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Dutch retail trade on the rise?

Relation between competition, innovation and productivity

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Abstract in English

The Dutch retail trade demonstrated a relatively meagre performance in terms of productivity (growth) during the 1990s, especially seen from an international perspective. This study analyses the productivity performance of the Dutch retail trade in more detail, and focuses on competition and innovation as two main drivers of productivity growth. More precisely, it takes the mutual relationship between competition, innovation and productivity explicitly into account. Between 1993 and 2002 changes in competition varied substantially within the retail trade. However, on average competition slightly declined. Furthermore, only a few firms in the Dutch retail trade innovate. Regression analysis reveals that both competition and innovation enhance productivity growth directly. Further, fiercer competition induces more innovation, and consequently also raises productivity indirectly via innovation.

Key words: competition, innovation, productivity, measurement, productivity policy

JEL code: D24, L1, L5, L81, O31.

Abstract in Dutch

Gedurende de jaren negentig boekte de Nederlandse detailhandel, nationaal en internationaal gezien, magere resultaten in termen van productiviteit. Deze studie analyseert de Nederlandse detailhandel in meer detail. Het richt zich vooral op concurrentie en innovatie als drijfveren van productiviteitsgroei, alsook de onderlinge relatie tussen concurrentie en innovatie. Tussen 1993 en 2002 liepen de veranderingen in concurrentie in de verschillende onderdelen van de detailhandel uiteen. Gemiddeld genomen is de concurrentie in de detailhandel licht gedaald. Daarnaast hebben weinig bedrijven in de detailhandel aan innovatie gedaan. Regressieresultaten tonen aan dat zowel concurrentie als innovatie positief bijdragen aan productiviteit. Verder leidt een hoger concurrentieniveau tot meer innovatie, en dus ook langs deze weg tot extra productiviteit.

Steekwoorden: concurrentie, innovatie, productiviteit, maatstaven, productiviteitsbeleid

Een uitgebreide Nederlandse samenvatting is beschikbaar via www.cpb.nl.

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Preface

The relatively meagre performance in terms of productivity (growth) of the Dutch retail trade during the 1990s may be reason for concern. In this study two main drivers of productivity growth are distinguished and analysed, namely competition and innovation. These drivers may serve as instruments for policy to enhance the productivity of this industry. The performance of the Dutch retail trade is analysed for the period 1993-2002. Conclusions are derived from a model that investigates competition, innovation, and productivity in detail. The model explicitly takes the relations between these three variables into account. The empirical analysis rests on a vast amount of firm-level data of the Dutch retail trade, including data from the 'Community Innovation Survey'.

The project was carried out by Henry van der Wiel (project leader), Harold Creusen, Björn Vroomen and Fred Kuypers. They thank Stephan Raes and Anne Reitsma (Ministry of Economic Affairs), Maarten Cornet, Free Huizinga, Bert Minne, and Bert Smid (CPB Netherlands Bureau for Economic Policy Analysis) for valuable comments on earlier drafts. They also benefited from the advice and assistance on data and econometric issues of George van Leeuwen (Statistics Netherlands). In addition, they thank participants of the CAED/BLD conference in Cardiff (August, 2005), the workshop on "Innovation, Competition, and Productivity" in Sophia-Antipolis (December, 2005) and the ISS Schumpeter Conference 2006 in Sophia-Antipolis (June, 2006) for their valuable comments. The data analysis reported in this document was carried out at the Centre for Research of Economic Micro data (CEREM) of Statistics Netherlands. The project was financed by the Dutch Ministry of Economic Affairs.

Coen Teulings
Director

Summary

Research questions

Although the labour productivity per hour worked in the Dutch retail trade is still above the EU average, the industry is loosing its favourable position. European productivity growth is stronger since the end of the 1980s. Moreover, the Dutch retail trade could not keep track with the strong growth of the US retail trade since the mid 1990s. According to McKinsey (1997), the poor productivity performance of the Dutch retail trade was due to less competition and less innovations. Recently, the American Conference Board affirmed these findings for the EU-retail trade in general (McGuckin et al., 2005).

In that regard, Dutch policy has taken several measures such as the new Competition Act in 1998 to stimulate competition in product markets including the retail trade. Moreover, retailers have been allowed having longer opening hours since 1996.

This study focuses on the following questions:

- Did competition in the Dutch retail trade change during the 1990s and early 2000s, and what are the main drivers of these changes?
- Did competition affect innovation intensity in this industry?
- Did competition and innovation affect labour productivity (growth) in this industry?

This study has two main limitations. First, one should note that we do not investigate employment legislation and innovation policies. These policy instruments are of importance to the performance of the Dutch retail trade as well. In addition, we only considered the period 1993-2002 and therefore cannot provide insights into the relation between competition levels and potential causes of the current 'price war' between supermarkets.

Main conclusions

Findings of this study suggest that fiercer competition and more innovation may stimulate productivity growth in the Dutch retail trade. Even more, an increase in competition stimulates innovation. The latter induces therefore an additional effect of competition on productivity via innovation. However, on average competition in the retail trade slightly declined between 1993 and 2002. Competition partly became less fierce due to the considerable growth of market demand. Finally, only a few firms in the Dutch retail trade innovate.

Theory on competition, innovation and productivity

In general, competition may increase productivity through two channels. First, competition may stimulate labour productivity directly through a reduction in X-inefficiency. The second, more

indirect channel is through a positive effect on innovation. Innovation is generally thought to raise labour productivity. Competition may on its turn stimulate innovation as firms might increase their innovative effort in order to escape intensifying competitive pressure. This is called the 'escape competition' effect. However, competition can be not conducive to innovation. This negative effect on innovation arises from the 'Schumpeter' effect, which states that (inefficient) firms will reduce their innovative effort in case of fiercer competition, because then their gain from innovation will become too low. Recent literature suggests that the combination of both effects may result in an inverted U-relationship between competition and innovation.

Obviously, if there is a positive relationship between competition and innovation (the second channel), the overall effect of competition on labour productivity is positive. However, if an inverted U-relationship between competition and innovation exists then the overall effect of competition on productivity is ambiguous.

Data

Three data sources obtained from Statistics Netherlands are applied for the analysis of the Dutch retail trade. Both developments in competition and labour productivity are mapped by firm-level data from the surveys of the 'Production Statistics'. Innovation data are derived from three consecutive Community Innovation Surveys (CIS). Finally, data on the entry and exit of firms come from the General Firm Register (in Dutch: ABR). The retail trade includes the SIC 52 industries ranging from supermarkets, department stores to chemists.

Results

The relative profits measure, as indicator of competition, demonstrates that competition in the Dutch retail trade at the SIC 5-digit level varied widely in terms of size and change between 1993 and 2002. However, competition in the retail trade as a whole slightly declined in this period. Using a similar model as in Creusen et al. (2006b), our findings suggest that the considerable growth of market demand may have weakened competition. Although explicit conclusions are difficult to draw, regulatory reforms seem to go along with an increase in competition.

The regression results provide no indications of an inverted U-relationship between competition and innovation for the Dutch retail trade. In contrast, the results suggest that more competition unambiguously enhances both the decision to innovate and the innovation outlays. Further, it turns out that less than 30 per cent of the sampled firms in the retail trade innovate.

Finally, our findings suggest that both competition and innovation have had a positive and significant effect on productivity. Therefore, more competition and more innovation in the Dutch retail trade can enhance productivity growth in the short term. Hence, the overall effect of competition on productivity is positive.

1 Introduction

Everyone is very familiar with the retail trade.[1] Each of us has frequently or even daily contact with this part of the economy. In fact, the retail trade acts as an intermediate between producers and consumers. The industry is responsible for a considerable part of output and employment of industrialised countries, including the Netherlands. For example, the share of nominal value added from this industry was approximately 4 percent in 2000 for the Netherlands. In terms of employment, the share is even larger and accounts for more than 7 percent of total employment in full-time equivalents.

According to several sources the labour productivity level and productivity growth in the Dutch retail trade was not outstanding in international perspective in the 1990s (McKinsey, 1997, OECD, 2004). Although, the Dutch labour productivity per hour worked is above the EU-average, it is much lower than in the US as it could not keep track with the strong productivity growth of the US retail trade after 1995. For example, during the period 1997-2002 the productivity growth per hours worked of the Dutch retail trade equals 2.1 per cent, whereas the US obtained a productivity growth of 7.4 per cent (RUG 2004, GGDC 60-industry database). Also in a longer perspective the Dutch productivity growth performance is less favourable than for the EU as a whole.

This economic performance of the Dutch retail trade might be reason for policy concern. The Conference Board (TCB) states that "… over [a] half of the economy-wide productivity growth lead of the US over Europe after 1995 is accounted for by diverging performance in wholesale and retail trade" (McGuckin et al., 2005). According to the TCB, slow adoption of new technologies and differences in legislation may explain the lag of the EU retail trade. This corresponds with earlier findings for the Dutch retail trade of McKinsey in 1997 (McKinsey, 1997) indicating that both aspects are characteristic for the meagre performance of this sector.

In the 1990s Dutch policy took various measures to enhance competitive forces in product and labour markets, which are in-line with reforms in other OECD countries. Two major regulatory reforms can be distinguished for the Dutch retail trade. First, a new competition law has been enacted in 1998. Second, several specific reforms have been set up with the aim to increase competition, deregulate and improve quality of regulations of specific markets (so called MDW-operation). The most important MDW-project for the retail trade concerns the liberalisation of shop opening hours in 1996.

These considerations and developments give rise to the following research questions:

[1] We define the retail trade according to the SIC 52-code, this includes industries like supermarkets, department stores, electronic appliances, and so on. This does not include trade in motor vehicles, motorcycles and petrol.

- Did competition in the Dutch retail trade change during the 1990s and early 2000s, and what are the main drivers of these changes?
- Did competition affect innovation intensity in this industry?
- Did competition and innovation affect labour productivity (growth) in this industry?

The issues are relevant for two respective reasons. First, recent literature points out that the relation between competition and innovation is ambiguous, as it may follow an inverted U-shape (see Aghion et al., 2002). Second, a positive impact of policy measures on competition may be counteracted by negative effects from other determinants, such as the strong economic growth in the 1990s (see Creusen et al., 2006b).

Using firm-level data for the Dutch retail trade covering the period 1993-2002, we analyse competition, innovation and productivity over time, and analyse their mutual relationship. To our knowledge current studies have only considered separate parts of this three-way relationship. Note that we do not investigate employment legislation and innovation policies. Both policy instruments are of importance to the performance of the Dutch retail trade as well, next to competition. In addition, due to data availability at the time of research, the period at issue in this study is before the current price war in the supermarkets, which started in 2003. We therefore do not go into causes and implications of this recent development.

