



Explaining Rates of Return Differences Across Industries: The Roles of Risk, Intangible Capital and the (Lack of) Competition

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Explaining rates of return differences across industries: the roles of risk, intangible capital and the (lack of) competition

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Abstract

Numerous empirical studies document persistent inter-sectoral differences in the rate of return on capital. From a theoretical perspective, persistent rate of return differences indicate inefficiency and point to a lack of competition. However, such an interpretation is valid only if returns are accurately measured. Maybe it is a lack of measurement rather than a lack of competition which is responsible for the evidence.

Our analysis of sectoral rates of return explores these issues in four steps. We first test this prediction using conventionally measured rates of return for the sectors of the German economy using a long time-horizon (step1). We then check whether the distribution of returns to capital across sectors is more in line with an equilibrating mechanism once we adjust returns for risk (step 2) and intangible capital (step 3). Finally, we investigate whether remaining permanent differences in adjusted returns can be explained by measures of competitive pressure (step 4).

Our analyses for Germany show: differences in profit rates between industries have been persistent over almost 40 years. Yet, we can also show that by accounting for differences in risk between industries, the sectoral differences in profit rates can noticeably be reduced. They shrink even more when accounting for the influence of intangible capital on profits. However even after these adjustments, considerable differences persist. They are correlated to differences in the competition intensity between sectors. But even accounting for those differences, there still persist a considerable remainder of unexplained variation.

JEL classifications: L23, E01, D24

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1. Introduction

That “in a competitive environment rates of return to capital tend to be randomly distributed around some normal [equilibrium] rate” (Neumann, Böbel, Haid 1979) is a cornerstone of economics. In this view, abnormally high returns can only exist temporarily. As Mueller (1977, p.369) put it in his well-known study, “the flow of resources into activities earning excess profits and the flow of resources from activities earning less-than-normal profits should bring all returns back to competitive levels”. Like many other empirical studies before and since, Mueller rejected this prediction of competitive equilibrium theory and found evidence of persistent “profits above the norm”.

Persistent differences in average returns across activities may be justified if they reflect corresponding differences in risk. In this case, differences in mean returns may be interpreted as premia necessary to compensate for the willingness to commit resources to such risky ventures. Risk will thus play a central role in our empirical investigation of rates of return to capital and adjusting risk-adjusted returns is a major aim of this paper.

However, unlike Mueller (and many other studies that followed in his footsteps) we will not study return differences at the level of individual firms. Instead, our analysis is conducted at the sectoral level. We thereby relate to a recent theoretical literature on capital reallocation within (e.g. Eberly and Wang 2009, Wang and Eberly 2011) and between (Jin 2012) economies that stresses sectors as an important analytical category for understanding capital flows and their remuneration. Empirically, we take advantage of the substantial efforts that have been made in the last decades to create rich, internationally comparable data at the industry level, particularly through the EUKLEMS (now WORLD-KLEMS) initiative.

A second reason why we work at the sectoral level is the measurement of intangible capital. There is a consensus about the growing importance of intangible assets such as knowledge and that such intangible assets should be incorporated into the measurement of capital stocks and capital formation. Measuring intangible capital, however, is challenging. We believe that at the present stage, firm-level measures of intangible capital still include a substantial amount of noise and that it is preferable to work with aggregated, sector-level figures.¹

Conceptually, intangible capital is – like risk - another possible explanation for observed permanent differences in conventional rates of return to capital that is in line with equilibrium

¹ Our sector level data on intangible capital was created as part of the INNODRIVE-EUKLEED initiative. A detailed description can be found in section 3.

theory. From this perspective, non-vanishing differences in conventional rates of return between sectors may arise from a failure to properly account for inter-sectoral differences in intangible capital. Once intangible assets are incorporated in capital measures, the resulting rates of return may no longer show the permanent inter-sectoral differences that are at odds with the equilibrating mechanism of neoclassical theory. If, however, permanent differences remain between adjusted differences then non-equilibrium explanations would have to be discussed.

Our analysis of inter-sectoral rates of return explores these issues in four steps. Before we proceed to the analysis of the role of risk and intangible capital in explaining rate of return differences between sectors we first re-establish the existence of such permanent inter-sectoral differences. This initial step solely relies on conventional rates of return to capital which are available over a period of almost thirty years (1970-2007). We study whether (as predicted by theory) rates of return converge during this period using the concepts of β -convergence and σ -convergence. We find little evidence for convergence. Permanent differences in conventionally measured rates of return to capital thus seem also to be present in the German economy since the 1970s. In the following steps we consider possible explanations of these differences. In steps 2 and 3 we adjust conventional rates of return for risk and intangible capital, respectively. Each time, we ask whether the adjusted returns still display pronounced differences or whether instead properly adjusted returns are more in line with the return equalization expected from the perspective of a well-functioning market economy. Each time, we find that adjusting returns somewhat diminishes the inter-sectoral variation but that considerable differences between sectors remain even if adjusted returns are investigated. In our fourth and final step, we thus turn to factors that may explain why market forces are prevented from pushing rates of return towards equilibrium. Specifically, we regress adjusted returns on measures of industry entry rates to explore whether sectors with high-entry rates (where competitive forces seem to be able exert pressure) have on average lower adjusted returns than their counterparts with less entry.

The four steps of our analysis are summarized in Table 1:

- Step 1: Studying convergence of conventional rates of return
- Step 2: Adjusting conventional rates of return for risk
- Step 3: Adjusting conventional rates of return for intangible capital
- Step 4: Explaining adjusted returns with entry intensities

The remainder of this paper is organized as follows. We describe our methodological approach in section 2. We then turn to the data which we describe in section 3. Section 4 contains the results of our empirical analysis. Section 5 concludes.

2. Methodology

That an efficient economy allocates resources (including capital) to its highest use and that rewards (returns) play a central role in this process is a hallmark of equilibrium theory. A testable implication of this proposition is that there should be no persistent differences in rates of return to capital between different activities – regardless if these are associated with firms, markets, or sectors.² Some activities may temporarily enjoy above-equilibrium returns. However, in the medium to long run such returns above the norm should disappear as the influx of additional capital attracted by the high returns eventually drives their level back to the economy-wide equilibrium norm.

We first test this prediction using conventionally measured rates of return for the sectors of the German economy using a long time-horizon (step 1). We then check whether the distribution of returns to capital across sectors is more in line with an equilibrating mechanism once we adjust returns for risk (step 2) and intangible capital (step 3). Finally, we investigate whether remaining permanent differences in adjusted returns can be explained by measures of competitive pressure (step 4). The methods in each step will be outlined in the following subsections.

