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The Direct and Indirect Effects of Product Market Regulations in the Retail Trade Sector

Theoretical Aspects and an Exploratory Data Analysis

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Abstract

The reduction of regulatory restrictions is arguably the most strongly advocated policy for improving economic performance in EU countries, particularly in many service activities, where regulatory barriers to competition are still widespread. This technical report considers the direct and indirect effects of product market regulations (PMR) applying to the retail trade sectors in the EU countries. Retail and wholesale trade are one of the largest service sectors in the EU. The functioning of the retail market affects the whole economy, because of its size and also because of its linkages with other sectors of the economy. It is also important for consumers, who spend 30% of their consumption expenditures in retail shops.

This technical report is divided into two parts. The first part provides a review of the theoretical literature on the relationships between anti-competitive PMR and economic performance in the directly affected sector as well as in upstream and downstream linked sectors. We also discuss special features of the retail trade, which are relevant to understand the indirect impacts of this sector's PMR on upstream manufacturing sectors.

The second part of the report provides an exploratory data analysis of the development of retail trade PMR as well of their direct and indirect effects on economic performance. Direct effects on economic performance comprise the impact on the market structure, labour productivity and ICT investment in the retail trade sectors of the EU countries. Since food items represent – with 40% to 60% – the largest part of retail turnover, the analysis of the indirect effects focuses on the impact on consumer prices for food, food demand of private households and employment in the food sector.

We find evidence for negative direct and indirect effects of retail trade regulations in the investigated areas. However, further research is needed to check the robustness of the findings and to employ more elaborated statistical analyses for the 28 EU countries. This will only be feasible if more internationally comparable data on retail trade PMR will become available.

1 Introduction

The reduction of regulatory restrictions is arguably the most strongly advocated policy for improving economic performance in EU countries, particularly in many service activities, where regulatory barriers to competition are still widespread. Following the consolidation of the Single Market for goods, attention focuses now on the integration of service markets. Beside other policy measures, this requires the elimination of obstacles and barriers to integration that originate from anti-competitive product market regulations. Policy efforts to spur this integration comprise a range of measures and proposals starting with the 2006 Services Directive and more recently the Single Market Strategy adopted in October 2015.

This technical report considers the direct and indirect effects of product market regulations (PMR) for the retail trade sectors in EU member states. Analysing these effects is of particular interest because, on the one hand, the Single Market Strategy announced that the Commission "will set out best practices for facilitating retail establishment and reducing operational restrictions in the Single Market. These will provide guidance for Member States to reforms and priority-setting for enforcement policy in the retail sector". On the other hand, retail and wholesale trade are one of the largest services sectors in the EU. The functioning of the retail market affects the whole economy, because of its size and also because of its linkages with other sectors of the economy. It is also important for consumers, who spend about 30% of their total consumption expenditures in retail shops. Retail trade brings the Single Market to the EU consumers with a wider choice of products available to consumers (EU, 2018).

Within the total of all economic activities, retail trade alone represents 4.5% of gross value added and 8.6% of employment in 2015. Retail and wholesale trade together generate 10% of EU value added and employ 13% of the total workforce (EU, 2018). Thus, reducing PMR might have relevant direct effects on the performance of this sector and its contribution to overall economic performance. However, retail trade is also closely linked with other sectors of the economy. Its links with the wholesale sector are obviously strong and it has impacts on the performance of manufacturers of certain products for final consumption, farmers, as well as providers of relevant services, including transportation and logistics, and other business services. Therefore, considerable indirect effects can be expected from lower PMR.

With regard to these linkages, the retail trade sector is also of particular interest from an analytical point of view. It is located at the end of the value chain, so that indirect effects of retail trade regulations downstream along the value chain are mainly on consumers. It can be expected that lower levels of retail trade regulations lead to lower consumer prices and more consumer demand. On the other hand, there may be indirect effects upstream along the value chain on manufacturing sectors that mainly produce consumer goods, because more consumer demand should induce more output and employment in these manufacturing sectors. Furthermore, the impact of the very close and special relationships between (especially large) retail traders and supplying firms from the manufacturing sector is relevant to describe theoretically and analyse empirically the indirect effects of product market regulations on consumers as well as on manufacturing sectors supplying consumer goods.

This technical report is divided into two parts. The first part (chapter 2) provides a review of the theoretical literature on the relationships between anti-competitive PMR and economic performance. The first section of this chapter deals generally with the direct (i.e. within sector) effects of an increase of competition due to a reduction of PMR on labour productivity and innovation performance via three relevant transmission channels: increases of allocative, productive and dynamic efficiency. The second section reviews the growing theoretical literature about the indirect impact of PMR in one sector on upstream and downstream sectors within the value chain. This literature mainly considers the impact of anti-competitive regulations in upstream service sectors on downstream manufacturing sectors. However, many of the derived arguments can also

be applied reversely, in our case from a downstream service sector (retail trade) to upstream manufacturing sectors (e.g. the food and beverages industry). Nevertheless, the retail trade sector has some special features, which are important to understand theoretically before analysing empirically the indirect impacts of this sector's PMR. Traditionally, retailers are seen as economic agents that only exist to resolve the spatial non-incidence between producers and consumers. They buy goods from manufacturers (and/or intermediaries) and make them available to consumers (Pellegrini, 2000). Today, there is tendency towards rising concentration of retailers and retailing market power (e.g. Boylaud and Nicoletti, 2001). Many retailing firms are larger and have bigger bargaining power than most of their suppliers. Thus, one branch of the literature argues that reductions of regulations and an increased concentration of retail trade can give large retailers a countervailing power over their suppliers from the manufacturing sectors. Another branch of the literature concludes that large retailers already possess too much market power. One important reason for this debate between the two branches is the introduction of slotting allowances and fees since the late 1980s, which now has become a widespread practise. These allowances are lump-sum up-front transfer payments from manufacturers to retailers in order to obtain shelf space for a product. The third section deals with these special features of the retail trade sector and their impact on the direct and indirect effects of a reduction of PMR.

Since the conclusions with regard to the effects of reductions of PMR derived from the general theoretical literature as well from the specific retail trade literature are ambiguous, an in-depth empirical analysis would be desirable. However, data limitations particularly with regard to indicators for PMR prevent an elaborated econometric analysis for the 28 EU countries. The only source of comparable PMR indicators for the retail trade sector is the OECD, which, however, publishes these data only every five years (1998, 2003, 2008 and 2013). The 1998 PMR data are available for 17 EU countries, the 2013 data for all 28 EU countries. Thus, the data analysis in the second part of this technical report has an exploratory character.

Chapter 3 in the second part analyses the direct effects of PMR in the retail trade sectors of the EU countries. The first section of this chapter describes the development of the PMR indicators for the retail trade sector. We put a special focus on the question of whether there is a convergence or divergence of the levels of retail trade PMR in the EU countries and which kinds of regulations further or hinder a convergence. The theoretical analysis suggests the direct economic performance improving effects of a reduction of PMR mainly go through increased competition, which supposes the effective or potential entry of domestic or foreign competitors as well as – if necessary – the exit of some incumbent firms. Therefore, we explore in the second section of this chapter the links between PMR and the entry rate as well as the turnover rate (entries and exits) in the retail trade sectors of the EU countries. In the third section we investigate whether in addition there are more direct effects of PMR on labour productivity in the European retail trade sectors. Furthermore, the theoretical literature shows that competition may foster innovation and, through this, productivity growth of incumbent firms. In the case of retail trade, process (as opposed to product) innovation is the main determinant of productivity growth. This implies that investment in information and communications technology (ICT) should be a fundamental determinant of productivity growth; as such technologies allow logistics, inventory management and so on to be rationalised (Schivardi and Viviano, 2011). Thus, in the fourth section, we try to describe with very limited data the links between PMR and ICT investment.

Chapter 4 in the second part makes an attempt to analyse in an exploratory manner the indirect effects of retail trade PMR on the downstream consumer demand for food, which with 40% to 60% represents the largest part of retail turnover, and – as a consequence – on employment in the upstream food industry. In this attempt, we apply a three-step procedure to estimate the following causal relationship. Lower levels of regulations in the retail trade sector should lead to lower consumer prices for food and beverages. Lower consumer prices for food should increase the demand for these products. The retail trade sector passes this higher demand on to the producers of food and beverages, which, in

turn, increase their employment. The estimates for consumer price functions for food and non-alcoholic beverages are presented in the first section of chapter 4. A food demand function for private households is specified and estimated in the second section of this chapter. Furthermore, we assume that the EU countries with retail sector PMR values above the average in 2013 move their regulatory restrictions to the EU average level and present some back-on-the-envelope calculations about the expected changes in food prices and demand. Finally, in the third section, we estimate two employment functions for the food sector and use them to assess the employment impact on the food sector, if the EU countries with retail sector PMR values above the average in 2013 would move their regulatory restrictions to the average level of the EU.

This technical report ends with some conclusions in chapter 5.

2 PMR and economic performance: Theoretical transmission channels

A large and still growing body of theoretical and empirical research has analysed the effect of product market competition on productivity and economic growth. One important branch of this research has focused on the direct effects of lacks or increases of product market competition in a sector on its performance, while another branch looks at the effects of a lack of competition in upstream sectors, e.g. due to product market regulations (PMR), on the productivity and other relevant economic indicators in downstream sectors. Additionally, a comparatively small branch of research has considered the impact of regulations and competition in downstream sectors (e.g. retail trade) on the performance of upstream sectors (e.g. production of food and beverages).

From a theoretical point of view, increased competition, e.g. due to the reduction of PMR, can affect the economic performance through the stimulation of productivity via three transmission channels (Ahn, 2002; Nicodème and Sauner-Leroy, 2007).

- The first channel is related to the reallocation of resources and affects the *allocative efficiency* within a sector.
- The second channel concerns the *productive efficiency* due to improved utilisation of production factors by firms.
- The third channel pertains to the *dynamic efficiency* due to increased incentives for firms to innovate.

Besides these three transmission channels, which are theoretically interesting, there are also some obvious direct links between a reduction of PMR and productivity, e.g. lower costs of business activities due to lower administrative burdens or less barriers to trade.

In this theoretical chapter, we will proceed in three steps. The first section deals with the direct impact of PMR in a sector on its productivity via the three transmission channels. The second section provides a short overview of theoretical literature with regard to the impact of PMR on the productivity and other relevant economic indicators in downstream sectors. Since the retail trade sector is at the end of the value chain (very downstream), we have to modify in the third section some general insights from section 2 in order to reverse the perspective of the impact of PMR from upstream onto downstream sectors to downstream onto upstream sectors. Furthermore, this section discusses some special theoretical issues with regard to the retail trade sector.

2.1 Direct impact of PMR via three transmission channels

In the following, the direct impact of a reduction of PMR in a sector on its productivity via the three transmission channels is considered.

2.1.1 Increase of allocative efficiency

If a reduction of PMR leads to more competitors or just to the threat of entry of new competitors, the reduction of the incumbents' market power and the contestability of markets will reduce mark-ups (firms will set prices closer to marginal costs) and allocation of factor inputs (capital and labour) and goods will become more efficient. Thus, scarce resources are allocated to the production of those goods and services that meet the wants and needs of consumers in a better way (Nicodème and Sauner-Leroy, 2007, p. 55). Furthermore, more product market competition can also increase allocative efficiency if less productive firms exit markets and market shares move from those firms to more productive firms. Since the pioneering work of Hsieh and Klenow (2009), this concept of static allocative efficiency has become very popular as an additional explanation for the large and persistent gross-country differences in productivity and income per capita (besides the impact of differences in human capital endowment and technical progress). This rather new empirical literature links these differences in aggregate productivity to the misallocation of resources across firms, which is defined as

static allocative efficiency and measured by the firm-level covariance between productivity and size (Andrews and Cingano, 2014).[1] The theoretical foundation for these empirical studies is taken from the core models of heterogeneous firms, e.g. Lucas (1978) and Melitz (2003). In these models, the optimal allocation implies a positive relationship between the productivity of firms and their size. Since allocative efficiency requires resources to be allocated to their highest valued use, the most productive firms are also the largest at any point of time (Andrews and Cingano, 2014, p. 258).

Besides anticompetitive regulations, size-dependent policies and regulations might also induce misallocation and allocative inefficiency (e.g. Guner et al., 2008; Garicano et al., 2016; Roys, 2016). Examples are regulations that only become effective beyond some employment thresholds or restrictions on the amount of physical space that a retail centre may operate (Restuccia and Rogerson, 2017).

However, Vickers (1995) argues that tighter competition does not always induce a rise of allocative efficiency. Tighter competition through more aggressive interactions between incumbent firms would reallocate profits from inefficient to more efficient firms and accordingly would crowd out inefficient firms. In the medium term, this process would escalate market concentration and mark ups. Nicodème and Sauner-Leroy (2007) counter to this argument that the model of Vickers (1995) implies that market entry of new firms is not possible. Thus, it does not mirror the whole picture.

2.1.2 Increase of productive efficiency

Nicodème and Sauner-Leroy (2007) define productive efficiency as the capacity of a firm to allocate its resources in a manner that allows reducing or eliminating the under-utilisation of its production factors. An increase of productive efficiency can be achieved by introducing new or better production methods within a firm. To link an increase of competition to an increase of productive efficiency, a variety of principal-agents models under information asymmetry is often used (Ahn, 2002). The basic idea of these models is that monopoly rents to a monopolistic firm can be skimmed to some extent by its managers and workers in form of managerial slack and lack of efforts. Tighter competition gives incentives to managers and workers to reduce such slack and to increase their efforts, which will improve the productive efficiency of the firm. Thus, more product market competition due to less PMR can discipline firms into efficient operation (Ahn, 2002, p. 6).

Nickell et al. (1997) identify three channels through which tighter competition creates incentives to increase productive efficiency:

1. Stronger competition generates more opportunities to compare performance under information asymmetry and therefore makes it easier for the owners or the market to supervise managers.
2. In markets with tighter competition, where the price elasticity of demand tends to be higher, cost-reducing productivity improvements could bring larger increases in revenues and profits.
3. In markets with tighter competition, the probability of bankruptcy tends to be higher, so that managers have to work harder to avoid this event.

Thus, in many model settings product market competition reduces managerial slack. However, there are also some exceptions. For example, by altering the model assumptions about managers' responsivity to monetary incentives, Scharfstein (1988)

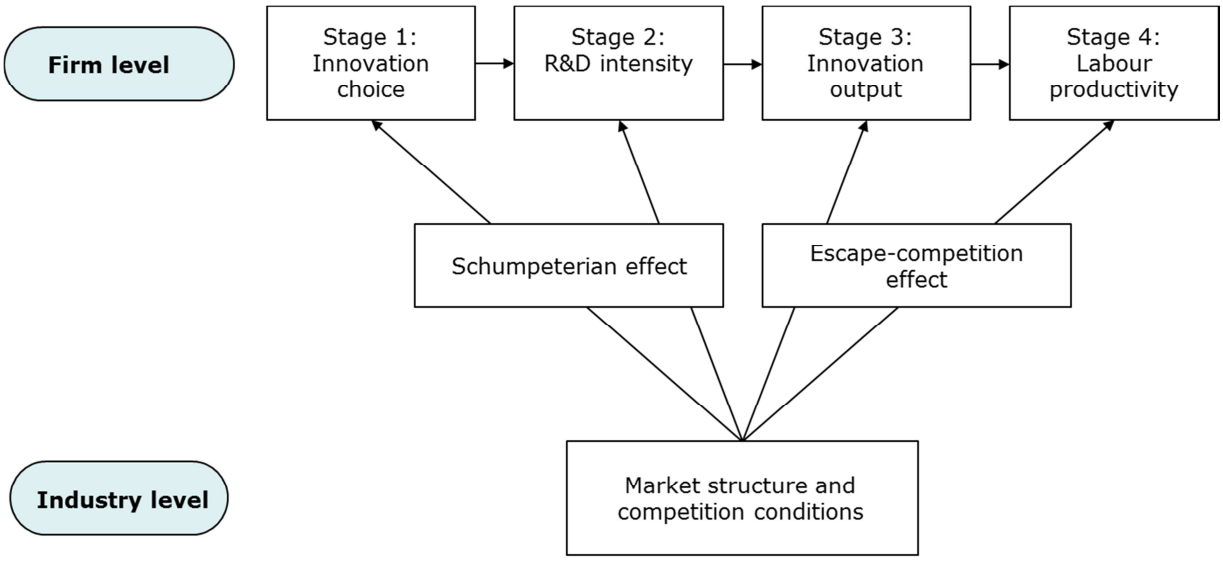
[1] The empirical findings of these studies (e.g. Hsieh and Klenow, 2009 and Bartelsman, 2013) and especially their estimates of the strong impact of an increase of allocative efficiency on manufacturing productivity are contradictory to earlier empirical analyses, e.g. Harberger (1954) and Leibenstein (1966). Harberger (1954) estimated that the costs of static resource misallocation due to lack of competition in the United States are much less than one per cent of GNP, while Leibenstein (1966) concluded from his analysis that "the welfare gains that can be achieved by increasing only allocative efficiency are usually exceedingly small".

shows that competition actually might aggravate the incentive problem. Similarly, while a higher price elasticity of demand under competition could increase the relative rewards from a cost reduction, larger scale operations for a monopolist tend to increase his absolute reward from a similar cost reduction (Ahn, 2002, p. 6).