The structure of this study is as follows. In chapter 2 we discuss the characteristics of the Dutch retail trade with a focus on productivity performance in an international and national perspective, and on regulatory reforms. Chapter 3 explores the available data and introduces several key variables. Finally, chapter 4 provides several theoretical considerations and it presents empirical findings on the relations between competition, innovation and productivity in the Dutch retail trade.

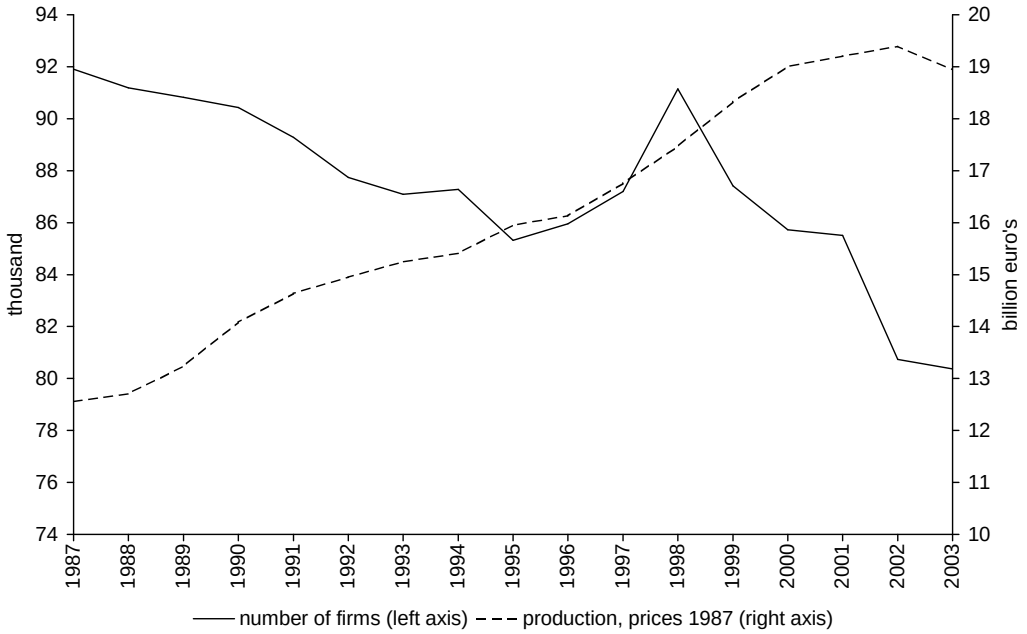
2 The Dutch retail trade

The Dutch retail trade is continuously liable to changes in consumers' shopping behaviour, firms' competitive behaviour and to regulatory reforms. In the 1990s, the level of labour productivity of the Dutch retail trade was higher than the EU average, but dropped behind the US after its strong productivity boom. During the 1990s, several regulatory reforms have taken place, such as the enactment of the new Competition Act in 1998. These reforms were introduced to enhance the level of competition in the Dutch retail trade in order to stimulate productivity growth.

2.1 Characteristics of Dutch retail trade

The retail trade is an industry which is continuously transforming and in most countries it is still in the midst of a process of structural change. Beginning at the end of the 1950s with the appearance of the self-service shops and supermarkets, the retail trade has undergone a tremendous metamorphosis. Recent major trends that can be distinguished include larger outlets, consolidation into retail chains, spreading of hypermarkets and increased vertical integration.

Figure 2.1 Lower number of firms and increased output in Dutch retail trade, 1987-2003



Sources: number of enterprises: Statistics Netherlands, Statline, Historie economische demografie production in prices of 1987: Statistics Netherlands, National Accounts.

Figure 2.1 summarises these developments in terms of the number of firms and output levels, pointing at larger firms. Despite the considerable pickup from 1996 to 1998 the number of firms decreased dramatically over time, whereas the output of the Dutch retail trade improved

considerably.[2] Note that this temporary pickup partly matches with the upturn in the business cycle at that time, but it also corresponds to the introduction of the longer opening hours in 1996 (see section 2.3.2). This pattern is less visible in the output of the industry.

Three major forces play an important role in this ongoing transformation of the (Dutch) retail trade; (1) consumers, (2) the government and (3) retailers themselves. First, the shopping behaviour of consumers is continuously changing. These changes are to a great extent determined by factors such as increases in income, more part-time workers, higher participation rates of women on the labour market and greater mobility (including an increase in car-ownership). For example, during the week time is precious and as shopping is time consuming, consumers increasingly prefer stores or locations where they can buy more products at once (that is, one-stop shopping, large shopping centres). However, consumers also spent more time on fun-shopping, as they perceive shopping as a form of recreation. Both shopping events give a good example of different expectations consumer may have of a shopping trip. Consequently, this translates into different expectations of the store/location the consumer plans to visit.

The second important force in the transformation is the role of the government. As we will discuss more extensively in section 2.3, legislation has shaped the structure of the Dutch retail trade for decades. A number of regulatory reforms may have affected competition in the retail trade as well.

Finally, retailers are continuously transforming their business concepts. Partially, this is a response to changing consumer behaviour and legislation. For example, supermarkets introduced more ready-to-eat meals to accommodate consumers' shortage of time and large shopping centres appear at several designated locations at the periphery of towns. But firms in retail trade may take various actions to reduce cost and enhance their competitive advantage. On the one hand, economies of scale can be pursued via larger outlets and consolidation into retail chains. On the other hand, economies of scope can be pursued via horizontal integration. For example, stores specialised in household appliances now sell also DVD-players and computers. In addition, technological developments, especially in the area of ICT, have altered logistic operations in the retail trade. For example, stock control is continuously optimised with the use of scanner data.

These three transformations may have altered the type of competition in the Dutch retail trade. Price levels in combination with product quality remain the main instrument of competition as is demonstrated by the recent 'price-war' between supermarkets. However, also the store itself

[2] Although the number of shops also declined over time, this reduction was smaller indicating that the shops per firm increased due to consolidation.

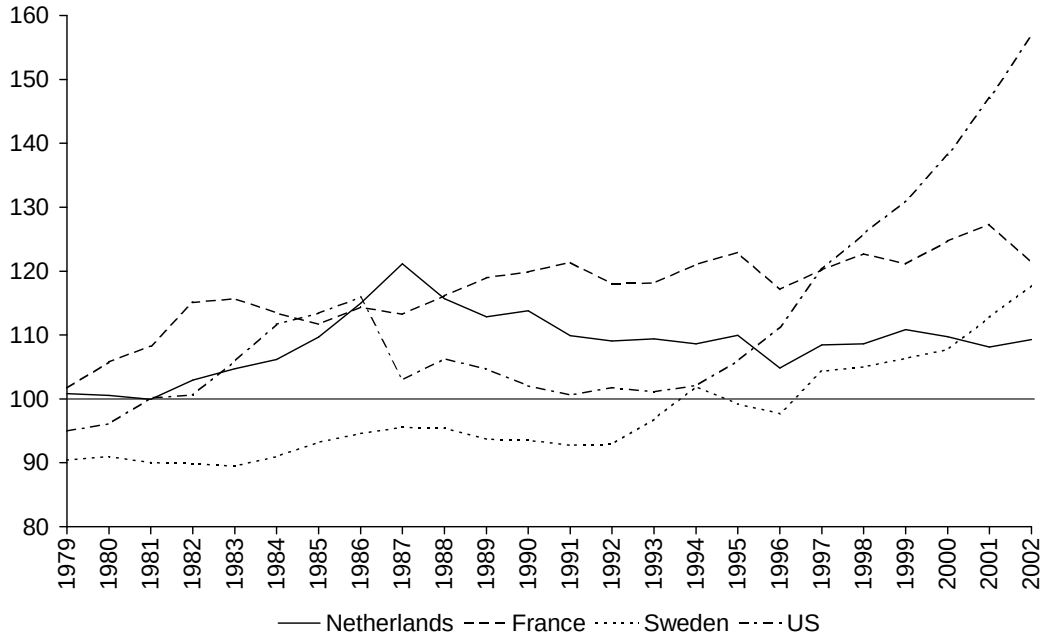
and the assortment offered are instruments of competition. For example, we already indicated the difference between fun-shopping and daily or one-stop shopping, which influences the characteristics of a store like assortment and service level. In addition, fun-shopping as a recreational activity induces more competition between retailers on the one hand and, for example, museums and cinemas on the other hand, as they all compete for the spare time of consumers. Another example of changing settings among competitors is that supermarkets with an increased assortment of ready-to-eat meals are becoming competitors of (fast-food) restaurants. To put it differently, a bundle of products have become closer substitutes over time.

2.2 Productivity performance of the Dutch retail trade

2.2.1 An international perspective

Reports of the OECD (2004) and McKinsey (1997, see box below) mention the under average performance of the Dutch retail trade. Figure 2.2 displays labour productivity per hours worked for several countries relative to the EU-average (EU=100).[3,4]

Figure 2.2 Labour productivity (per hours worked) relative to EU-average. 1979-2002



Source: Groningen Growth and Development Centre, 60-Industry Database, February 2005, Rijksuniversiteit Groningen, http://www.ggdc.net

[3] Measurement issues often hamper a productivity analysis, especially in services sectors like the retail trade. Difficulties in measuring output, quality and labour input in terms of hours hinder to gauge the efficiency in these industries.

[4] Productivity is a key indicator for the efficiency of a particular firm, industry or for the economy at large. Productivity can be expressed in terms of labour productivity or in terms of total factor productivity (TFP). Labour productivity is a partial productivity concept relating only output to labour. TFP is defined as labour productivity adjusted for (changes in) capital intensity and use of economies of scale within the same technology. TFP growth merely reflects the productivity changes due to reduced X-inefficiency or adaptation of new technologies, but this productivity concept is hard to measure.

McKinsey very critical to Dutch retail trade

In 1997 McKinsey in cooperation with the Max Geldensstichting, extensively analysed the Dutch economy (see McKinsey, 1997). One of the case studies was the performance of the Dutch retail trade. Based on their findings, McKinsey was very critical to the Dutch retail trade. According to McKinsey, the Dutch retail trade is a sector characterised by lack of competition and lack of incentives to create and seek jobs, inflexible work and compensation legislation, limited opening hours (in spite of deregulation in 1996), restrictive zoning laws and slow innovation. McKinsey proposed three main actions which should boost Dutch retail :

- Reform the labour market by increasing incentives to employ and seek work, and by reducing complexity and inflexibility of Collective Labour Agreements (CAO, in Dutch: "Collective Arbeidsovereenkomst")
- Stimulate competition by enforcing the New Competition Act and removing the ban on parallel imports and create more out-of-town shopping centres with large anchors and small-scale retail chains
- Innovate with new formats. Retailers should consider differentiation, faster innovation and adding more service

McKinsey stated that the Dutch retail trade has the potential to increase output and employment. Its lagging performance is partly related to consumer preferences, the functioning of the labour market and regulation of physical planning and municipal zoning schemes that designate retail outlet sites.