Step 1: Studying convergence

In the first stage, we use the German files of the EUKLEMS database³ to investigate whether there is evidence for persistent sectoral rate of return differences in Germany during the last 30 years (1970 - 2007). Theory suggests that such persistent differences should diminish or even be eliminated over time, i.e. that we should observe rate of return convergence. To study whether sectoral return rates are persistent or convergent we draw upon the convergence concepts developed in the literature on convergence (of income or productivity) across countries or regions. The two established concepts of convergence in this literature are σ -convergence and β -convergence. σ -convergence, in our context, refers to a decreasing variance of rates-of return across sectors. In terms of a formal test, σ -convergence thus considers the ratio of the variance in some initial period σ_1^2 and the variance in the final period σ_T^2 . While our focus is not on a statistical test of the sharp null hypothesis of variance equality ($\sigma_1^2 = \sigma_T^2$, i.e. a complete absence of σ -convergence) we nonetheless employ the variance ratio as an analytical tool.

² If there is free trade and no restricting regulation the rate of return should also converge across countries (economies).

³ Details about the EUKLEMS data and our other data sources can be found in section 3.

σ -convergence focuses on overall variability and does not consider the positions of particular sectors within the distribution. The latter perspective on the return rate distribution is taken up by β -convergence. It is based on the notion that for convergence to occur, sectors with a relatively low initial rate of return must achieve relatively fast return growth while the opposite must be true for sectors with high initial period returns.⁴ Hence in case of complete convergence last period returns should not be systematically related to first period returns. Put differently, the initial position in the return distribution should not help to predict the period T position. It is thus formalized as a regression of the last period return r_{iT} on the initial period return r_{i1} (where i is indexing sectors):

$$(1) r_{iT} = \alpha + (1 - \beta)r_{i1} + \varepsilon_i$$

If $\beta=0$ then there is a very tight relationship between initial and final period return and thus no convergence. The other extreme occurs if $\beta=1$ and last period returns are not systematically (linearly) related to first period returns (complete convergence). Formal tests of β -convergence can thus be built on estimates of β derived from least squares estimates of equation (1). Again, while our focus is not on formally testing the sharp null hypothesis of no β -convergence, we nonetheless use estimates of β to discuss convergence in the sense of changes in position within the distribution.

Changes in the relative positions within the distribution associated with β -convergence have implications for the variance. The two concepts of convergence are thus related (Lichtenberg 1994). This is highlighted by test statistic for σ -convergence proposed by Carree and Klomp (1997):

$$(2) Z_{\sigma} = \sqrt{n} \frac{\hat{\sigma}_1^2 / \hat{\sigma}_T^2 - 1}{2\sqrt{1 - (1 - \hat{\beta})^2}}$$

Here $\hat{\sigma}_1^2$ and $\hat{\sigma}_T^2$ are the sample variances of the rate of return distribution in the initial and final period, respectively, n is the sample size and $\hat{\beta}$ is the estimate of β from equation (1).

Step 2: Adjusting for sectoral risk

The idea that differences in returns may be justified as „risk premia“ has a long tradition in economics (see Mangoldt 1855, Knight 1921, and Schumpeter 1934). This idea was later formalized in portfolio theory (Markowitz 1952, Tobin 1958, Sharpe 1966). However, how risk may be measured and how returns may be adjusted for risk is still controversial. We use two fundamental approaches from financial econometrics that are associated with different

⁴ This has implications for the variance of the distribution. In other words, β -convergence and σ -convergence are related (Lichtenberg 1994).

perspectives on risk: Sharpe ratios and CAPM betas. Both measures have been developed as instruments to improve decisions on financial investments. Here we take up the perspective of a “social planner” who tries to allocate capital across industries in order to maximize expected returns (e.g. Eberly and Wang (2011)).

a) Sharpe Ratio

The empirical (**ex-post**) Sharpe ratio for sector j is defined here as the ratio of its (historic) average return and its historic (realized) standard deviation (both computed over the most recent T periods):

$$(3) \quad SR_{ex,j} = \frac{\bar{r}_j}{S_j}$$

From the perspective of the Sharpe ratio, sectoral risk is measured by the time-series variation in the return of the sector. If two industries have the same average rate of return, then the industry with the lower variation of the return rate over time seems to promise lower risks for a prospective investor. The Sharpe ratio of an industry with a continuous flow of returns is higher than the one of an industry with a high volatility of the return rate. The Sharpe ratio defines risk not only by the degree of volatility around a long-term stable return rate. It also covers long-term structural risks if the return rate of an industry is changing permanently.

The division of the average return rate by its standard deviation can be considered an adjustment of a sector’s average return. However, the resulting ratio is unitless and cannot be easily compared to the original returns. In particular, it is difficult to say whether the Sharpe ratios possess less variation (i.e. show a greater tendency to equalize as theory predicts) than the unadjusted returns. We offer two solutions to this problem.

One solution amounts to comparing unadjusted average returns with Sharpe ratios that have been rescaled to the original scale by multiplying with the standard deviation of the average returns across sectors. The latter acts as an overall scale measure (first part of the product below) while the average return of a particular sector is still divided by its particular standard deviation:

$$(4) \quad S_{\bar{r}_j} \cdot SR_{ex,j} = S_{\bar{r}_j} \cdot \frac{\bar{r}_j}{S_j}$$

Alternatively, a Z-transformation can be applied to both the unadjusted returns and the Sharpe ratios:

$$(5) \quad Z_{\bar{r}_j} = \frac{\bar{r}_j - \bar{r}}{S_{\bar{r}}} \quad Z_{SR_{ex,j}} = \frac{SR_{ex,j} - \overline{SR}_{ex}}{S_{SR_{ex,j}}}$$

This will put the unadjusted average returns and the Sharpe ratios scale-wise on an equal footing. If the positions of sectors are preserved after Sharpe-adjusting then the Z-transformed average returns and the Z-transformed Sharpe ratios should form a 45° line in a scatter plot. If, however, sectors that had particularly high (low) Z-transformed unadjusted average returns have less extreme positions in the distribution of Z-adjusted Sharpe ratios then we have “regression to the mean”, i.e. a more compressed distribution after Sharpe-style risk-adjustment that is in better agreement with an equilibrating tendency.

b) CAPM

From the perspective of the Capital Asset Pricing Model (CAPM), some of this risk is irrelevant as it can be diversified away by investing capital into a portfolio of sectors. The relevant risk is thus solely the non-diversifiable risk stemming from the correlation between a sector's return and the (economy-wide) market return. This is summarized by the well-known relation between a sector's expected return (in excess of a risk-free return) and the expected excess return of the market portfolio:

$$(6) \mathbf{E}[r_i] - r_f = \beta_i (\mathbf{E}[r_M] - r_f)$$

The crucial CAPM β coefficients can be shown to be ratio of the covariance of the (excess) returns of sector j and the market. Hence, if $\beta_i = 0$ the return of sector i has no linear relationship with that of the market and is thus – from the viewpoint of the CAPM - risk-less. Its risk premium (its expected return minus the risk-free return) would be zero. On the other hand, large positive β indicate a strong correlation with the movement of the market return and thus high risk. For each sector, β can be estimated from a least squares regression of its observed excess returns on the observed market excess returns.

