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An analysis of inventory turnover in the Belgian manufacturing industry, wholesale and retail and the financial impact on inventory reduction

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AN ANALYSIS OF INVENTORY TURNOVER IN THE BELGIAN MANUFACTURING INDUSTRY, WHOLESALE AND RETAIL AND THE FINANCIAL IMPACT OF INVENTORY REDUCTION

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ABSTRACT
Various inventory studies have been published in the last decades. Some studies emphasize the importance of low inventories, other examine the evolution of inventories over time and especially focus on the impact of the just-in-time (JIT) revolution. The aim of this paper is to investigate the level of inventories held by Belgian companies at one moment in time, namely May 2004. First we examine differences in inventory ratios between manufacturing industry sectors as well as between wholesale and retail. We find empirical evidence that the type of production process is the most important driver for work in process inventory. The finished goods inventory ratio also differs significantly among industry sectors, but here the reasons for the difference are harder to distinguish. Finally we find the inventory ratio to be significantly higher in retail than in wholesale. Furthermore, we examine the financial impact of inventories in the manufacturing industry. We find that companies with very high inventory ratios have more chance to be bad financial performers. Regression analyses partially support the hypothesis of a negative relationship between inventory ratio and financial performance but significant results could not be obtained for all sectors.

Keywords: Manufacturing, Inventory

Introduction

Over the previous years, numerous studies have been published studying the evolution (Ginter and La Londe (2001), Rajagopalan and Malhotra (2001), Chen et al. (2005), Boute et al. (2004)), drivers () and financial impact (Chen et al. (2005)) of inventory levels. For the Belgian industry comparable results are sparse, on the one hand there are sector level studies that search for patterns in inventory holdings and wonder whether Belgian inventories decreased over the past decades (Boute et al. 2004), but on the other hand these studies do not make clear which sectors have a high or a low inventory ratio. Attempting to fill this research gap this study examines Belgian inventories using company level data. Using data at this level of detail makes it

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possible to check the significance of differences in the inventory ratio between sectors by means of analysis of variance (ANOVA). Moreover, working on a company level has the advantage that we can examine the financial impact of using regression analysis.

Literature Review

During the previous years, numerous papers have appeared discussing the level and evolution of inventories over time. We distinguish between the macro approach, in which sector-level data is used to describe inventory trends and the micro approach, in which company-level data allows a more profound study of inventory levels.

We are only aware of one study on the macro level for the Belgian industry. Boute et al. (2004) study the inventory evolution for each inventory type for the period 1979-2000. The authors analyze 15 manufacturing sectors, including different levels of aggregation. Furthermore, the retail and wholesale sector were included. Inventory ratios are used to measure the inventory position, they are calculated by dividing the raw material, work-in-process and finished goods inventory levels by the material cost increased with respectively 0%, 50% and 100% of the added value. These inventory ratios were then used as dependent variables in a simple linear regression model with time and sector output growth as explanatory variables. The latter was included to correct for the impact of business cycles. The raw material inventory ratio significantly decreases in eight sectors and there is a decrease in work-in-process inventories in six sectors. As expected, the finished goods segment is not performing very well. Only four sub-sectors (chemicals, textile, electronics & ICT and rubber & plastics) show a significant decrease. Boute et al. (2004) conclude that the general expectations of drastic reductions in inventory ratios were not fulfilled. The reason behind this is that there also exist factors causing inventories to increase such as revenue enhancing strategies, export and an increasing degree of outsourcing. Overall, it is concluded that despite an increased focus on inventory reduction, no significant overall decrease of inventory ratios over time is found. A possible explanation might be that the business strategy pursued by many companies includes forces that potentially may increase inventory ratios. Further insight into the drivers of inventory levels and the impact of the latter on financial performance might be obtained by performing a firm-level analysis.

Unfortunately, no such analysis was available for the Belgian industry up to now. In the US, Chen et al. (2005) examine the inventories of publicly traded American manufacturing companies. The authors find that respectable inventory reductions did take place over the 1981-2000 period. The largest decline is found for work-in-process inventory days, which dropped about 6% per year. Raw materials have fallen about 3% per year, but finished goods inventories did not decline. In some industries, finished goods inventory days actually increased. Furthermore, the authors study the financial impact of inventories. (2005) relate the firms relative inventory position compared to its sector peers to the financial performance of the firm. The authors conclude after extensive analysis that inventory does not seem to matter much for the market-to-book ratio. However, firms with abnormally high inventories do have poor stock returns over time. More surprisingly, firms with the lowest levels of inventory do not perform well either.