Since 1995 the US labour productivity growth accelerated compared to the EU, and the US productivity level quickly caught up and surpassed the Dutch and French retail trade. The labour productivity in Sweden was initially below the EU average, and could neither keep track with the strong US growth pattern. However, it did catch up with the Netherlands around 2000 and is heading towards France with a growth pattern in-line with the US. Still, the differences between the EU-countries and the US in 2002 demonstrate that the productivity gap has become substantial, and that EU-countries may have a considerable catch-up bonus to collect.

Focussing on the Netherlands, we see that until 1987 the Dutch retail trade demonstrated a stronger growth pattern than the EU. But after that the lead in productivity compared to the EU gradually declined and levelled off just above the EU-average. Further, between 1987 and 1995 the Dutch retail trade had a somewhat higher productivity level than the US retail trade. Like other EU-countries, the Dutch retail trade could not follow the steep productivity growth of the US since 1996.

The TCB attributes the lag in productivity growth of EU-retailers to US retailers to five determinants (see McGuckin et al., 2005). These determinants are (1) the head-start US retail trade in the adoption of new (ICT) technologies, (2) the regulatory obstacles within and

between EU-countries, (3) the scale advantage of the US retail trade,[5] (4) the slower complementary changes in the EU,[6] and (5) culture and taste differences across Europe.

Gordon also emphasizes the impediments in some EU-countries to develop "big box" retail formats (see Gordon, 2004). Following Phelps (2003), Gordon also points to Europe's underdevelopment of capitalists' institutions like venture capital, the overdevelopment of corporatist institutions such as employee participation in management and business licensing, social cultural differences and different view on environmental planning.

With regard to the number of outlets per 10,000 inhabitants the Dutch retail trade has fewer outlets than the EU-average (see table 2.1). The Netherlands are however characterised by a high population density. This may enable retailers to obtain economies of scale via larger outlets as they can serve a large group of consumers from one location. The size of the enterprises in terms of employees is above the EU-average. The latter effect is mainly due to the high Dutch part-time factor. Recent Dutch figures from Statistics Netherlands show that in 2000 the average firm in the retail trade employs about 5.7 full-time equivalents.

Table 2.1 Key figures on efficiency levels of the retail trade, 2000

	Labour productivity[a, b]	Outlet density[c]	Employees per enterprise
Netherlands	110	54	8.5
Belgium	106	80	3.5
Germany	105	35	9.0
France	125	64	4.2
United Kingdom	83	36	14.2
Sweden	108	65	4.3
European Union	100	71	6.3
United States	138	.	.

[a] Value added per hours worked, EU = 100.
[b] Source: RUG (2004), GGDC, 60-Industry database.
[c] Outlet density is defined as number of enterprises per 10,000 inhabitants.
Source: OECD (2004).

2.2.2 A national perspective

In addition to the international comparison we provide in table 2.2 figures on the performance of the Dutch retail trade compared to other industries in the Netherlands. In terms of value added (prices of 1995) the share of the retail trade remains quite stable at just over 4 per cent in

[5] The TCB indicates the reduced opportunity of cross-border scale in the EU as a factor for lower productivity levels compared to the US. Our study purely focuses on the Dutch market itself and it indicates that the retail trade is characterised by constant returns to scale for larger firms (see chapter 4).
[6] I.e. regulatory changes in industries related (complementary) to the retail trade, for example, transportation.

the 1990s, whereas other Dutch services industries experienced a rise of their share in the Dutch economy.

Table 2.2 Dutch retail trade in a national perspective, 1990-2002

		Share in economy		Labour productivity in hours	
	1990	2000	1991-2000	1991-1996	1997-2002
		% of total value in prices 1995		Annual growth rates in %	
Total economy	100.0	100.0	1.2	0.9	1.2
Market sector	69.0	73.0	1.5	1.0	1.8
Manufacturing	18.0	16.9	2.9	3.0	2.1
Services	46.7	53.2	1.1	0.4	1.7
Retail trade	4.1	4.1	1.2	0.4	1.7

Source: CBS, National Account data 2003.

The figures on the labour productivity growth reveal that the growth rates of the retail trade are lower than the growth rates of the market sector. However they are similar to the values for services as a whole. Moreover, linked to the upturn in the business cycle growth over the period 1997-2002 has improved for the Dutch retail trade.

The relatively meagre productivity growth in the retail trade, particularly between 1991 and 1996, may point to other factors besides the decline in economic growth. Studies of the OECD (2002) and Van der Wiel (2001) indicate that the poor growth performance in this period might be caused by the relatively low use of ICT technology when compared to other countries.

2.3 Regulatory changes in Dutch retail trade

During the 1990s several regulations have changed the institutional setting of the Dutch retail trade. We will first briefly discuss some general changes followed by a more extensive discussion on several regulations specific for the Dutch retail trade.

2.3.1 Main regulatory changes

Most OECD-countries have shifted their attitude from tight government control to a confidence in market mechanisms and incentives to enhance welfare in the 1990s (see Gonenc et al., 2000). In this regard, the new Competition Act of 1998 is of importance as it may have affected the intensity of competition in the Dutch retail trade. Following practices in other European countries, the Netherlands changed its competition policy to a prohibitive system.[7] The new Competition Act explicitly prohibits abuse of dominant positions and cartels, except for several exemptions such as franchising, purchasing combinations or cooperation in technical research.

[7] The previous system was more permissive and allowed, for example, cartels unless they caused needless welfare costs.

As result of the new Competition Act, the Dutch Competition Authority (NMa) was founded to enforce the prohibition of cartels and the abuse of market dominance. In addition, the NMa also monitors mergers and take-overs in markets and is therefore an important factor in market structure.

2.3.2 Specific regulatory changes

A wide range of regulatory restrictions affects the scope of the Dutch retail trade, including regulations related to health and safety of employees, urban planning and other environmental issues. Besides overall regulatory reforms, the Dutch government deployed specific reforms as part of a larger operation called the MDW (Competition, Deregulation, Legislation quality). This operation focuses on competition but also on deregulation and the improvement of legislation quality (less and uncomplicated regulations).

Three specific regulatory changes within the MDW-operation are directly related to the retail trade: (1) the liberalisation of opening hours, (2) PDV/GDV policy (policy on peripheral and large-scale retail outlets), and (3) the business licensing requirements or establishment law.

The liberalisation of opening hours is the most important MDW-operation concerning the retail trade. Until June 1996, Dutch retailers were not allowed to be open on evenings and on Sundays. The new regulation allows retailers to be open from 6 AM to 10 PM. Moreover, shops may be open 12 times a year on Sundays and public holidays (these days are assigned by municipalities). Under some conditions, retailers are allowed to be open after 10 PM and on more than 12 Sundays a year (for example in tourist regions).

Concerning the PDV/GDV policy the Netherlands apply a specific zoning planning policy similar to other European countries. That is, the freedom of establishment is restricted by local and urban planning laws, particularly for the retail trade. Since 1973, the Netherlands has pursued a specific policy regarding the establishment of large retailing formats. In essence, the aim of the policy is twofold, i.e. to maintain the function of shops in the inner city or centre of a town, and to strengthen competitive forces in this industry. As a result of this policy, it was hardly allowed to establish a retail enterprise on the outskirts of a town.[8] This limits market entry and protects shops in town centres. During the 1990s this zoning and planning policy (in Dutch GDV/PDV-policy) has slightly been changed by extending the allowance of establishments on thirteen municipal junctions. More precisely, any type of retail firm is allowed to establish in these locations. Further, the zoning policy for the retail trade is decentralised to municipal and provincial authorities.

[8] Only certain types of retail were allowed. These are retailing in dangerous or voluminous products (e.g., fuel, cars and caravans), large scaled furniture retail trade, and builder's merchant.

Finally, up to 1996, the conditions for entrepreneurs to start a new enterprise are constitutionalised in the 'Vestigingswet Bedrijven 1954' (Act on Business licensing requirements). This act protected consumers against non-capable entrepreneurs in terms of reliability, creditability and competencies. The law also protected incumbents against new competitors by evoking entry barriers. In 1996, the Dutch Act has been liberalised. In general entrepreneurs in the Dutch retail trade only have to fulfil general conditions on entrepreneurs' requirements nowadays. Particularly, the regulations for new retailers became more favourable as the main aim of the deregulation was to enlarge market dynamics by simplifying entry.[9]

[9] In fact, in 1993 the government already allowed firms to enter the market under these less restrictive rules.

3 Data and descriptive statistics

To assess the mutual relationship between competition, innovation and productivity several sources of data are used. The relative profits measure, which indicates the developments in competition, demonstrates that competition in the Dutch retail trade as a whole became slightly less intense in the period 1993-2002. In addition, only a sixth to a third of firms in the retail trade indicated that they have innovated. Finally, productivity only slightly increased over time.

3.1 Data

Three sources of information are used to obtain a comprehensive overview of the development of competition, innovation and productivity, and the interactions between these three variables. We use firm-level data from the production statistics (PS, in Dutch "Productiestatistieken"), the General Firm Register (ABR, in Dutch: "Algemeen BedrijfsRegister") as well as data from the Community Innovation Survey (CIS), all obtained from Statistics Netherlands.

Production Statistics

The PS-data provide a complete coverage of firms with at least 20 employees. Firms with fewer than 20 employees are sampled. The accounting data in the PS include, among other variables, the following key variables: total sales[10], employment in full time equivalents and in persons, intermediate inputs[11], wages (including social security charges), and depreciation costs.

The PS-data cover the period 1993-2002 and contain information on five per cent of the total population of firms in the Dutch retail trade. Table 3.1 presents some statistics based on these PS-data. Comparing the firms in the PS-dataset with the population, we see that the PS contain on average firms with more employees and slightly higher productivity levels than the average of the total population.[12]

General Firm Register

Information on the number of firms active in the retail trade is derived from the ABR data set. This set contains information for each firm on its SIC-code, its date of birth and its date of death (if relevant). From these figures we can determine the total number of firms in the retail sector, as well as the entry and exit rate.[13]

[10] I.e. the value added by trade activities, calculated as the gross sales of traded goods minus the purchasing costs of traded goods.

[11] Excluding purchasing costs of traded goods.

[12] To obtain estimates of the inputs and sales at an aggregated level such as an industry, sampled firms are multiplied with a raising factor. This factor is a ratio of the number of sampled firms to the total of firms in the same stratum of the population. This raising factor is provided by Statistics Netherlands.