2.1.3 Increase of dynamic efficiency

While increases of allocative and productive efficiency are movements closer to the technological frontier, increases of dynamic efficiency are movements of the frontier, resulting from investments in product and process innovations (Nicodème and Sauner-Leroy, 2007). Generally, the theoretical literature on product market competition, innovation and growth emphasises the importance of economic profits in providing incentives for firms to innovate or to increase efficiency, but it is inconclusive regarding the direction of the effect. Greater competition may increase incentives for incumbent firms to innovate in order to protect or enhance their market position (i.e., an "escape-competition effect"). On the other hand, increased competition may reduce the rewards to innovation or entry into a market and thus discourage these activities (a "Schumpeterian effect") (Griffith et al., 2010).

Figure 1. Competition and the impact on innovations



Source: Castellacci (2011)

Castellacci (2011) uses the model of Crepon et al. (1998) to relate the two effects (Schumpeterian and escape-competition effect) to the different stages of the innovation chain (Figure 1). Originally, the model of Crepon et al. (1998) differentiates between four stages of the link between innovation and productivity. In the first stage, the firm decides whether to engage in innovation activities. Secondly, if this decision is positive, it sets the amount of R&D resources. In the third stage, the innovative inputs lead to an innovative output (product or process innovation). Finally, in the fourth stage, the innovative output induces an improvement of the labour productivity of the firm.

Castellacci (2011) argue that the Schumpeterian effect is related to the ex-ante incentives to innovate, and therefore it is likely that it can be observed in the two early stages of the innovation process. In contrast, the escape-competition effect associated with the ex-post effects of innovation and is more likely to be observed in the later two stages of the innovation process, i.e. the technological and economic performance of innovative investments. With regard to the market structure, Castellacci (2011) expects that the probability that a firm engages in innovation and the amount of resources it decides to invest are higher in oligopolistic sectors than in competitive industries

(Schumpeterian effect in early innovation stages).[2] On the other hand, the impact of innovative efforts on firm performance (innovation output and productivity) should be higher in competitive sectors than in oligopolistic industries (escape-competition effect in late innovation stages).

A recent strand of the literature has attempted to include these two effects in a single model (e.g. Aghion et al., 2004, 2005, and 2006). These models predict that innovation is initially increasing and then decreasing in the strength of product market competition (an inverted U relationship). A key feature of these models is that firms innovate "step-by-step", in the sense that a laggard firm in any industry must first catch up with the technological leader before becoming itself a leader in the future. Two types of industries can be distinguished: those where firms are very close technologically, "neck-and-neck" industries, and those where firms are unequal, "unlevelled" industries. Firms compete in a duopoly setting where the intensity of competition is modelled as a function of the degree of substitutability between the goods produced by the two firms, and where in an unlevelled industry only the leader can make a positive profit. In neck-and-neck industries, the "escape-competition" effect dominates and greater product market competition increases innovation incentives, since the reward to innovation in the form of increased profits becomes higher. In unlevelled industries the Schumpeterian effect is expected to dominate and greater competition may reduce innovation incentives, since the laggard firm's ex post reward to catching up with the technological leader falls as product market competition intensifies.

Bourlès et al. (2010, 2013) follow the conclusion from these models that firms near to the global technological frontier are more affected by anticompetitive regulations than lagging firms. More specifically, they expect that the positive "escape-competition effect" on firms' efforts to improve productivity is likely to be stronger in markets where a large proportion is close to the frontier than in markets where a large proportion of firms has a wide technological gap to fill. In the latter case, the "Schumpeterian or discouragement effects" due to an increase in competition can be strong enough to deter any innovation activities. Therefore, anti-competitive regulations can have different aggregate effects on productivity in different countries and industries depending on specific technological and market factors, such as the average position of firms relative to global frontier production technologies.

2.2 Indirect impact of PMR from upstream and downstream industries

The recent literature also analyses the indirect impact of product market regulations (PMR) in one sector on the performance in related sectors, because to the extent that expected rents from innovation or technology adoption are underlying efforts to improve efficiency relative to competitors, focussing only on within-industry competition misses an important part of the story. These rents, and the corresponding within-industry incentives to improve productivity, may be reduced by a lack of competition in industries that sell intermediate inputs necessary for production. Similarly, PMR in a downstream sector like retail or wholesale trade might have an impact on sectors which are strongly dependent on these sales channels. An example is the food and beverage industry.

However, most of the general theoretical and empirical literature is related to the upstream to downstream indirect impacts of PMR. Bourlès et al. (2010, 2013) identify two channels through which lack of competition in upstream industries can generate trickle-down effects that affect the productivity performance of other (downstream) industries:

[2] The Schumpeterian effect is related to the concept of dynamic efficiency postulated by Schumpeter (1942). He emphasized in his late work the significance of monopolistic power as a precondition for technical and economic progress (Schumpeter Mark II), whereas he had previously argued that innovation activities through ''creative destruction'' are characterized by a technologically easy to manage market access and dependent on individual entrepreneurs and new firms (Schumpeter Mark I) (Schumpeter, 1934).

1. If markets for intermediate inputs are imperfect, downstream firms may have to negotiate with (and can be held up by) suppliers. In this case, regulations that increase suppliers' market power can reduce incentives to improve efficiency downstream, as part of the (possibly temporary) rents that downstream firms expect from such improvements will have to be shared with suppliers of the intermediate inputs that are necessary for downstream production.
2. Anticompetitive regulations in an upstream industry can reduce competition downstream, if access to downstream markets requires using intermediate inputs produced upstream, particularly in the case of services inputs where import competition is limited. For example, tight licensing requirements in retail trade or transport can narrow access to distribution channels and overly restrictive regulation in banking and finance can reduce the range of available sources of financing for all firms in the economy.

However, according to Correa-López and Doménech (2017), these channels are not new on the agenda of industrial organization research. Starting with the early work of Horn and Wolinsky (1988), the industrial organization literature has explored the effects on industry equilibrium of the lack of competition in the market for inputs. Market imperfections in the form of entry barriers lead to non-competitive solutions in upstream markets, where input prices are often determined by a bargaining process between suppliers and producers. Furthermore, as a result of irreversible investments, downstream firms may be locked into bilateral monopoly relations with providers, which may make pro-competitive reforms more challenging to deliver. In this context, the literature has shown that the equilibrium input price varies with the structure of the upstream industry. In their classic paper, Horn and Wolinsky (1988) established that more competition in the market for inputs yields lower bargained input prices when downstream firms compete in imperfect substitutes. Several papers in this tradition have deepened our understanding of the consequences on downstream firms' outcomes of an imperfectly competitive set-up in input markets (see, e.g., Correa-López and Naylor, 2004; Correa-López, 2007; Gabszewicz and Zanaj, 2008; Manasakis and Vlassis, 2013).

The influence of competition in upstream sectors for productivity improvements downstream is likely to be particularly relevant in developed countries where most industries are increasingly involved in global competition (cf. Bourlès, 2010). In sectors or markets exposed to trade, direct competitive pressures from rival firms (both incumbents and new entrants) are often strong and provide the expected incentives for efficiency improvement. By contrast, several non-manufacturing sectors are often protected from extensive trade pressures by either the need for proximity or the fact that service provision occurs through national physical networks. With these non-manufacturing sectors accounting for rising shares of total intermediate inputs, lack of competition there propagates throughout the economy by increasing the cost (or reducing the quality) of the services provided to downstream sectors. In turn, the cost of goods produced using these services are also inflated, with a cascading effect on other intermediate inputs. Higher costs (or lower quality) of intermediate inputs indirectly frustrate efforts of firms that purchase these goods and services to improve efficiency in order to escape competition, because the expected returns from such efforts are shrunk. As these returns are higher for firms that compete neck-and-neck with rivals that are close to the technological frontier, lack of competition upstream is likely to reduce downstream incentives to improve efficiency more markedly when distance to frontier is short, as it is often the case in increasingly globalized markets.

Bourlès et al. (2010) present a formalisation of these links between upstream competition and downstream productivity, based on an extension of the Neo-Schumpeterian endogenous growth model by Aghion et al. (1997). In their model, firstly, imperfect competition in upstream sectors makes the search for intermediate input suppliers time-consuming and costly for new downstream firms. Secondly, rent-seeking efficiency incentives in downstream sectors are reduced by the search costs implied by imperfect competition in upstream sectors. These costs provide market power to

upstream suppliers, creating a wedge between the intermediate input price and the marginal cost of producing the input, which is assumed to be constant. In their setting, input prices are determined by the sharing of the total product market rents between upstream and downstream firms, which depends on the power of negotiation of the upstream firms. They assume that the power of negotiation of the upstream firms is decreasing with the level of competition in the upstream sectors.

Their model has the following implications:

- The number of downstream firms is inversely related to the expected cost (i.e. time) of finding an intermediate input supplier. In turn, stronger competition downstream increases the incentives to efficiency improvements by reducing profits in levelled industries, i.e. by increasing the gap between pre- and post-innovation rents.
- The bargaining power of upstream firms reduces incentives to efficiency improvements because it decreases the leader's expected profit by distorting the competition with followers.
- It is natural to assume that, as competitive pressures increase in upstream markets, the bargaining power of intermediate goods suppliers and the expected cost for a downstream firm to find a supplier falls (because either the hazard rate or the search cost falls, or both).
- With easier access to suppliers and higher expected profits from becoming a leader, incentives to improve efficiency increase for downstream firms.

Therefore, the main prediction of the model is that weak upstream competition can reduce efficiency growth in downstream firms.

Amable et al. (2009) challenge the very clear predictions of the models in the spirit of Aghion et al. (2004, 2005, 2006) and propose a simple modification of the "distance to frontier" framework. Actually, they show theoretically that the conclusion of an increasingly negative impact of regulation on innovation can be reversed when one enables the leader to innovate, making it more difficult for followers to catch-up. They achieve their results by introducing a parameter in the model à la Aghion et al. – the technological leader effect – that captures the impact of the leader's innovation effort on the probability of success of the follower (this parameter is implicitly zero in the Aghion et al. models). As a consequence of a multiplicity of equilibria they derive three propositions characterizing the stationary R&D efforts:

1. For a high impact of the technological leader effect (>1), there exists a stationary R&D strategy of the leading firm for which the innovative effort decreases with competition.
2. For a high impact of the technological leader effect (>1), there exists a stationary R&D strategy of the levelled firm for which its innovative effort decreases with competition.
3. For a high impact of the technological leader effect (>1), competition discourages the stationary R&D effort of the follower firm when the innovative leading effort is high enough.

With regard to the aggregate innovations, the model implies that, in neck-and-neck industries, competition can be detrimental to innovation. Thus, the aggregate effect of competition can in fact be negative. Moreover, the inverted U relationship is only a special case resulting from a low leading innovation effect. Actually, if the technological leader effect is very small, the model of Amable et al. (2009) shows also the inverted U relationship between competition and innovation. However, there are two further equilibria. Firstly, if the technological leader effect has a high impact (>1) and the R&D effort of the leader is relatively small, the inverted U relationship no longer holds and innovation monotonically increases with competition. Secondly, if the technological leader

effect has a high impact (>1) and the R&D effort of the leader is relatively large, innovation monotonically decreases with competition.

Amable et al. (2009) as well as Amable et al. (2016) conclude that these theoretical results as well as their empirical results suggest that some channels linking regulation to innovation have been neglected in the "distance to frontier literature". Product market deregulation could alter the competitive environment and lead firms to favour the cost-cutting dimension of competition rather than product innovation and quality improvement; it could make firms' economic environment more uncertain and thus discourage them from undertaking risky innovative investment, or shift the focus of innovative activity on incremental modifications with little technological but potentially large economic value rather than more radical improvements. With regard to policy they reason that deregulation policy cannot be a substitute for active science and technology policies in developed countries.

Ledezma (2013) obtains similar results from a semi-endogenous quality-ladder model without scale effects, which captures the potentially defensive behaviour of patent-race winners and the ensuing effect on aggregate R&D effort. He starts from the empirical observation that firms use a variety of strategies to protect the value of their innovations and argues that this multiplicity is key for the understanding of the effect of product market regulation on R&D incentives. In this situation, when firms have alternative methods to keep their profits, competitive pressures may not necessarily act as a neutral slack-reducing device. The threat of competition can in practice trigger a defensive reaction from incumbents, who will construct different types of strategic barriers to reduce the risk of losing innovation contests. Furthermore, he argues that the appropriation of innovation returns relies on the exploitation of asymmetries in private knowledge and capabilities, and, thus, product market regulations will likely have a different effect on innovation incentives according to firms' business positions. It is then important to estimate the net effect at the aggregate level, taking into account winners' and losers' reactions in equilibrium.

The quality ladder model of Ledezma (2013) emphasises the role of strategic behaviour in vertical innovation. In his model, each vintage is characterised by a vector composed of several quality dimensions, which contains information on two important aspects of quality. Its magnitude measures the level of quality of the vintage and is labelled as the intensive margin of quality. Its direction summarises the mix of quality dimensions offered by the good and hence relates to what can be called the extensive margin of quality. A given level of quality can be potentially provided by a number of mixes of quality dimensions so that vertical innovation will also likely affect the extensive margin. In order to fend off the threat from followers, after discovering a new idea and before manufacturing, the innovator can introduce additional complexity into the good by adding new dimensions of quality. He puts this vector representation into a standard R&D race with constant returns to scale in R&D technologies and Nash–Cournot equilibrium behaviour. By strategically manipulating the extensive margin of quality, the new successful innovative firm acquires an R&D cost advantage vis-a-vis its competitors. This advantage may be large enough to render R&D attractive to leaders (incumbents) despite the cannibalisation of their current rents. Then, the R&D investment of outsiders is not worthwhile, and their optimal strategy is not to invest. Conversely, with smaller resulting R&D cost advantages, the leader is absent from R&D races and innovation relies only on outsiders. At this point, production market regulations come into play, as they increase the costs of upgrading both the intensive and extensive quality margins. Since the new innovative firm is the sole producer that has the knowledge to implement the new idea it is also the sole producer affected by the costs related to the extensive margin. Knowledge asymmetries translate then into cost asymmetries influenced by product market regulations. The main result is that product market regulations can have either a positive or a negative effect on aggregate R&D intensity. The sign depends on whether product market regulations are above or below a certain threshold, which can be seen as distinguishing "liberal" from "regulated" markets. In liberal environments the equilibrium is characterised by a permanent innovative monopolist. More product market

regulations are here detrimental to innovation as they distort the innovative activity of the sole innovator (the leader). However, with product market regulations above the critical threshold, the economy experiences Schumpeterian leapfrogging in which leaders are continuously replaced by innovative outsiders. In this case, regulatory provisions can increase aggregate R&D since they reduce the deterrent effect on outsiders. This positive effect is stronger for larger innovations when there are considerable incentives to behave defensively. According to Ledezma (2013), the fact that firm renewal only comes about after a certain level of product market regulations and that the presence of a permanent monopolist obscures a constant competitive threat, underlines the complexity of the link between product market regulations and competition.

A further argument concerning the different impacts of anti-competitive regulations at the industry level is mentioned by Arnold, Nicoletti and Scarpetta (2011). Hence, the effects of anticompetitive regulations can also differ depending on an industry's propensity to use certain types of technologies. For instance, anticompetitive regulations may slow down the take-up of new general-purpose technologies, such as information and communication technologies (ICT). This is because with low competitive pressures, the incentives to invest in such technologies so as to increase productivity and retain market shares may be lower than in more competitive markets.

In two further papers, Arnold et al. (2011, 2016) analyse the effects of services liberalization on the performance of the manufacturing sectors. They assume that, with services liberalization, new domestic and foreign providers will enter the market and increase the choice of providers for downstream users of services. This greater choice may affect the performance of manufacturing sectors in three ways:

1. New services may become available through the entry of more sophisticated or technologically advanced services providers. Availability of such services may allow manufacturers to introduce productivity enhancing changes to their operations.
2. A wider availability of services that were formerly restricted to certain groups of users, such as internet coverage in rural areas or an improved availability of business consulting services to smaller firms. The improved access may lead to enhanced performance of smaller or remotely located enterprises.
3. The reliability of existing services may improve as a result of privatization, competition and the entry of internationally successful players. These improvements will in turn limit disruptions to production and reduce operating costs in downstream manufacturing sectors.

Cette et al. (2016) assess the consequences on productivity of anti-competitive regulations in product and labour markets through their impact on production prices and wages. They test whether the indirect impact of anti-competitive regulations is due to their effects on firm market power. Owing to the use of production prices and wages, they can consider six channels through which regulation can impact (multifactor) productivity:

- Direct and indirect influences of product market regulations on rent building in manufacturing and non-manufacturing sectors.
- Direct influence of labour market regulations on the rent sharing process between, on the one hand, firms, and, on the other hand, skilled and unskilled workers.