Roumiantsev and Netessine (2005) analyse inventories in US companies for the period 1992-2002. They find empirical evidence that firms operating with more uncertain demand, longer lead times, higher gross margins and lower inventory

holding costs have higher inventory levels. Furthermore, larger companies appear to benefit more from economies of scale and therefore have relatively less inventory than smaller companies.

Data Set

We use data from companies in the Belgian manufacturing, wholesale and retail sectors. We only consider the year 2004 since this study aims to explain cross-sectional differences. The data was extracted from the Bel-First database, containing detailed financial reports and statistics on Belgian and Luxembourg companies. Only large companies were considered since small companies are exempt from reporting inventory information on the level of detail we required for this study. Furthermore, sectors with too little observations and outliers were removed from the dataset in order to avoid biases. This results in a final data set of 883 retailers, 3386 wholesalers and more than 1000 companies in the manufacturing industry (3035 for raw materials, 1531 for work-in-process and 2161 for finished goods) split up over 17 sectors.
We have made the sample size as large as possible to guarantee a very representative idea of the situation in a sector for a given inventory type, as a consequence, sample size differs between inventory types for certain sectors in the manufacturing industry. Note that we omitted sectors with too little observations (16 *Tobacco*, 19 *Leather & shoes*, 30 *Office & computer*, 33 *Medical equipment & clocks*, 35 *Other means of transportation)*. Furthermore, outlying observations were removed when the ID ratio exceeded the outer fences of the box plot, i.e. when data are outside the following interval:] Q_1-3×IQR; Q_3+3×IQR [. Q_1 and Q_3 are the first and the third quartile and IQR is the interquartile range, i.e. Q_3-Q_1. Using this method to remove outliers is preferred when the distribution of the data is crooked, a phenomenon we observed for the inventory ratio data. In contrast, the distribution of the financial data is normal. Therefore we used a more traditional method based on the standard deviation to remove outliers.

Metrics

It is necessary to use inventory ratios instead of absolute inventory values in order to correct for inflation and varying sector output. We are particularly interested in how many days inventory is held (based on Rajagopalan et al. 2001; Chen et al. 2005), therefore, we measure a company's inventory position using the inventory days ratio (ID). Inventories are split up in raw materials, work in process and finished goods. The ratio is then modified to take into account the process of value creation along the production chain.

Table 1: inventory days ratios

Inventory type	Ratio
Raw materials	$\frac{inventory\ raw\ materials \times 365\ days}{material\ costs}$
Work in process	$\frac{inventory\ work\ in\ process \times 365\ days}{material\ costs + 0.5 \times value\ added}$
Finished goods	$\frac{inventory\ finished\ goods \times 365\ days}{material\ costs + value\ added}$

To measure financial performance, we prefer to use return on assets (ROA) for reasons of data availability and accuracy. Often other ratios are used, such as the market-to-book ratio (Chen et al. 2005), earnings per share (Huson et al. 1995) or profit margin (Oliver et al 1994). We could have used these ratios too, but because of data unavailability this would have obliged us to reduce our sample size drastically. We use the following definition for return on assets:

$$Return\ on\ assets\ (ROA) = \left(\frac{recurrent\ profit}{total\ assets} \right) \times 100$$

The use of ROA is appropriate because the recurrent profit in the numerator is the result of the regular management, i.e. the sum of the operating profit and the financial profit, but without the exceptional profit. The total assets in the denominator corrects for company size. Note that we can only use this ratio to compare companies within sectors since the ratio is strongly correlated with the sector's capital intensity.

