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**The Dispersion in Profit Rates in Germany:
A Result of Imperfect Competition?**

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Bernd Görzig¹ and Martin Gornig²

Abstract

While the model of perfect competition proves to be a very practical benchmark for assessing existing economies, most economists agree that this ideal state is practically never reached. Observed dispersions in return rates on capital seem to prove that the existence of monopolistic profits is more the rule as an outlier. However, recent research on intangible capital has shown that at least part of the dispersion of return rates is caused by the insufficient coverage of capital input. In conventional accountancy frameworks - commercial as well as national - investment is defined by certain types of classified goods. Given the economic definition of investment as expenditures with expected future returns, this practice covers only parts of total investment and capital input in production.

In this paper, it is argued that the observed return rates on capital at firm level have an upward bias if firms are producing with unobserved – mostly – intangible capital. Using a comprehensive firm level database for Germany (Eukleed), this theoretical preposition is confirmed empirically. Making unobserved intangible capital observable, the dispersion in return rates reduces dramatically. The results clearly support the assumption that a considerable part of the observed dispersion in return rates among firms can be contributed to unobserved capital formation in intangible capital and cannot be attributed to imperfect competition.

JEL classifications: L23, E01, D24

Keywords: Firm-level profitability, Intangible capital, National Accounting

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1 Research question

Labour economists are intensively discussing the apparent inconsistency between the theory-based rule of equal wage for equal labour with the empirical observation that the same type of labour is, in fact, paid differently (Abowd, Kramarz, and Margolis 1999). Similarly, IO researchers are puzzled by the fact that profit rates differ considerably between firms.¹

In “Persistence of Profits Above the Norm”, Mueller (1977, p. 369) states that “In an efficient market economy, profits above or below the norm should quickly disappear.” This statement is contrary to the findings in several empirical studies that some firms can maintain above average level of profits over extended periods of time. Persistent deviations from the average level of profits are found for several countries (*US*: Qualls 1974, Jacobson 1988; *UK*: Geroski and Jaquemin 1988, Cubbins and Geroski 1987; *Canada*: Rigby 1991).

At industry level, EU KLEMS (2007) finds that internal rates of return in Germany averaged over the years 1999 to 2003, are ranging from -11% in hotels and restaurants to 22% in wholesale trade. Diversions for individual years are much higher, but are explainable by the development in the business cycle. The puzzling feature is that the diversions seem to be very persistent even at industry level. If this result is caused by different degrees of monopolistic power policy makers should be alerted to enforce more competition to foster the efficiency of the economy.

However, lack of competition is not the only explanation for the divergence of return rates. Several theories exist explaining this persistency (Roberts 2001). Ayanian (1975), referring to Weiss (1969) and Bloch (1974), remarks that if advertising expenditures are assessed to be intangible capital formation then the accounting rate of return could be potentially biased upwards by an amount that is positively related to the firm's advertising intensity. Fisher and McGowan (1983) suggest a measurement problem: not all activities - such as *R&D* - are properly capitalized as they should be under economic aspects.

¹ Throughout this paper firm is used synonymously with establishment, the local unit.

Megna and 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 of the effectiveness of competition, if it refers to total capital in use, including unobserved capital. Observed differences in the return rate could be caused by the different use of own account capital formation. In particular, expenses for *R&D* and for advertising made by the firms are frequently not counted as capital formation and therefore the capital stock used in production is underestimated.

There is a direct line from this argumentation to the increasing interest of researchers into the impact of so far unobserved intangible assets. Most interest is with the growth aspects of intangible assets (Jona-Lasinio, Iommi, and Roth 2011; Corrado, Hulten, and Sichel 2009; Marrano, Haskel, and Wallis 2009; Hao and Manole 2007; Marrano and Haskel 2006). Dougherty and Jorgenson (1997) find that if human and intangible capital is included, then output growth in most of the G7 countries can almost entirely be explained by differences in total investment. Timmer and van Ark (2005) refer to ICT as a driver for productivity. Basu, Srinivasan, and Oulton (2004) argue that TFP growth will be biased if unmeasured outputs or inputs are neglected. In particular, TFP growth will be overestimated if unmeasured input is growing and underestimated if unmeasured output is growing.

The aim of this paper is to analyse, whether any assessments of the degree of competition in the German economy or its industries has to be changed if intangible capital formation at firm level is capitalized in order to calculate return rates on total capital. The analysis focuses on the extent to which observed dispersions in firm profitability are caused by the production and simultaneous use of capital assets neglected in conventional calculations. First, we address the question: what would happen to the rate of return if unobserved capital formation and unobserved use of capital in a firm must be assumed? In the second step, we analyse this question empirically using a comprehensive firm level dataset for Germany.

2 Methodology

2.1 The accountancy aspect

Marrano, Haskel, and Wallis (2009), hereafter MHW, focusing on growth, conclude that observed labour productivity would be underestimated if hidden formation of intangible capital existed. They do not elaborate the consequences for firm level

return rates, which is the focus of the following description. Beside being relevant for intangible assets, the conclusions can also be applied to any type of so far not considered capital formation within a firm, as for instance inventories, land, or natural resources. With respect to the empirical part of the paper, the following discussion addresses the hidden capital produced by the firms themselves, their own account production of intangibles.