Their empirical approach is theoretically based on a general equilibrium model of Blanchard and Giavazzi (2003), which relies on two assumptions. Firstly, monopolistic competition in the goods market determines via higher prices the size of rents. Secondly, bargaining in the labour market determines the distribution of rents between workers and firms. The indirect effects of product market regulations in upstream industries consist of weaker incentives to improve efficiency and innovate in downstream industries, because the rents they can generate are appropriated by upstream industries that have market power and can charge them relatively high prices for the intermediate inputs they

must use. The result is a definitely negative impact on (multifactor) productivity. Labour market regulations lead to higher wages and lower profits, because rents, which could have been fully appropriated by firm owners and shareholders, are shared with workers. Thus, firms have fewer incentives and financial resources to improve their efficiency and innovate. Again, the result is a negative impact on (multifactor) productivity. Since high-skilled workers have a stronger bargaining power than low-skilled workers, it is also likely that the negative impact would be larger for the former than the latter.

Barone and Cingano (2011) analyse the effects of anti-competitive service regulation by examining whether OECD countries with less anti-competitive regulation show a better economic performance in manufacturing industries that use less-regulated services more intensively. Their results indicate that lower service regulation increases value added, productivity and export growth in downstream service-intensive manufacturing industries. The regulation of professional services and energy provision has particularly strong negative growth effects. Their theoretical foundation to illustrate why regulations might affect industry specialization uses insights from new trade theory and relates service regulations to the costs of production in downstream industries. They consider an economy using two production technologies combining labour and an intermediate input that is a composite of different varieties of services. One sector is relatively more intensive in the intermediate input, and, thus, more service-intensive. Service regulation is introduced assuming that only a fraction of varieties can be bought at competitive prices, while the other fraction is available in regulated markets, where inputs are sold at monopolistic prices. In the equilibrium, the relative cost of services in the service-intensive industry is a decreasing function of deregulated markets. Their model shows that regulatory reforms raising the share of deregulated input markets above a threshold share would imply a dramatic shift in the country's production structure from full specialization in labour intensive industries to full specialization in service-intensive industries. However, less extreme implications can be derived from the model following new trade theory approaches with firms within each industry supplying varieties of imperfectly substitutable goods (see Helpman and Krugman, 1985). In such a framework, service deregulation would therefore imply an increase in the service-intensive industry share of total production, driven by shifts in both domestic and foreign demand. Furthermore, from profit maximisation it can be derived that relative labour productivity in the service-intensive industry is also increasing with the extent of deregulation.

Barone and Cingano (2011) emphasize that because output prices decrease with deregulation, the elasticity of relative production to regulation is lower when production is measured in current rather than constant prices. Therefore, they conclude that an empirically interesting implication of their framework is that detecting the effects of regulation on the structure of industrial production would be easier using real as opposed to nominal measures of value added, as they allow insulation of the industry accounts from the offsetting effects of deregulation on industry prices.

Box 1. PMR and macroeconomics

Hitherto, the review of the theoretical aspects concerning the links between upstream product market regulations and productivity focused on effects at the firm and industry level. Finally, a short glance shall be thrown at the macroeconomic level. From this point of view, we have to differentiate between long-run and short-run effects. If a reduction of product market regulations leads to higher productivity via an increase of competition (with a rise of innovativeness and efficiency as well as a fall of mark-ups), long-term aggregated supply (the production potential) will increase. Otherwise, if the "Schumpeterian or discouragement effects" prevail, long-term aggregated supply will decrease.

Actually, long-term positive effects of product market reforms on growth and productivity are a well-established result from macroeconomic model-based simulations (e.g. Arpaia et al., 2007, and IMF, 2016). However, Cacciatore et al. (2016) and Monteiro et al. (2017) pointed out that the positive long-run effects might take time to materialize and might even be negative in the short-run. For example, lower mark-ups might drive incumbents into leaving the market, implying, in the short-run, physical and human capital scrapping, and thus a reduction of short-term aggregated supply. Furthermore, the increased unemployment due to the exit of the least productive firm reduces aggregated demand in the short-term, which triggers a multiplier effect with regard to unemployment and short-term output. Finally, households' possible perception of increased income insecurity might raise precautionary savings and thus reduce aggregate demand.

Model-based simulations actually indicate the presence of such short-term costs. The New Keynesian dynamic stochastic general equilibrium model of Cacciatore et al. (2016) shows that deregulation entails short-run transition costs for small open economies. Moreover, their results suggest that product market deregulation does not create deflationary pressure; therefore, concerns about the zero lower bound on interest rates (or the inability to use independent monetary policy in a monetary union) should not be viewed as an impediment to increased deregulation.

The model-based simulations of Eggertsson et al. (2014) with an open economy version of the standard New-Keynesian model yield opposite results. This model includes two sectors (tradable and non-tradable) and two countries that form a currency union. They find that the short-run transmission mechanism of the product market reforms critically depends on the ability of the central bank to provide policy accommodation. In normal times, reforms increase households' permanent income and stimulate consumption. Accompanied with falling aggregate prices, the central bank cuts the nominal interest rate and the currency union experiences a vigorous short-term boom. These effects, however, are completely overturned in crisis times. When the nominal interest rate is at the zero lower bound, reforms are contractionary, as expectations of prolonged deflation increase the real interest rate and depress consumption. In their simulations, the short-run output losses associated with the zero lower bound constraint are increasing with the magnitude of the reforms and become particularly large when reforms are not fully credible (and are later undone).

The results of Eggertsson et al. (2014) are put into question by Fernández-Villaverde et al. (2014) by assuming that supply-side policies – like deregulation of product markets – can play a role in fighting a low aggregate demand that traps an economy at the zero lower bound of nominal interest rates. According to their New-Keynesian model, reductions in mark-ups or future increases in productivity triggered by supply-side policies generate a wealth effect that pulls current consumption and output up. Since the economy is at the zero lower level, increases in interest rates do not undo this wealth effect.

2.3 Special features of the retail trade sector

From a traditional point of view, retailers are seen as economic agents that only exist to resolve the spatial non-incidence between producers and consumers. They buy goods from manufacturers (and/or intermediaries) and make them available to consumers. This should happen at the lowest possible cost, meaning that the difference between prices paid upstream and charged downstream should not exceed the distribution costs and the reference distribution cost coincide with the gross margin of the most efficient retail format (Pellegrini, 2000, 125-126). According to Pellegrini (2000), this view might have been a reasonable approximation of the role of this sector when it consists of a very large number of small independent shops that could not interfere in the relationship between manufacturers and consumers. However, it is certainly not admissible for the modern retail trade sector with its high degree of complexity, where many different store formats exist and many retail firms are larger and have bigger bargaining power than most of

their suppliers. Changes can also be observed with regard to the market structure of the retail trade sector, which has been traditionally characterised by monopolistic competition, with low entry barriers, high entry and exit rates and a large number of competitors whose size is relatively small. Although this picture remains partly true, recent changes in some segments of the industry, such as food retailing, suggest a move towards rising concentration and retailer power (Boylaud and Nicoletti, 2001; Dobson and Waterson, 1997; Hewitt, 2000). More drastically, Raff and Schmitt (2016) conclude, that important changes like (1) the shift in employment from manufacturing to retailing, (2) the increase in retailer product assortment and (3) the emergence and subsequent increase in slotting allowances as up-front payments by manufacturers to retailers lead to a world in which retailers control access to consumers and thus determine the variety of goods available to consumers. At the same time, increased international market integration for manufacturers and retailers as well as the development of online electronic commerce have emerged.

The changes in the retail trade sector have occurred against the background of a variety of national and local regulations. With regard to retailing, two different groups of regulations can be differentiated, namely, on the one hand, entry regulations, and, on the other hand, regulations of operations. In order to control entry, governments can adopt three main types of measures (Pozzi and Schivardi, 2015). First, they can choose to exercise direct control on an activity or to grant (local) monopolies to selected players. Entry can also be restricted by requiring potential newcomers to comply with various rules, including registration procedures and fees. Finally, urban and regional planning legislation can be used to single out areas where entry can be prohibited or subject to approval (zoning). Additionally, planning legislation can limit the size of new stores or shopping centres. Requirements and procedures to open a new store or shopping centre vary widely not only across countries but also within countries, because often local and regional administrative and legislative institutions are empowered to decide these matters within the framework of national legislation.

Generally, the theoretical framework to analyse regulation in retail markets does not substantially differ from the broadly analysis of regulations, which is summarised in the previous two sections (Pozzi and Schivardi, 2015, 3). Thus, entry of new competitors plays a crucial role for the direct impact of regulations on efficiency. However, there are some special issues that are important for the retail trade sector and its relationship to the upstream suppliers in the manufacturing sectors. According to Pellegrini (2000, 153), entry regulations have three main consequences:

1. The immediate one is a rationing of the services of new store types to consumers.
2. The more long-term one is a slow-down or delay of the diffusion of large stores and the consolidation of the retail trade sector.
3. The indirect one is a reduction of the bargaining pressure of retail companies on their suppliers from the manufacturing sector.

The first point, especially the rationing of large stores, has a negative impact on consumer prices and welfare, because consumers who want to purchase their goods from a large supermarket cannot do so and have to carry on buying from a traditional grocery shop. Let us assume that a consumer has the choice between a traditional grocery shop and a large supermarket with lower prices for the same basket of goods.[3] If both stores would be located in the same distance to the consumer, the consumer would choose the cheaper supermarket and this gain could be measured by the price differential. However, since a large supermarket needs more customers to survive than a smaller grocery shop, the consumer probably has to cover a larger distance to enjoy the advantage of lower prices. Thus, his gain from the price differential partly melts away due the opportunity costs of the time needed to move to and from the supermarket and/or a larger stock of goods held at home in order to reduce the frequency of supermarket visits.

[3] The following example is taken from Pellegrini (2000, 154).

The second point concerns the diffusion of large stores and thus the consolidation of the retail trade sector. It is broadly accepted that store formats, especially large stores, have cost advantages which translates into lower prices. If regulation discourages the spreading of these formats, then it leads to welfare losses. E.g., large stores are more efficient in using labour, because they hardly operate below the level corresponding to the full use of employees needed to keep the store open (Pellegrini, 2000). Generally, besides the already discussed reduction of potential competition from new entrants and diminishment of incentives for the incumbents to engage in cost-reducing innovations, there is a second impact of entry regulations on productivity by distorting the format choice of new entrants (Pozzi and Schivardi, 2015). Larger stores are often more efficient both because of economies of scale and scope. Thus, if regulation affects the choice of the store format and influences the number of large versus small and medium stores operating in a market; it also impairs the productivity of the retail trade sector. Economies of scale and scope do not only exist at the level of a single store, but also with regard to the central functions and physical distribution of retail chains. If these firms cannot grow by opening new stores, then the economies in these functions cannot be fully exploited. One important example is the diffusion of retail brands, which are a low-cost way to pass information to consumers and to guarantee product quality, because they cover a large number of goods and require less advertising than manufacturer brands (Pellegrini, 2000, 154).

The special attention of regulators towards large stores (often labelled as big box stores) comes from the assumption that, on the one hand, they provide consumers with the opportunity to save money, but, on the other hand, that their entry is also associated with a series of undesirable consequences (Pozzi and Schivardi, 2015, 5). The entry of a large store often takes place at the periphery of a city, which might potentially lead to city centres desertification, urban sprawl and sometimes congestion. Furthermore, there is the fear that large stores can crowd out small, independent stores, which might lead to a reduction of overall employment in the retail trade sector. However, such regulations with regarding to zoning and size can have unintended consequences when entrants can change their entry format. Analysing a planning reform launched in the United Kingdom in the 1990s, Sadun (2015) shows that independent retailers were actually harmed by the erection of entry barriers against large stores. Instead of simply reducing the number of new large stores entering a market, the entry barriers created the incentive for large retail chains to invest in smaller and more centrally located formats, which competed more directly with independent stores and accelerated their decline.

The third point comprises the suppliers in the manufacturing sector. First, to some extent, suppliers also can realise efficiency with larger retail store formats, because they experience a reduction of their transaction costs due to a smaller sales force and lower logistic and inventory costs. These lower costs should lead to lower upstream prices, and, if the retail trade sector is competitive, to lower consumer prices. Second, there is the disputed hypothesis that a consolidation and concentration within the retail sector will reduce the rents gained by suppliers who have some degree of market or monopolistic power, e.g. the manufacturers of powerful brands. Thus, reductions of regulations and an increased concentration of retail trade can give large retailers a countervailing power to their suppliers from the manufacturing sector. This hypothesis was made popular by Galbraith (1952), who suggests that large buyers cause competitive pressure on large manufacturers, so that large retailers would be able to obtain lower prices and pass them through to the consumers. Thus, these large retailers "developed the countervailing power which they have used, by proxy, on behalf of the individual consumer … (Galbraith, 1952, 131).

An early opponent to Galbraith's idea was Stigler (1954), who argued that large retailers actually could reduce the rents of their suppliers but Galbraith (1952) has not a rational explanation for why the retailers would have incentives to pass cost savings through to consumers.[4] If retailers are large enough to be indispensable purchasers for monopolistic

[4] A similar argument can be found in Hunter (1958).

suppliers, they also must be monopolists. If not, manufacturers would reject to sell at the price requested by the most aggressive retailers and would sell more to their competitors. These aggressive retailers, dispossessed of products desired by consumers, would lose market shares to their competitors.

Von Ungern-Sternberg (1996) uses the Nash bargaining concept to study the predictions of the theory of countervailing power within two theoretical models, a Cournot model and a model of perfect competition. Within the Cournot model a decrease in the number of retailers unambiguously leads to an increase in equilibrium consumer prices. In the model of perfect competition the reverse is true. Thus, he concludes that countervailing power can have positive effects for the consumers only if competition at the retail level is very fierce. Furthermore, Dobson and Waterson (1997) considers the importance of countervailing power, manifested as the effects of increased retail concentration on consumer prices and welfare within a market setting where imperfectly competitive retailers negotiate intermediate prices with a monopoly supplier. Only when retailer services are regarded as very close substitutes, final prices fall following a reduction in the number of retailers.[5] Even in these circumstances, the social benefits of countervailing power may not be realised as the supplier may seek to protect its profits by using a refusal to supply restraint to engage in exclusive trading.

Additionally, Chen (2003) shows also that an increase of the countervailing power of a dominant retailer can lead to a fall of consumer prices. However, total surplus does not always increase with the rise of countervailing power because of the possible efficiency loss in retailing. Furthermore, the attendance of fringe competition is crucial for countervailing power to benefit consumers. Inderst and Wey (2007) argue on the basis of a game theoretic approach that the presence of larger buyers may reduce the supplier's profits and increase the supplier's incentives to undertake certain types of product or process innovations. Facing larger buyers, the supplier cares more about reducing incremental production costs at high volumes and more about reducing the loss in revenues that could arise from a disagreement with a large buyer. For the case of process innovation they show that if the presence of large buyers actually shifts the supplier's choice of technology, this is likely to increase welfare. For product innovation, however, the supplier may always have too high incentives, which are further distorted upwards in the presence of larger buyers. In order to explain factors driving bargaining power in manufacturer-retailer relationships, Haucap et al. (2013) use a demand model where consumer demand determines the total pie of industry profits and apply furthermore a bargaining concept on the supply side to analyse how profit is split between retailers and manufacturers. Recently, Christou and Papadopoulos (2015) demonstrate in a dominant firm-competitive fringe model, where firms purchase input from a common supplier via two-part tariff contracts, that countervailing power may be neutral. Unlike Chen (2003), more countervailing power may not lead to lower consumer prices. They show that despite the existence of a competitive fringe, countervailing power remains neutral as in the bilateral monopoly case with two-part tariff contracts. The size of the fringe that can be interpreted as a measure of the intensity of downstream competition has no influence on the effectiveness of countervailing power.

There is an ongoing controversy in the economic and policy literature whether large retailers own too much market power. One important reason for this debate is the introduction of slotting allowances and fees since the late 1980s, which now has become a widespread practise. These allowances are lump-sum up-front transfer payments from manufacturer to retailer, when the former launches a new product (Rao and Mahi, 2003, 246). Bloom et al. (2000, 93) differentiate between five types of slotting allowances and fees that manufacturers have to pay to retailers:

1. Presentation fees: Fees paid for the possibility of making a sales presentation.
2. Slotting fees: Up-front payments in order to obtain shelf space for a product.

[5] In reality, however, major retailing firms try to distinguish themselves from each other in terms of their image and retail offer (Dobson and Waterson, 1997, 429).

3. Display fees: Fees paid for special merchandising and display of products.
4. Pay-to-stay fees: Fees paid to continue stocking and displaying a product.
5. Failure fees: Fees paid when a product does not meet expected goals.

Furthermore, these authors identify two schools of thought with regard to the analysis of the impact of slotting fees on the relationship between manufacturers and retailers and of the retailing market in general. The one school of thought judges the impact of these fees positively. It is labelled by the authors as "efficiency school", which considers the fees as a means for signalling and screening new products. They enable manufacturers to communicate and retailers to evaluate information with regard to new products. Furthermore, they are an instrument for cost sharing, because they compensate retailers for the costs of introducing and managing new products, and risk shifting, since they help to reallocate the risks of new product introductions to those best informed to control them. Furthermore, shelf space in a store is limited, so that slotting fees allows allocating shelf space to its best possible use (Sullivan, 1997, Klein and Wright, 2006). The latter three means are often discussed in the context of the so-called cannibalisation effect, which means that a retailer who sells one new variety of a product reduces the demand for the other varieties he sells. Altogether, according to the "efficiency school", slotting fees help to equate the supply of new products and their demand by consumers. Finally, they allow facilitating practices for lowering of retail prices and provide a means for increasing competition (Bloom et al., 2000, 94).