$$(7) r_{i,t} - r_{f,t} = \alpha_i + \beta_i (r_{M,t} - r_{f,t}) + \varepsilon_{i,t}$$

Particularly in the present context, the CAPM represents a rather extreme view on risk and the diversification potential with a finite number of sectors is naturally limited. The above theoretical CAPM formula suggests a way to adjust returns for risk as measured within the CAPM framework: after dividing through by its β , each sector should earn the equilibrium market (excess) rate of return:

$$(8) \Rightarrow (\mathbf{E}[r_i] - r_f) / \beta_i = (\mathbf{E}[r_M] - r_f)$$

Step 3: Adjusting for intangible capital

In addition to the influence of risk, Fisher/McGowan (1983) suggest a measurement problem: not all activities - such as R&D - are properly capitalized as they should be under economic

aspects. Megna/Mueller (1991) suspect that the observed dispersion in return rates might be the result of measurement errors caused by the insufficient consideration of intangible capital. They argue that the dispersion of return rates can only be justified as a test for the efficiency of competition, if it refers to total capital in use, including unobserved capital. From the several possible types of unobserved capital, intangible capital has increasingly come into the focus of researchers. In particular, own account expenses for R&D and for advertising made by the firms are frequently not accounted for as capital formation and therefore the capital stock used in production as well as the operating surplus are underestimated. It has been shown that both, the numerator and the denominator of the return rate are understated if we neglect unobserved intangible capital (Görzig/Gornig 2013). In fact, the relation between the “true” rate of return, r , if intangible capital is included, and the observed rate of return, r_o , with intangible capital neglected can be described by the following equation:

$$(9) \quad r_o = r + (r - g_I) \frac{K_I}{K_o}$$

With K_I standing for intangible capital and K_o denotes observed capital. g_I is the growth rate of intangible capital. From this relation (Görzig/Gornig 2013) conclude: “The observed rate of return will only be equal to the true rate of return if there is no unobserved capital: $K_I = 0$. If unobserved capital, K_I , exists, then the observed rate of return, r_o , will be, in general, above the market rate of return, r , provided the growth rate of hidden capital, g_I , is below the market return rate on capital.”

Step 4: Explaining the inter-sectoral variation in return rates

In our last step we ask whether the remaining variance of sectoral profit rates can be explained through differences in market imperfections as claimed in theory. The empirical assessment of market imperfections is rather complex (Barla 2000). There are several approaches used in the studies at hand.

One approach focusses on the empirical measurement of market power, using indicators like the distribution of market shares (Herfindal-Index; Entropy) or the heterogeneity of firm size (Firm Size Inequality: FSI). If comprehensive datasets, with information on market prices and marginal costs are available, firm-specific indicators for market power like mark ups (Price Cost Margin: PCM, Lerner-Index) and heterogeneity of profits (Relative Profit Differences: RPD, Boone-Indicator) can be used.

Another approach, applied in the empirical analyses of market imperfections, looks at institutional regulations and their potential impact on the intensity of competition. Market entry barriers play a dominant role here. These studies usually compare national regulation systems by use of corresponding regulation indicators.

However, at sectoral level there is hardly any measurable comprehensive indicator describing the degree of competition regulations. Within one country, however, differences in the impact of institutional regulation between sectors are nearly impossible to evaluate. Hence, studies usually use market entry and exit as a measurable result driven indicator (for Germany i.e. Prantl 2012). In this study, we calculate the sector specific shares of employment in new firms in total employment of the sector (intensity of market entries).

3. Data

The central database for analysing the development of the rate return on the industry level in the long run in our first working step is the EUKLEMS database. EUKLEMS supplies information on factors of production and output for several industries. It is fully integrated into the National Accounting framework of EUROSTAT. A comprehensive description is given by O'Mahony and Timmer (2009).

We use the EUKLEMS data files for Germany from the November 2009 Release. For the historical analyse we combine this information with data which were calculated within the EUKLEMS project for former Western Germany. This data set covers annual information for 30 industries for the period from 1970 until 2007. A list of covered industries can be found in the appendix of the paper. The EUKLEMS data set supplies long time series on the rate of return by industry. The internal rate of return ($i_{j,t}$) in the EUKLEMS database is an important part of the growth accounting methodology.

The rate of return is assumed the same for all assets in an industry j , but is allowed to vary across industries and over time t . It is derived according to the following equation (O'Mahony/Timmer 2009):

$$(10) \quad i_{j,t} = \left(p_{j,t}^K K_{j,t} + \sum_k (p_{k,j,t}^I - p_{k,j,t-1}^I) S_{k,j,t} - \sum_k p_{k,j,t}^I \delta_{k,j} S_{k,j,t} \right) / \sum_k p_{k,j,t-1}^I S_{k,j,t}$$

The first term in the numerator is the capital compensation in industry j at time t . The second terms describes the sum of the holding gains for all types of assets k , and the third term is the sum of the depreciation at current prices for all types of assets k based on a constant depreciation rate $\delta_{k,j}$. This expression is related to the sum of stocks of all types of

assets $S_{k,j,t}$ at time t , valued at previous year investment prices $p_{k,j,t-1}$ of asset k in industry j .

A second data source for our analysis is supplied by EUKLEED. This is a comprehensive integrated micro data set including imputed employment, investment, output, and operating surplus. The dataset is based on information from the German Social Security data (Alda, Bender, and Gartner 2005; Fritsch and Brix 2004). EUKLEED is fully integrated into the National Accounts for Germany. It covers about 1.6 million establishments between 1999 and 2003 with about 40 million employment cases per year. Integration into the National Accounts means that the basic data set is compatible with the National Accounts for Germany at the industry level of EUKLEMS. However, some sectors are not completely represented like agriculture, real estate activities, or public administration. A detailed description of the EUKLEED dataset is given in Görzig (2011). Different from the EUKLEMS data set, EUKLEED data are only available for 25 industries (see classification in the appendix).

The micro data of EUKLEED are used twofold: First, the firm level information on the use of own account intangible is aggregated on the level of the industries referred to in this study. The firm level information on intangibles has been assessed in the INNODRIVE⁵ project according to the methodology developed by Corrado, Hulten, and Sichel (CHS 2004)

CHS distinguish between three broad categories: computerized information, innovative property, and economic competencies. We restrict our exercise to a segment of these intangibles, namely the own account production of information technology (ICT), research and development (R&D), and organisational capital (OC). We have to exclude purchased intangibles because our data do not separate purchased intangibles from intermediate consumption. Own account production apparently constitutes an important share of intangibles. CHS find that they account for nearly one-third of all intangibles.