We assume a perfect competitive economic surrounding for a firm. The firm is producing two types of output. One type X_o is assumed to be sold on the markets. We do not explicitly state whether X_o is an investment or consumption good. For simplicity, we exclude intermediate consumption. The second type of output X_I , is assumed to be own account production of assets.

Production of X_o requires labour L and capital K , both from purchased capital K_o and own account produced capital K_I :

$$(1) \quad X_o = O'(L_o, K_o, K_I).$$

Another production function assumes that production of own account capital depends on labour input:

$$(2) \quad X_I = I'(L_I).$$

To simplify the deductions only labour is assumed to be a factor of production. For the following discussion, we do not need to specify details on the production function. The argumentation is based on nominal values, using simple accountancy relations. Given p_o and p_I as product prices, the value of total output Y is given as:

$$(3) \quad Y = Y_o + Y_I = p_o X_o + p_I X_I$$

The costs accruing to produce total output are the expenses for wages, $W = w(L_o + L_I)$, and the costs for the use of capital, given by depreciations, D , and operating surplus, $P = r(K_o + K_I)$. The only relevant price for the following deductions is the rate of return, calculated as:

$$(4) \quad r = \frac{P}{K}.$$

r might be assumed to be the competitive market rate of return for capital input, K . For the discussion put forth here, it is sufficient to assume that it defines the "true" or internal rate of return of a firm, which is applied to decide on alternative investments. It is assumed to be the same for all types of capital in the firm (Jorgenson and Grilliches 1967).

Next, we assume that production and use of capital from own account production remain unobserved. At firm level, accountancy legislation may be the reason. At the aggregate level, the reason could be that own account production is not related with market transactions, such that it remains undiscovered for external observers, in particular statistical institutions. Intangible capital formation could be such a case. Other candidates for hidden use of capital in conventional studies could be land, inventories, or natural resources (OECD 2001).

Observed value of output is lower than total output value, $Y_o = Y - Y_I$, because the value of Y_I cannot be observed, while observed labour input, L , and labour compensation, W , remain unchanged. Obviously observed labour productivity will also be lower. We want to quantify the net effect on the observed rate of return:

$$(5) \quad r_o = \frac{P_o}{K_o} = \frac{Y_o - W - D_o}{K_o}.$$

Both the numerator and the denominator of the return rate are understated if we neglect unobserved intangible capital. Principally, the bias could go either way or could be equalized. Both, observed depreciation, $D_o = D - D_I$, and observed capital stock, $K_o = K - K_I$, will be lower. In contrast, wages, W , and labour input, L , do not change, since the labour input necessary to achieve total output, including Y_I can be observed completely. Labour input, L_I , and labour compensation, W_I , used to produce the value of unobserved own account capital formation Y_I are now falsely allocated to the value of observed output Y_o . The basic assumption is that of asymmetric measurement: Capital formation and the use of capital with respect to own account production are not observed, while the other factors of production are but partly attributed to the wrong type of output.

Observed operating surplus, calculated as a residual, is given with:

$$(7) \quad P_o = Y_o - W - D_o$$

and can be converted into

$$(8) \quad P_o = P - (Y_I - D_I).$$

The observed operating surplus is the "true" operating surplus, minus net own account capital formation, $Y_I - D_I$, the change in unobserved capital. In a growing economy, when capital formation tends to be higher than depreciation, we would expect that the observed values of the operating surplus to be below those which would arise if all capital is included.

Expanding the term $(Y_I - D_I)$ with K_I , yields $g_I K_I$ with,

$$(9) \quad g_I = \frac{Y_I - D_I}{K_I},$$

the growth rate of unobserved capital. The "true" operating surplus, P , can be transformed to rK , and given equation,

$$(10) \quad K = K_I + K_o,$$

converts to

$$(11) \quad P_o = rK_o + rK_I - g_I K_I$$

such that

$$(12) \quad r_o = \frac{P_o}{K_o}$$

converts to

$$(13) \quad r_o = r + (r - g_I) \frac{K_I}{K_o}.$$

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. In most economies, this holds for the majority of firms but it cannot be excluded that r_o is below r if the growth rate of unobserved capital is higher than the market rate of return. In rare cases, if the growth rate of unobserved capital is more than twice the market rate of return, negative observed return rates could even occur.

If unobserved intangibles are included in the rate of return calculations, then resulting values will be below the observable values. Therefore, high correlations between expenditures for intangibles and observed profitability might be misleading. They do not necessarily signal a high overall profitability. For instance, whether an innovation strategy pays out for a firm can only be assessed if the return rate for total capital is considered. For this, intangible assets have to be capitalized with the result that earlier measured high return rates are reduced and converge toward that of firms with less intangible input.

2.2 Measurement of intangibles

If unobserved capital formation differs between firms, divergent return rates can be observed even if the market return rate is the same for all firms. Accounting for intangible capital as part of the unobserved capital might help to explain observed differences in return rates between firms.

It is broadly accepted that estimates on the use of intangibles in firms are extremely difficult and researchers often have to refer to simple plausible settings for many relevant parameters². Corrado, Hulten, and Sichel (2009), hereafter CHS, suggest how to quantify the impact of intangibles³ for the US. In the INNODRIVE³ project (INNODRIVE 2011), the size and the impact of organisational capital are quantified for selected countries at firm level.