The other school of thought, labelled as "market power school", gauges slotting fees negatively and considers them as exercising and enhancing market power on the part of the retailers toward manufacturers. These fees have damaged the manufacturer and retailer channel relationships, which lead to concerns for channel efficiency. According to this school, slotting fees allow retailers to discriminate among manufacturers, especially large versus small suppliers. Insofar, slotting fees are a competitive mechanism that enables larger and more resourceful competitors to foreclose smaller rivals from access to acquired inputs, e.g. as retail shelf space. All in all, these fees are considered as a means to diminish retail competition (Bloom et al., 2000, 95).

Actually, Shaffer (1991) shows in a seminal game-theoretic analysis that slotting fees can be used by retailers to reduce price competition between them. Narratively, the following results emerge from this analysis. Since pure transfers of profit between industries have no welfare consequences, at the first glance slotting allowances seem to be harmless. However, this includes the implicit assumption that the sum of the manufacturers' and retailers' profits is fixed, which will generally not be true. Manufacturers are in competition with each other to obtain retailer promotion, and retailers compete among themselves to win customers' favour. Actually, slotting fees serve to increase the sum of the profits of both sectors by reducing competition in the retail sector. Since manufacturers must earn nonnegative profits, slotting fee contracts lead to per-unit wholesale prices, which are above marginal production costs. Retailers who sign such contracts not only receive a direct up-front payment, but also benefit indirectly from reduced downstream competition. By agreeing a relatively high wholesale price, a retail firm essentially announces its intention to be less aggressive in its pricing. Other firms are then prompted to raise their retail prices, and the original firm gains through the feedback effects (Shaffer, 1991, 121).

According to Foros and Kind (2008), the main problem with both the efficiency and the market power school is their presumption about the structure and organisation of the market. Both schools presume that there are only two layers: manufacturers at the upstream level and retailers at the downstream level. Furthermore, both schools assume that each retail chain behave like a vertically integrated firm with regard to its decisions on procurement contracts and retail pricing. However, what actually is often observed, especially in Europe, is a three-layer structure. Large retailer chains have established procurement alliances (buyer groups), so that concentration is higher for procurement than for retailing. The headquarters of each buyer group typically are engaged in

procurement while the retailer sub-chains deal with retailing including final consumer pricing. The sub-chains are typically organized as divisionalized firms, even when they are fully owned by the procurement headquarters.

Including this three-layer structure the theoretical analysis of Foros and Kind (2008) shows that a buyer group will use slotting fees to reduce intra-retailer competition as long as there is imperfect competition among the members. Furthermore, the emergence of large buyer groups increases the potential for using slotting fees to raise retail prices. Their analysis also implies that efficiency-enhancing and anti-competitive rationales for slotting fees may coexist, e.g. if manufacturers undertake market-expanding investments (advertising etc.). In order to generate incentives for such investments of the manufacturers, it may be optimal for the retailer to claim slotting fees and in return offer relatively high unit wholesale prices. In such cases the use of slotting fees may increase welfare.

However, there are also some alternative instruments to slotting fees, which could achieve the same efficiency-enhancing effects, hence raising the question of why retail firms prefer to use slotting fees (Foros and Kind, 2008, 381-382). The reason could be that these fees have the side-effect of reducing retail competition. This will reduce the social gain from slotting fees, but the total effect can remain positive. Thus, regulatory authorities and competition policy should not only consider whether the efficiency effects of slotting fees dominate the anti-competitive effect, but also whether the efficiency effects could be achieved with alternative instruments without anti-competitive side-effects.

Caprice and von Schlippenbach (2013) argue that not only retail buyer power but also a change of consumer shopping behaviour towards one-stop shopping can be a reason for the use of slotting fees. One-stop shopping means that consumer increasingly make a substantial part of their weekly grocery purchases with a single trip to one retailer. Thus, their shopping carts from these trips include items from various product categories as well as multiple items from the same product category, which implies that their purchase decisions depend on the price for the whole shopping cart rather than the prices of individual goods. Hence, there are complementarities between products offered at a retail outlet that are initially independent or substitutable. The authors show that taking the consumer preferences for one-stop shopping and its consequences into account slotting fees may emerge as a result of a rent-shifting mechanism in a three-party negotiation framework, where a monopolistic retailer negotiates sequentially with two suppliers about two-part tariff contracts. According to their results, the wholesale price negotiated with the first supplier is upward distorted, if the goods are initially independent or sufficiently differentiated. Thus, the retailer and the first supplier can extract rent from the second supplier. Furthermore, to compensate the retailer for the higher wholesale price, the first supplier pays a slotting fee as long as its bargaining power compared to the retailer is not too large.

The industrial organization literature hitherto discussed used partial-equilibrium approaches to focus on competition issues. In addition to this literature, Raff and Schmitt (2016) develop a more general monopolistic competition model of retailers and manufacturers to analyse the interplay of (1) the shift in employment from manufacturing to retailing, (2) the increase in retailer product assortment, (3) the emergence and subsequent increase in slotting fees and (4) international market integration. Their model consists of three main components. The first is a monopolistic competitive manufacturing sector where each manufacturer produces a single variety of a consumer good with increasing-returns-to-scale technology. Secondly, there is a retailing sector, which distributes all differentiated products. The two choices of the retailers – product assortment and retail prices – give them power, but this power is limited by monopolistic competition. Thirdly, there is a wholesale market that connects manufacturers and retailers. The latter charge an upfront payment (slotting fee) for each product they stock. After determining which products to stock and receiving the upfront payment, each retailer bargains pair-wise with each of its manufacturers over the

wholesale price. Albeit this bargaining is efficient in the sense that the wholesale price maximizes the surplus of the retailer-manufacturer pair, the wholesale price exceeds the marginal cost of production, because the bargaining pair takes into account the cannibalisation effect that selling the new variety generates for the retailer. As in the other models, this rent generated by the wholesale margin is transferred to the retailer via the upfront payment.

The authors consider at first a closed economy model and afterwards extend their model to allow for international product market and retail market integration. In a closed economy the equilibrium upfront payment of a manufacturer is increasing in the retailer fixed cost, the cost of adding a variety and the elasticity of substitution and is decreasing in the manufacturer's fixed cost and the fraction of income spent on differentiated goods (Raff and Schmitt, 2016, 687). Introducing international product market integration, which means that goods become tradable across countries but retail services remain non-tradable, lead to an increase of upfront payments by the manufacturers, a larger product assortment stocked by retailers and a shift of employment from manufacturing to retailing. Allowing additionally international retail market integration, meaning that retailer get access to foreign customers by opening up stores in each country, leads to welfare gains, because it reduces the gap between the market equilibrium wholesale price and the marginal cost of production. Thus, international retail market integration lowers the importance of upfront payments (Raff and Schmitt, 2016, 702).

Although there is an elaborated theoretical literature about the market structure in the retail sector, its impact on upstream sectors (like the food industry) and the setting of wholesale and retail prices, there is only little theoretical literature on how regulation or deregulation induced changes of market structures (e.g. increased entries and exits of retailers) and prices for consumer prices translate into employment and productivity changes in the retail sector as well as in upstream sectors.

Often, the theoretical literature with regard to the employment effects of regulation in the retail trade sector considers only one kind of regulation or deregulation. One branch of this literature analyses the impact of the liberalisation of shopping hours on retail prices and employment with rather mixed results. Gradus (1996) considers the optimisation problem of a spatially monopolistic retail store working under an elastic product demand function and increasing returns to scale. Furthermore, the optimal price set by a firm depends on the number of opening hours and the demand curve turns with the opening hours of the firm and its competitors. In this setting, three effects on employment in the retail sector occur (Gradus, 1996, 256):

1. A *threshold labour effect*, i.e. an increase of the number of opening hours induces an increase of fixed labour, because the minimum amount of workers necessary to keep a store open rises.
2. A *sales effect*, i.e. a likely increase of sales will induce an increase of the amount of variable labour. The absolute increase of the retail sales volume is determined, on the one hand, by the elasticity to a change of the opening hours under constant retail prices, and, on the other hand, by the price elasticity to the regulation (Paul, 2015, 332). The model of Gradus (1996) concludes that the overall price of retail purchases (i.e. the retail price itself and the accessing costs) decreases.
3. A *labour productivity effect*, i.e. labour productivity will increase if the number of opening hours is extended. This increase of labour productivity corresponds with a decrease of variable labour, because e.g. fewer cashiers might be necessary to serve customers if customers are more equally distributed over a longer opening period (Bossler and Oberfichtner, 2017, 757).

The first two effects have a positive impact on employment in the retail trade sector, while the impact of the third effect is negative.

While the model of Gradus (1996) predicts falling retail prices, Inderst and Irmen (2005) argue on the basis of a model with imperfect duopolistic competition that retail prices may rise in response to the deregulation of opening hours. In a deregulated market retailers treat the choice of opening hours as a means to increase the degree of perceived product differentiation thus reducing price competition. If the preferences of the consumers for time are sufficiently, asymmetric shopping hours occur in the equilibrium, with one retailer staying open longer than the other. Thereby, both retailers charge higher prices than under regulation, and both are better off.

Similarly, Shy and Stenbacka (2008) analyse a duopolistic differentiated retail industry where shops engage in two-stage competition with respect to business hours and prices. Within this framework, the authors explore the effects of consumers' shopping time flexibility by comparing bi-directional consumers with forward or backward-oriented consumers, who can either postpone or advance their shopping, but not both. In the price equilibrium retailers with longer opening hours charge higher prices, but they have a higher overall market share over the whole period of possible opening times. Furthermore, opening hour differentiation softens price competition and competition does not create incentives for retailers to expand their business hours beyond social optimum.

Wenzel (2010) considers the relationship between liberalisation of shopping hours and concentration in the retail sector within a model of competition with free entry. Competition takes places in two dimensions, firstly, competition with regard to prices, and, secondly, competition with regard to opening hours. Without any restrictions on opening hours, the competitive outcome leads to market failures with excessive entry into the market and under-supply of business hours. However, restrictions on opening hours do not improve the market outcome, but, even worse, works in the opposite direction by inducing further entry. Thus, the author concludes that restrictions on opening hours exacerbate the market failures and are not adequate to improve welfare. Starting with an inelastic demand, the degree of market failure increases the more elastic demand becomes. With regard to the impact of a liberalisation of opening hours, the model shows that in the short run (i.e. without market entry and exit) prices remain constant, but in the long run (i.e. with free market entry and exit) retail prices and concentration in the retail sector increases. Nevertheless, there might be a positive impact of liberalisation on employment, because total retail sector opening hours increase.

Wenzel (2011) proposes a variant of his original model in order to analyse the impact of shopping hour deregulation on the competition between large retail chains and smaller, independent retailers. The latter might fear to be harmed by the deregulation of shopping hours, because they might not be able to match longer shopping hours at chain stores. The induced decrease of their demand might lead to lower profits and, if the effects are strong enough, deregulation might lead to the exit of independent retailers. In order to analyse these fears from a theoretical point of view, Wenzel (2011) assumes two firms in the retail market. One firm is a retail chain with multiple stores and the other firm is an independent retailer with one store. Both firms compete in two directions (first, the choice of opening hours, and, secondly, the choice of retail prices) in a spatially differentiated market. Under deregulation, shopping hours can be chosen without restriction, and the outcome in this setting is compared to the one with regulated shopping hours. The results show that the impact of deregulation depends on the efficiency difference between the retail chain and the independent retailer. Using the obvious assumption that retail chains have lower operating costs either due to more buyer power, more efficient organisational structures or economies of scale, the independent retailer never chooses shorter opening hours than the retail chain when the efficiency differences are sufficiently small. However, the situation reverses when the retail chain is much more efficient than the independent retailer. If deregulation leads to longer shopping hours in both firms, both retailers lose in terms of profits. If deregulation cause asymmetric shopping hours, the retailer that chooses longer shopping hours gains and the retailer that chooses shorter shopping hours is harmed. The author concludes that deregulation of shopping hours does not harm smaller independent retailers per se,

but in combination with lower efficiency compared to a large retail chain. Actually, if the cost difference is sufficiently small, deregulation might favour the independent retailer. Furthermore, in this model, welfare and consumer surplus increase due to deregulation.

3 Exploratory analysis of the direct effects of PMR in the EU retail trade sectors

Based on the theoretical aspects discussed in the previous chapter, the following two chapters are devoted to an empirical analysis of the direct and indirect effects of product market regulations (PMR) in the retail trade sector of the EU countries. This analysis has an exploratory character, because EU-wide indicators of PMR are only available for the years 1998, 2003, 2008 and 2013. This data limitation prevents an elaborated econometric analysis. Furthermore, more generally, country comparisons are plagued by omitted variables bias, since countries are heterogeneous in unobserved dimensions. Thus, many authors consider exploiting within country changes in legislation as a more promising approach to identify the true effect of regulations in the retail trade sector (Pozzi and Schivardi, 2015).[6]

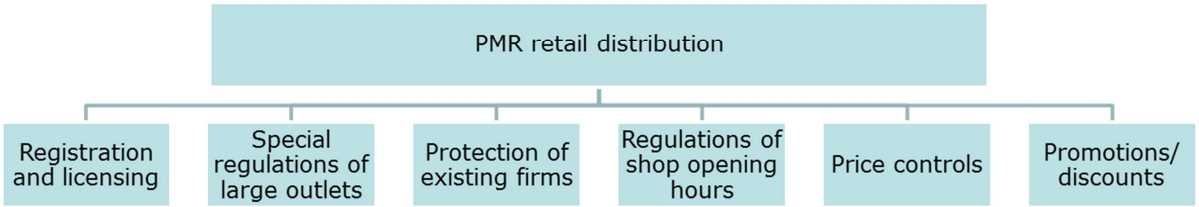
The indicators of PMR are taken from the current OECD PMR database, which is described in Koske et al. (2015). In the next section of this chapter we analyse the development of the PMR indicators for the retail trade sectors in the 28 EU countries. The other three sections of this chapter deal with the direct effects of PMR in the EU retail trade sectors. According to the theoretical analysis, it can be expected that PMR affect the market structure and the entry as well as exit of firms in the retail trade sector. This issue is considered in section 2. Section 3 analyses in an exploratory manner whether there are hints for an impact of PMR on labour productivity growth in the EU retail trade sectors. Since ICT investment and the use of ICT are considered as important drivers of productivity growth in the retail trade sector, the possible empirical links between ICT adoption and PMR are the topic of section 4.

The indirect impact of retail trade PMR on the EU food sectors is analysed empirically in chapter 4.

3.1 Development of PMR

Generally, local and national governments have a choice of instruments to control entry but also doing business in the retail trade sector and significant discretion in how to implement them. As a consequence, comparing regulations across countries is problematic (Pozzi and Schivardi, 2015). In order to deal with this issue, the OECD has been compiling a series of comparable cross-country indices with regard to entry and doing business regulations in retail trade. The necessary information is collected through a questionnaire sent to governments in OECD and non-OECD countries. The database covers all OECD countries and 21 non-OECD countries. It is updated every five years and currently covers the years 1998, 2003, 2008 and 2013 (though not all data are available for all years and countries) (Koske et al., 2015).

Figure 2. Composition of the PMR retail distribution of the OECD



Source: Koske et al. (2015)

[6] Examples for studies exploring the within country variation of regulations are with regard to employment Bertrand and Kramarz (2002), Bossler and Oberfichtner (2017) as well as Paul (2015) and with regard to retail prices, productivity, ICT investment and employment Schivardi and Viviano (2011).

The construction of the index follows a bottom-up approach. First, the available information is aggregated into six subindices with a zero to six scale, where a lower value reflects a more competition-friendly regulatory stance. Afterwards, the main index of PMR in the retail trade sector is calculated as a simple average of the six subindices. Figure 2 shows this bottom-up approach with the six subindices. The first three indices concern entry regulations, the other three indices capture regulation with regard to doing business.

Table 1. PMR retail values for the EU member countries

Country	ISO	1998	2003	2008	2013
Austria	AUT	4.07	3.50	3.30	2.40
Belgium	BEL	4.65	4.68	4.56	4.06
Bulgaria	BGR	.	.	.	0.20
Cyprus	CYP	.	.	.	1.67
Czech Republic	CZE	0.93	1.03	1.23	1.56
Germany	DEU	3.40	3.38	2.88	2.71
Denmark	DNK	3.00	3.00	1.83	1.69
Spain	ESP	4.20	3.67	3.48	2.88
Estonia	EST	.	.	1.40	1.50
Finland	FIN	2.86	2.86	2.89	2.86
France	FRA	4.50	3.76	3.80	2.64
United Kingdom	GBR	3.38	2.15	2.18	1.79
Greece	GRC	4.62	4.50	3.85	2.55
Croatia	HRV	.	.	.	1.42
Hungary	HUN	0.82	0.79	1.44	2.06
Ireland	IRL	1.17	0.87	1.53	1.53
Italy	ITA	4.35	3.85	4.06	3.15
Lithuania	LTU	.	.	.	1.11
Luxembourg	LUX	.	4.17	4.47	4.54
Latvia	LVA	.	.	.	0.40
Malta	MLT	.	.	.	1.09
Netherlands	NLD	1.67	1.47	0.91	0.91
Poland	POL	3.12	2.52	2.43	2.55
Portugal	PRT	3.46	3.29	3.97	1.83
Romania	ROU	.	.	.	1.80
Slovak Republic	SVK	.	1.14	1.04	1.75
Slovenia	SVN	.	.	0.90	0.63
Sweden	SWE	1.10	0.72	0.60	0.60

Source: OECD

The available values for the EU countries of the main PMR index for retail distribution are displayed in Table 1. The boxplots in Figure 3 show that the arithmetic mean of the PMR index decreases over the period from 1998 to 2013, but the range of the values increases. This increase results from the inclusion of some new EU member countries with very low PMR index values for retail distribution. This finding is also obvious from the coefficients of variation, which are plotted in Figure 4.[7] The coefficient of variation for the 17 EU countries with data available already for 1998 decreases (the brown line), while the coefficient of variation calculated on the available data in each year increases (the blue line).