The distribution of intangible capital across sectors is documented in the appendix (Table A1). It can be seen that some raw materials industries have particularly high values of own account intangibles which may reflect their high emphasis on highly efficient production processes. High values can also be found among manufacturing sectors focusing on investment goods (Machinery, Electrical and Transport equipment). The dominant component of intangibles is research and development. R&D is also important among the service sectors with high intangible capital intensity. However, in this part of the economy

⁵ INNODRIVE is a project funded by the EC under the Socioeconomic Sciences and Humanities Theme in the 7th Framework Programme. Its aim is to estimate organisational capital at firm level for several countries and to integrate the results in a macroeconomic growth accounting approach.

intangible capital, also consists to a considerable degree, of organisational capital. This is particularly true for financial services where organizational capital is the dominating component of intangible capital, accounting for 80% of its level.

EUKLEED micro data are only available for the years 1999 until 2003. We compare the average rate of return including intangibles with the average return rate not including intangibles. These sectoral multipliers are applied for all years for which return rates in the EUKLEMS data set are available.

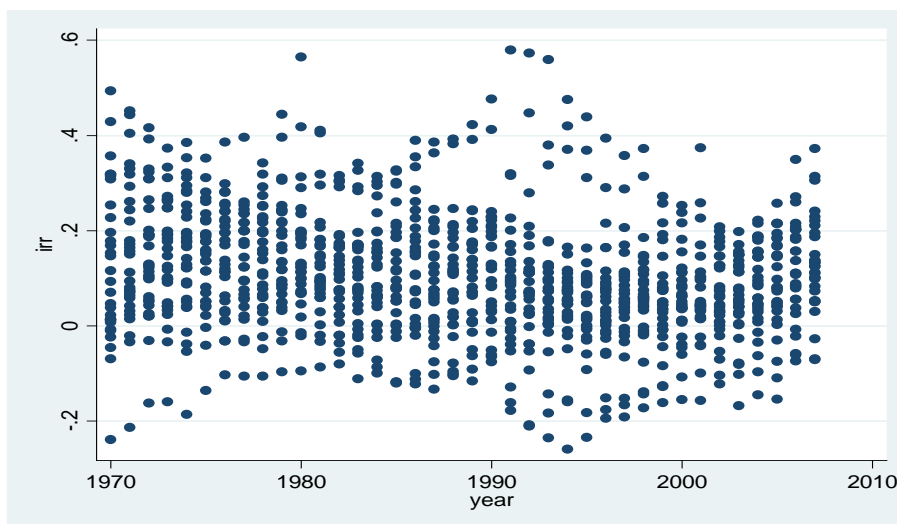
The second use of the EUKLEED data base is the evaluation of an indicator for the entry-intensity in the industries considered in this analysis. Here, we compare by industry the employment number of new founded firms with total employment in an industry.

4. Empirical results

Step 1: Sectoral convergence

A first visual impression of the development of the distribution of sectoral rates of return on capital can be obtained from the following scatter plot.

Figure 1



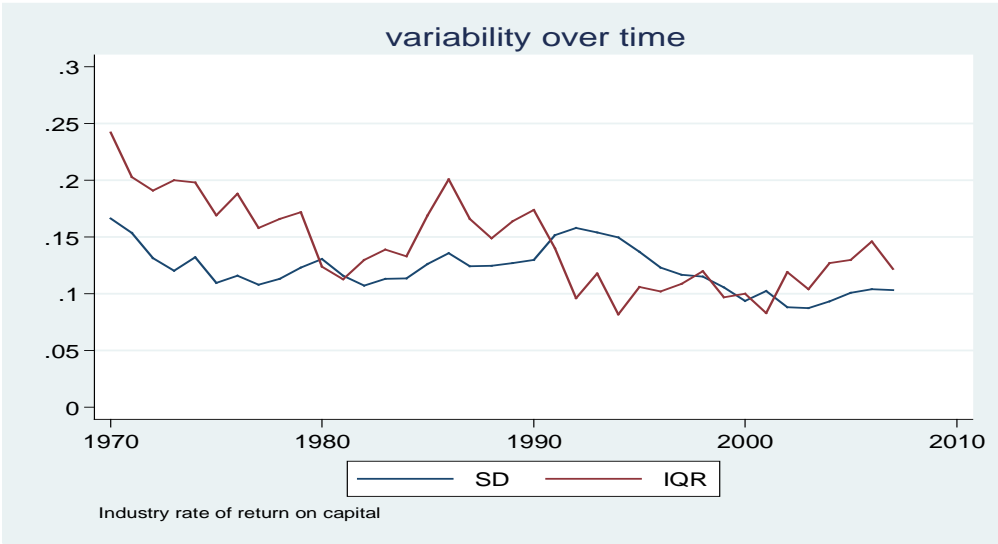
For each year, from 1970 to 2010, the observed rates of return of each of the 20 sectors are plotted vertically. There does not appear to be a pronounced monotonous reduction in the variation in return rates over this period of almost 40 years. There are, however, visible movements in the tails of the distribution. In particular, a gradual disappearance of the strongly negative rates of return in the early seventies can be observed. There is, on the other hand, a clearly visible increase in rather extreme return rates at either end of the distribution just after German reunification in the early nineties. Apparently, some sectors

were able to particularly capitalize on the opportunities offered by the fall of the iron curtain while others were pushed into the negative direction by this large economic shock.

While there were pronounced movements at the extremes, the average level of the rate of return on capital remained fairly stable: it is almost 15% in the early seventies and still amounts to 12% 2007, the most recent year of our observation period in stage 1. There was, however, an interim period of about ten years between 1995 and 2005 where the average rate of return dropped to a level as low as 5%.

Turning our attention again to the variability in return rates, the following graph shows the development over time of the variability in rates of returns across the 30 sectors.

Figure 2



We employ and graph two measures: the standard deviation (SD) and the interquartile range (IQR). Both measures suggest that there is no uniform monotonous tendency for the variability to decline. However, the level of the inter quartile range is consistently lower after reunification. The standard deviation shows a visible decline in the seventies and in the early nineties. It has however remained constant thereafter.

We have also conducted formal test for σ -convergence based on the test statistic given in equation (2). Under the null hypothesis of no convergence (i.e. of variance equality between the period T variance and the period 1 variance) the test statistic has an asymptotic $N(0,1)$ distribution. However, since the alternative hypothesis is a reduction in the variance the test is carried out as a one sided test where large positive values are regarded as evidence against H_0 . We have carried out the test for multiple choices of period 1 (1970-1980) and for a given period T (2007). Results are reported in the table 1 below that also gives the p-values.