The methodology applied is based on the rules of an accountancy framework, as it is common at the firm level and, and to some extent also at the national level in the National Accounts. A key definition is that of investment. Investments are all expenditures not used for consumption - intermediate or final - in the current period (Hunter, Webster, and Whyatt 2005). While this definition (based on an exclusion principle) is widely accepted among economists, the practical problem is empirically identifying investment expenditures. The currently applied methodology in this field is basically a bottom up approach: Certain types of goods are characterized as

² The literature on intangibles makes frequent use of intelligent guesses on shares of intangibles in total expenditures to quantify intangibles. Furthermore, production figures frequently are used as proxies for expenditures.

³ 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.

investments and cumulated to yield total capital. This is practised both in the National Accounts⁴ and in firm accountancies. While recent revisions of the National Accounts go beyond this practice and define certain types of expenditure, like software and intellectual property⁵ as intangible investment, a broad consensus exists that these intangibles are not exhaustive and omit, in particular, organisational capital.

In the literature, various definitions for intangibles are suggested. 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.

Frequently own account capital formation is estimated using the expenditures for labour input afforded to produce it. Based on employment characteristics as types of occupation and education, INNODRIVE defines three groups of employees in a firm, whose labour input can contribute to intangible capital formation:

- *ICT personnel* in total⁶.
- *R&D* employees.
- Management and marketing employees (*OC personnel*).

INNODRIVE assumes that, from these types of labour input, only a certain proportion, depending on the type of good, is engaged in the production of new intangible goods. The remaining employees of each respective type of labour are engaged in current production. In addition to these groups of employees, in this study 20% of labour input made by self-employed is assumed to be part of own account organisational capital (*OC*) formation.

⁴ Even for tangible goods, problems exist in distinguishing empirically between goods used for investment, final, or intermediate consumption. This will not be elaborated further here.

⁵ Upcoming revisions of the National Accounts will include *R&D* intangible investments.

⁶ It has to be mentioned that there might be the possibility of double counting with this item, since the calculations of own account software already included in the National Accounts are partly based on the same source.

Table 1: Share of labour cost dedicated to the production of intangible goods

	Type of labour input		
	ICT	R&D	OC
Share of labour costs used for own account production of intangibles	0.50	0.70	0.20

Different from CHS, INNODRIVE also evaluates the value of intermediate and capital cost in addition to the labour cost necessary in own account production of intangible capital goods. This is done in referring to those industries that are engaged in market production of comparable goods. These are the following industries:

- Computer and related activities (Nace 72) as proxy for *ICT* goods;
- Research and development (Nace 73) as proxy for *R&D* goods; and
- Other business activities (Nace 74) as proxy for *OC* goods.

Based on the EU KLEMS data-base (www.euklems.net), weighted averages are used for the relationship between labour, intermediates, and capital expenditures for Nace 72, 73, and 74, as proxies for the cost structure of own account production of intangible goods in the firms. Combined with the figures for the share of labour costs dedicated to the production of intangible capital, a combined multiplier on labour costs is applied. The central settings for intangibles by INNODRIVE are shown in Table 2.

Table 2: Central settings for intangibles in INNODRIVE

	Type of labour input		
	ICT	R&D	OC
Intangible investment share of labour costs	0.50	0.70	0.20
Combined factor for other inputs (capital & intermediates)	1.48	1.55	1.76
Final multiplier on labour costs	0.70	1.10	0.35
Depreciation rate	0.33	0.20	0.25

For each firm, labour cost for *ICT*, *R&D*, *OC* employees, and self-employed are calculated according to the employment structure of the firm⁷. A number of industries

⁷ See Annex 7.4 for a description of the types of employees classified as producer of intangibles.

are excluded from the analysis, namely the public sector, real estate, agriculture, and mining⁸.

The figures for capital formation are applied in order to calculate intangible capital stock and depreciation. Principally, these are calculated following the EU KLEMS methodology (EU KLEMS 2007) and are made for tangible stock in the same manner as for intangible stocks. Following ESA 95, and in line with theory, depreciation should be calculated at constant prices and revaluated at current replacement prices to yield current depreciation costs. Since we do not have firm specific investment prices⁹ in our database, this methodology is not possible. We are only able to calculate stocks and depreciation at historical costs, as it is done in commercial accountancies. Thus the calculated rate of return is comparable with the return rate calculated from balance sheets of firms.

Because of data restrictions we are not able to follow exactly the definitions of the National Accounts with respect to depreciation. However, we do not expect that this will severely influence our results on the dispersion of the return rate for three reasons. First, because the assumed depreciation rates of intangible assets are fairly high, that valuation changes are expected to have a low impact. Second, because valuation changes affect both the denominator and the numerator, only the net effect is relevant. Third, we are primarily looking at the relationship between firms and not at the development over time.

3 The revised accountancy scheme

Table 3 gives an overview on the composition of the totals calculated from the firm-level estimates. Firms, which belong to industries like agriculture, fishing, mining and quarrying are excluded from the analysis. In addition, we do not consider governmental and similar units, where the possibility of making profit is excluded by definition in the conventional estimates (Public Administration, Education: Nace L,M) or where value added is constructed in the National Accounts (Real Estate: Nace 70).

The assumptions made about the production of intangible assets are resulting in considerably higher values for revised capital formation compared with the observed

⁸ See Annex 7.5 for a list of the industries applied in this analysis.