Methodology

We use analysis of variance (ANOVA) to check the significance of differences between groups (sectors). In order to apply ANOVA, some assumptions have to be fulfilled. Deviation from the assumption of homogeneity of variance is not so problematic since ANOVA's F-test is very robust for deviation from this hypothesis. However, the second assumption states that the data within a group need to have a normal distribution. A violation of this assumption has a stronger impact on the validity of the F-test. Since the ID ratios do not seem to be normally distributed, we perform a logarithmic transformation on this dataset. This leads to a dataset with a normal distribution of the data. The analysis of variance is performed on the transformed dataset. We also use an additional test because the null hypothesis of this test, namely that there is no significant difference between the means of the different groups, is already rejected if two groups differ significantly from one another. Therefore we carry out Tukey Post-Hoc tests, which compare the mean of every sector with the mean of every other sector (pairwise comparison). This post hoc test can be used to determine the significant differences between group means in an analysis of variance setting.

For analysing the financial impact we use a regression analysis using ROA as the dependent variable and the inventory ratio ID as the independent variable:

$$ROA = \alpha + \beta \times ID + \varepsilon$$

We will estimate this model for every inventory type and every sector.

Inventory Analysis Manufacturing Sector

Table 1 gives an overview of the average and median values of the ID-ratio's per manufacturing sector.

Table 2: ID Manufacturing Sector

code	sector	Raw Materials			Work in Process			Finished Goods		
		Median	Average	Sector Size	Median	Average	Sector Size	Median	Average	Sector Size
15	Food & drinks	16,4	24,8	418	2,9	5,8	154	8,4	13,0	339
17	Textile	37,2	53,9	223	11,8	17,5	150	24,0	31,3	191
18	Apparel & fur	36,9	47,4	46	15,2	19,9	31	21,9	32,4	40
20	Wood and wood products	42,0	54,2	89	16,6	20,1	36	17,9	22,8	63
21	Paper & carton	28,8	32,8	104	2,8	6,0	61	12,6	18,2	89
22	Publishing & printing	25,0	28,0	146	7,4	8,0	52	12,3	27,6	59
23	Cokes & petroleum products	16,7	54,5	31	1,3	1,6	10	10,1	11,0	20
24	Chemicals	29,0	40,6	335	4,7	9,6	166	17,2	21,3	287
25	Rubber & plastics	28,8	38,6	213	6,4	8,5	115	18,5	21,5	190
26	Non-metallic minerals	26,0	34,9	261	4,7	7,7	85	24,0	44,1	186
27	Iron & steel	45,8	52,0	140	10,0	19,9	83	17,4	23,5	101
28	Metal products	43,3	52,7	385	12,0	16,9	171	16,2	21,2	180
29	Machinery & tools	40,4	60,2	235	15,1	22,5	154	14,0	17,7	132
31	Electrical appliances	36,9	54,7	109	13,2	19,4	75	10,8	13,6	72
32	Audio, video & telecom	51,5	64,4	51	15,1	25,3	35	12,7	15,0	37
34	Cars & trailers	28,8	35,4	96	6,4	11,5	55	7,7	11,4	61
36	Furniture & other industry	43,7	52,9	153	11,3	16,9	98	13,2	20,0	114

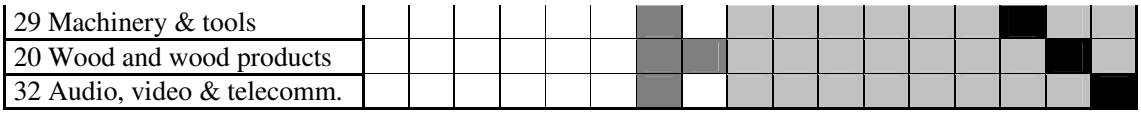
It immediately becomes apparent that the sector usually determines the relative inventory position compared to other sectors for all inventory types. Let us for example compare the sectors Food & Drinks (15) and Textile (17). The former has relatively low inventory holdings for each inventory type whereas the opposite is the case for the latter. Furthermore, if we look at each sector in detail we observe that the distributions are right-skewed. This indicates that the majority of companies has a lower than average inventory position. This right-skewedness is also the reason we give the median values. Furthermore, we observe large differences in the inventory positions of companies from different sectors for work in process and finished goods. We will now take a closer look at these sectoral differences.

Work in Process

We performed an ANOVA analysis, coupled with the well-known *Tukey Post-Hoc* test in order to compare the pairwise differences in average ID values between sectors.