[13] I.e. the number of firms that entered and/or exited during some year as a percentage of the total number of firms at the beginning of that year.

CIS

We further employ three consecutive waves of the CIS, i.e. the CIS 2, CIS 2.5 and CIS 3 survey. These surveys cover, respectively, the periods 1994-1996, 1996-1998 and 1998-2000. The CIS provides firm-level data and consists of a sample of firms, which is smaller than the sample of the PS. Furthermore, the sample covers only firms with 5 or more employees. Consequently, this censoring omits a substantial part of small-sized firms. In particular, a large fraction of just started new firms are not included, even though these firms may be very important sources of innovation.[14]

Statistics Netherlands collects the CIS-data every two years, but the survey spans a three year period. Several variables in this survey provide information on the total three year survey period. Due to this construction of the survey, variables cover information in overlapping years as the survey is conducted each two years. However, our variables of interest are only available for the last (third) year of each wave of the survey. This implies that the information on innovation is discontinuous and that this will hamper the analysis of taking account of dynamic effects.

Table 3.1 Characteristics of PS-data, PS-CIS-data compared to total population, 1996 and 2000[a]

	Survey-PS	PS-CIS	Population
2000			
Average firms size in full time equivalents	48.4	300.9	5.5
	x 1000		
Number of firms	3.9	0.3	85.7
Labour productivity per full-time equivalent	32.5	34.6	30.4
1996			
Average firms size in full time equivalents	46.0	180.7	5.1
	x 1000		
Number of firms	4.0	0.4	86.0
Labour productivity per full-time equivalent	31.7	30.5	26.8

[a] Survey PS are data derived from the PS, PS-CIS are matched data from PS and CIS, Population data are derived form Statline CBS.

Merging of datasets reduces coverage

To make assertions on the relationship between competition, innovation, and productivity we merge the PS-data and CIS-data into one data set. This merging, however, reduces the number of observations.[15] In total the merged data set covers yearly a meagre 0.5 per cent of the total population. Yet, more than 1000 observations remain for the analysis. The low coverage of

[14] Although the sample is continuously updated with young firms, those firms will pop up with a certain delay.

[15] This loss of information arises due to sampling of firms. Only firms present in both sets can be used for our analysis.

firms in the CIS-dataset could underestimate the importance of innovation in the retail trade. In Table 3.1 we provide several statistics which reveal that, when compared to the population or the PS-data, this merged set consists of very large firms. However, their productivity levels are in line with those of the PS-data.

Seen from an international perspective the number of observable firms is still large. Additionally, an international comparison of innovation activities is unfortunately not possible for the retail trade, as this sector is frequently missing in CIS-data for other countries. Despite both shortcomings, CIS-data remain imperative for assessing the role of innovation and the interaction between competition, innovation and productivity (growth).

3.2 Descriptive statistics competition, innovation and productivity

The (merged) datasets discussed above provide several indicators on the extent of competition and innovation in the Dutch retail trade. In this section we present two indicators, together with the average productivity growth of the Dutch retail trade derived from the Production Statistics. These indicators will be used to determine the relations between competition, innovation and productivity growth in chapter 4.

3.2.1 Competition 1993-2002

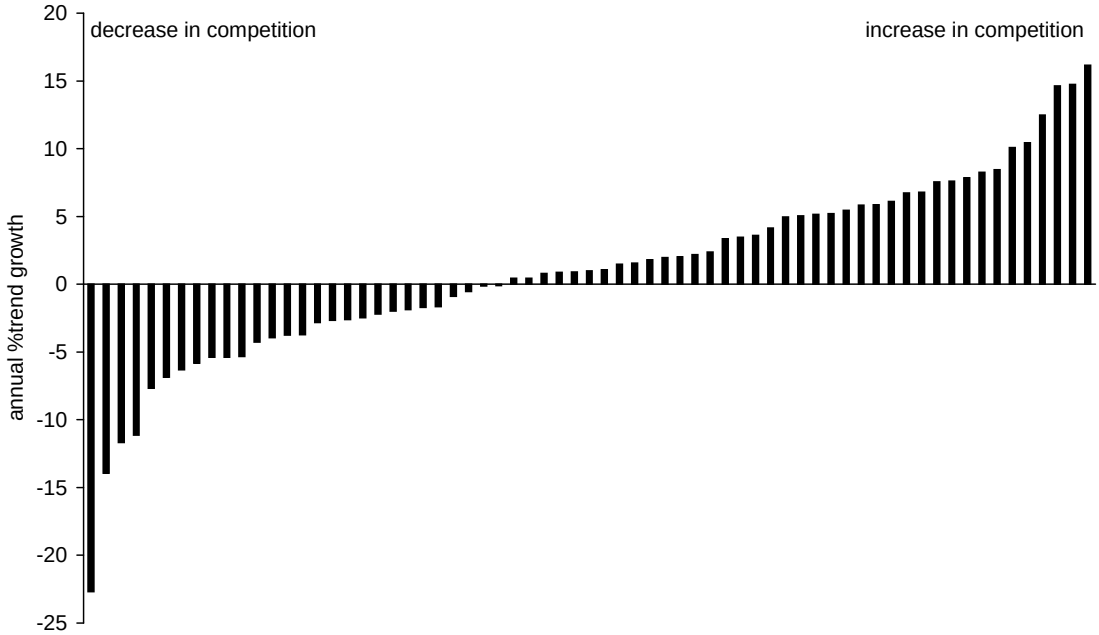
In this study, the developments in competition are mapped by the relative profits measure (RPM, see Boone, 2000). The RPM is a measure on the performance of firms, and rests on the assumption that firms in an industry mutually differ in their marginal costs. Fiercer competition can be observed by a steeper slope of the relation between firms' relative profits and relative levels of productivity. In fact, rising competition induces firms to exploit their efficiency advantage as much as possible. Then, efficient firms are more rewarded and attain relatively higher profits at the expense of less efficient firms. The RPM signals this as an increase in competition.[16]

We calculate the RPM for each industry in the Dutch retail trade at the SIC 5-digit level by using the PS-data. Figure 3.1 ranks all industries within the Dutch retail trade according to their trend growth. The figure reveals that the changes in competition are rather heterogeneous. About 40% of these industries demonstrate a decline in competition, and the other 60% an increase. In addition, changes in the intensity of competition are of a different magnitude. Note

[16] The literature provides additional indicators like the familiar price-cost margin (PCM). The PCM denotes firms' ability to set prices above marginal costs. It may serve as a competition indicator, because fiercer competition is reflected by lower prices and lower price-cost margins. In fact, if there are many competitors on a market with a low level of demand, then competition forces the firms to reduce prices until marginal costs. In this study we focus on the RPM. However, to obtain insights on the robustness of our analysis, we report in appendix C results of our analysis with the PCM as indicator of competition.

also that in figure 3.1 the industries have different sizes, and vary for example from small cheese stores to large supermarkets.

Figure 3.1 Changes in RPM across SIC 5-digit industries within the Dutch retail trade, 1993-2002



To obtain an indication of competition development for the *whole* retail trade, we aggregate the RPM of all industries, each weighed by its industry's market share in the total sales of the Dutch retail trade.

Figure 3.2 Competition development according to the RPM of Dutch retail trade, 1993-2002

Figure 3.2 presents this average RPM and its trend for the period 1993-2002. The average indicator suggests that competition is not constant over time. More precisely, competition dropped from 1993 to 1995, but recovered thereafter and stabilised until the late 1990s. At the start of the new millennium, competition declined again and only partly recovered in 2002.[17] Overall, the trend of the average RPM suggests that competition in the retail trade demonstrated a small decline over the whole period.

3.2.2 Innovation 1994-2000

Table 3.2 presents some key statistics on innovation.[18] It points out that the number of firms with innovation expenditures is relatively low. Only a sixth to a third of the firms indicated to invest in innovations. The average innovation expenditure for *all firms* in the sample demonstrates an increase between CIS 2 and CIS 2.5, but remains stable between CIS 2.5 and CIS 3. In contrast, the average innovation expenditure for the *innovating firms* increased during the three consecutive periods.

[17] An analysis of competition development based on the price-cost margin and the Herfindahl index yields similar results as for the RPM.

[18] Note, these aggregated firm-level statistics may differ from the total population due to sampling of firms and the merging of the CIS and PS data, as discussed in section 3.1.

Table 3.2 Statistics on innovation CIS 2, 2.5 and 3

	CIS 2	CIS 2.5	CIS 3
Number of firms in sample	425	447	275
	%		
Share of innovating firms	24	31	15
	× 1000 euro		
Average innovation expenditures for all firms in sample	122	190	196
Average innovation expenditures for innovating firms	507	608	1350

Source: own calculations based on CIS data.

Innovations in retail trade mostly on processing

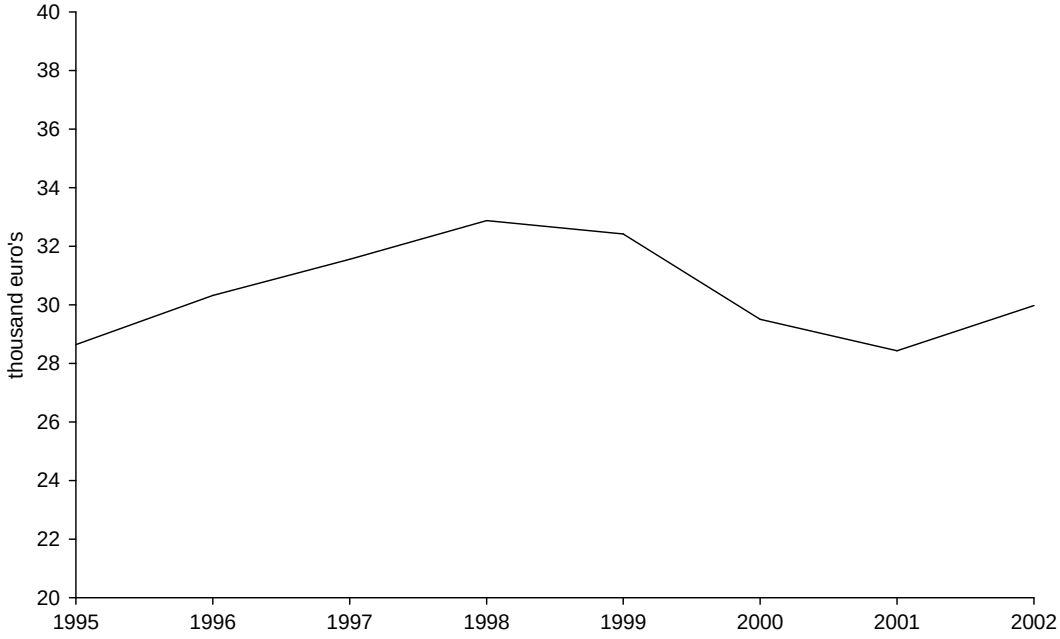
One may divide innovation into two types, process and product innovations. Concerning the retail trade product innovations affect the store concept, for example switching to self-service, or selling on the Internet. Process innovations, with the objective of increasing efficiency, include for instance a new cash-register system and an automated supply-management and stock system.