⁹ Taking industry specific deflators from the EU KLEMS database would mean that for all firms of an industry the same deflator is applied with the result that the relation between the firms would be the same as in the case that historical costs are used.

ones. Research and development as well as organisational capital contribute with equal shares of 18% - 19% to the revised capital formation. Self-employed, neglected in other studies, contribute with 8% to total capital formation. In our study, own account production of intangibles accounts for more than 70% compared with observed capital formation, as quantified according to the definitions in the National Accounts.

Table 3: Composition of capital formation - averages 1999 - 2003

	mill. €	%
Capital formation	310.613	100
Observed (Eukleed) ¹	181.705	58
Buildings	52.167	17
Equipment	113.818	37
Intangibles (software, databases, etc.)	15.720	5
New intangibles (INNODRIVE) ²	128.908	42
Information & Communication	14.464	5
Research & Development	55.759	18
Organisational	58.685	19
<i>of which:</i>		
Self-employed	24.898	8
¹ Establishment values for Nace rev1 industries: D to J, K (excl. 70), N, O. - ² Firm-level estimates with Eukleed (2010). - Sources: EU KLEMS (2007), INNODRIVE (2011), own calculations.		

In the revised estimates some components of value added, such as taxes and wages, remain unchanged with the assumptions of additional capital formation. Usually production taxes are calculated only for market transactions and wages are already covered in total. The only difference is that now some wages are treated as costs in the production of intangible assets instead for traded goods of a firm.

Major changes in the accounting system have to be made for operating surplus. Its value increases because of the higher value added contributed by own account produced intangibles. This increase is partly compensated by the depreciation cost connected with the additional capital stock accumulated by additional capital formation. Thus, changes in operating surplus are given by net investment in intangible assets. These changes are calculated here at firm level and consequently aggregated to compare the outcome with the observed Eukleed (Görzig 2011) based calculations (see annex 7.2). The aggregated result can be derived from table 4. The

calculations show that the net effect on operating surplus has with 10% a similar magnitude as in the case of value added.

Table 4: Impact of intangibles on value added - averages 1999 – 2003

	mill. €	%
Value added	1.231.084	100
Observed (Eukleed) ¹	1.102.176	90
New intangibles (INNODRIVE) ²	128.908	10
Operating surplus	180.762	100
Observed (Eukleed) ¹	162.980	90
+ New intangibles (INNODRIVE) ²	128.908	71
- New depreciation (INNODRIVE) ²	- 111.126	- 61
¹ Establishment values for Nace rev1 industries: D to J, K (excl. 70), N, O. - ² Firm-level estimates with Eukleed (2010). - Sources: EU KLEMS (2007), INNODRIVE (2011), own calculations.		

A comparison of these aggregated firm-level results with other relevant studies made at the macro level (Jona-Lasinio, Iommi, and Roth 2011; CHS 2009; MHW 2009) must consider that INNODRIVE uses firm level data with partly differing industry selections. Main divergences from other studies result from the inclusion of self-employed intangible capital formation and the assumption that apart from wages also conventional capital and intermediate costs are needed in the production of intangible assets

CHS calculate for the US at the macro level, that 15% of total income is used as intangible capital formation, referring to the whole economy and including purchased intangibles. INNODRIVE considers only own account production, which according to CHS counts for one third of intangible capital formation, i. e. 5% of value added (Table 5). However, looking at own account production only, the INNODRIVE definition of intangible investment is broader. CHS only refer to labour costs as intangible capital formation. These account for 5% of value added in INNODRIVE as well. INNODRIVE includes additional capital and intermediate costs to be applied in producing intangible assets (3%). Furthermore, INNODRIVE considers intangible assets produced by self-employed (2%).

Table 5: Comparison of the results with CHS

	INNODRIVE ¹	CHS ²
	per cent of value added	
Total intangible investment	X	15%
Purchased	X	10%
Own account production	10%	5%
Self-employed	2%	X
Other personnel	8%	5%
Wage costs	5%	5%
Capital & intermediate costs	3%	X
¹ Corrado/Hulten/Sichel (2009). - ² INNODRIVE (2011). -		

Nearly half of the expenditures defined here as intangible capital formation consists of organizational capital. This corresponds with the results found by MHW (2009) for the UK that 50% of total intangible investment is attributable to economic competencies. Again it should be noted that these figures are not directly comparable, since the MHW estimates are made for a different industry breakdown and also include purchased intangibles and other items not considered in our calculations.