[7] The coefficient of variation is a relative measure of variation, calculated as the ratio of the standard deviation to the mean of a sample or population. It is often expressed as a percentage.

Figure 3. Boxplots of the PMR retail distribution for the EU countries

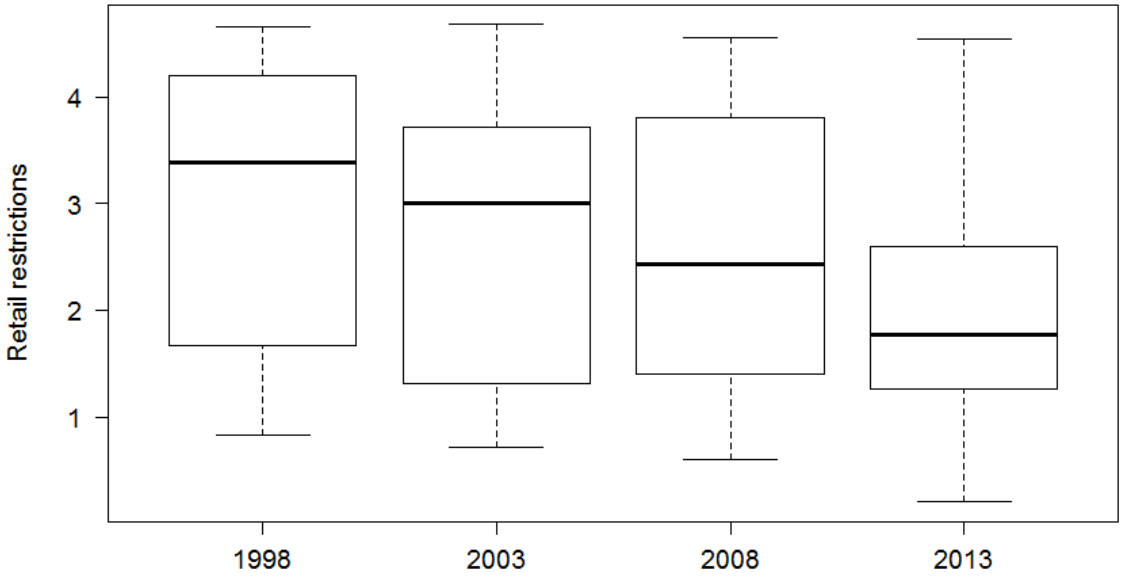
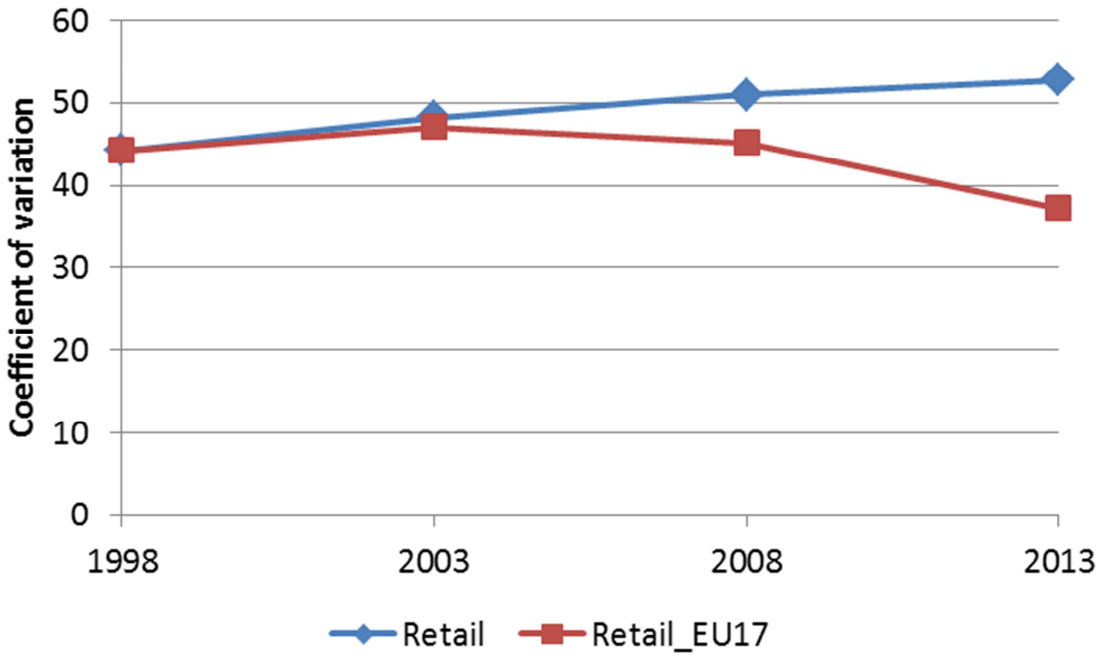


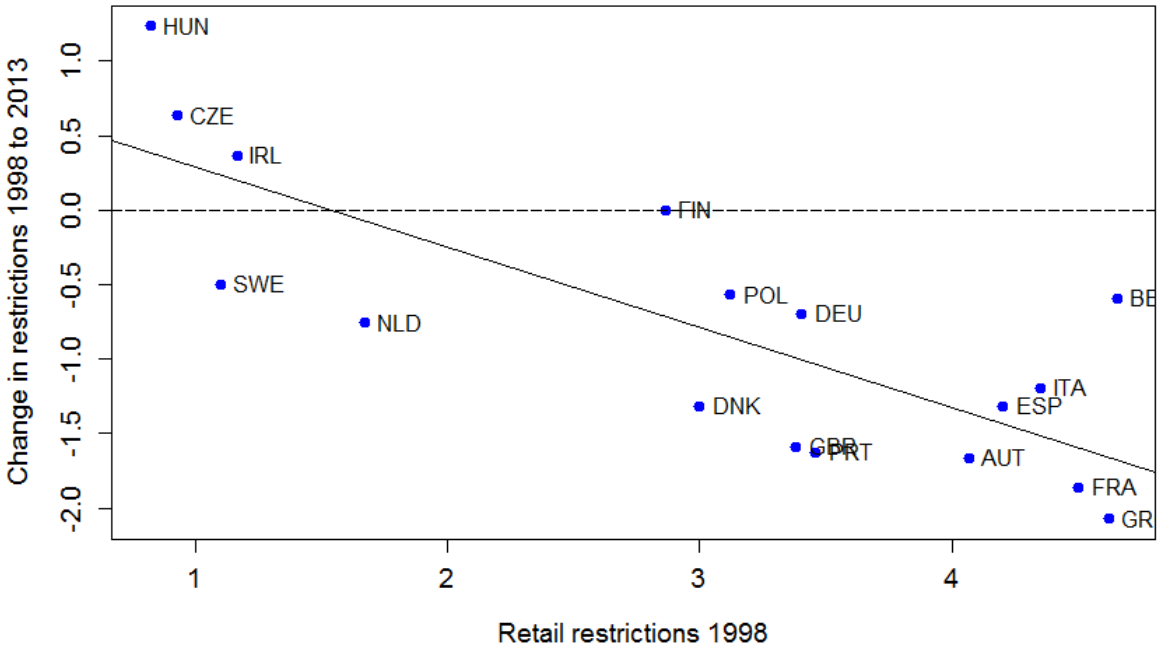
Figure 4. Coefficients of variation of the PMR retail distribution for the EU countries



The decrease of the coefficient of variation is a first hint that there is a convergence of the levels of PMR at least for the 17 EU countries with data available already for 1998, because the relative dispersion of the levels of regulation became smaller during the period from 2003 to 2013. This concept of convergence is termed σ-convergence. Another concept of convergence is termed β-convergence, because there will be convergence of the levels of regulations, if the countries with initially high levels of regulations have large reductions of their regulations and the countries with initially low levels of regulations have small changes in their regulation levels. Thus, if the changes of regulation levels (PMR indices) are regressed on initial levels of the PMR indices, there should be a negative relationship (a negative β-coefficient). Figure 5 shows the test for

β-convergence for the 17 EU countries with data available for 1998. There is obviously the expected negative relationship hinting at a convergence of regulation levels, although three of the countries (Czech Republic, Hungary and Ireland) with the lowest levels of regulations in 1998 experienced a rise of regulation levels in the retail sector between 1998 and 2013.

Figure 5. Test for β-convergence of the PMR retail distribution for the EU countries



In order to assess which PMR subindices (areas of regulation) drive the convergence of the main PMR index and which PMR indices hamper the convergence, we can decompose the coefficients of variation of the PMR main index for the years 1998 and 2013 following the approach of Shorrocks (1982) and Ercelawn (1984). The coefficient of variation for the main PMR index (VC) is the sum of the contributions from the six PMR subindices, thus

$$VC = \sum_{i=1}^{6} w_i c_i, \text{ with } w_i = \frac{\mu_i}{6\mu} \text{ and } c_i = \rho_i VC_i.$$

The weight w_i of the PMR subindex i in the PMR main index is the ratio of the mean μ_i of the i-th PMR subindex to six times the mean μ of the PMR main index.[8] The relative concentration coefficient c_i of the i-th subindex can be calculated by multiplying the correlation coefficient ρ_i between the i-th PMR subindex and the PMR main index by the coefficient of variation of the i-th PMR subindex (VC_i).

According to the standard approach of decomposition analysis, the change in variation in each PMR subindex can be decomposed further into three effects:

$$\Delta(w_i c_i) = w_{i,1998}\Delta c_i + c_{i,1998}\Delta w_i + \Delta w_i \Delta c_i.$$

The first term on the right-hand side of this equation is the share effect. It measures whether the variation in a PMR subindex changes due to a change in relative concentration, assuming the same regulation structure in both periods. This term can also be considered as within-subindex convergence. The second term represents the

[8] The factor 6 is necessary because the PMR main index is an aggregate of the equally weighted six subindices.

relative regulation change or structural effect. It measures whether the variation in a PMR subindex changes due to an increasing weight of this subindex, assuming the same relative concentration in both periods. The last term is the interaction effect.

Table 2. Sources of convergence of the PMR retail distribution

Indicator	1998		2013		Change between 1998 and 2013			
	$w_i c_i$	share	$w_i c_i$	share	$\Delta(w_i c_i)$	$w_{i,1998}\Delta c_i$	$c_{i,1998}\Delta w_i$	$\Delta w_i \Delta c_i$
Licences or permits needed to engage in commercial activity	7.7	0.17	5.8	0.15	-2.0	-2.5	0.8	-0.3
Specific regulation of large outlet	8.9	0.20	9.8	0.26	0.9	-1.8	3.4	-0.7
Protection of existing firms	6.0	0.14	6.8	0.18	0.8	2.5	-1.2	-0.5
Regulation of shop opening hours	6.2	0.14	5.2	0.14	-1.0	-1.0	0.0	0.0
Price controls	2.8	0.06	1.3	0.04	-1.6	-1.4	-0.3	0.2
Promotions/discounts	12.7	0.29	8.5	0.23	-4.2	-3.1	-1.5	0.4
VC of retail trade restrictions	44.3	1	37.2	1	-7.1	-7.3	1.2	-0.9

The results of the whole decomposition analysis are displayed in Table 2. The coefficient of variation of the PMR main index decreases from 44.3% in 1998 to 37.2% in 2013. In 1998, the largest contributions to variation of retail regulations between the 17 EU countries with data available for that year came from regulations with regard to promotions and discounts (0.29) and specific regulations of large outlets (0.20). Until 2013, these two PMR subindices have changed the ranks, but still contributed most to the relative variation of the PMR main index. Actually, the contribution of specific regulation of large outlets increased also in absolute terms between 1998 and 2013. In both years licences or permits needed to engage in commercial activities, protection of existing firms and regulation of shop opening hours contributed at a medium level to the variation in retail trade regulations, while the contribution of price controls was only small.

The right panel of Table 2 shows how much of the reduction of the PMR main index variation (-7.1) is attributable to each of the six PMR subindices. The largest amount of reduction is due to a convergence of promotions and discounts regulation levels (-4.2). The convergence of the levels of licences and permits needed to engage in commercial activity, price controls and regulations of shop opening hours also contributed to the reduction of the PMR main index variation. On other hand, levels of specific regulation of large outlet and protection of existing firms became less similar cross EU countries, and, thus, deteriorated the convergence of the PMR main index for retail trade.

The last three columns in the right panel of Table 2 display the results of the further decomposition of the changes in variation in each PMR subindex und the PMR main indicator. It is very obvious that the reduction of the PMR main index variation is mainly caused by the share effect, i.e. changes in relative concentration of the PMR subindices, assuming the same regulation structure in both periods. This effect is partially offset by increased weights of the specific regulation of large outlets and to a lower extent of licences or permits needed to engage in commercial activities (relative regulation change effects). In contrast, the interaction effects contributed to a small extent to the reduction of the PMR main index variation. With the exception of protection of existing firms, the

share effects of all other PMR subindices advance convergence of retail trade regulation levels. Overall convergence enhancing small relative regulation change effects emanate from the protection of existing firms and regulations of promotions and discounts. The interaction effects are generally small.

In a nutshell, the decomposition exercise shows that differences in the level of the retail trade regulations in the 17 EU countries with data available already for 1998 are mainly resulting from differences in regulations with regard to outlets, promotions and discounts, protection of incumbents as well as licences and shopping hours. Differences with regard to price control only play a minor role. Furthermore, reductions of differences of overall regulation levels between 1998 and 2013 mainly came from the reduction of differences with regard to promotions and discounts, and to a lower extent from the reduction of differences with regard to permits and price controls. On the other hand, differences with regard to outlets and protection of incumbents moved in the opposite direction between 1998 and 2013.

3.2 PMR and market structure

The theoretical analysis suggests that the effects of a reduction of product market regulations (PMR) mainly go through increased competition, which constitutes a condition for the three channels (allocative efficiency, productive efficiency and dynamic efficiency) to be put into effect in order to improve productivity and economic performance in general. Competition, however, supposes the effective or potential entry of domestic or foreign competitors as well as – if necessary – the exit of some incumbent firms. Thus, it can be expected that EU countries with lower levels of PMR, especially with regard to entry barriers and the protection of incumbents, experience relatively more entries and exits in their retail trade sectors.

In order to explore this hypothesis, simple ordinary least squares regression models are estimated for the cross-section of the 28 EU countries. In the first set of models, the dependent variable is the annual average turnover (fluctuation) rate of firms in the retail trade sector (except of motor vehicles and motorcycles) for the years 2014 and 2015. This, so-called churn rate, is calculated as the number of entries and exits divided by the total number of firms in this sector (in %). In the second set of models, the dependent variable is the annual average entry rate in the retail sector for the years 2014 and 2015. This rate is defined as the number of entries divided by the total number of firms in the retail trade sector (except of motor vehicles and motorcycles). The data for both variables are taken from the business demography statistics which are part of the structural business statistics of Eurostat. Explanatory variables in the various models are the PMR main index for retail distribution as well as the six PMR subindices for 2013. Based on the results from the first seven models for each of the two dependent variables, we construct two further explanatory variables. The first one is an index of entry barriers as a simple average of the subindex for licenses and permits needed to engage in commercial activity and the subindex for the protection of existing firms. The second additional index is a simple average of the two entry barrier subindices and the subindex for regulations of shop opening hours.

Table 3 shows the regression results for the annual average turnover rates of the retail trade sectors of the 28 EU countries in 2014 and 2015. The PMR main index has a negative impact on the turnover rates, but is only at a significance level of just above 5% different from zero. The R^2 indicates that 13.8% of the cross-country variation within the EU can be explained by differences in the whole regulatory framework captured by the PMR main index. Regulations with regard to licenses and permits, outlets, prices and discounts have no influence on turnover rates at the usual significance levels. However, regulations with regard to the protection of incumbents and with regard to shop opening hours exert at a 5% level a significant negative effect on turnover rate. The former regulation explains 14.6% of the cross-country variance of the turnover rates, while the latter explains 15.4%.