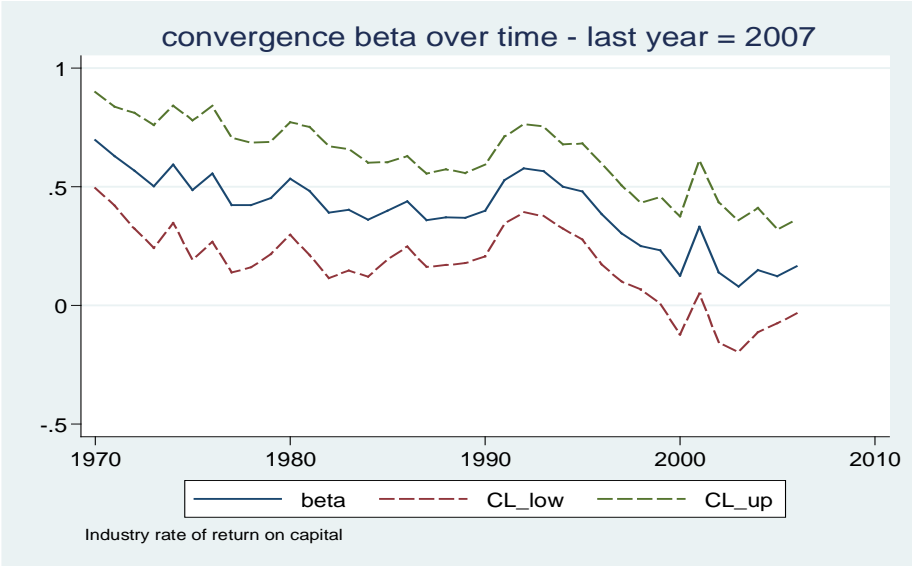
Table 1

Year	Z_{σ}	p-value
1970	4.54	<0.001
1971	3.55	<0.001
1972	1.86	0.032
1973	1.13	0.130
1974	1.91	0.028
1975	0.38	0.350
1976	0.79	0.214
1977	0.31	0.380
1978	0.66	0.256
1979	1.36	0.087
1980	1.84	0.033

It can be seen that the sharp null hypothesis of variance equality (no convergence) is rejected in some years but there are also various years where the p-values are quite large and the hypothesis cannot be rejected at conventional significance levels.

The preceding analysis in the spirit of σ -convergence focuses on a reduction in the overall variability and does not consider the positions of particular sectors within the distribution. It is therefore not sufficient for answering the question regarding persistent rate of return differences across sectors. Persistency requires not only that the variance does not vanish but also that relative positions within the distribution are maintained. The latter aspect is considered by β -convergence to which we now turn in the following graph (figure 3). In this graph we show estimates of β obtained from least squares regressions based on equation (1) where we fix the final period (i.e. T=2007 throughout) but vary the initial period. We thus plot the estimates of β obtained by successively regressing y_{i2007} on y_{i1970} , y_{i1971} , ... and finally y_{i2006} .

Figure 3



The blue line shows the estimates of β plotted against initial year of the corresponding regression along with 95% confidence intervals (dashed lines). As expected, estimated β values are largest (and closest to the complete convergence value of 1) for the most distant initial years (early 70s). Similarly, it is not surprising that the estimated β values approach the no-convergence value of 0 if we take very recent years as the initial years in regression (1). Except for the early 70s, the estimated β is below or close to 0.5 with a temporary increase for the years just after reunification. This overall pattern is confirmed if we also vary the period of the final year (results not shown). We thus conclude that there is some convergence, but also that relative positions are fairly stable, as the rates in the initial year generally have some predictive power for the final period returns.

This overall conclusion is confirmed by taking the data from all years (1970 – 2007) and by carrying out an F-Test of the hypothesis that there are no differences in average returns between sectors. The corresponding ANOVA table is given below.

Table 2

Source	Partial SS	df	MS	F	p-value
Sectors	11.168	29	0.38511	62.62	<0.001
Residual	6.826	1110	0.00615		
Total	17.994	1139	0.01580		

The F-Test clearly rejects the null hypothesis. That is, the variation across sectors is large enough relative to the within-sector variation to conclude that there are thus significant differences in average returns across sectors.

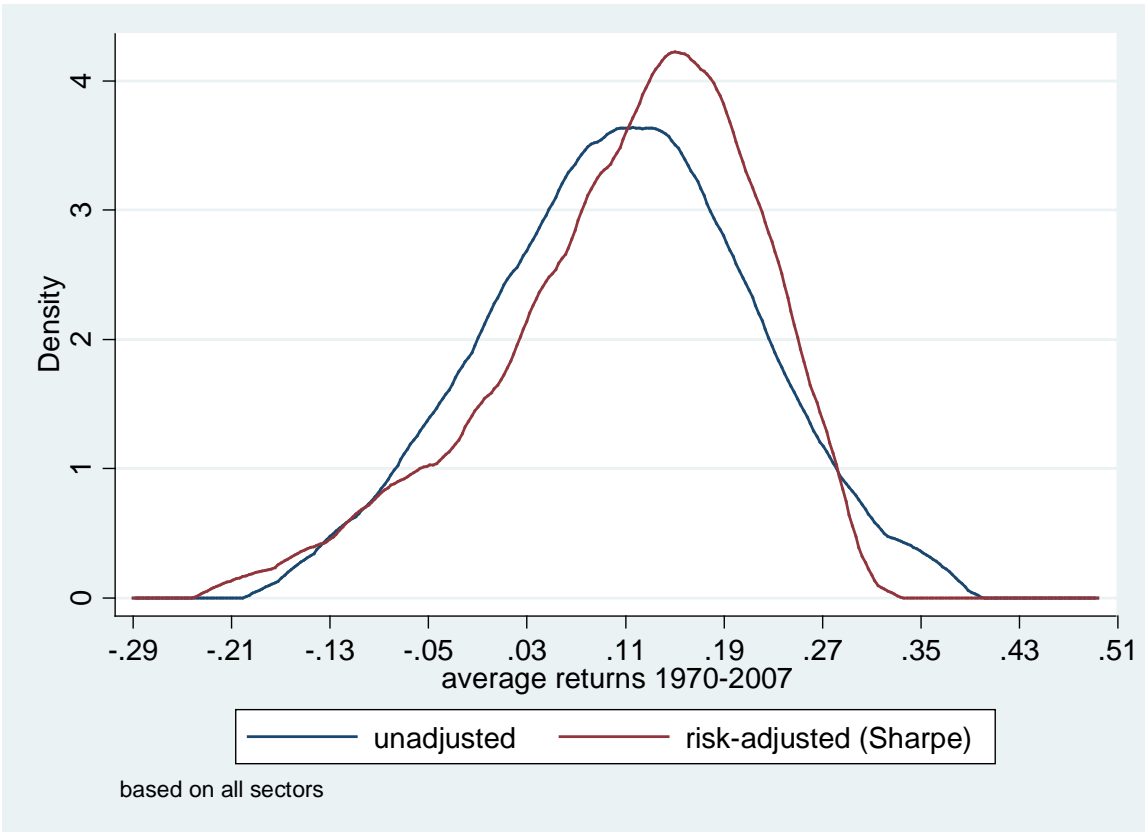
The evidence from the medium to long-term analysis presented here has shown that while there is movement within the inter-sectoral return distribution there are still persistent differences across sectors. There is thus transitory and permanent variation in sectoral rates of return to capital. This statement is in line with the findings of other empirical studies on inter-sectoral differences in the rate of return on capital (Qualls 1974, Geroski and Jacquemin 1988, Jacobson 1988).