4 Results

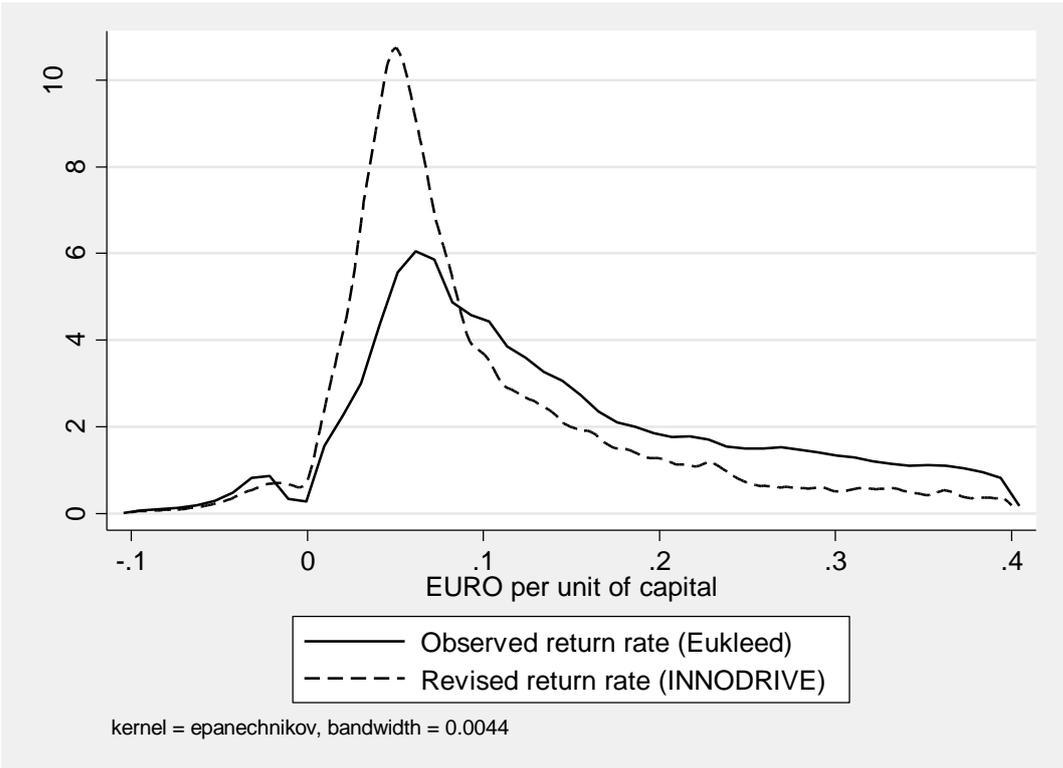
4.1 Firm-level results

Firm specific rates of return on capital are calculated as operating surplus (after deductions of labour compensation for self-employed) divided by the average net capital stock at historical costs¹⁰. Figure 1 shows that calculated with the conventional methodology the dispersion of the return rates among firms is fairly wide, including also firms with negative return rates. A majority of firms gather around the 10% return rate. The distribution displays a long right tail - partly cut off - in Figure 1, with a number of firms having really large return rates. The results seem to be heavily influenced by outliers in the sense that a number of firms earn an operating surplus per unit of capital that is far above the average. A possible explanation for such extreme return rates could be that operating surplus includes elements that should economically be counted as costs: for example, the costs of the use of intangibles.

¹⁰ As already discussed, we would prefer a valuation at current replacement costs. Due to the lack of firm-specific investment prices this is not possible.

For a better understanding of these facts, it should be noted that production behaviour of existing firms can differ remarkably from the typical textbook examples. This is particularly true for the quite large number of small firms in the sample. Factual capital usage by small service firms very often is not based on previously invested capital goods but is instead on rented capital. These expenditures are counted as intermediate consumption in the firm’s accounting system. For example, a consultant firm consisting of the owner and an office clerk may rent the office space, the office equipment and use a leased car. In this case, the costs are only for labour and intermediate consumption. Although there is no capital observable, the residual in textbooks is often described as capital compensation. It accrues to the owner of the firm.

Figure 1: Density distribution of the return rate on capital - averages 1999 – 2003



Sources: INNODRIVE (2011), own calculations.

Literature suggests several, non-exclusive explanations for this residual. One is that the residual can be seen as the compensation of entrepreneurial labour input, a common procedure in growth accounting. Another is that it is not a rent on capital but rather exhibits the characteristics of innovation or monopolistic rent. As discussed in

the methodological section, it can be also explained as rent on unobserved capital, in this case the use of intangible capital invested by the owner.

We find a remarkable difference between the aggregated return rate and the non-weighted average across all firms. Note that for the non-weighted average all firms have the same weight independent of their size, which is a natural assumption in IO analysis of entrepreneurial behaviour. Since the majority of establishments in the analysis are very small, the return rates of small firms exert a strong influence on the results. The observed mean of the non-weighted return rate is 176%; which is extremely high and far above the observed weighted average return rate (11.2%).

Table 6: Rate of return for revised estimates - averages 1999 - 2003

	Dimension	Observed (Eukleed)	Revised (INNODRIVE) ²
Operating surplus		162.980	180.762
Net capital stock ³	mill. €	1.453.659	1.945.495
Return in cent per Euro of net capital stock			
Weighted mean		0,11	0,09
Mean of firm specific annual averages		1,76	0,26
¹ Establishment values for Nace rev1 industries: D to J, K (excl. 70), N, O. - ² Firm-level estimates with Eukleed (2010; see Annex 6.2). ³ Valued at historical costs. - <i>Sources:</i> EU KLEMS (2007), INNODRIVE (2011), own calculations.			

In the theoretical world of perfect competition, only one price for the use of capital exists and no profits can develop. In this case, there would be no dispersion in the return rates between firms and the two measures - the weighted average and the non-weighted average across firms - would be identical. If we could assume that no measurement errors exist then the relation between weighted and not weighted average of the return rate could just be another measure of the degree of imperfect competition.