Table 3. Regression results for the turnover rates in the retail trade sectors

	Dependent variable:								
	Turnover (entry and exist) rate of firms								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PMR	-1.551*								
	(0.759)								
Permits		-0.741							
		(0.533)							
Outlets			-0.086						
			(0.349)						
Incumbents				-0.792**					
				(0.375)					
Hours					-1.019**				
					(0.469)				
Price						-0.149			
						(0.879)			
Discount							-0.356		
							(0.432)		
Entry barriers								-1.860***	
								(0.617)	
Entry barriers and hours									-2.183***
									(0.635)
Constant	21.4***	20.9***	18.6***	19.6***	19.8***	18.6***	19.0***	22.9***	22.9***
	(1.652)	(1.945)	(1.160)	(0.952)	(1.003)	(1.486)	(1.075)	(1.653)	(1.486)
Observations	28	28	28	28	28	28	28	28	28
R^2	0.138	0.069	0.002	0.146	0.154	0.001	0.025	0.259	0.312
Note:	*p<0.10, **p<0.05, ***p<0.01								

When the simple average of PMR subindices for permits and protection of incumbents is taken as a composite index for regulatory entry barriers, 25.9% of the cross-country variance of the turnover rates can be explained.[9] The impact of this composite index is statistically highly significant with a level below 1%. Furthermore, the estimate of the regression coefficient can be interpreted in the following way: it can be expected that a country with a 1 point higher entry barrier index has a 1.86 percentage points lower turnover rate in its retail trade sector. Figure 6 shows the relationship between the turnover rates and the composite entry barrier index values. The falling line in this graph is the estimated regression curve.

[9] When the two subindices are included without any restriction into the model, the R^2 is almost the same, so that the simply averaging is a valid restriction that increases the available degrees of freedom for the estimation.

Figure 6. Scatterplot of the turnover rate and entry barrier index

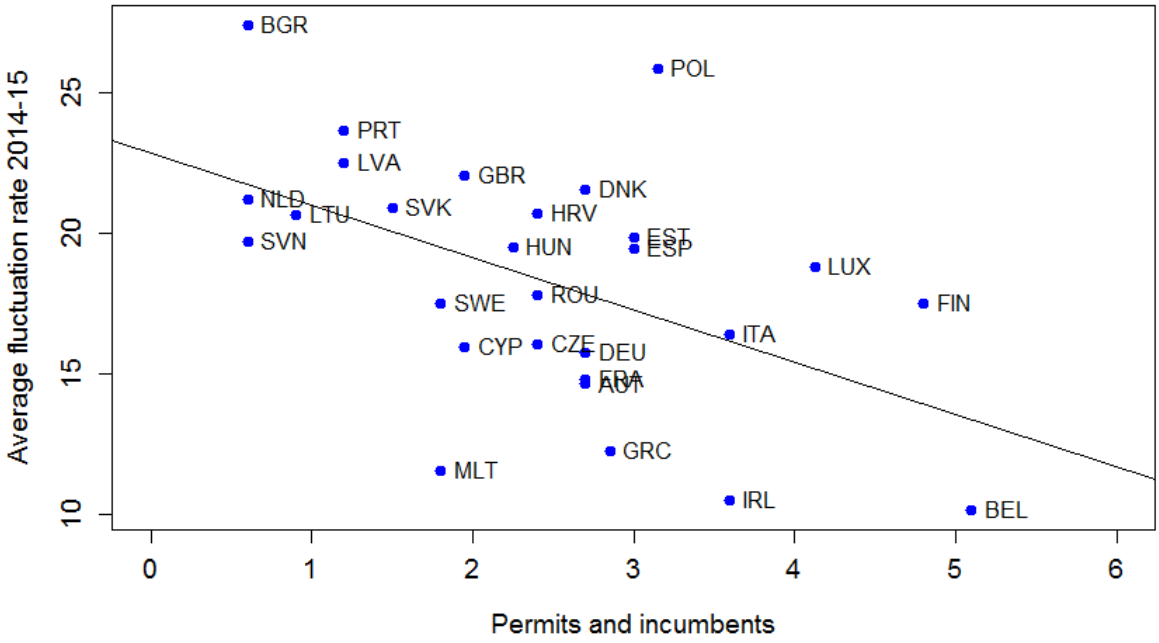
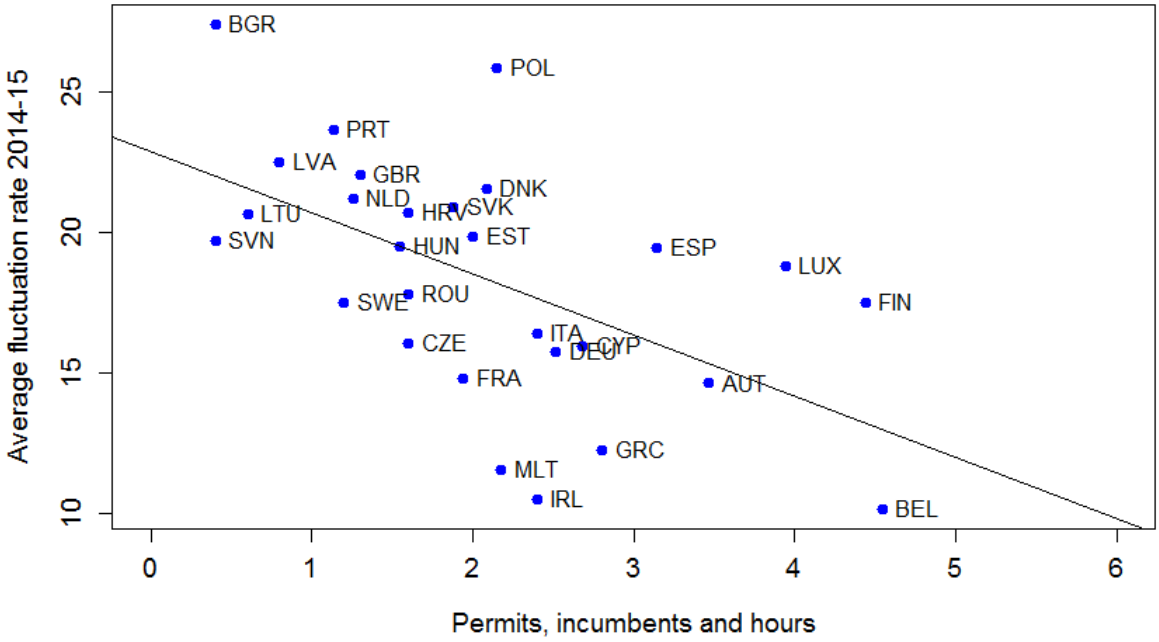


Figure 7. Scatterplot of the turnover rate and composite entry barrier/hours index



Since regulations with regard to shop opening hours also seem to exert a negative effect, a further composite index includes additionally these regulations.[10] The inclusion of this type of doing-business regulation increases the explanatory power of the model further to an R^2 of 31.2%. From the estimate of the regression coefficient it now can be expected that a country with a 1 point higher value of this composite index has a 2.18 percentage

[10] A simple averaging of the three subindices is again admissible, because including the three PMR subindices without any restriction into model yields almost the same R^2 as the estimate with the composite index.

point lower turnover rate in its retail trade sector. The scatterplot between the turnover rate and the composite entry barrier plus hours index is displayed in Figure 7. The falling line in this graph is the estimated regression curve.

Table 4. Regression results for the entry rates in the retail trade sectors

	Dependent variable:								
	Entry rate of firms								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
PMR	-1.084**								
	(0.496)								
Permits		-0.653*							
		(0.341)							
Outlets			-0.031						
			(0.231)						
Incumbents				-0.499*					
				(0.250)					
Hours					-0.727**				
					(0.304)				
Price						-0.057			
						(0.580)			
Discount							-0.274		
							(0.284)		
Entry barriers								-1.328***	
								(0.395)	
Entry barriers and hours									-1.558***
									(0.403)
Constant	11.4***	11.5***	9.4***	10.1***	10.3***	9.4***	9.7***	12.5***	12.5***
	(1.079)	(1.245)	(0.766)	(0.633)	(0.652)	(0.981)	(0.706)	(1.058)	(0.942)
Observations	28	28	28	28	28	28	28	28	28
R^2	0.155	0.123	0.001	0.133	0.180	0.0004	0.035	0.303	0.365
Note:	*p<0.10, **p<0.05, ***p<0.01								

The regression results for the annual average entry rates of the retail trade sectors of the 28 EU countries in 2014 and 2015 are displayed in Table 4. With regard to their statistical significance the results are very similar to those for the turnover rates. However, the impact of the PMR main index is now at a significance level of 5% different from zero and the impact of licenses and permits at least at a level of 10%. The other two statistically significant influences come again from the protection of incumbents and regulations of shop opening hours. Furthermore, the results improve again considerably when the two additional composite indices are used as explanatory variables. The composite entry barrier index explains 30.3% of the cross-county variance of entry rates. Including additionally regulations of shop opening hours in this composite index, increases the explanatory power to 36.5% of the cross-country variance. The implication of the regression coefficients is that a country can expect to increase its entry rate in the retail trade sector by 1.33 percentage points, if its composite entry barrier index would be 1 point lower. If its composite entry barriers plus hours index would be 1 point lower,

it can expect that its entry rate in the retail trade sector would be 1.56 percentage points higher.

Figure 8. Scatterplot of the entry rate and entry barrier index

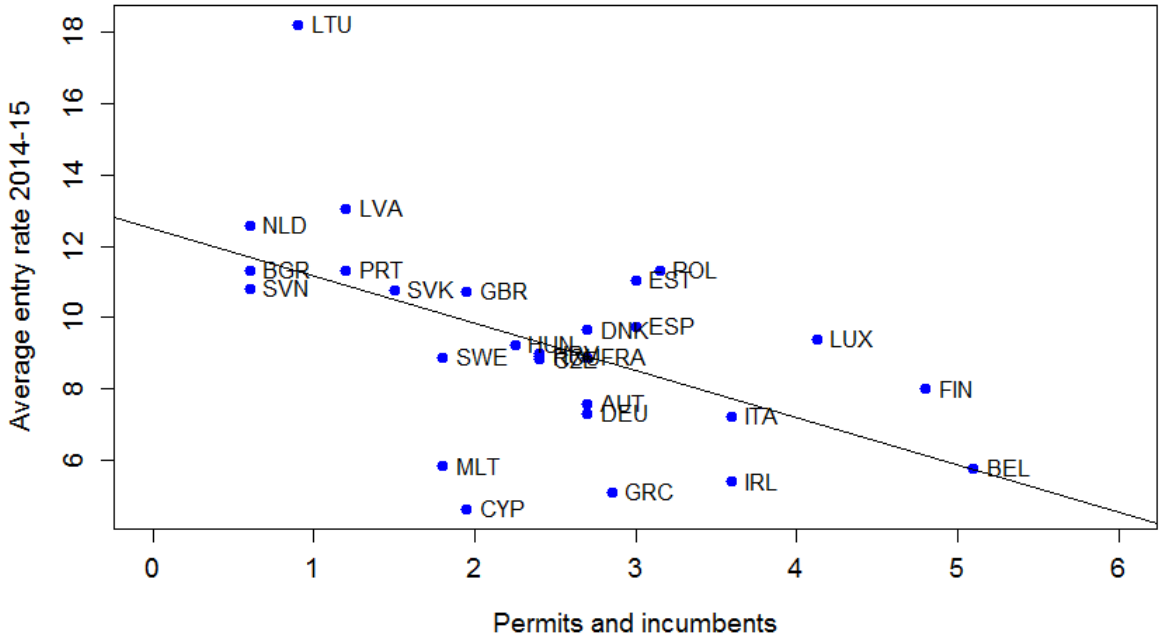
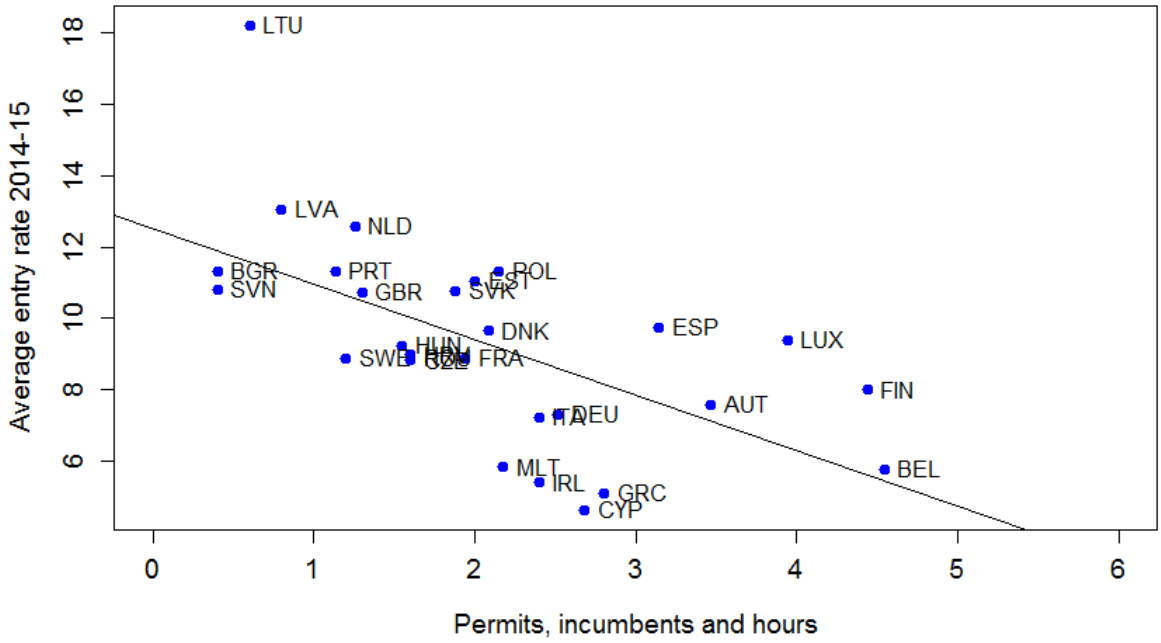


Figure 8 plots the relationship between the entry rates and the composite entry barrier index values. The falling line in this graph is the estimated regression curve. The scatterplot between the entry rates and the composite entry barrier plus hours index values is displayed in Figure 9.

Figure 9. Scatterplot of the entry rate and composite entry barrier/hours index



Altogether, the results of the exploratory analysis obviously point to negative relationships between the entry as well as turnover rates in the EU countries' retail trade sector and entry barrier regulations, captured by the licenses and permits needed to engage in commercial activity and the protection of incumbents. Additionally, as a doing-business regulation restrictions of shop opening hours also affect entry and turnover rates negatively. However, the analysis is only based on the entry and turnover rates for the years 2014 and 2015 and the PMR indices for 2015. Thus, we looked for a way to use more of the actually very limited data. Entry rates for most EU countries are available in the business demography statistics of Eurostat for the period from 2008 to 2015. Within this period, there are only two cross sections of PMR index data available, namely for 2008 and 2013. However, one of the relevant entry barrier regulations index (protection of existing firms) shows only very little variation over time. The only way to include most of the available information about entry rates in the retail trade sector is to select those EU countries with no changes in regulations with regard to the protection of incumbents between 2008 and 2015 and to check whether the average entry rates for country groups with no regulations, medium regulations and strong regulations are statistically significant different.

There are 18 EU countries with no changes in regulations to protect incumbents and the index for these 18 countries possesses only three different values: 0, 3 and 6. Thus, the following three country groups can be observed:

- *No regulations (index 0)*: AUT, CZE, EST, GBR, HUN, NLD, SVK, SVN
- *Medium regulation (index 3)*: DEU, DNK, ESP, ITA, LUX, POL, SWE
- *Strong regulations (index 6)*: BEL, FIN, IRL.

Table 5. Descriptive statistics for the entry rates of the retail trade sectors

		Descriptive statistics for entry rates 2008 - 2015						
Regulations	n	mean	sd	median	trimmed	mad	min	max
				All new firms				
low	64	10.32	2.73	10.55	10.26	1.92	4.76	23.13
medium	54	8.95	1.83	8.71	8.78	1.39	5.8	14.18
strong	23	7.22	2.61	5.85	6.91	0.86	4.4	13.61
				New firms with 0 employees				
low	64	14.49	5.59	13.32	14.13	4.37	5.55	46.75
medium	54	13.05	3.73	12.21	12.97	4	6.62	21.4
strong	23	11.08	4.18	10.18	10.86	4.67	5.18	20.17
				New firms with 1 to 4 employees				
low	64	7.35	4.04	6.06	6.86	3.8	2.31	20.1
medium	54	6.58	2.17	5.97	6.39	1.88	3.55	15.52
strong	23	4.69	1.21	4.54	4.65	1.2	2.96	7.23
				New firms with 5 to 9 employees				
low	64	2.71	1.45	2.47	2.57	1.45	0.62	7.07
medium	54	2.24	0.96	2	2.16	0.99	0.9	4.5
strong	16	0.96	0.42	0.9	0.97	0.53	0.2	1.56
				New firms with 10 and more employees				
low	64	1.72	1.26	1.33	1.58	0.83	0.19	7.9
medium	53	0.94	0.54	0.9	0.91	0.59	0	2.21
strong	16	0.45	0.37	0.3	0.41	0.26	0.05	1.3

Table 5 summarises the descriptive statistics for the entry rates of the retail trade sectors in the 18 EU countries for the period from 2008 and 2015. It contains not only the statistics for all new entries, but also the statistics differentiated according to the number of employees in new firms. The number of observations (n), the arithmetic means (mean) and the standard deviations (sd) are needed for our analysis, the other statistics are devoted to the readers with a deeper interest in statistics. The average entry rate for all new firms in countries with no regulations with regard to the protection of existing firms was 10.32%. The result is based on 64 observations (8 countries for 8 years). The countries with medium regulations had an average entry rate of 8.95%, while this rate was 7.22% for the countries with strong regulations.