Table 3: Results Tukey Post-Hoc test Work in Process ID

	23	15	21	26	24	34	22	25	27	18	28	36	31	17	29	20	32
23 Coke & petroleum prod.																	
15 Food & drinks																	
21 Paper & cardboard																	
26 Non-metallic minerals																	
24 Chemicals																	
34 Cars & trailers																	
22 Publishing & printing																	
25 Rubber & plastics																	
27 Iron & steel																	
18 Apparel & fur																	
28 Metal products																	
36 Furniture & other industry																	
31 Electrical appliances																	
17 Textile																	



The first column and the first row show the sectors in order of increasing mean log(ID ratio). The black square in each row indicates the position of the considered sector in that row. Grey coloured squares indicate that the average ID-ratio's of those sectors do not differ significantly from the average ID-ratio of the considered sector. A white square, on the other hand, indicates a significant difference. Based on this test, two groups of sectors, indicated by the two light-grey squares, can be visually distinguished.

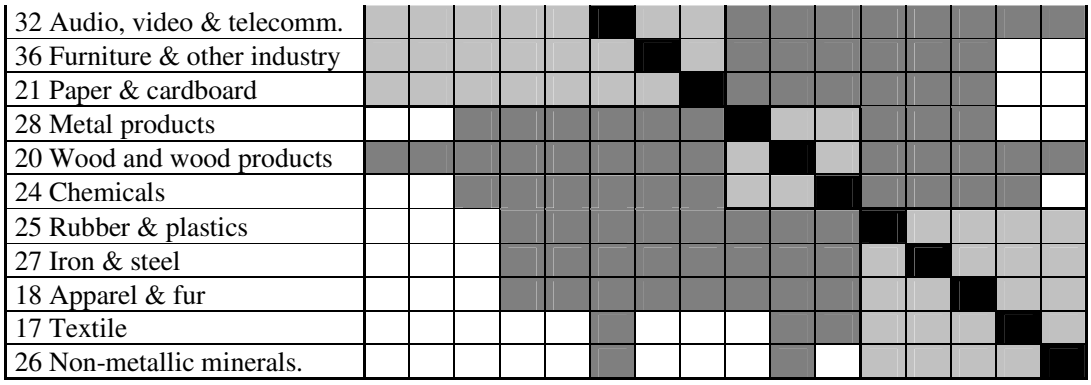
We start off in the top-left and the bottom-right corner and continue, respectively to the right-bottom and to the left-top, adding sectors to the two groups until a sector is encountered for which the average ID-ratio is significantly different from at least one of the sectors already included in the group. The result is the creation of two groups in which none of the sectors included show a significant pairwise difference with one another regarding their average ID-ratio values. The group containing sectors with relatively low inventory ratio's includes sectors 23,15,21,26,24,34 and 22. The group containing those with relatively high ID-values comprises 27,18,28,36,31,17,29,20 and 32.
If we look in detail at the types of sectors comprising each group we see that a distinction can be made based on the type of production process in a sector. Sectors with a continuous production process usually seem to have a low inventory level whereas the opposite holds for sectors with a discrete production process. This confirms the ideas behind both continuous and discrete processing. In continuous processing it is usually impossible or undesired to keep inventories in between production phases whereas for discrete production these inventories are often required to decouple steps of the production process to compensate for time/rhythm-differences. There are, however, two exceptions to this general finding. The sector Cars and Trailers (34) is clearly a sector in which one would expect a discrete production system. Nevertheless, inventory levels for work in process seem to be very low for this sector. This is no doubt due to the high level of automation and the strong emphasis on just-in-time production. On the other hand, we see that the sector metallurgy (27) is characterized by high inventories even though this is a sector with a continuous production process.

Finished Goods

In order to group the sectors according to relative finished goods inventory positions, we use the same technique as for the work in process inventories. We obtain the results in table 3.