Unfortunately, the CIS-innovation survey among firms in services does not make a distinction between product and process innovations. Retailers however were asked to provide descriptions on their innovation activities. An analysis of these innovation examples revealed that innovations in the retail trade mostly consist of process innovations.

3.2.3 Productivity 1995-2002

In section 2.2 we already discussed productivity levels of the Dutch retail trade for several periods in a national and international perspective. Figure 3.3 plots the average labour productivity levels per full-time equivalent for the whole retail trade between the years 1995 and 2002, based on the PS-data. In this period, labour productivity hardly improved. Until 1998 productivity significantly increased, thereafter productivity considerably declined. Productivity recovered again in 2002.

Figure 3.3 Average labour productivity per full-time equivalents for the whole Dutch retail trade, 1995-2002



Source: own calculation based on PS-data. Productivity levels deflated by price mutations derived from the input-output tables of the national accounts (1992=100).

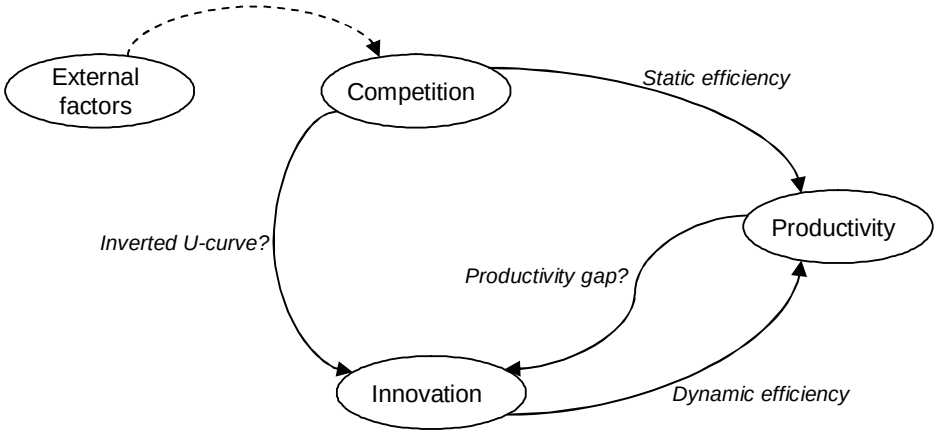
4 Competition, Innovation and Productivity

The findings suggest that some regulatory reforms seems to go along with intensified competition. In contrast, considerable growth of market demand may have weakened competition. Additionally, more entry increased the competitive pressure on the Dutch retail trade markets. Further, the regression results reveal that competition has a positive effect on innovation. These estimations also confirm that both competition and innovation may directly stimulate productivity growth. So eventually, more competition in Dutch retail trade enhances productivity growth directly, but also indirectly via innovations.

4.1 Introduction

Theoretically, both competition and innovation are important drivers of productivity (growth). Our conceptual framework is presented in figure 4.1, which captures the mutual relation between competition, innovation and productivity. This framework includes the direct impact of competition and innovation on productivity as well as the impact of competition on innovation.

Figure 4.1 Relations between competition, innovation and productivity



An increase in competition may force firms to achieve the highest level of efficiency in production and management, given available technologies. This is often referred to as *static efficiency*. That is, increasing competition may reduce various forms of X-inefficiency like managerial slack, and subsequently enhance the level of static efficiency in the market (see, e.g. Nickell, 1996). In addition, innovations may affect efficiency levels in the (near) future and stimulate the level of *dynamic efficiency* of the market (see, e.g. Baumol, 2003).

Competition and innovation are also interrelated. Aghion et al. (2001 and 2002) illustrate that this relationship include two counteracting effects. Combining these two effects may result in an inverted U-relationship (see section 4.3). However, still no consensus exists in the theoretical or empirical literature on the relationship between innovation and competition (see Canton et

al., 2005). Therefore our analysis of this relationship is of an explorative type and assesses whether the Dutch retail trade is characterised by an inverted U-relationship or a linear relationship between competition and innovation.

Our conceptual model neglects two (feedback) mechanisms as we do not apply a simultaneous model explaining competition, innovation and productivity at once. First, we assume that innovation does not effect competition directly in the short term. If innovation affects competition, this will be in the long term via productivity increases or product differentiation. Second, we ignore a direct effect from productivity on competition. Our measure of competition, the RPM (see section 3.2.1), is based on relative marginal costs. In a special case these relative marginal costs are the reverse ratio of labour productivity. This implies that changes in productivity are captured by our measure of competition.

We will elaborate on the theoretical notions and empirical findings of the explanation of competition, the interaction between competition and innovation, and finally the impact of competition and innovation on productivity in respectively subsections 4.2, 4.3 and 4.4.[19]

4.2 Explanation competition development

4.2.1 Theoretical assertions on competition

Policy frequently considers more competition as a stimulus of economic growth. In that sense, policy has taken various measures to enhance competitive forces on the product markets, also in the Dutch retail trade (see section 2.3).

However, we cannot directly identify effects of regulatory reforms on competition in the Dutch retail trade. Still, we may obtain indications for such effects by investigating possible shifts in the level of competition after a reform occurred. For example, such a shift may occur after the reforms on opening hours and business licensing in 1996 and after the introduction of the competition act in 1998.

In addition to regulatory reforms, other determinants may affect competition as well. Therefore, in line with Creusen et al. (2006b) we include five additional explanatory variables to explain competition development: entry, exit, market demand, strategic interaction and advertising.[20] More entry is expected to have a positive impact on competition and more exit a negative impact. The decision to enter or to exit the market is not exogenous but depends on other

[19] In the main text of this study we focus on the RPM. However, to obtain insights on the robustness of our analysis, in appendix C we report results of our analysis with the PCM as indicator of competition.

[20] We ignore the impact of import on competition because import by the retail trade is not present according to the National Accounts.

determinants.[21] An increase in market demand due to economic growth reduces competition (and vice versa).[22] Then all firms can set higher prices without being impeded by competitors' price cutting.

Formal model for explaining competition

The competition model exists of two steps. The second step is the subject of this section: explanation of competition. The first step concerns the pre-determination of entry and exit. After taking logarithms of each variable, the regression equation for the relative profits measure (RPM) of industry *j* in period *t* reads as follows:

$$RPM_{tj} = \beta_0 + \beta_1 \overline{Entry_{tj}} + \beta_2 \overline{Exit_{tj}} + \beta_3 RPM_{t-1,j} + \beta_4 MD_{tj} + \beta_5 ADV_{tj} + \beta_6 SI_{tj} + \beta_7 Dob_{tj} + \beta_8 Dca_{tj} + \varepsilon_{tj}$$

with $\overline{Entry}$ estimated number of entrants as percentage of total number of firms

$\overline{Exit}$ estimated number of exiting firms as percentage of the total number of firms

MD market demand, i.e. total sales adjusted for supply-side effects

ADV advertising rate, i.e. advertising costs as percentage of total sales

SI dummy on strategic interaction [a]

Dob dummy on the liberalization of shop opening hours and business licence requirements (1996 and later)

Dca dummy on the new Competition Act (1998 and later)

The lagged RPM may capture the slack of incumbents' response to previous changes in the determinants. The fitted values of entry and exit ($\overline{Entry}$ and $\overline{Exit}$) capture the joint effects of all other determinants on competition that go through entry and exit. These predicted values are obtained from two other equations, which are used to solve for the issue of endogeneity. In fact, we also regressed the entry rate (*Entry*) and exit rate (*Exit*) on all the other lagged determinants. In these equations we used a one year lag, because it is likely that entry and exit only take place if the change in the determinant becomes more settled and definite. Stated formally, we estimated:

$$Entry_{tj} = \gamma_0 + \gamma_1 Entry_{t-1,j} + \gamma_2 DEP_{t-1,j} + \gamma_3 TS_{t-1,j} + \gamma_4 ADV_{t-1,j} + \gamma_5 Dob_{t-1,j} + \gamma_6 Dca_{t-1,j} + \gamma_7 RPM_{t-1,j} + \gamma_8 Exit_{t-1,j} + \mu_{tj}$$
$$Exit_{tj} = \delta_0 + \delta_1 Exit_{t-1,j} + \delta_2 DEP_{t-1,j} + \delta_3 TS_{t-1,j} + \delta_4 ADV_{t-1,j} + \delta_5 Dob_{t-1,j} + \delta_6 Dca_{t-1,j} + \delta_7 RPM_{t-1,j} + \delta_8 Entry_{t-1,j} + v_{tj}$$

with *TS* (deflated) total sales of the Dutch market

DEP capital intensity, measured by depreciation costs as percentage of total sales

The equations can be estimated in two sequential steps by the Ordinary Least Squares-technique. This procedure is known as the 2-Stage Least Squares-technique to correct for endogeneity problems (see for example Verbeek, 2004).[b]

[a] A positive and significant correlation between the RPM and the price-cost margin points to the existence of reallocation effects, i.e. when changes in competition also induce shifts in market shares (see Creusen et al., 2006b). These reallocation effects, however, typically emerge if competition is altered by changes in strategic interaction. So, simultaneous increases (decreases) in the RPM and the price-cost margin point to an increase (decrease) in firm's strategic interaction.

[b] Note that serial correlation may occur in the cross-sections of the SIC 5-digit sectors. This could mainly bias the significance of the parameters.

[21] I.e. including capital intensity as an indicator of the level of economies of scale. In fact, the contestability theory suggests that higher capital intensity and more economies of scale induce fewer firms on the market.

[22] We approximate changes in market demand by adjusting the total sales for supply-side effects, such as changes in productivity and the number of firms. These changes are computed at the SIC 2-digit level due to data limitations.

In contrast, competition may increase if strategic interaction intensifies, i.e. when firms react more aggressively to their opponents in using their competitive advantages. Finally, advertising has an ambiguous impact on competition. In fact, advertising can raise competition if it increases market transparency, but may also reduce competition if it lowers product substitutability and effectively raises an entry barrier.

To investigate the effects of the explanatory variables on competition, we apply the two stage model from Creusen et al. (2006b, see also the box above). Using PS-data, we estimate this model at the SIC 5-digit level.