Compared with the conventional measures, which are given by the observed values in the Eukleed database in table 6, we can see that including intangibles operating surplus is higher by the value of net investment into intangibles. The increase is about 11%. But also total capital stock is higher than in the conventional measure due to the cumulated additional net intangible capital formation. This increase in capital stock is with about 34% much higher. As predicted in the methodological

section, the weighted return rate including intangible capital and its depreciation is with 9% about one fifth below the observed rate of return of 11% (Table 6). The non-weighted return rate reduces from 175% to 26%. Thus, the reduction in the return rate is huge if we look at the mean of the non-weighted return rate where each firm has the same weight. Including own account production of intangibles in the calculations of the return rate reduces the gap between the weighted and not weighted rate of return considerably.

While these calculations make transparent that quite a big proportion of the diversion in measured return rates might be contributed to the fact that relevant proportions of capital stock are omitted in the conventional calculations, we cannot conclude that the revised results do allow a final assessment of the “true” dispersion in return rates. As already mentioned earlier, coverage of capital still might be insufficient. The analysis refers only to the own account part of intangible investment, which covers according to CHS only one third of total intangible investment. In addition, other elements of capital stock like inventories, land and natural resources are omitted.

4.2 Results for EU KLEMS industries

From a policy perspective and a more macro oriented analysis the aggregated return rate might be of higher interest. In this case, each firm is weighted with the capital she uses in production such that bigger firms are weighted heavier than the numerous small firms. This leads to results which are consistent with return rates at higher levels of aggregation as for instance in the EU KLEMS data base¹¹. In this paper we are primarily interested into the overall repercussions of the inclusion of intangibles on the average return rates for industries. In the following we therefore concentrate on the results for the weighted return rate¹².

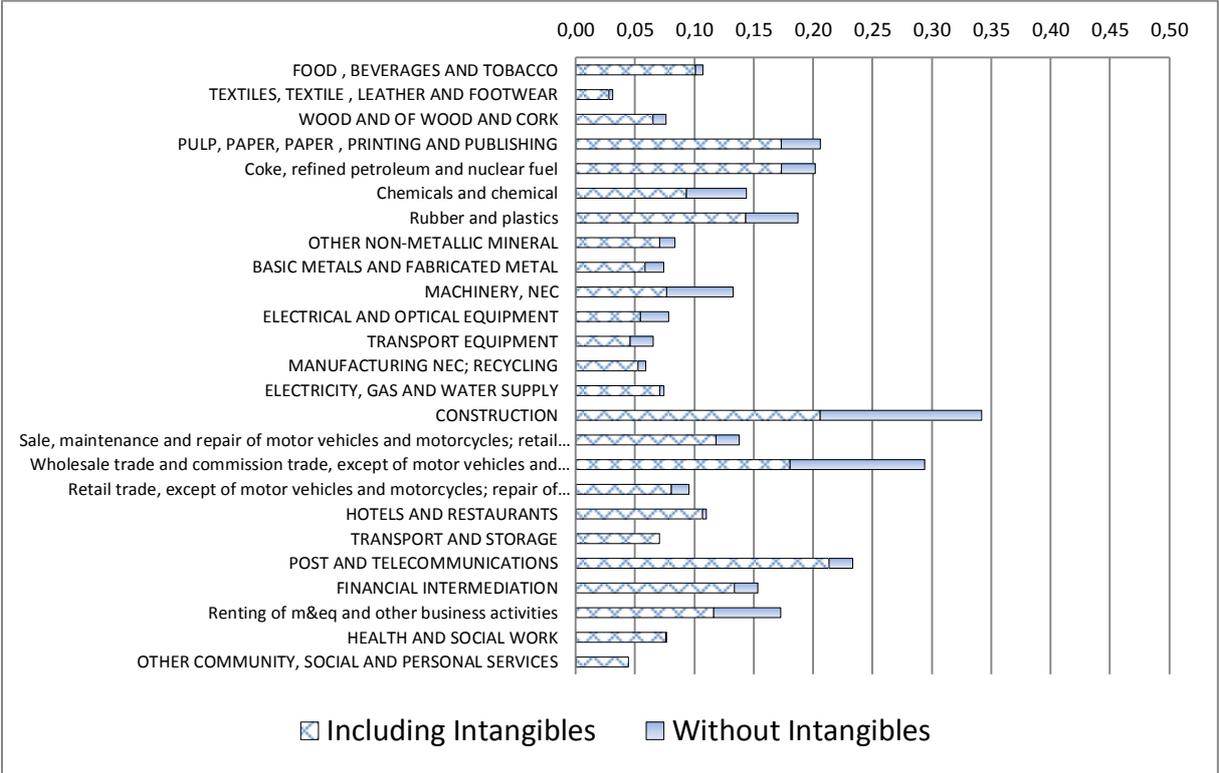
Also at the EU KLEMS industry level, we can observe lower rates of return if intangible capital is included in the calculations (Figure 2). However, the impact of

¹¹ For the majority of industries, the aggregated rates of return calculated from the observed values in the Eukleed database are consistent with the internal rate of return (IRR) as developed in the EU KLEMS project. Exceptions apply for industries such as *retail trade (52)* and *hotels and restaurants (H)* with a high proportion of family workers in the self-employed workforce. Eukleed is valuing labour compensation of family workers considerably lower than EU KLEMS with the result that in the average the aggregated rate of return for these industries is positive.

