecture Revisited", Journal of Labor Economics, Vol. 14, No 3, pp. 505-519.
- [15] Chirinko, R. S. & Schaller, H. (1995). "Why does Liquidity Matter in Investment Equations?", Journal of Credit, Money and Banking, Vol. 27, pp. 527-548.
- [16] Devereux, M. & Schiantarelli, F. (1989). "Investment, Financial Factors, and Cash Flow in Asymmetric Information, NBER Working Paper 3316.
- [17] Fazzari, S. R., Hubbard, R. G. & Petersen, B. (1988). "Financing Constraints and Corporate Investment", Brookings Paper on Economic Activity, No 1, pp. 141-206.
- [18] Fazzari, S. R., Hubbard, R. G. & Petersen, B. (2000). "Investment-Cash Flow Sensitivities are Useful: A Comment on Kaplan and Zingales", Quarterly Journal of Economics, Vol. 115, pp. 695-705.
- [19] Gan, J. (2007). "Collateral, Debt Capacity, and Corporate Investment: Evidence from a Natural Experiment", Journal of Financial Economics, Vol. 85, pp. 709-734.
- [20] Gertler, M. & Hubbard, R. G. (1989). "Financial Factors in Business Fluctuations", NBER Working Papers 2758.
- [21] Gertler, M. & Gilchrist, S. (1993). "The Role of Credit Market Imperfections in the Monetary Transmission Mechanism: Arguments and Evidence", Scandinavian Journal of Economics, Vol. 95, pp. 43-64.
- [22] Gertler, M. & Gilchrist, S. (1994). "Monetary Policy, Business Cycles, and the Behavior of Small Manufacturing Firms", Quarterly Journal of Economics, Vol. 59, pp. 309-340.

- [23] Griliches, Z. (1969). "Capital-Skill Complementarity", *Review of Economics and Statistics*, Vol. 51, No 4, pp. 465-468.
- [24] Hall, B. (2002). "The Financing of Research and Development", NBER Working Papers 8773.
- [25] Hall, G., Hutchinson, P. & Michaelas, N. (2000). "Industry Effects on the Determinants of Unquoted SMEs' Capital Structure", *International Journal of the Economics of Business*, Vol. 7, No 3, pp. 297-312.
- [26] Himmelberg, C. P. & Petersen, B. C. (1994). "R&D and Internal Finance: A Panel Study of Small Firms in High-Tech Industries", *Review of Economics and Statistics*, Vol. 76, No 1, pp. 38-51.
- [27] Hoshi, T., Anil, K. & Scharfstein, D. (1991). "Corporate Structure, liquidity, and investment: Evidence from Japanese industrial groups", *Quarterly Journal of Economics*, Vol. 106, pp. 33-60.
- [28] Hubbard, R. G. (1998). "Capital-market imperfections and investment", *Journal of Economic Literature*, Vol. XXXVI, pp. 193-225.
- [29] Kaplan, S. N. & Zingales, L. (1997). "Do Investment-Cash Flow Sensitivities provide useful measures of Financing Constraints?", *Quarterly Journal of Economics*, Vol. 112, No 1, pp. 169-215.
- [30] Kaplan, S. & Zingales, L. (2000). "Investment-Cash Flow Sensitivities Are Not Valid Measures of Financing Constraints", *Quarterly Journal of Economics*, Vol. 115, pp. 707-712.
- [31] Kiyotaki, N. & Moore, J. (1997). "Credit Cycles", *Journal of Political Economy*, Vol. 105, No 2, pp. 211-248.
- [32] Löfgren, K-G., Persson, T. & Weibull, J. W. (2002). "Markets with Asymmetric Information: The Contributions of George Akerlof, Michael Spence and Joseph Stiglitz", *Scandinavian Journal of Economics*, Vol. 104, pp. 195-211.

- [33] Martinsson, G. (2008). "Firm Collateral and the Cyclicity of Knowledge Intensity", CESIS Working Paper Series, No 134, [http://cesis.abe.kth.se/working\\_papers.php](http://cesis.abe.kth.se/working_papers.php)
- [34] Modigliani F. & Miller, M. (1958). "The Cost of Capital, Corporation Finance and the Theory of Investment", *American Economic Review*, Vol. 48, pp. 216-297.
- [35] Rajan, R. G. & Zingales, L. (1995). "What do We Know about Capital Structure? Some Evidence from International Data", *Journal of Finance*, Vol. 50, No 5, pp. 1421-1460.
- [36] Reid, G. C. & Jacobsen, L. R. (1988). *The Small Entrepreneurial Firm*. Aberdeen: The David Hume Institute, Aberdeen University Press, 1988.
- [37] Roodman, D. (2006). "How to do xtabond2: An Introduction to "Difference" and "System" GMM in Stata", CGDEV Working paper 103.
- [38] Sargan, J. (1958). "The estimation of economic relationships using instrumental variables", *Econometrica*, Vol. 26, pp. 393-415.
- [39] Semenov, R. (2006). "Financial systems, financing constraints and investment: Empirical analysis of OECD countries", *Applied Economics*, Vol. 38, pp. 1963-1974.