Step 2: Adjusting for risk

a) Sharpe Ratio

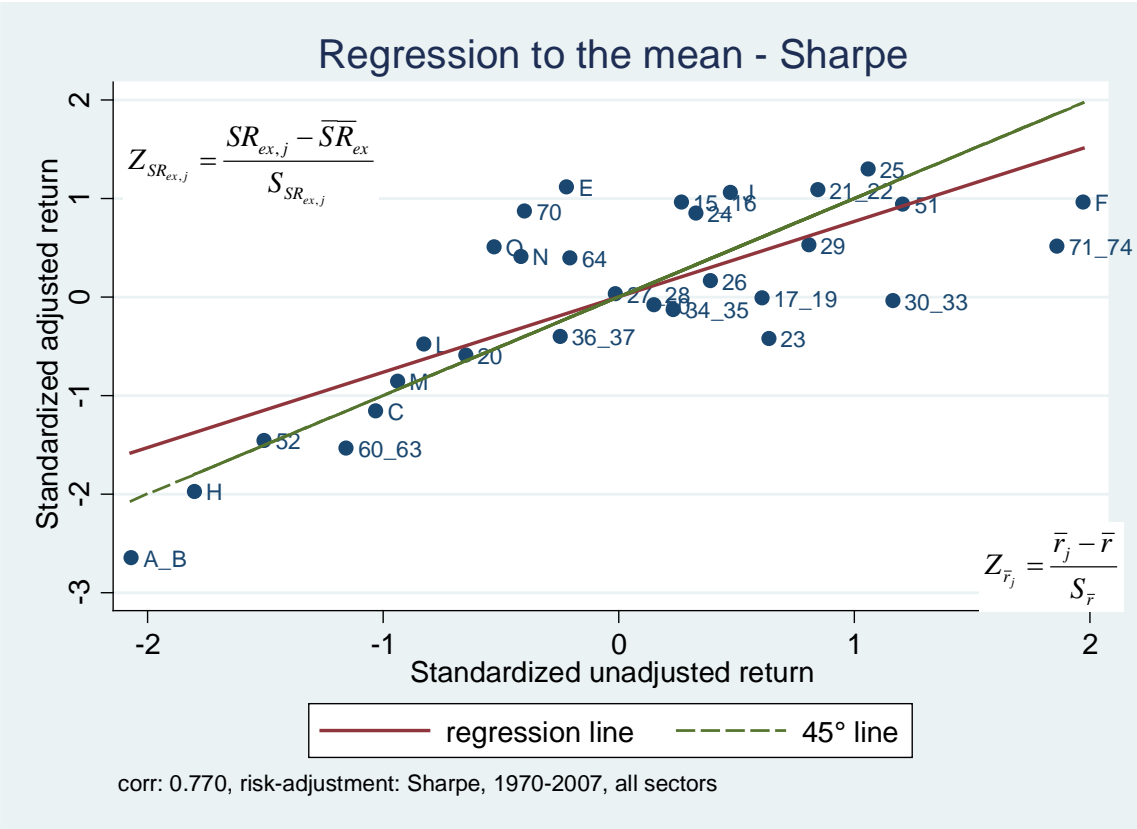
The Sharpe ratio is a simple measure to assess the impact of risk on the return of an investment. Figure 4 compares the kernel density distribution of the Sharpe adjusted standardized return rates with the original distribution across industries. Apart from the fact that the distribution of the adjusted rates is moving to the right the results also seem to be more concentrated than the unadjusted return rates.

Figure 4: Kernel densities of unadjusted rates of returns and Sharpe ratios



To investigate this more deeply, Figure 5 compares the risk-adjusted rates with the unadjusted rates of return in a scatter diagram. Both rates have been standardized with the suggested Z-transformation (section 2). The dots represent the position of the industries with their Nace 1 code. For a better visual understanding, a 45° line with a slope of 1 has been inserted. If all dots would be on or around this line, risk adjustment would have no impact on the rates of return. Conversely, if all dots would be along a horizontal line, with a slope of zero, risk adjustment would explain all differences in conventional rates of return.

Figure 5



It can clearly be evaluated that the computed regression line is different from 45° line. The slope of the regression (0.77) is significantly below 1. This means that risk-adjusting compresses the distribution of average return rates across industries but cannot explain all differences in the return rates.

For financial investment decisions, Sharpe ratios are used for benchmarking. Variable D, whose mean and standard deviation are calculated, is often called the differential or excess return, i.e. the difference between the return of an asset and the benchmark return, which is

frequently assumed to be the risk free return. In this study, we compute Sharpe ratios using “unbenchmarked” industry returns, implying that the risk free rate of return is zero.

b) CAPM

Based on the calculations made for the Sharpe adjustment the CAPM methodology has been applied on the data available. So far, however, the results were not convincing.

Step 3: Adjusting for intangible capital

In the context of the INNODRIVE Project we calculated firm profit rates, both accounting for intangible capital and not accounting for intangible capital (Görzig/Gornig 2013). For the years 1999 to 2003 we aggregated them for 25 of the 30 sectors in Germany (see Appendix). We then calculated the ratio between the returns with and without intangible capital (IC). This ratio was then multiplied with the risk adjusted profit rates.

$$\frac{\text{rate of return of sector } i \text{ with IC}}{\text{rate of return of sector } i \text{ without IC}} * \text{risk adjusted returns } ^i$$

To illustrate the variation of sectoral profit rates adjusted for intangible capital we calculated a kernel density functions (figure 6). Compared to the graph only adjusted for the influence of risk, this function is more compact around the median. Also, the frequency of above average profit rates reduces when accounting for the influence of intangible capital.

The reduction of variation in profit rates also shows when comparing the values only adjusted for risk to those values adjusted for both risk and intangible capital (figure 7) When only considering the short period of 1999 to 2003 the correlation decreases from 0.81 to 0.73, which means it converges towards the mean.

In summary: adjusting for intangible capital leads to an additional reduction in variability of returns across sectors. However, substantial differences remain.