4.2.2 Empirical findings on competition

Table 4.1 presents the regression results and shows that the signs of most coefficients of the explanatory variables fit well with the theoretical assertions as depicted above. Increases in strategic interaction and advertising have a significant positive impact on competition in the Dutch retail trade. The positive impact of advertising suggests that advertising is used to inform consumers in order to enhance market transparency and hence to intensify competition. A larger market demand reduces competition, which was the case during the booming economy in the late 1990s. In addition, the significant and positive parameter of the lagged competition indicator suggests that effects of changes in determinants and entry/exit rates last for multiple periods.

Table 4.1 Estimation results for determinants of competition in the Dutch retail trade, 1993-2002

Dependent variable: RPM

Determinant	Expected sign[a]	Estimated parameter	t-value
Regulatory reforms			
Dummy 1996 on opening hours/ business licensing	+	0.12	2.66
Dummy 1998 on Competition Act	+	– 0.01	– 0.30
(Fitted) entry rate	+	0.06	1.54
(Fitted) exit rate	–	– 0.05	– 0.68
Market demand	–	– 6.94	– 3.72
Strategic interaction	+	0.05	3.90
Advertising rate	?	0.13	2.61
Lagged RPM	+	0.42	11.55
Intercept		0.40	2.46
R-squared		0.26	
Degrees of freedom		563	

[a] Positive sign indicates positive effect on competition, and visa versa.

Joint effects of regulatory reforms

Table 4.1 presents the results with separate year dummies to capture the joint effect of the liberalization of shop opening hours and the business licensing requirements in 1996, and the effect of the enactment of the new Competition Act in 1998.

One can also combine the separate reforms in an overall indicator on regulatory reform.[1] In this way we get an overall view of the impact of regulation on competition, which implicitly includes the complementarity of several types of reforms. Still, the weighing of the separate regulatory reforms is somewhat debatable. In a first attempt to combine the separate reforms, we assume that the two reforms in 1996 had an equivalent effect on competition as the new Competition Act in 1998. By this assumption, we can construct the overall indicator on regulatory reforms by simply adding the two year-dummies of 1996 and 1998. The table below presents the results of a regression of the RPM including the overall indicator on regulatory reforms. The results suggest that the regulatory reforms had a positive and significant impact on competition.

Estimation results for determinants of competition in the Dutch retail trade, 1993-2002

Determinant	Expected sign[a]	Estimated parameter	t-value
Indicator on regulatory reforms	+	0.05	2.29
(Fitted) entry rate	+	0.07	1.74
(Fitted) exit rate	–	– 0.07	– 0.86
Market demand	–	– 6.60	– 3.56
Strategic interaction	+	0.05	3.87
Advertising rate	?	0.10	1.91
Lagged RPM	+	0.42	11.49
Intercept		0.52	3.27
R-squared		0.26	
Degrees of freedom		564	

[a] Positive sign indicates positive effect on competition, and visa versa.

[1] In a similar way, for each OECD-country the OECD has constructed an overall indicator on regulation by weighing and adding up the impact specific regulatory reforms (see Nicoletti et al., 2000, and Boylaud, 2000). However, these indicators are based on a single survey across all the countries (in 1996), and only take a snapshot on the intensity of regulation at one moment.

In addition, our findings indicate that some regulatory reforms might have affected competition positively in the Dutch retail trade. The dummy variable for the period following the reforms on opening hours and business licensing, demonstrates that a significant upward shift in the level of competition occurred. However, such a shift is not identified after the introduction of the competition act in 1998. Further research is required to identify the effect of both regulatory reforms on the level of competition in the Dutch retail trade.

4.2.3 Conclusion

The regression results provide preliminary insights into the impact of a number of explanatory variables on the competition level in the Dutch retail trade. The findings are in line with

Creusen et al. (2006b) who examined the competition development across 119 Dutch industries at the 3-digit level. Considerable growth of market demand and more exits may have weakened competition in the Dutch retail trade. In addition, regulatory reforms seem to go along with an increase in competition.

4.3 Relation innovation and competition

4.3.1 Theoretical assertions on innovation

Recent theory suggests that the incentive to innovate depends on the level of competition and the differences in efficiency level between competing firms (see Aghion et al., 2001 and 2002, Boone, 2001). It particularly shows that two countervailing effects determine the relation between competition and innovation.[23] On the one hand, an increase in competition enhances the innovative effort of leading firms, because in this way these firms can escape from fierce competition (escape competition effect). On the other hand, increases in competition forces lagging firms to refrain from innovation, because those innovations become non-profitable (Schumpeter effect). The escape competition effect therefore points to a positive relation between competition and innovation. However, the Schumpeter effect points to a negative relation.

Aghion et al. suggest however, that combining these two effects in a dynamic model results in an inverted U-relationship between competition and innovation (see Aghion et al., 2001 and 2002). In fact, an initial rise in competition will first enhance total innovation efforts by the escape competition effect, but beyond some point it will reduce total innovative efforts as the Schumpeter effect becomes larger. Further, lower differences in efficiency levels would amplify the inverted U-relations. To test whether an inverted U-relationship exists, we run three different variants of the innovation expenditure equation (see the box below for more details).

When estimating the relationship between competition and innovation, one should be aware of the various steps firms have to go through in deciding to innovate. Recall that more than 70 percent of the retailers in our sample indicated that they had no innovation expenditures. Ignoring this group of non-innovative retailers and only focussing on the 30 percent of the retailers that *do* innovate may bias our empirical results on the relation between competition and innovation. So to capture all relevant innovation decision of all retailers, we employ the Tobit-I procedure and implicitly combine the decision to innovate in the first step with the decision on expenditures in the second step. As a result, the parameter estimates have now two

[23] These effects denoted by Aghion et al. resemble the famous Schumpeter's mark I and mark II, in the sense that there are two countervailing effects of competition on innovation. Schumpeter's mark I argues that more competition stimulates (all) firms to innovate (see Schumpeter, 1934). Schumpeter's mark II, however, argues that too much competition may reduce innovation, because firms must have sufficient size and financial sources to benefit from innovation (see Schumpeter, 1942).

interpretations. First they demonstrate an effect on the probability of innovation and second an effect on the relative innovation expenditures. Consequently, the impact of competition and market share on those expenditures, that is the marginal effects, are dependent on the probability of innovation.

Formal equation explaining innovation

To determine the dominant effect (escape competition or Schumpeter), the linear relation between competition and innovation for each firm *i* in industry *j* in period *t* reads as:

$$IS_{ijt} = \varphi_0 + \varphi_1 RPM_{jt} + \varphi_3 W_{ijt}$$

with *IS* innovation rate, i.e. the firm's innovation expenditures as a percentage of its total sales
RPM relative profits measure of the industry
W market share, i.e. total sales of each firm as a percentage of the total sales of the industry

This equation includes the firm's market share as an explaining variable as firms may have exploit economies of scale from innovation. It is expected that larger firms have more opportunities to conduct research, such as financial funds or risk-sharing, or can better exploit economies of scale after implementing the innovation. Therefore, firms with a higher market share may also have more innovation expenditures in comparison to their sales.
Following Aghion et al. (2002) the relation between competition and innovative effort can be estimated by regressing the innovation rate of each firm on a quadratic function of the RPM of the respective industry.
The regression equation for the innovation rate becomes:

$$IS_{ijt} = \varphi_0 + \varphi_1 RPM_{jt} + \varphi_2 RPM_{jt}^2 + \varphi_3 W_{ijt}$$

We also investigate the impact of the average productivity gap, as a lower productivity gap between firms entails a stronger impact of competition on innovation (see Aghion et al., 2001 and 2002). In that sense we added a cross term which multiplies the quadratic function of RPM by the average productivity gap (*PG*):

$$IS_{ijt} = \left(\varphi_0 + \varphi_1 RPM_{jt} + \varphi_2 RPM_{jt}^2\right)\left(1 + \psi PG_{jt}\right) + \varphi_3 W_{ijt}$$

with *PG* productivity gap, i.e. the industry average deviation of firms' productivity level from the average productivity level of the industry's technological leaders[a]

Note that innovation outlays as an indicator of innovation are left censored, which means that these variables can only take values larger than or equal to zero. In estimating all the equations we have to take account of this censoring and therefore apply the so-called censored regression technique (Tobit-I model, see Verbeek, 2004).

[a] To take account for potential outliers in productivity levels, the average leaders' productivity level is defined as the average productivity level of the top 5 per cent firms in industry *j*.

Differences compared to the study of Aghion et al., 2002

Aghion et al., (2002) attempted to find empirical evidence for the inverted U-relationship between competition and innovation for the UK. In this paper we follow their research methodology, but deviate on the following aspects:

• Aghion et al. used the Lerner-index and the average price-cost margin as indicators of competition. In our paper we measure competition by the RPM. A drawback of the price-cost margin is that this measure may point to deviating changes in competition if the underlying determinants of these changes also enhance shifts in market shares (see Creusen et al., 2006a).
• Aghion et al. use the number of (citation weighted) patents at firm level to denote the innovation effort of firms. This paper, however, measures innovation effort by firms' total innovation expenditures relative to their total sales. Data on the number of firms' patents are not present in the CIS- or PS-dataset.
• To investigate the impact of the productivity gap, Aghion et al. consider only two sub samples of industries with an average TFP-gap above or below the median of all industries. In this paper we add a cross term between the average total labour productivity gap and the square function of competition. In this way we can instantly catch the impact of the productivity gap on the relation between competition and innovation.
• In contrast to Aghion et al., we do not consider the issue of endogeneity of competition with respect to innovation. We assume that the effect of innovation on competition will be in the long term.
• Aghion et al. consider 19 two-digit industries in manufacturing. This paper, however, focuses on the retail trade sector for two reasons. First, by focussing on one industry we avoid intertwining results from several industries that may counteract with each other. Focussing on one industry reduces the probability of ambiguous results. Second, we particularly focus on the retail trade sector to investigate the lack and/or potential of competition and innovation for productivity growth (see section 2.2).
• Aghion et al. also investigates the impact of financial pressure, measured as the ratio of debt payments to total cash flow, on the inverted U-relationship. We have no data on the financial pressure of firms in the Dutch retail trade, However, we catch firms' financial strength and their ability to cover risks by their size, measured as their market share.

4.3.2 Empirical findings on innovation

We use the firm's innovation expenditures as a percentage of total sales as an indicator of innovation activities in the Dutch retail trade. Although, for example, the decision to exit the market is also a decision not to innovate, we will not analyse the impact of such effects separately. Furthermore, we assume that effects of legislation, strategic interaction, entry and exit are all captured by changes in the RPM as our indicator of competition.

The analysis of innovation partly consists of firm-level data (i.e. innovation expenditures and market share) as well as industry-level data (i.e. RPM and average productivity gap). In addition, the RPM, market share and the average productivity gap are pre-determined on PS-data at the industry level (5-digit).