Variable	Mean	Q1	Median	Q3	Min	Max
<b>Whole Sample (Obs.=101582)</b>						
No Employees	6.51	1.00	2.00	6.00	0.00	190
Sales (1)	7151	933	1954	5729	1.00	830571
Variation of Sales (2)	0.02	-0.19	0.04	0.25	-8.96	11.91
Knowledge Int. (3)	0.47	0.00	0.44	1.00	0.00	1.00
<b>With Collateral (Obs.=22280)</b>						
No Employees	6.19	1.00	2.00	6.00	0.00	163
Sales (1)	6796	1100	2025	5917	1.00	830571
Variation of Sales (2)	0.01	-0.18	0.03	0.22	-7.67	8.51
Knowledge Int. (3)	0.47	0.00	0.47	1.00	0.00	1.00
<b>Without Collateral (Obs.=79302)</b>						
No Employees	6.59	1.00	2.00	6.00	0.00	190
Sales (1)	7251	888	1927	5685	1.00	716100
Variation of Sales (2)	0.02	-0.19	0.04	0.26	-8.96	11.91
Knowledge Int. (3)	0.47	0.00	0.44	1.00	0.00	1.00

Table 1: Descriptive statistics of the sample <sup>13</sup>

<sup>13</sup> (1) In thousand SEK; (2)  $\ln(S_{i,t}) - \ln(S_{i,t-1}) = \ln(S_{i,t}/S_{i,t-1})$ ; (3) Employees with a university education exceeding three years / Total employment. The sample is divided based on if the firm has had at least half of its observations reporting book value of real estate and/or land assets.

Dep: K.I.			One-step	Two-step	One-step	Two-step
	<b>OLS</b>	<b>Fe</b>	<b>Diff GMM</b>	<b>Diff GMM</b>	<b>Sys GMM</b>	<b>Sys GMM</b>
K.I.(t-1)	0,613*** (0,005)	0,077*** (0,007)	0,431*** (0,014)	0,453*** (0,013)	0,453*** (0,010)	0,474*** (0,009)
K.I.(t-2)	0,183*** (0,005)	-0,090*** (0,006)	0,070*** (0,080)	0,071*** (0,008)	0,067*** (0,009)	0,072*** (0,008)
Ln(Sales)	0,009*** (0,001)	0,077*** (0,002)	0,111*** (0,011)	0,101 (0,011)	0,081*** (0,003)	0,069*** (0,002)
Ln(Sales)*F_C	-0,008*** (0,002)	-0,019*** (0,004)	-0,155*** (0,0169)	-0,128*** (0,016)	-0,101*** (0,014)	-0,074*** (0,013)
Obs	78776	78776	69945	69945	78776	78776
Firms		21051	18942	18942	21051	21051
Av Obs per firm		3,7	3,7	3,7	3,7	3,7
Sargan				0,000		0,000
AR(1)			0,000	0,000	0,000	0,000
AR(2)			0,906	0,666	0,345	0,291
St Errors	Robust	Robust	Robust		Robust	

- Diff GMM: Instruments for differenced equation: GMM-type l(2/3).K.I.; l(1/.)ln (Sales); l(1/.)ln (Sales)\*F\_C. Standard: D.F\_C; D.99-D.04.
- System GMM: Instruments for differenced equation: GMM-type l(2/3).K.I.; l(1/.)ln (Sales); l(1/.)ln (Sales)\*F\_C. Standard: D.F\_C; D.99-D.04. Instruments for level equation: GMM-type LD.K.I. D.ln (Sales) D.ln (Sales)\*F\_C

Table 2: Regression results from the knowledge intensity equation <sup>14</sup>

<sup>14</sup> The dependent variable K.I. is knowledge intensity defined as employees with a university education exceeding three years / Total employment. F\_C is firm collateral and is a binary variable assigning 1 if the firm has had collateral and 0 otherwise. Standard errors are within parenthesis and all regressions are run with time dummies. \*\*\*, \*\*, \* correspond to a 1, 5, and 10 percent significance level respectively.