The average entry rates for retail trade firms with no employees are clearly higher, but show a similar decline with an increase of the level of regulations to protect incumbents. With lower values than for all new firms, the average entry rates for firms with 1 to 4 employees also decline similarly with a rise of the regulation level. The picture is a little different for the entry of larger retailers. For new firms with 5 to 9 employees, the relative decline of entry rates is particularly between the country groups with medium and strong regulations. The average entry rates for new retail trade firms with 10 and more employees are in absolute terms small, but decrease by 45% between the country groups with no regulations and medium regulations. Between the country groups with medium and strong regulations there is a further decline of 52%.

In order to check whether the observed decreases of mean entry rates for the different levels of regulations with regard to the protection of existing firms are statistically significant, two-sample *t*-tests for a difference in means were used. The null hypothesis that the mean entry rates are the same for country groups with different levels of regulations is tested against the alternative hypothesis that a country group with lower incumbent protecting regulation levels has a higher mean entry rate. The results of these tests are displayed in Table 6.

Table 6. Descriptive statistics for the entry rates of the retail trade sectors

	H_0: low = medium H_A: low > medium	H_0: medium = high H_A: medium > high	H_0: low = high H_A: low > high
All new firms	p = 0. 001	p = 0.003	p = 0.000
New firms 0 employees	p = 0.050	p = 0.029	p = 0.002
New firms 1 to 4 employees	p = 0.095	p = 0.000	p = 0.000
New firms 5 to 9 employees	p = 0.018	p = 0.000	p = 0.000
New firms 10 and more employees	p = 0.000	p = 0.000	p = 0.000

The null hypothesis has to be rejected in all cases at least at significance level of 10% in favour of the alternative hypothesis that a country group with lower incumbents protecting regulation has a higher entry rate for the retail trade sector. For 12 out of the 15 tests the rejection is valid at a 1% significance level, for 2 tests at a significance level of 5% and for one test only at a significance level of 10%. Thus, the results of the t-tests for a broader data basis of entry rates confirm the results from the simple regression models that higher regulatory entry barriers in EU countries go hand in hand with lower observed entry rates in their retail sectors.

3.3 PMR and labour productivity growth

Increased competition mainly due to the entry of new firms and – if necessary – exit of some incumbents – might be a prerequisite to improve labour productivity as well as total factor productivity in the retail trade sectors and, as empirically shown in the last section, an increase of entries can be facilitated by a reduction of product market

regulations (PMR) concerning market entry of new firms and protection of existing firms. However, there might also be more direct effects of PMR on productivity. In this section, we will directly explore empirically the impact of product market regulations on labour productivity growth in the retail trade sectors of the EU countries. The empirical analysis is based on a simple econometric panel data model. The dependent variable is the average annual rate of change in labour productivity in the retail trade sectors during three sub-periods (1999-2003, 2004-2008 and 2009-2013). In order to calculate labour productivity, data for real value added and persons employed are taken from OECD STAN database. The first explanatory variable is the log-level of labour productivity in the year before the beginning of each sub-period (1998, 2003 and 2008). The second explanatory variable – our variable of interest – is again the OECD index for PMR in the retail trade sector in the year before the beginning of each sub-period. We use in the analysis the PMR main index in this sector (PMR) as well as the six subindices.

Table 7. Regression results for labour productivity in the retail trade sectors

Dependent Variable: Average annual rate of change in labour productivity in the retail trade sectors							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Constant	0.8720*** (0.3053)	0.8327** (0.3061)	0.8051** (0.3077)	0.8637** (0.3216)	0.8535** (0.3232)	0.8636*** (0.3160)	0.1899 (0.116)
Initial log lp	-0.0837*** (0.0301)	-0.0797** (0.0300)	-0.074** (0.0313)	-0.0849** (0.0316)	-0.0834** (0.0319)	-0.0853** (0.0313)	-0.0172 (0.0110)
PMR	-0.0059** (0.0029)						
permits		-0.0046* (0.0025)					
outlets			-0.0162*** (0.0040)				
incumbents				0.0013 (0.0011)			
hours					-0.0004* (0.0002)		
price						0.0043** (0.0018)	
discounts							-0.0025** (0.0012)
F-test named regressors	6.739***	7.185***	11.171***	6.690***	6.078***	6.865***	5.036***
F-test fixed country effects	2.930***	2.675***	3.778***	3.237***	3.389***	3.272***	n.a.
R^2	0.688	0.694	0.738	0.687	0.699	0.690	0.162

Remarks: Beck-Katz panel corrected standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

Furthermore, we include fixed country effects in our model, but no fixed time effects because the latter are at the usual levels statistically not significant. For the different sub-periods, according to the availability of PMR data, different numbers of EU countries can be included in the analysis. The maximum is 21 EU countries in the last sub-period. Altogether, equations (1) to (6) are based on 57 observations and equation (7) on 55 observations.

The estimation results for different variants of the panel data model are shown in Table 7. The first equation suggests that the PMR main index has a significant negative impact on labour productivity growth in the retail trade sectors of EU countries. The estimate of the coefficient implies that a 1 point increase of regulation is accompanied by a 0.6% decrease of labour productivity. The results for the subindices (equations (2) to (7)) are somewhat mixed. The coefficient for licenses and permits needed to engage in commercial activity is at least at a significance level of 10% different from zero and these

regulations have a negative impact. Specific regulations of large outlets exert a highly significant negative influence on labour productivity. Astonishingly, protection of existing firms seems to have no direct impact on labour productivity. Regulations of shop opening hours have in absolute terms a small influence, but it is statistically significant at the 10% level. The coefficient for regulations of prices is at a 5% level significantly different from zero, but has a positive sign. The results with regard to regulations of promotions and discounts have to be evaluated with great care, because equation (7) includes no fixed country effects. These effects are excluded, because they are perfectly collinear with the discount variable, which shows no variation over time.

Furthermore, the initial log of labour productivity is statistically significant at least at a 5% level in all equations with the exception of equation (7). The impact of this variable is always negative, so that it can be concluded that there is a conditional β-convergence of labour productivities in the retail trade sectors of EU countries. It is only a conditional and not an absolute convergence, because the steady state levels of labour productivity depend on the statistically highly significant fixed country effects and the statistical significant impacts of the PMR indices. Thus, a convergence of the regulation indices to a low level would also stimulate the convergence of labour productivity in the EU retail trade sectors, but only to different steady state levels determined by country specifics that do not change over time (fixed country effects).

3.4 PMR and ICT investment

The review of the theoretical literature has shown that in addition to the traditional idea that market power generates production inefficiencies, competition may foster innovation and, through this, productivity growth of incumbents. In the case of retail trade, process (as opposed to product) innovation is the main determinant of productivity growth. This implies that investment in information and communications technology (ICT) should be a fundamental determinant of productivity growth; as such technologies allow logistics, inventory management and so on to be rationalised (Schivardi and Viviano, 2011). For example, O'Mahony and van Ark (2005) found the more rapid use and diffusion of ICT is important to understand the differences in productivity growth between the US and UK retail trade sectors. Thus, on the one hand, entry restrictions can slow down the diffusion of new technologies among incumbents, which are less at risk of lagging behind more efficient entrants. On the other hand, doing-business regulation might also reduce ICT investment.

The options for an empirical analysis of the relationship between retail trade restrictions and ICT investment on the level of the EU countries is limited, on the one hand, by the fact that only 10 EU countries provide ICT investment data for the EU KLEMS database, and, on the other hand, by the availability of the PMR indices in five-intervals from 1998 to 2013. The ICT variable of interest is annual average real ICT investment to real value added ratio for the period from 2013 to 2015. Actually, it is important to take the real figures, because nominal figures would lead to an underestimation of the relevance of ICT investment, because of the fast price decline of ICT goods. Both variables needed to calculate this ratio are taken from the EU Klems data base.[11]

Table 8 shows the results of simple regression with the average ICT investment ratio as dependent variable and the PMR main index as well as the subindices in 2013 as explanatory variables. The model (1) confirms that the PMR main index for retail distribution has a significant negative impact on ICT investment (α=0.05). The scatterplot for this model in Figure 10 shows that the Slovak Republic clearly can be considered as an outlier that diminishes the relationship between ICT investment and the PMR main index. Thus, in model (10) this observation is omitted, so that the significance of the negative relationship increases considerably. Now, the variation of the PMR main index explains 76.2% of the variation of ICT investment.

[11] The ICT investment data is available for Austria, Czech Republic, Germany, Denmark, Finland, United Kingdom, Italy, Luxemburg, Slovak Republic and Sweden.

Table 8. Regression results for ICT investment in the retail trade sectors

	Dependent variable:										
	Average ICT investment to VA ratio (in %), 2013-2015										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
PMR	-1.165**									-1.325***	
	(0.402)									(0.280)	
Permits		-0.317									
		(0.403)									
Outlets			-0.272								
			(0.227)								
Incumbents				-0.196							
				(0.301)							
Hours					-0.386						
					(0.304)						
Price						-0.635					
						(0.580)					
Discount							-0.519**				
							(0.186)				
Entry barriers								-0.630			-1.147***
								(0.420)			(0.305)
Doing-business									-0.924**		
									(0.333)		
Constant	5.336***	3.777**	3.385***	3.062***	3.342***	3.592***	3.791***	4.405***	4.338***	6.010***	6.296***
	(1.016)	(1.544)	(0.820)	(0.857)	(0.768)	(1.024)	(0.588)	(1.282)	(0.741)	(0.727)	(0.976)
Observations	10	10	10	10	10	10	10	10	10	9	9
R^2	0.512	0.072	0.153	0.050	0.168	0.130	0.493	0.220	0.490	0.762	0.669
Note:	*p<0.10, **p<0.05, ***p<0.01										

The models (2) to (7) investigate the impact of the six subindices of PMR index for retail distribution. Only regulations of promotions and discounts seem to exert a significant negative influence on ICT investment. Thus, we calculated two composite subindices, one for regulatory entry barriers as a simple average of the first three subindices (permits, outlets and incumbents) and another for doing-business regulations as a simple average of the last three subindices (ours, price and discount). The models (8) and (9) show the results of the regressions with these two composite PMR subindices. Regulatory entry barriers as a whole seem to have no significant impact, while the impact of doing-business regulations is at a level of 5% different from zero and negative. The scatterplots for both regressions are displayed in Figure 11 and 12.

It is obvious from Figure 11 that Slovak Republic is also an outlier with regard to the relationship between regulatory entry barriers and ICT investment. Therefore, this observation is omitted in model (11) with the consequence that a highly significant negative relationship occurs. Variations in regulatory entry barriers can explain 66.9% of the variation in ICT investment between the 9 EU countries considered.

Figure 10. Scatterplot of the ICT investment to VA ratio and PMR main index

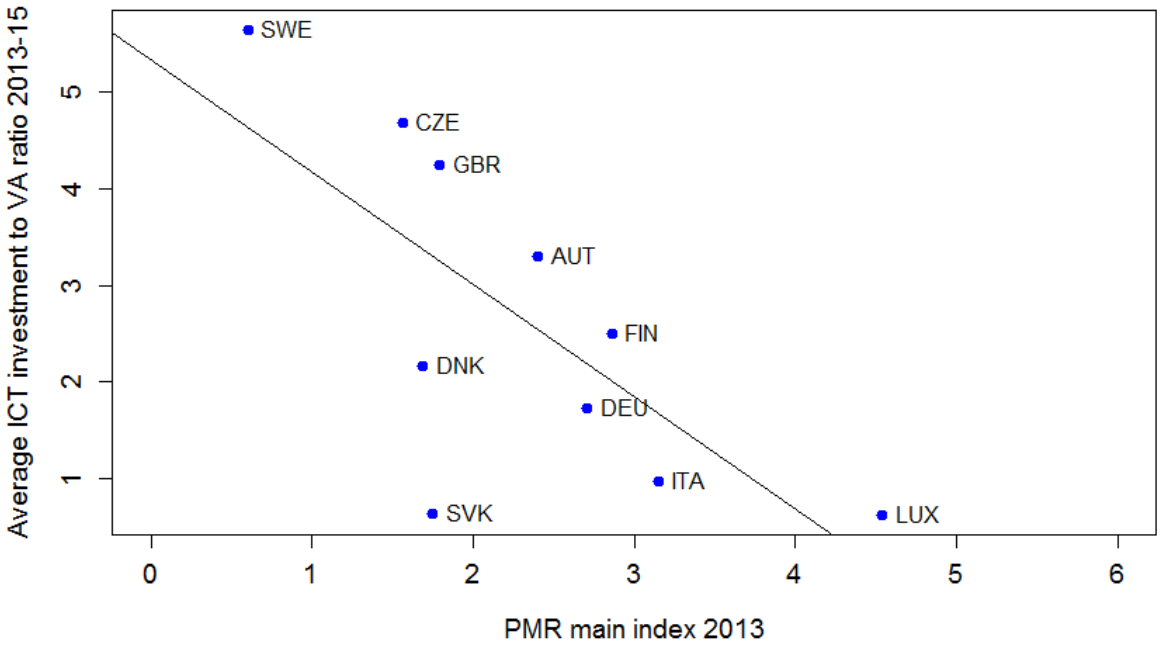


Figure 11. Scatterplot of the ICT investment to VA ratio and entry restrictions index

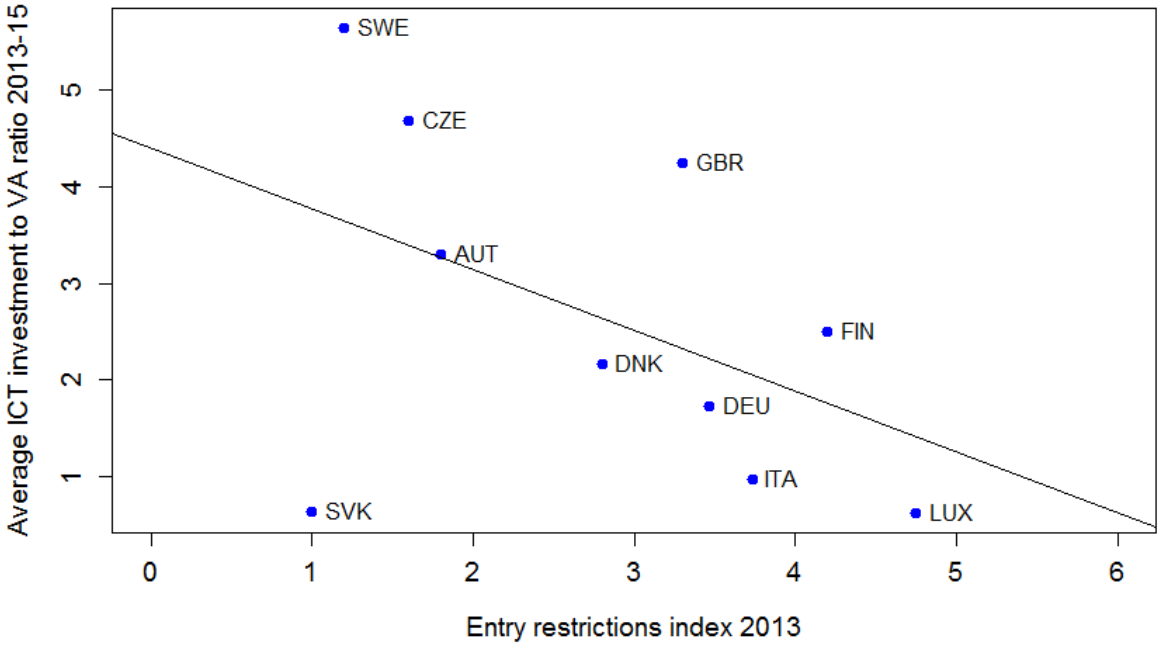
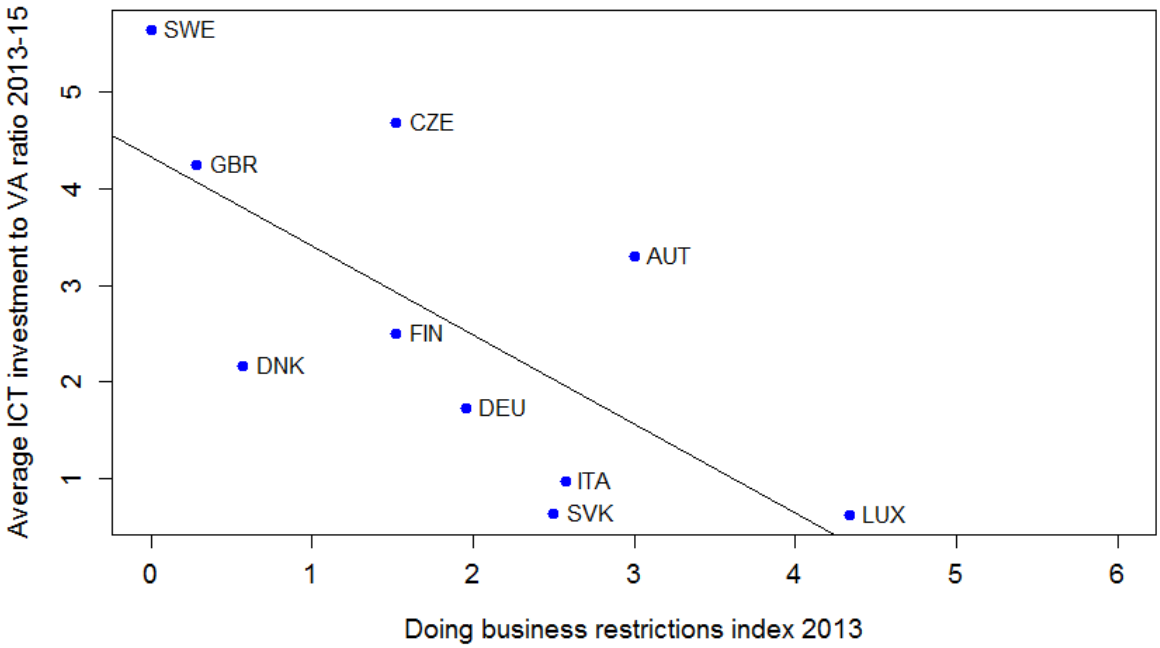