Table 4.2 presents the results of the estimated linear relation between innovations expenditures and competition. Remember that the coefficients of a Tobit-I model have two interpretations.

So these estimations results indicate that higher competition induces a higher probability of innovation as well as a higher ratio of innovation expenditures relative to the sales levels of firm *i* (positive sign of competition).[24] Then in terms of the theory (see section 4.3.1), these results suggest that the escape competition effect dominates in the Dutch retail trade, i.e. some (leading) firms innovate to escape fierce competition. Further, the empirical results also point out that firms with a higher market share spend relatively more on innovation than firms with a lower market share.[25]

Table 4.2 Estimation results for Innovation (Tobit-I model)

Dependent variable: innovation rate (at firm level)

Determinant	Estimate	t-value
Intercept	– 0.14	9.08
RPM	0.02	4.31
Market share	0.24	5.14
Scale parameter[a]		21.63
Number of observations		1147
Left-censored observations		864
Log-likelihood		– 72.9

[a] Scale parameter in the distribution used to normalise the underlying variable.
Source: own calculations based on PS- and CIS-data.

Additionally, we test the existence of an inverted U-relationship. The results do not support the theoretical notions of this relationship. Appendix B provides the empirical results. Even the augmented model, which also includes the impact of the average productivity gap, does not indicate a quadratic relationship between innovation and competition.

4.3.3 Conclusion

Our study provides preliminary insights on the relation between innovation and competition in the Dutch retail trade. It finds a positive and linear relationship between innovation and competition, despite theoretical notions of the existence of an inverted U-relationship. Stimulating competition seems therefore to be conducive for innovation.

The results for innovation should however be interpreted with care. First, innovation is a difficult concept, particularly in service-related industries. The distinction between product and process innovations is hard to make and is to some extent also related to investments in physical

[24] Parameters of the Tobit-I model cannot directly be interpreted as the marginal effect on innovation because the probability of having a positive outcome should also be taken into account. We therefore focus on the sign of the estimates and not on the magnitude.

[25] Although it can be argued that there is a relationship between market shares and the relative profit measure, the correlation between both explanatory variables is low. We therefore expect no multicollinearity issues to occur in this respect.

capital. Second, our model used innovation expenditures to measure the intensity of (successful) innovations. Innovation expenditures, however, are an input measure, and reliable output measures of innovations at the firm level are not available for the Dutch retail trade. Finally, due to data availability, we had to use the same explanatory variables for the decision to innovate and for the amount of innovation expenditures of innovating firms.

Formal equation of productivity

Assume that each firm *i* in industry *j* produces in period *t* according to a Cobb-Douglas production function $Y_{ijt} = A_{ijt} K_{ijt}^{\kappa_j} L_{ijt}^{\lambda_j}$

with *Y* deflated value added (i.e. total sales minus material inputs),
K deflated capital expenditures (approximated by deflated depreciation)
L labour in hours worked

We assume that the elasticities of capital and labour (κ, λ) do not vary over time or across firms within the respective industry. However, total factor productivity of each firm (*A*) is allowed to grow independently over time.
Following Solow, we can rewrite the firms' production function to a decomposition of a firm's change in labour productivity (=*p*) in contributions of changes in capital intensity, shifts in the firm's size (in terms of employed staff) and TFP growth (with Δx denoting the delta logarithm which approaches the annual percentage change of variable *X*) :

$$\Delta p_{ijt} \equiv \Delta y_{ijt} - \Delta l_{ijt} = \Delta a_{ijt} + \kappa_j \left(\Delta k_{ijt} - \Delta l_{ijt}\right) + \left(\kappa_j + \lambda_j - 1\right)\Delta l_{ijt}$$

Note that the parameter on firm size specifies whether the firms in industry *j* can benefit from increasing economies of scale if $\kappa_j + \lambda_j - 1 > 0$ (and visa versa). We assume that A depends on the stock of knowledge (say S), the intensity of competition (measured by RPM) and some growing trend :

$A_{ijt} = e^{v_0 t + v_1 S_{ijt} + v_2 RPM_{jt}}$ with $v_0 > 0,\ v_1 > 0,\ v_2 > 0$

Further we assume that stock of (internal) knowledge only increases with the firm's innovative effort in the previous year approximated by each firm's innovation expenditures as a percentage of its *value added* (*IV*)[a] :

$S_{ijt} = S_{ij,t-1} + \mu IV_{ij,t-1}$ with $\mu > 0$

Combining the latter two equations gives an expression for the TFP-growth:

$$\Delta a_{ijt} = \left(v_0 + v_1 \mu IV_{ijt-1} + v_2 \Delta RPM_{jt}\right)$$

Note that v_0 captures the impact of external knowledge. Implementing this latter expression in the productivity equation, including two year dummies to capture incidental effects and after some rewriting, we arrive at:

$$\Delta p_{ijt} = \varphi_0 + \varphi_1 IV_{ijt-1} + \varphi_2 \Delta RPM_{jt} + \varphi_3 \left(\Delta k_{ijt} - \Delta l_{ijt}\right) + \varphi_4 \Delta l_{ijt} + \varphi_5 D_{1999} + \varphi_6 D_{2001}$$

This equation can be estimated by ordinary least squares.[b]

[a] Note that we assume that there is no depreciation of knowledge.
[b] Serial correlation may occur for the firms within the SBI 5-digit sectors (see Moulton, 1986) and on a higher level in the cross-sections of these sectors. However, this issue is beyond the scope of this paper.

4.4 Impact competition and innovation on productivity

4.4.1 Theoretical assertions on productivity

In general firms' labour productivity depends on amongst others total factor productivity (TFP), capital intensity, use of economies of scale, and on cyclical fluctuations. In this study, the first determinant, TFP, is most crucial. In fact, we assume that firms may enhance their TFP-level by innovation, that is, by conducting research to develop new technologies and/or new products. Furthermore, theory suggests that fierce competition forces firms to reduce X-inefficiency as much as possible, and consequently affects TFP-growth in the short term (see for instance Nickel, 1996, for an overview). Weak competition makes managers and employees lax, or even seduces managers and employees to shirk. Therefore, in our model we assume that TFP-growth in the short term is not only related to innovation, but to competition as well.

These relations described above are transformed in a formal model (see box), and can be estimated empirically. As labour productivity is highly correlated with the business cycle due to labour hoarding, we added two year dummies (i.e. for the year 1997 respectively 1999) to control for incidental effects, including business cyclical effects.

4.4.2 Empirical findings on productivity

Estimation of the productivity equation is based on the merged data set of PS and CIS-data at the firm level. The set of the RPM are pre-determined from the PS-data at the 5 digit industry level. Due to the restrictive availability of the innovation data and the assumed lagged effect of innovation, these joined data concern the years 1997, 1999 and 2001.

The positive and significant coefficients for competition and innovation reveal that they both enhance TFP-growth, as can be seen in table 4.3. The positive effect of competition on the productivity growth is in line with the findings of Nickell (1996), and indicates that the market attains higher static efficiency with increasing competition. The positive effect of innovation on productivity growth is supported as well (dynamic efficiency). The insignificance of the coefficient on labour indicates that the Dutch retail trade as a whole is characterised by constant returns to scale.

Table 4.3 Estimation results labour productivity growth, 1997-2001[a]

Dependent variable: productivity growth (at firm level)

Determinant	Estimate	t-value
Intercept	– 0.02	– 0.61
Change RPM	0.07	1.91
Lagged innovation rate[b]	0.01	2.19
Capital intensity	0.22	12.95
Labour	– 0.00	– 0.45
Dummy 1999	– 0.04	– 0.93
Dummy 2001	0.05	1.09
R-squared		0.17
Degrees of freedom		877

[a] Note that only the growth rates of the years 1997, 1999, and 2001 can be used due to the CIS-data.

[b] Relative to (lagged) value added.

Source: own calculations based on PS- and CIS-data. Productivity levels deflated by price indices derived from the input-output tables of the national accounts (1992=100).

4.4.3 Conclusion

The empirical results confirm the assertion that competition may directly stimulate firms to attain higher productivity levels, and may thus enhance the static efficiency in the retail trade sector. In addition, the general idea that innovation is an important driver behind productivity growth is supported as well.

Combining the positive impact of innovation on productivity with the positive impact of competition on innovation suggests that competition has a second *indirect* effect on productivity growth via innovation. If indeed competition leads to higher innovation incentives, the initial effect of competition on productivity becomes even stronger in the long term.

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Appendix A Estimation results entry and exit

In section 4.2 competition is explained using several explanatory variables including entry and exit. The latter two variables are endogenous and partially depend on competition. Therefore we used a two-stage least squares method which also estimates the impact of the explanatory variables on entry and exit. The estimation results for entry and exit are reported in the two tables below. For the exit rate, a trend is included to control for the strong decline in the number of firms that is not caused by the other explanatory variables. This trend is not noticeable in the entry rate.

Table A.1 Estimation results for entry

Dependent variable: entry rate

Determinant[a]	Estimated parameter	t-value
Regulatory reforms		
Lagged dummy 1996 on opening hours/business licensing	– 0.11	– 2.49
Lagged dummy 1998 on Competition Act	– 0.29	– 2.87
Lagged total sales (deflated)	2.53	2.52
Lagged capital intensity/depreciation	– 0.06	– 0.97
Lagged advertising rate	0.02	0.34
Lagged RPM	0.08	2.19
Lagged exit rate	0.04	1.09
Lagged entry rate	0.79	29.67
Intercept	– 11.19	– 2.46
R-squared		0.69
Degrees of freedom		563

[a] All determinants are included as lagged variables for explanation of entry.

Table A.2 Estimation results for exit

Dependent variable: exit rate

Determinant	Estimated parameter	t-value
Regulatory reforms		
Dummy 1996 on opening hours/business licensing	0.19	4.90
Dummy 1998 on Competition Act	– 0.35	– 3.99
Lagged total sales (deflated)	7.11	5.61
Lagged Capital intensity/depreciation	– 0.02	– 0.42
Lagged advertising rate	– 0.08	– 2.11
Lagged RPM	0.02	0.58
Lagged entry rate	0.14	6.60
Lagged exit rate	0.52	17.10
Trend	– 0.17	– 7.10
Intercept	– 31.98	– 5.54
R-squared		0.53
Degrees of freedom		562

We briefly discuss the findings in tables A1 and A2, which show that the entry and exit levels demonstrate a significant shift after 1996 and 1998. These shifts may be related to the regulatory reforms in both years. The change to longer opening hours correlates with more exits but remarkably less entry. Moreover, the new Competition Act goes along with significantly less entry and less exit. Although beyond the scope of this document, further research is required on how regulatory reforms affect entry and exit and, subsequently, affect competition in the Dutch retail trade.