Figure 6: Kernel densities of Sharpe ratios with and without adjusting for intangible capital

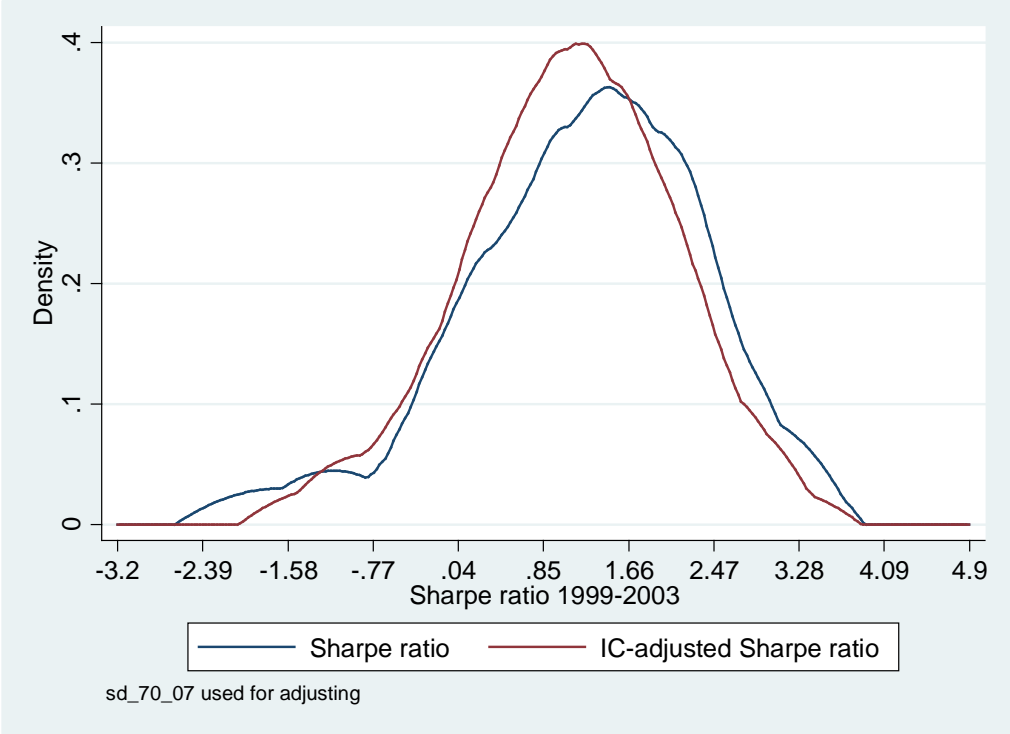
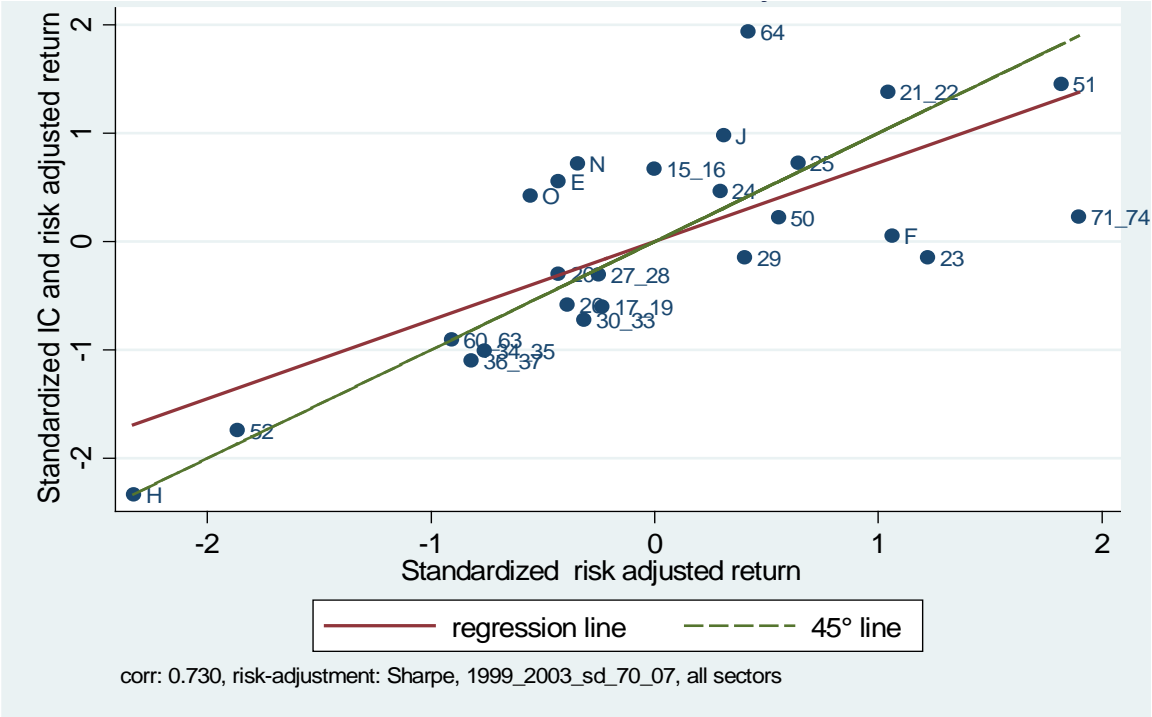


Figure 7: Regression to the mean: standardized Sharpe ratios with and without adjusting for intangible capital



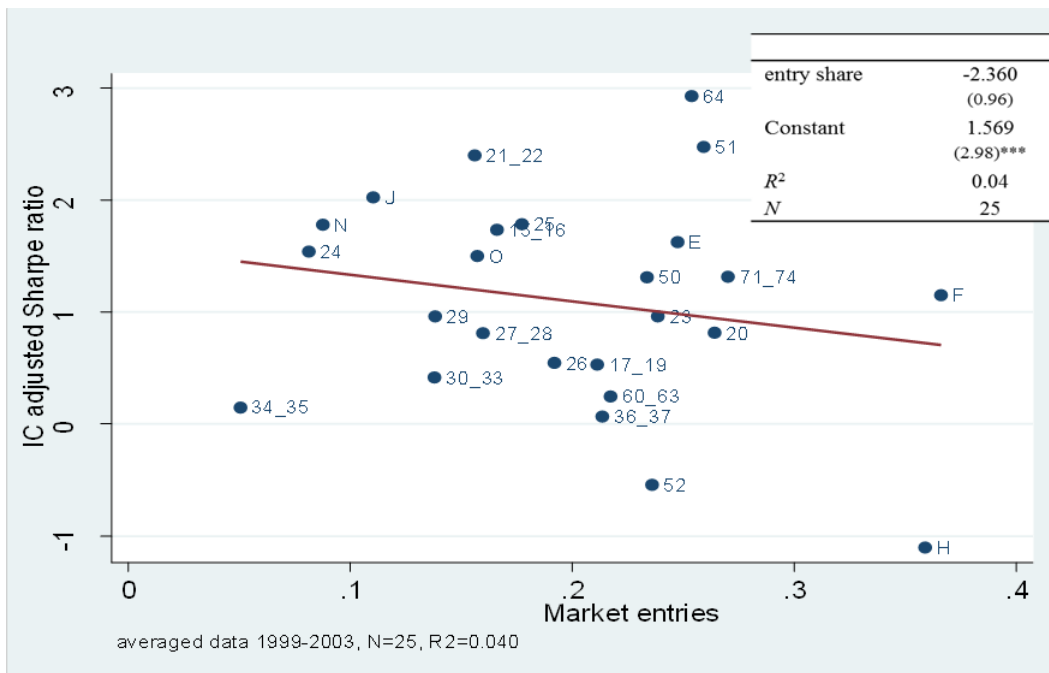
Step 4: Explaining adjusted returns by effects of competition