Table 4: Results Tukey Post-Hoc test Finished Goods ID

	34	15	31	22	29	32	36	21	28	20	24	25	27	18	17	26
34 Cars & trailers																
15 Food & drinks																
31 Electrical appliances																
22 Publishing & printing																
29 Machinery & tools																



Three groups can be distinguished based on these results. They are again indicated using light-grey squares. We obtain 8 sectors with a relatively low inventory of finished goods, 3 sectors with an average inventory position and 5 sectors with relatively high values for the ID Finished Goods-ratio. We can cite various possible causes for a difference in inventory holdings such as the degree of customer customization, the product variety, the product life cycle length, ... However, it is hard, if not impossible, to obtain reliable data for these variables. Another possible finished goods inventory driver, which is also very important for Belgium in general, is export. In 2004, Belgian export represented 86.9% of the Gross Domestic Product[5], indicating that Belgium is very dependent on foreign trade. We suspect that export is also important for the finished goods inventory ratio. When the export ratio rises, deliveries will occur less frequently and order costs will increase, resulting in a higher finished goods inventory ratio. Therefore, we try to link the export ratio of the sectors (defined as the percentage of orders destined for export) with the relative inventory position (low, medium, high). We obtain the results in table 4 (only sectors for which the relevant data are available are included).

Table 5: export orientation and ID finished goods

Sector	Export ratio	ID finished goods ratio
34 Cars & trailers	87,3%	Low
32 Audio, video & telecom	80,8%	Low
17 Textile	79,0%	High
24 Chemicals	77,9%	Medium
27 Iron & steel	77,0%	High
29 Machinery & tools	69,5%	Low
21 Paper & cardboard	65,7%	Low
31 Electrical appliances	61,1%	Low
18 Apparel & fur	49,3%	High
28 Metal products	43,3%	Low

As expected, we see that a relatively low export ratio corresponds to a relatively low finished goods inventory position. However, for some sectors these results do not hold. We see that the sectors Cars & Trailers (34) and Audio, Video & telecom (32) have a high export orientation but low finished goods inventories. The reason is that other factors come into play. Cars & Trailers (34) is a sector characterized by a strong make-to-order strategy, hence less inventories will be needed. The opposite is true for

[5] Source: http://statbel.fgov.be/press/fl065_nl.asp

the sector Apparel & Fur (18), a sector characterized by a low export orientation but a high inventory position.

Inventory Analysis Wholesale and Retail

Table 6: ID ratio's wholesale and retail

	Code	sector	Median	Average	Sector Size
wholesale	512	Wholesale automotive	20,17	34,73	88
	513	Wholesale automotive parts	14,68	23,08	367
	514	Wholesale agriculture and live animals	43,2	52,06	935
	515	Wholesale food and beverage	37,42	48,62	950
	518	Wholesale consumer goods	32,28	41,17	623
	519	Wholesale non-agriculture products and waste	39,6	47,18	155
	50101	Wholesale machines and appliances	39,61	49,82	193
	50301	Wholesale other	48,68	58,66	75
retail	521	Retail automotive	31,62	44,13	126
	522	Retail automotive parts	10,36	17,71	52
	523	Retail fuel	36,98	43,67	65
	524	Retail non-specialized stores	56,56	65,74	361
	526	Retail cosmetics and pharmaceuticals	11,37	24,75	17
	505	Retail other specialized	10,2	10,57	35
	50103	Retail second hand and antiques	46,46	48,7	204
	50302	Retail not in shops	48,4	51,06	20

For retail and wholesale we only have to consider finished goods inventories. We find that the average inventory level for retail (45 days) is slightly higher than the level in wholesale (51 days). This rather small but significant (p-value of F-test smaller than 0.001) difference could be due to the lower product variety in the wholesale. Wholesalers often specialize in one type of product whereas retailers usually offer a wide variety of products to their customers, implying a higher inventory level.

Financial Impact of the Inventory Level

This section presents the second part of the results from our analyses, i.e. the financial impact of inventories. First we show the results of the regression analysis, followed by a comparison of the financial performance of the different ID quartiles.

We expect that low inventory ratios usually lead to good financial results. First of all, low inventories will facilitate the elimination of non-value adding activities, leading to lower costs and a higher ROA. Secondly, a lower inventory will demand less working capital and a higher free cash flow. Finally, in the spirit of JIT and lean manufacturing, low inventories are often considered strictly right. In that view one can state that firms with a lower inventory ratio are generally better managed. This results in more overall efficiency and consequently a better financial performance. On the other hand, we can also cite various counterarguments, linking low inventories with bad financial performance. Reducing inventories can be very costly because of

the implementation of expensive JIT or ERP systems leading to a lower ROA. Furthermore a too low inventory ratio increases the risk of stockouts, delays in deliveries, possible lost sales and higher costs from emergency purchases. This might lower the profit. The above argumentation does not make clear what to expect about the relationship between the inventory ratio and financial performance. However, we hypothesize a negative relationship because it seems hard to believe that firms would reduce their inventory ratio when it leads to poor financial performance.