Appendix B Estimation of inverted U-relationship

This appendix provides the results of estimating a non-monotone relation between competition and innovation. According to the theory from Aghion et al. (2002), this relation might follow an inverted-U relationship.

Following the abridged model of section 4.3.1, table B.1 presents the results of a regression of the innovation rate on a quadratic function of competition and the firm's market share. These results suggest that that there is no inverted U-relationship between competition and innovation. The estimated coefficient of competition squared, i.e. φ_2 in the notation of section 4.3.1, is positive and significant, and thus contrasts with the theory of Aghion et al. (2002).

Table B.1 Estimation of quadratic model (Tobit I)

Determinant	Estimate	t-value
Intercept	−0.07	−1.76
RPM	−0.05	−1.50
RPM squared	0.02	2.22
Market share	0.24	4.59
Scale parameter[a]		21.65
Number of observations		1147
Left-censored observations		864
Log-likelihood		– 70.46

[a] Scale parameter in the distribution used to normalise the underlying variable.

Source: own calculations based on PS- and CIS-data.

Table B.2 presents the regression results of the extended model, i.e. a regression of the innovation rate including the impact of the industry average productivity gap on the quadratic function of competition. These results again do not support the existence of an inverted U-relationship. In fact, the average productivity gap for all industries is quite low. So for all industries and for all years, the joint coefficient of the squared RPM and the average productivity gap, i.e. $\varphi_2\left(1+\psi PG_{jt}\right)$ following the notation section 4.3.1, is always positive.

Table B.2 Estimation of full quadratic model (Tobit I)

Determinant	Estimate	t-value
Intercept	0.59	1.82
RPM	−0.70	−2.18
RPM squared	0.16	2.24
Gap	−1.17	−2.01
Gap × RPM	1.17	2.02
Gap × RPM squared	−0.27	−2.02
Market share	0.24	5.12
Scale parameter[a]		21.67
Number of observations		1147
Left-censored observations		864
Log-likelihood		– 68.03

[a] Scale parameter in the distribution used to normalise the underlying variable.

Source: own calculations based on PS- and CIS-data.

Appendix C Estimations with the price-cost margin

We replicate the analysis of chapter 4 using the price-cost margin (PCM). For this purpose we calculate the PCM for each industry in the Dutch retail trade at the SIC 5-digit level using the PS-data.

Regarding the explanation of competition, innovation and productivity, the estimation results with the PCM are similar to the results obtained with the RPM with regard the signs of the estimated parameters (see table C.1-C.3).[26] However, the significance of estimated parameters is much lower in case of the PCM as dependent variable. The findings for the PCM point to a non-significant shift in the level of competition after the reforms on opening hours and business licensing (see Table C.1). In addition, the models for explanation of innovation and productivity do no longer indicate a significant effect of competition (tables C2 and C3).[27]

The differences in significance of effects between the RPM and PCM may be related to the difference in both indicators. That is, due to reallocations in output the RPM and the PCM may point in different directions of competition (see Creusen et al., 2006a).

Table C.1 Estimation results for determinants of competition in the Dutch retail trade, 1993-2002

Dependent variable: PCM

Determinant	Expected sign [a]	Estimated parameter	t-value
Regulatory reforms			
Dummy 1996 on opening hours/ business licensing	–	0.01	0.49
Dummy 1998 on Competition Act	–	0.00	0.04
(Fitted) entry rate	–	−0.05	−2.36
(Fitted) exit rate	+	0.02	0.61
Market demand	+	1.75	1.91
Strategic interaction	+	0.02	4.08
Advertising rate	?	−0.12	−4.71
Lagged PCM	+	0.73	26.44
Intercept		−0.65	−7.07
R-squared		0.66	
Degrees of freedom		563	

[a] Positive sign indicates a negative effect on competition, and visa versa.

[26] Remember that the signs of the explanatory variables for RPM should be mostly opposite to the ones for the PCM, because the two indicators measure changes in competition in the opposite way. The only exceptions are the parameters of the lagged indicators and the indicator on strategic interaction due to its definition.

[27] Note that a negative sign of the PCM in the regressions of the innovation and productivity growth points to positive impact of competition, because a higher PCM points to less competition (and visa versa).

Table C.2 Estimation results for Innovation (Tobit-I model)

Dependent variable: innovation rate (at firm level)

Determinant	Estimate	t-value
Intercept	– 0.07	– 3.42
PCM	– 0.07	– 0.85
Market share	0.19	4.28
Scale parameter[a]		21.56
Number of observations		1147
Left-censored observations		864
Log-likelihood		– 82.1

[a] Scale parameter in the distribution used to normalise the underlying variable.

Source: own calculations based on PS- and CIS-data.

Table C.3 Estimation results labour productivity growth, 1997-2001[a]

Dependent variable: productivity growth (at firm level)

Determinant	Estimate	t-value
Intercept	– 0.02	– 0.73
Change PCM	– 0.15	– 0.21
Lagged innovation rate[b]	0.01	2.18
Capital intensity	0.22	12.93
Labour	– 0.00	– 0.51
Dummy 1999	– 0.02	– 0.55
Dummy 2001	0.05	1.17
R-squared		0.17
Degrees of freedom		877

[a] Note that only the growth rates of the years 1997, 1999, and 2001 can be used due to the CIS-data.

[b] Relative to (lagged) value added

Source: own calculations based on PS- and CIS-data. Productivity levels deflated by price indices derived from the input-output tables of the national accounts (1992=100).

Appendix D Competition across 5-digit industries

The table below presents the industries in the Dutch retail trade at 5-digit level that are used in this Document. For each industry, the table also gives a quick glance at the intensity and changes of competition by presenting the level of the RPMs in 2002 and the annual trend-growth of the RPMs over the period 1994-2002. Note that these industries refer to the Dutch market as a whole, and thus abstract from regional differences in competition.

Table D.1 Changes in competition by 5-digit industries

SIC-code	Name	RPM Level 2002	Trend growth 1994-2002
52110	Supermarkets and retail sale in non-specialized stores with food, beverages or tobacco predominating	2.92	– 0.14
52121	Department stores	2.84	– 0.11
52122	Retail sale in non-specialized stores (no department stores)	2.23	– 3.74
52210	Retail sale of potato's, fruit and vegetables	1.39	– 0.90
52221	Retail sale of meat and meat-products	1.87	0.89
52222	Retail sale of flesh and poultry	0.67	– 11.69
52230	Retail sale of fish, crustaceans and molluscs	1.38	1.48
52241	Retail sale of bread, cakes and flour confectionery	2.13	1.00
52242	Retail sale of sugar confectionery	2.29	14.63
52250	Retail sale of alcoholic and non-alcoholic beverages	1.87	7.54
52260	Retail sale of tobacco products	1.07	2.01
52271	Retail sale of cheese	1.41	0.44
52272	Retail sale of natural food and health food products	1.94	7.85
52273	Retail sale of foreign food	1.74	5.05
52274	Retail sale of food in specialized stores n.e.c.	1.36	– 2.65
52321	Chemist's	1.48	1.07
52322	Retail sale of medical and orthopaedic goods	1.81	4.14
52330	Retail sale of perfumes, cosmetics and toilet articles	2.29	2.37
52411	Retail sale of fabrics	1.67	– 1.71
52413	Retail sale of knitting wool, needle work and smallwares	1.52	– 1.87
52421	Retail sale of men's clothing	2.14	3.36
52422	Retail sale of women's clothing	1.88	– 2.83
52423	Retail sale of children's clothing	2.82	6.12
52424	Retail sale of clothing in non-specialized stores	1.88	– 5.39
52425	Retail sale of underclothing, foundation etc.	1.73	5.83
52426	Retail sale of fashion articles and jewellery	1.53	2.18
52427	Supermarkets and retail sale in non-specialized stores with textiles predominating	1.59	5.86
52431	Retail sale of footwear	1.60	0.43
52432	Retail sale of leather goods	1.50	3.46
52441	Retail sale of furniture	2.24	– 3.76
52442	Retail sale of home furnishing textiles	1.34	– 6.32
52443	Retail sale of lighting equipment	2.36	6.73
52444	Retail sale in non-specialized stores with furnishing predominating	2.41	1.97
52445	Retail sale of glassware, china and kitchenware	2.57	4.96
52447	Retail sale in non-specialized stores with household goods predominating	1.42	– 6.87
52451	Retail sale of electrical household appliances	1.09	– 5.32

Table D.1 Continued

52452	Retail sale of radio and television sets	2.07	1.55
52453	Retail sale of sound recording media	2.74	6.78
52455	Retail sale of spare parts for electrical household appliances	0.17	– 22.70
52456	Retail sale in non-specialized stores with electrical household appliances, radio and television sets and sound recording media predominating	1.97	– 0.54
52457	Retail sale of musical instruments and music scores	2.44	5.21
52458	Retail sale of sewing and knitting machines	0.41	– 13.95
52461	Retail sale of hardware, plumbing and building materials	1.64	– 1.97
52462	Retail sale of paint, paints and wallpaper	2.33	10.10
52463	Retail sale of wooden building and gardening materials	2.54	5.17
52465	Retail sale of kitchens	3.13	12.47
52466	Retail sale of parquet, laminate and cork floors	2.76	16.16
52467	Other retail sale of building materials in specialized stores	2.82	5.46
52468	Builders' merchants and other retail sale in non-specialized stores with building materials predominating	2.12	0.80
52471	Retail sale of books, newspapers and magazines	1.68	– 5.83
52473	Retail sale in non-specialized stores with books, magazines, stationery and school supplies predominating	2.23	– 2.20
52481	Retail sale of photographic equipment and related services	1.90	1.80
52482	Retail sale of spectacles and other optical goods	1.40	– 5.38
52483	Retail sale of jewellery, watches and clocks	1.38	– 3.94
52485	Retail sale of bicycles	1.15	8.27
52487	Retail sale of sports and leisure goods (except aquatic goods)	1.79	0.90
52488	Retail sale of camping equipment	1.47	8.45
52489	Retail sale of caravans	1.78	3.60
52491	Retail sale of flowers and plants, seeds and gardening supplies	1.41	– 4.28
52492	Garden centres	2.28	– 2.62
52493	Retail sale of pet animals, pet supplies and fishing articles	2.17	14.74
52494	Retail sale of computers	0.84	– 11.14
52495	Retail sale of games and toys	1.38	– 2.47
52497	Retail sale of floor coverings	2.50	– 1.65
52499	Other retail sale in specialized stores	1.90	7.62
52501	Retail sale of antiques	0.60	– 7.67
52503	Retail sale of second-hand goods (except clothing)	2.12	10.45