Dep: ln(Emp)			One-step	Two-step	One-step	Two-step
	<b>OLS</b>	<b>Within</b>	<b>Diff GMM</b>	<b>Diff GMM</b>	<b>Sys GMM</b>	<b>Sys GMM</b>
lnE(t-1)	0,732*** (0,003)	0,210*** (0,006)	0,220*** (0,012)	0,216*** (0,012)	0,461*** (0,008)	0,485*** (0,008)
ln (Sales)	0,203*** (0,003)	0,288*** (0,005)	0,180*** (0,031)	0,085*** (0,025)	0,383*** (0,003)	0,377*** (0,006)
ln (Sales)*F_C	0,017*** (0,003)	0,001 (0,006)	0,269*** (0,019)	0,192*** (0,019)	0,219*** (0,012)	0,134*** (0,019)
Observations	96697	96697	84694	84694	96697	96697
Firms		23341	20974	20974	23391	23391
Av Obs. per firm		4,1	4	4	4,1	4,1
Sargan				0		0
AR(1)			0	0	0	0
AR(2)			0,624	0,697	0,01	0
St Error	Robust	Robust	Robust		Robust	

- Diff GMM: Instruments for differenced equation: GMM-type  $l(2/3).ln(E)$ ;  $l(1/.)ln(Sales)$ ;  $l(1/.)ln(Sales)*F_C$ . Standard: D.F\_C; D.99-D.04.
- System GMM: Instruments for differenced equation: GMM-type  $l(2/3).ln(E)$ ;  $l(1/.)ln(Sales)$ ;  $l(1/.)ln(Sales)*F_C$ . Standard. Standard: D.F\_C; D.99-D.04. Instruments for level equation: GMM-type  $LD.ln(E)$   $D.ln(Sales)$   $D.ln(Sales)*F_C$

Table 3: Regression results from the employment-sales equation <sup>15</sup>

<sup>15</sup> The dependent variable is ln (Employment). F\_C is firm collateral and is a binary variable assigning 1 if the firm has had collateral and 0 otherwise. Robust standard errors are within parenthesis and all regressions are run with time dummies. \*\*\*, \*\*, \* correspond to a 1, 5, and 10 percent significance level respectively. The constant is not reported and subsequently is also the binary variable FC for different level of employment omitted from the table.

Dep: ln(emp)	GRR		K.I.		Leverage	
	<b>Above</b>	<b>Below</b>	<b>Above</b>	<b>Below</b>	<b>Above</b>	<b>Below</b>
lnE(t-1)	0,250***	0,451***	0,483***	0,400***	0,398***	0,459***
	(0,007)	(0,010)	(0,011)	(0,010)	(0,010)	(0,011)
lnS	0,314***	0,348***	0,311***	0,443***	0,478***	0,285***
	(0,007)	(0,009)	(0,009)	(0,011)	(0,013)	(0,008)
lnS*F_C	-0,014*	0,216***	0,151***	0,087***	0,080***	0,170***
	(0,007)	(0,024)	(0,025)	(0,029)	(0,028)	(0,025)
Obs	58712	50631	54413	54930	53400	55943
Firms	12250	11695	11711	12234	11996	11949
Av Obs per firm	4,8	4,3	4,6	4,5	4,5	4,7
St Error	Robust	Robust	Robust	Robust	Robust	Robust

Table 4: Regression results from sample splits <sup>16</sup>

---

<sup>16</sup> Run as system GMM in table 3.

Dep: ln(Emp)	1997-2000		2001-2004	
	One step	Twostep	One step	Twostep
	Sys GMM	Sys GMM	Sys GMM	Sys GMM
lnE(t-1)	0,413***	0,442***	0,501***	0,513***
	(0,012)	(0,012)	(0,015)	(0,014)
lnS	0,460***	0,440***	0,347***	0,344***
	(0,008)	(0,013)	(0,009)	(0,008)
lnS*F_C	-0,067**	-0,032	0,256***	0,157***
	(0,021)	(0,025)	(0,024)	(0,032)
Obs	41334	41334	51991	51991
Firms	16414	16414	20541	20541
Av Obs per firm	2,5	2,5	2,5	2,5
St Error	Robust		Robust	

Table 5: Regression results from the sample split based on time <sup>17</sup>

<sup>17</sup> Run as system GMM in table 3.