¹² For a discussion of the long term development of the return rates in the EU KLEMS industries see Görzig/Gornig/Werwatz (2012).

intangibles on the return rate is very different depending on the industry in question. In general, industries with very high return rates as *construction* and *wholesale trade* have a stronger reduction than those, which already show a return rate at a lower level. For some industries, as *textiles etc. (17t19)*; *electricity, gas and water supply (E)*; *hotels and restaurants (H)*; *transport and storage (60t63)*; *health and social work (N)*; or *other community services (O)* the inclusion of intangible capital has only marginal impacts on the revised return rate.

Figure 2: Rates of return by industries - averages 1999 - 2003



Sources: INNODRIVE (2011), own calculations.

The expectations developed in the methodological section that own account production of intangible assets reduces the rate of return can be verified for nearly all industries (Table 7). The assumptions made about intangible capital clearly lead to a higher uniformity not only of firm specific but also of industry specific return rates. The standard deviation of the return rates between EU KLEMS industries reduces from 0.079 to 0.053.

Table 7: Impact of intangibles on the rate of return - averages 1999 - 2003

EU KLEMS industries	EU KLEMS No.	Cent per Euro - annual weighted averages		
		Observed (Eukleed)	Revised (INNODRIVE) ²	observed minus revised
FOOD , BEVERAGES AND TOBACCO	15t16	0,107	0,101	0,006
TEXTILES, TEXTILE , LEATHER AND FOOTWEAR	17t19	0,031	0,028	0,003
WOOD AND OF WOOD AND CORK	20	0,076	0,065	0,011
PULP, PAPER, PAPER , PRINTING AND PUBLISHING	21t22	0,206	0,173	0,033
Coke, refined petroleum and nuclear fuel	23	0,202	0,173	0,028
Chemicals and chemical	24	0,144	0,093	0,051
Rubber and plastics	25	0,187	0,143	0,044
OTHER NON-METALLIC MINERAL	26	0,083	0,071	0,013
BASIC METALS AND FABRICATED METAL	27t28	0,074	0,058	0,016
MACHINERY, NEC	29	0,133	0,077	0,056
ELECTRICAL AND OPTICAL EQUIPMENT	30t33	0,078	0,054	0,024
TRANSPORT EQUIPMENT	34t35	0,065	0,046	0,019
MANUFACTURING NEC; RECYCLING	36t37	0,059	0,052	0,007
ELECTRICITY, GAS AND WATER SUPPLY	E	0,074	0,071	0,004
CONSTRUCTION	F	0,342	0,206	0,136
Sale, maint. and repair of motor veh. and m.cycles.; retail sale of fuel	50	0,138	0,118	0,019
Wholesale and commission trade, exc. of motor vehic. and m.cycles	51	0,294	0,181	0,113
Retail trade, exc. of motor vehic. and m.cycles; repair of househ. goods	52	0,095	0,080	0,015
HOTELS AND RESTAURANTS	H	0,110	0,107	0,003
TRANSPORT AND STORAGE	60t63	0,069	0,070	- 0,001
POST AND TELECOMMUNICATIONS	64	0,233	0,213	0,020
FINANCIAL INTERMEDIATION	J	0,153	0,134	0,020
Renting of m&eq and other business activities	71t74	0,173	0,116	0,056
HEALTH AND SOCIAL WORK	N	0,077	0,076	0,001
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	O	0,043	0,044	- 0,001
Total		0,112	0,093	0,019

¹ Establishment values for Nace rev1 industries: D to J, K (excl. 70), N, O. ² Firm-level estimates with Eukleed (2010). ³ Operating surplus divided by net capital stock at historical costs. -
Sources: EU KLEMS (2007), INNODRIVE (2011), own calculations.

5 Conclusions

The results of this analysis clearly support the preposition that a considerable part of the observed dispersion in return rates between firms and also between industries might be attributed to unobserved own account capital formation in intangible capital. Observed dispersion in return rates therefore cannot completely be attributed to different degrees of competition but is for a considerable part instead the result of

measurement errors resulting from insufficient coverage of capital. The analysis does not allow a final conclusion on the degree of competition for individual industries since it considers only own account production of intangibles while other types of unobserved capital as purchased intangibles, land, inventories, or natural resources are still omitted in the calculation of the return rates. Further research remains necessary. However, it looks striking that we can observe above average differences between the revised and the observed return rates specifically in industries, which are commonly believed to have a complex product portfolio like machinery and chemicals.

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7 Annex

7.1 Database

Many firm level studies rely on readily available databases such as COMPUSTAT, which is based on published balance sheets. While larger firms are reliably represented in this data set, small and medium sized firms (SMEs) are not covered; thus conclusions might be biased¹³. In order to include SMEs in our firm-level analysis, an establishment level, panel dataset, Eukleed for Germany (Görzig 2011) is applied. Eukleed is a comprehensive integrated micro data set including employment, investment, and output based on German Social Security (SIS) data (Alda, Bender, and Gartner 2005; Fritsch and Brixi 2004). It is fully integrated into the National Accounts for Germany and 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 70-industry level of EU KLEMS (2007) and the 16 Federal States level with respect to all published data (NA FED 2009).