Table X shows the results for the ordinary least squares estimations of the regression model used to link inventory performance with financial performance:

$$ROA = \alpha + \beta \times ID + \varepsilon$$

Table 7: results regression analyses financial impact

Code	Sector	Inventory type		
		$ID_{raw\ materials}$	$ID_{work\ in\ process}$	$ID_{finished\ products}$
15	Food & drinks	-0.035*	0.009	-0.032
17	Textile	-0.036**	-0.153**	-0.121**
18	Apparel & fur	-0.021	-0.017	0.001
20	Wood and wood products	-0.041*	-0.037	-0.091(*)
21	Paper & cardboard	-0.030	-0.027	-0.067
22	Publishing & printing	-0.009	0.088	0.062
24	Chemicals	-0.039*	-0.022	-0.130**
25	Rubber & plastics	-0.035	-0.203**	-0.060
26	Non-metallic minerals	-0.025	-0.358*	-0.068**
27	Iron & steel	-0.010	0.015	-0.103*
28	Metal products	-0.010	-0.034	-0.013
29	Machinery & tools	-0.014	-0.031	-0.080
31	Electrical appliances	-0.024	0.059	-0.180
32	Audio, video & telecomm.	-0.033	-0.007	-0.138
34	Cars & trailers	-0.022	0.066	-0.003
36	Furniture & other industry	-0.055**	-0.067	-0.128**

(*) close to significance (p-value<10%)
* significant (p-value<5%)
** very significant (p-value<1%)

From the regression analyses we can conclude that for almost all sectors the coefficients are negative, indicating that a high inventory position would correspond to a lower ROA. Unfortunately, it is hardly possible to draw statistically correct conclusions based on this regression analysis because the coefficient is only significant in 29% of the cases studies. This is not so surprising since it is very hard to explain the ROA.

In order to have better idea of the link between inventory performance and financial performance we propose an additional analysis. We start from the total data set in which we determine the relative inventory position and financial performance for each firm compared to the other firms in its sector. More specifically, we determine in which quadrant (defined by the first, second (median) and third quartiles) we can

locate the company, for the ID ratio (split up per inventory type), as well as for the ROA ratio. We can then aggregate these results over all sectors by summing the observations in each combination of ID quadrant and ROA quadrant. Dividing these results by the total number of companies, we obtain a table with the probabilities that a random company belongs to each quadrant. However, it is more interesting for our analysis to consider the conditional probabilities that a company is financially a good or bad performer given its inventory performance. These results can be found in tables 6 through 8. Let us consider the extreme cases (first and last quadrant for ID combined with first and last quadrant for ROA). For raw materials and finished goods we observe that a bad inventory performance usually leads to a bad financial performance (respectively 31% and 29% chance) whereas companies with a relatively good ID ratio within their sector usually also have a relatively high ROA (27% and 31%). Similar results hold for work in process inventories but here the companies in the second lowest ID quadrant perform best.

Table 8: financial impact raw materials

P(ROA | ID)		$ID_{raw\ materials}$			
		1	2	3	4
ROA	1	*21%*	*23%*	*25%*	*31%*
	2	*24%*	*27%*	*24%*	*26%*
	3	*28%*	*24%*	*24%*	*24%*
	4	*27%*	*27%*	*27%*	*20%*

Table 9: financial impact work in process

P(ROA | ID)		$ID_{work\ in\ process}$			
		1	2	3	4
ROA	1	*25%*	*25%*	*25%*	*26%*
	2	*22%*	*25%*	*21%*	*31%*
	3	*30%*	*17%*	*29%*	*23%*
	4	*23%*	*33%*	*25%*	*20%*

Table 10: financial impact finished goods

P(ROA | ID)		$ID_{finished\ goods}$			
		1	2	3	4
ROA	1	*22%*	*22%*	*26%*	*29%*
	2	*22%*	*26%*	*22%*	*29%*
	3	*26%*	*23%*	*27%*	*24%*
	4	*31%*	*28%*	*25%*	*18%*

7. Conclusions

Several studies have been published discussing reasons to hold inventories and studying the impact of just-in-time on inventories. The first part of this empirical study discussed the reasons to hold inventories and the effect of them on the ID ratio of different manufacturing industry sectors, wholesale and retail. We used large sample sizes to make the results of this study as reliable as possible. We did not study sectors where no sufficient data were available for.