“Because competition acts to direct resources towards uses offering the highest returns, persistently unequal returns mark the presence of either natural or contrived impediments to resource flows” (Rumelt 1979).

It could be assumed that the differences in profit rates between sectors that remain after adjusting for risk and intangible capital would be highly correlated with the differences in the market foreclosure of different industries.

A popular way of making market entry barriers visible and thus reduced competition is the use of market entries as an empirical indicator. For our analyses we estimated market entries by using the share of employees working in in new firms per sector. However, the rate of return in a sector shows only a weak dependency on this indicator (figure 8).

Figure 8: Regression of risk and intangible capital adjusted returns on market entry intensities



The adjusted return of a sector does show a decreasing tendency with increased market entry barriers. But, when considering all sectors, differences in the intensity of market entries can only explain a small fraction of the variation in returns on capital between sectors. Additionally on the 5% level the correlation is not statistically significant.

In our further analyses we want to test the robustness of our findings. We want to refine our indicator for market entry, by differentiating the likelihood of market entry by size classes. We also want to test alternative Indicators for competition intensity, like the relative differences of returns between firms within a sector.

5 Conclusion

Existing empirical studies do not sufficiently explain the influence of risk indicators or intangibles on sectoral differences in profits. This is true for studies that concentrate on risk only (Baker 1973, Moskowitz/Vissing-Jorgensen 2002) or that only consider intangibles like advertising or R&D (Ayanian 1975, Megna/Mueller 1991, Grabowski/Vernon 1994). But even empirical work that considers both intangibles and risk variables simultaneously to explain sectoral differences in profit does not deliver significant explanations (Sherman/Tollison 1972, Ferguson-Esposito 1985).

Our analyses of sectoral development in Germany show: differences in profit rates between industries have been persistent over almost 40 years. Yet, we can also show that by accounting for differences in risk between industries, the sectoral differences in profit rates can noticeably be reduced. They shrink even more when accounting for the influence of intangible capital on profits.

However even after these adjustments, considerable differences persist. They are –as predicted by theory - correlated to differences in the competition intensity between sectors. But even accounting for those differences, there still persist a considerable remainder of unexplained variation.

We believe that empirical work will profit from the advancement of theoretical models on the structural components of generating revenue, that can be observed, and we will be able to take a further step towards solving the riddle of sectoral differences in profit rates.

Irrespective of these developments, easier access to data will further improve the footing of empirical work. This is particularly true for the use of micro data. For our analyses we only had the chance to use such data that was covering a relatively short period of 5 years.

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Annex

Classification of Industries

EUKLEMS industry	EU KLEMS No.
<i>Agriculture, Hunting, Forestry, and Fishing*</i>	AtB
<i>Mining and Quarrying*</i>	C
FOOD , BEVERAGES AND TOBACCO	15t16
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17t19
WOOD AND OF WOOD AND CORK	20
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21t22
Coke, refined petroleum and nuclear fuel	23
Chemicals and chemical	24
Rubber and plastics	25
OTHER NON-METALLIC MINERAL	26
BASIC METALS AND FABRICATED METAL	27t28
MACHINERY, NEC	29
ELECTRICAL AND OPTICAL EQUIPMENT	30t33
TRANSPORT EQUIPMENT	34t35
MANUFACTURING NEC; RECYCLING	36t37
ELECTRICITY, GAS AND WATER SUPPLY	E
CONSTRUCTION	F
Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	50
Wholesale trade and commission trade, except of motor vehicles and motorcycles	51
Retail trade, except of motor vehicles and motorcycles; repair of household goods	52
HOTELS AND RESTAURANTS	H
TRANSPORT AND STORAGE	60t63
POST AND TELECOMMUNICATIONS	64
FINANCIAL INTERMEDIATION	J
<i>Real estate activities*</i>	70
Renting of m&eq and other business activities	71t74
<i>Public Administration and Defence, Compulsory Social Security*</i>	L
<i>Education*</i>	M
HEALTH AND SOCIAL WORK	N
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	O

* Not included in the EUKLEED data.

Table A1: Own account intangible capital¹ by industries

In Euro

EUKLEMS No.	EUKLEMS industry	Organisational Capital	ICT	Research & Development	Total
15t16	Food , beverages and tobacco	2835	375	4178	7387
17t19	Textiles, leather and footwear	3334	583	9425	13342
20	Wood and of wood and cork	3502	302	8540	12345
21t22	Pulp, paper, printing, publishing	3845	1316	5703	10864
23	Coke, refined petroleum, nuclear fuel	15471	2983	61557	80011
24	Chemicals and chemical products	9013	1449	52975	63437
25	Rubber and plastics	3803	520	12417	16740
26	Other non-metallic mineral	4905	648	12724	18278
27t28	Basic metals and fabricated metal	3479	872	17963	22314
29	Machinery, nec	7954	1849	31249	41052
30t33	Electrical and optical equipment	14811	3429	28232	46472
34t35	Transport equipment	8992	1592	31817	42401
36t37	Manufacturing nec.; recycling	3030	394	9420	12844
E	Electricity, gas, water supply	11684	2519	31374	45577
F	Construction	2860	132	8776	11768
50	Sale, repair of motor vehicles etc.	4246	445	4322	9013
51	Wholesale trade, commission trade	10318	2522	12260	25100
52	Retail trade; repair of household goods	5254	755	1462	7472
H	Hotels and restaurants	1400	74	915	2390
60t63	Transport and storage	2750	437	1638	4825
64	Post and telecommunication	1655	2677	12446	16777
J	Financial intermediation	14253	2859	502	17613
71t74	Other business activities	8061	9276	17534	34871
N	Health and social work	1945	338	3094	5377
O	Other community; personal services	5659	915	8493	15067

¹ Capital stock per employed person, median 1999 – 2003.