7.2 Capital stock methodology

Intangible stocks are calculated applying the EU KLEMS methodology. Capital stock at historical prices, as in commercial accountancies, is applied. The opening stock, K_t , for an establishment is given with:

$$(7-1) \quad K_t = K_{t-1}(1 - \delta) + I_t,$$

¹³ In addition, some authors, as McGahan/Porter (2002), drop the remaining comparatively small enterprises from the COMPUSTAT data file when analysing of the variance of profitability.

with I_t the capital formation of the current year and a constant depreciation rate, δ . Starting values for capital stocks are calculated by using a modified version of a methodology suggested by Griffith (1999). The relation between capital formation and capital stock by type of asset and industry calculated from the EU KLEMS database is used. This relation is applied to firms existing on the first day of our observation period (January 1, 1999) in order to calculate the opening stock of firm-specific capital. Capital stock calculations are based on observed figures of investment and an estimate of the initial closing capital stock, $K_{\theta-1}$, in the year prior to the start of observation in the data. We assume a constant growth rate of investment, g , before the first year of observation. Let θ be the first observation for a firm. Back extrapolating yields:

$$(7-2) \quad I_{\theta-1} = I_{\theta}(1-g) ,$$

with I_t for the capital formation of the current year and a constant growth rate, g . Given the general cumulative definition of the closing stock in equation (7-1), we apply the following equation to calculate the initial stock:

$$(7-3) \quad K_{\theta-1} = I_{\theta-1} \sum_0^{\infty} (1-\delta-g)^t .$$

δ is the depreciation rate and g is the growth of investment in the years preceding the initial year. Applying the sum formula for a geometric row leads to

$$(7-4) \quad K_{\theta-1} = \hat{I} \frac{1-(1-\delta-g)^T}{1-(1-\delta-g)} .$$

The initial investment, \hat{I} , stands for the starting value, $I_{\theta-1}$, in the back extrapolation, assuming the growth rate of investment g , before the first observation. In theory, T should be infinite, for practical purposes it can be set to 100. \hat{I} is set to be the average investment in the five-year period following the first observation year, θ . The average is used to assess the average investment over the business cycle. It is corrected by a discount factor reflecting the growth of investment in the observation period.

Firms that do not exist at the beginning of the observation period are assumed to have an opening capital stock of zero. If a firm is closed before the end of a year, the

average stock is reduced according to the days of its usage. This implies the assumption that the closing stock of the firm is sold to other firms¹⁴.

A critical issue in this expression is the assumption on the growth of investment before the first year of observation. However, sensitivity calculations show that differences in the results applying alternative assumptions are low at the aggregate level and the changes in the indicators of the dispersion in return rates are nearly negligible.

7.3 EU KLEMS Depreciation Rates

type of asset	abbreviation	minimum rate	maximum rate
Residential structures	Rstruc	0,011	0,011
Non-residential structures	NRStruc	0,023	0,069
Infrastructure	Infra	0,023	0,069
Transport equipment	TraEq	0,061	0,246
Computing equipment	ICT	0,315	0,315
Communications equipment	CT	0,115	0,115
Other machinery and equipment	OMach	0,073	0,164
Products of agriculture and forest	Agri	0,073	0,164
Other products	Oth	0,073	0,164
Software and other intangibles	Soft&Int	0,315	0,315

Note: for rates by industry, see Appendix Table 1 in EU KLEMS 2007.

¹⁴ According to the definition given by ESA 95, gross fixed capital formation (GFCF) of a firm is defined as new investment plus acquisition of used assets minus the sale of used assets.

7.4 INNODRIVE Classification of Intangibles

BKdI88 ¹	description ²	Characteristics of employees creating intangible assets of type:			
		ICT	R&D	Management	Marketing
31-32	Agricultural engineers and administrators, a.s.			All	
601-612	Engineers, physicist, mathematicians, a.s.		Low	High	
621-635	Technicians, a.s.		All		
681	Wholesale, retail trade agents, purchasing agents, a.s.			High	Low
682-688	Sales assistants, a.s.				High
691-692	Banker, a.s.			High	
703	Advertising specialists, a.s.				High
733-734	Communication experts, a.s.	All			
751-763	Chief executives, consultants, tax adviser, a.s.			All	
771-773	Financial officers, chief accountants, a.s.			High	
774	IT experts, a.s.	All			
781-782	Office executives, a.s.			High	
783	IT assistants, a.s.	All			
784-794	Office clerks, a.s.			High	
862-863	Chief executives, consultants of social institutions, a.s.			High	
881	Economists, statisticians, a.s.		All		
883	Natural scientists, a.s.		All		
911	Directors of hotels, restaurants, a.s.			High	
921	Home economy administrators, a.s.			High	

¹ German classification of occupations (IAB 2007; chapter 5).² -Translated from German - All: All employees; High: Employees with higher education; Low: Employees without higher education. - Higher education: University degree or similar (Code numbers 4 to 6 in IAB (2007; chapter 8). - a.s.: and similar. Sources: IAB (2007), Piekkola (2009), own definitions.

7.5 Classification of EU KLEMS Industries

EU KLEMS industry	EU KLEMS No.
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
Renting of m&eq and other business activities	71t74
HEALTH AND SOCIAL WORK	N
OTHER COMMUNITY, SOCIAL AND PERSONAL SERVICES	O