We find that the $ID_{raw\ materials}$ ratio does not differ significantly between most manufacturing industry sectors, except for sector 15 *Food & drinks*, a sector with a very low $ID_{raw\ materials}$ ratio, probably due to the perishable nature of its products.
What work in process inventory is concerned, we conclude that the inventory ratio is determined by the kind of production system. We examined two types of production systems. Our results show that the discrete production process leads to a high inventory ratio. In contrast the continue production process results in a low inventory ratio. We do not claim that companies with a discrete production process can not have a low work in process inventory ratio, but because it is possible to hold inventory with this kind of production system, a lot of companies will be tempted to do so. The reason for this is that these companies try to hide their problems and non value-adding activities, which prevent the fluent flow of products if the inventory ratio is lower.
For the finished goods inventory, we find that export can influence the inventory ratio of companies, but that it is not the only driver of the $ID_{finished\ goods}$ ratio, though we were limited by the availability of export data. We find that the fact that a company produces on inventory or that it assembles to order also has a significant impact. When a company produces or assembles to order, the product will not have to wait in inventory until the customer buys the product, which is the case when a company produces on inventory. Regarding sector 18 *Apparel & fur*, the news vendor problem is applicable, meaning that this sector suffers the problem of not saleable inventories.
Besides the argument stated above, we find the inventory ratio of a sector relatively to the other sectors to be similar among the three inventory types. Especially the similarity among raw materials inventory and work in process inventory is striking. This brings us to the conclusion that the industry sector and the nature of the product play a key role in the level of all types of inventory.
For wholesale and retail, we find the variety of the assortment and the maturity of the inventory management to be more important for the $ID_{trading\ goods}$ ratio than the supply frequency. The product assortment variety is often larger in retail than in wholesale, which can lead, on the base of the EOQ formula, to a higher global inventory ratio. Remark we only assume that inventory management is more mature in wholesale than in retail, but that further research is necessary to check these differences.

In the second part of this paper, we have studied the financial impact of inventories. The results of the regression analysis are not very clear. We do find negative coefficients relationship between the inventory ratio and financial performance (Return On Assets), but this coefficients is only significant in 29% of the cases studied. We think a portfolio-approach, as used by Chen et al. (2005), might result in more significant coefficients. This was not possible in this study, because data on the market value of the companies studied was not available. Furthermore it would be necessary to elaborate the study over several years. Nevertheless, future studies can focus on this approach and might find more significant relationships.
The analysis of variance shows that companies with a very high inventory ratio (top 25%) have much more chance to be bad financial performers than companies with a very low inventory ratio (lowest 25%). We do not find significant differences between the romantic and the pragmatic version of JIT regarding the financial performance.

Our study has certain limitations. First of all we use data of one point in time, namely May 2004, making this study a picture at a given moment in time. This means that we do not take seasonal inventory fluctuations and economic swings into account. Furthermore the inventory ratios in a certain company might differ one year to

another, but apart from the economic swings this should not make a difference on a sector level where all the company data come together. Secondly, we do not discuss the differences among companies within a sector. Our results show that there are very large differences among companies within an industry sector, but to focus on companies, it is important to have data of various moments in time to obtain reliable results. This is not in line with the basic purposes of this paper. Finally, we were not able to discuss all industry sectors, because there were not sufficient data available for some sectors.

Future research could study the financial impact of inventories across different years. We hope that this will lead to more clarity on the relationship between these two variables. A study like that can also check whether the differences between the sectors stay the same. Finally, in spite of the fact we use company data, we do not compare companies within a sector. Maybe future research can combine company data with internal company information to get a better understanding of the reasons to hold inventories.

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