Figure 12. Scatterplot of the ICT investment to VA ratio and doing-business regulations index



Our results confirm the conjecture of O'Mahony and van Ark (2005) that, on the one hand, regulations might be seen as an obstacle to ICT investment in the EU, but, on the other hand, that broadly casting it as overregulated and uncompetitive is an oversimplification. The authors conclude, and that is also the conclusion from our regression results, that it should be avoided treating the EU as one harmonised regulatory environment. As examples for why different regulations are relevant for ICT investment in different EU countries they mention:

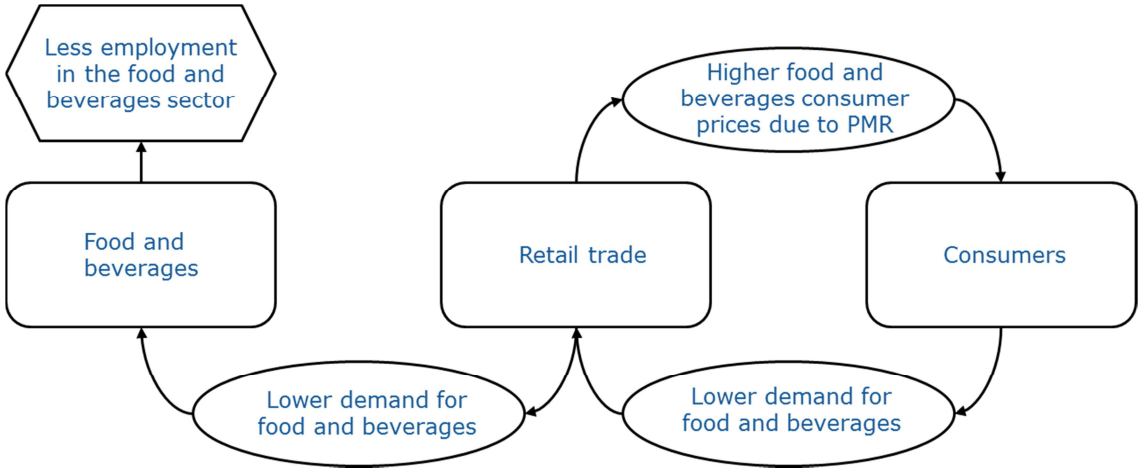
- Land use regulations in the UK seem to constrain the move to the scale of operation that makes the best use of ICT in the retail trade sector.
- An overly regulated product market in France has created the largest number of square meters of hypermarkets per 1000 people in the world, but largely favours French firms.
- Product markets in Germany are quite competitive, but restricted planning laws and high labour cost have established a large discount sector consisting of relatively small stores (e.g. Aldi and Lidl) (O'Mahony and van Ark, 2005, 302).

4 Exploratory analysis of the indirect effects of retail trade PMR in the EU food sectors

The retail trade sector is located at the end of the value chain, so that indirect effects of regulations in this sector downstream along the value chain are mainly on consumers. On the other hand, there may be indirect effects upstream along the value chain on manufacturing sectors that mainly produce consumer goods. Food and beverages, for example, is an essential component of the consumption basket of every household.[12] Actually, grocery retailers also provide the largest part of retail turnover, from 40% in Austria to 60% in Romania (EU Commission, 2018). Thus, it seem to be promising to explore empirically the indirect impact of product market regulations (PMR) with regard to retail trade on the food sectors in the EU countries.

From the review of the theoretical literature as well as from preliminary empirical research, we cannot expect that PMR of retail distribution have a direct impact on consumers' demand for food and beverages. However, as sketched in Figure 13, higher levels of regulations in the retail trade sector should lead to higher consumer prices for food and beverages. Higher consumer prices for food should reduce the demand for these products. The retail trade sector passes this lower demand on to the producers of food and beverages, which, in turn, reduces their employment.

Figure 13. Three-step procedure to estimate the indirect impact of PMR for retail distribution



Thus, we apply a three-step procedure to estimate the impact of PMR for the retail trade sector on downstream food demand of consumers and upstream employment in the food and beverages producing sector. First, a function is estimated for the consumer prices of food, including the impact of the PMR main index for retail distribution. Secondly, we estimate a demand function for the real expenditures of households for food and non-alcoholic beverages, including the consumer price index for these products. Thirdly, we estimate an employment function for the food and beverages producing sectors, including the demand as an explanatory variable.

Together, the three equations form a recursive system that can be used to simulate the impact of changes in the levels of PMR for retail distribution on consumer prices for food prices, food demand of households and employment in the food and beverages producing sectors.[13]

[12] Expenditure on goods that are normally purchased from retailers accounts for ca. 30% of household budgets, out of which 16% on food and non-alcoholic beverages, 5% on clothing and footwear, over 2% on furniture and household appliances (EU Commission, 2018).

[13] This system of equations is called recursive, because the joint determination of the variables is recursive.

4.1 Retail trade PMR and consumer prices for food in the EU countries

In the first step, the impact of product market regulations in the retail trade sector on the price indices for consumer expenditures for food and non-alcohol beverages of private households is analysed. The dependent variable is the log of this price index in 1999, 2004, 2009 and 2014. These data are taken from the annual national accounts of Eurostat. The explanatory variable of interest is the log of the OECD index for product market regulations (PMR) in the retail trade sector in 1998, 2003, 2008 and 2013. As additional explanatory variables we use the log of real disposable income as a demand side factor and the log of labour costs per hour in the food industry as a supply side factor affecting food prices.[14] Data for real disposable income is also taken from the annual national accounts of Eurostat, while labour cost data come from the EU KLEMS database. Furthermore, we include fixed country and time effects in our model. For the four different sub-periods, according to the availability of PMR data and other data, different numbers of EU countries are included in the analysis. The maximum is 27 EU countries in the last sub-period. Altogether, the equations are based on 77 to 84 observations. All estimated coefficients can be interpreted as elasticities. The initial estimations with all available observations are displayed in Table 9.

Table 9. Estimation results for consumer prices for food

Dependent variable: Log of the price index for food consumption expenditures of private households

	(1)	(2)	(3)	(4)
Constant	4.216*** (0.049)	-0.260 (1.621)	2.404*** (0.389)	0.280 (1.653)
Log(PMR)	0.174*** (0.043)	0.138*** (0.041)	0.065 (0.044)	0.061 (0.042)
Log(real income)		0.456*** (0.166)		0.253 (0.168)
Log(labour costs)			0.457*** (0.099)	0.364*** (0.078)
F-test fixed country effects	2.632***	3.092***	1.911**	2.136**
X^2-test fixed time effects	184.0***	128.8***	33.87***	60.91***
N	84	83	78	78
R^2	0.844	0.870	0.861	0.871

Remarks: Arellano (HAC) corrected standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

PMR in the retail trade sector have a highly significant positive impact on the price index for food consumption expenditures of households in the models (1) and (2), but this impact is no longer significantly different from zero, when labour costs are included as a further variable in the models (3) and (4). Since this result was a little surprising, we checked the squared residuals of equation (4) and dropped the five observations with the largest squared residuals, because these observations can be considered as outliers. The dropped observations are Spain in 1999, Ireland in 2014, and Portugal in 1999, 2009 and

[14] Real estate prices might be included at a later stage as an additional cost-proxy on the supply side.

2014. Table 10 shows the estimation results for the observations without these five outliers. Now the PMR index has in all four models a highly significant positive impact on food prices. Since all coefficients can be interpreted as elasticities, the coefficient of the PMR in model (1) in Table 10 means that the price index for food decreases by 0.196 % if the PMR is reduced by 1 %. This is surely the upper bound with regard to the impact of regulation reductions in the retail sector on consumer prices for food and non-alcohol beverages. The elasticity of prices with regard to PMR changes in model (2) can be considered as an intermediate value and the very similar elasticities in the models (3) and (4) are the lower bound for the impact.

Table 10. Estimation Results for consumer prices for food (without outliers)

Dependent variable: Log of the price index for food consumption expenditures of private households

	(1)	(2)	(3)	(4)
Constant	4.181*** (0.031)	0.886 (1.017)	2.561*** (0.312)	1.428 (1.110)
Log(PMR)	0.196*** (0.030)	0.170*** (0.032)	0.104*** (0.034)	0.102*** (0.034)
Log(real income)		0.336*** (0.104)		0.134 (0.122)
Log(labour costs)			0.408*** (0.079)	0.360*** (0.081)
F-test fixed country effects	4.115***	4.066***	3.791***	3.850***
X^2-test fixed time effects	671.9***	419.2***	91.70***	113.7***
N	79	78	73	73
R^2	0.911	0.925	0.943	0.945

Remarks: Arellano (HAC) corrected standard errors in parentheses. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

4.2 Impact of regulation induced food price changes on real final demand for food and non-alcohol beverages

In the second step, we combine the results from the estimations of the impact of PMR retail restrictions on the food price index with a standard demand function for real final demand of food and non-alcohol beverages by private households in an actual panel data model with yearly data. This is possible, since there are no longer the data availability restrictions from the PMR data of the OECD. The dependent variable is the log of real per capita food expenditures of private households from 1995 to 2016. Data for this variable is taken from annual national accounts of Eurostat. The explanatory variables are the log of real per capita disposable income, the log of the price index for food and non-alcohol beverages as well as the price index for other consumption expenditures of private households in the same years. The latter also comes from the annual national accounts of Eurostat. Furthermore, we include fixed country and time effects in our model. According to the availability of data, 21 EU countries with a minimum of 18 and a maximum of 22 yearly observations were included in the analysis. Altogether, the food demand equation is based on 457 observations. The results are displayed in Table 11.

Table 11. Estimation Results for the food demand function

Dependent variable: Log of real per capita food expenditures of private households		
Explanatory variable	Coefficient	t-statistics
Constant	2.407	1.963*
Log(real income)	0.549	4.067***
Log(consumer price food)	-0.923	-11.62***
Log(consumer price other)	0.825	12.48***
Fixed country effects	yes***	
Fixed time effects	yes***	
Number of observations	457	
R^2	0.977	

Remarks: t-statistics based on Arellano (HAC) corrected standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

The estimated price elasticity of food demand is statistically highly significant different from zero and, as expected, negative and near to one. The cross-price elasticity of food demand, capturing the impact of the prices of other consumer goods, is also statistically highly significant and positive. Finally, the income elasticity is also statistically highly significant and, as expected, positive, but clearly smaller than one.

Table 12. Impact of PMR reductions on food prices and final demand for food (in %)

				Food price reductions (in %)			Increase in real final demand for food (in %)		
	PMR	Deviation from average	Reduction of PMR (in %)	lower bound	Inter-mediate	upper bound	lower bound	Inter-mediate	upper bound
AUT	2.40	0.48	19.8	2.0	3.4	3.9	1.9	3.1	3.6
BEL	4.06	2.13	52.6	5.4	8.9	10.3	4.9	8.2	9.5
DEU	2.71	0.79	29.0	3.0	4.9	5.7	2.7	4.5	5.2
ESP	2.88	0.96	33.2	3.4	5.6	6.5	3.1	5.2	6.0
FIN	2.86	0.94	32.8	3.3	5.6	6.4	3.1	5.1	5.9
FRA	2.64	0.71	27.1	2.8	4.6	5.3	2.5	4.2	4.9
GRC	2.55	0.62	24.4	2.5	4.1	4.8	2.3	3.8	4.4
HUN	2.06	0.14	6.6	0.7	1.1	1.3	0.6	1.0	1.2
ITA	3.15	1.23	39.0	4.0	6.6	7.6	3.7	6.1	7.0
LUX	4.54	2.62	57.6	5.9	9.8	11.3	5.4	9.0	10.4
POL	2.55	0.63	24.5	2.5	4.2	4.8	2.3	3.8	4.4

To assess the impact of reductions of regulations in the retail sector on final demand for food and non-alcohol beverages we conduct the following as-if simulations. In our scenario we assume that the EU countries with retail sector PMR values above the

average in 2013 move their regulatory restrictions to the average level, which is 1.92. We calculate a lower bound scenario with an elasticity of 0.102 with regard to the impact of regulation changes on food prices, an intermediate scenario with an elasticity of 0.17 and an upper bound scenario with an elasticity of 0.196. These are the PMR elasticities from the price models without outliers in Table 10. The resulting food price reductions and increases in real final demand for food are displayed in Table 12.

As an example, let us take Austria with a PMR of 2.4 in 2013, which is 0.48 points over the EU average of 1.92. Thus, Austria would have to reduce its PMR by 19.8% to reach the average. This would lead to reduction of food prices between 2.0% (lower bound) and 3.9% (upper bound). Using now the own price elasticity of food from Table 11 gives us the expected increase of real final demand for food by private households, which is estimated between 1.9 % (lower bound) and 3.6% (upper level).

In the next step, we use the actual real per capita final demand for food by private households in 2016 to calculate the implied absolute real increase per capita in Euro (Table 13). E.g., for Austria, annual per capita real final demand would be between 33.38 Euros (lower bound) and 64.15 Euros (upper bound) higher than actually observed in 2016. Taking finally the population numbers for 2016 provides us with the total real increase of final demand for food. In the case of Austria, the increase would be between 0.291 billion Euros (lower bound) and 0.560 billion Euros (upper bound). For the combined total of all eleven EU countries with above average PMR indexes, the increase of real total final demand for food would be 18.5 billion Euros in the lower bound scenario, 30.9 billion Euros in the intermediate scenario and 36.6 billion Euros in the upper bound scenario.

Table 13. Impact of PMR reductions on final demand for food (absolute values)

	Increase per capita real final demand for food (in Euros)			Increase of total real final demand for food by private households (in billion Euros)		
	lower bound	intermediate	upper bound	lower bound	intermediate	upper bound
AUT	33.38	55.64	64.15	0.291	0.486	0.560
BEL	106.02	176.70	203.73	1.202	2.004	2.310
DEU	48.46	80.77	93.12	3.997	6.662	7.681
ESP	51.32	85.53	98.61	2.385	3.976	4.584
FIN	67.38	112.30	129.47	0.370	0.617	0.711
FRA	57.43	95.72	110.36	3.842	6.403	7.383
GRC	42.90	71.50	82.44	0.462	0.770	0.888
HUN	5.87	9.78	11.28	0.058	0.096	0.111
ITA	80.53	134.21	154.74	4.882	8.137	9.382
LUX	140.51	234.19	270.01	0.082	0.136	0.157
POL	24.93	41.55	47.91	0.947	1.578	1.819

These – somehow back of the envelope – calculations show only the direct effects of reductions of regulations via food prices on the final demand for food. Further multiplier effects can be expected on the demand side (consumption multiplier via higher income) and on the production side (via intermediate inputs).

4.3 Effects of changes of real final demand for food and non-alcohol beverages on employment in the food sector

In the third and last step, we estimate two versions of a labour demand function for the sector "food, beverages and tobacco" and use them to assess the impact of price induced demand changes on employment in the food sector. From a theoretical point of view a labour demand function should include the demand for the produced good, the price of labour, the prices for the other substitutional production factors, and an indicator for the effect of technological progress. In our empirical application the dependent variable is, in the one version of the labour demand function, the log of the number of employed persons from 1995 to 2015, and, in the other version, the log of the number of hours worked in the food sector for the same period. Data for both variables come from the EU KLEMS database.

Table 14. Estimation Results for the employment function of the food sector

Dependent variable: Log of persons employed in the food sector		
Explanatory variable	Coefficient	t-statistics
constant	3.665	4.026***
Log(labour costs)	-0.221	-1.812*
Log(real food expenditures)	0.203	1.989**
Country-specific trends	yes***	
Fixed country effects	yes***	
Fixed time effects	yes***	
Number of observations	410	
R^2	0.999	

Dependent variable: Log of hours worked in the food sector		
Explanatory variable	Coefficient	t-statistics
constant	10.839	9.629***
Log(labour costs)	-0.248	-2.280**
Log(real food expenditures)	0.246	2.064**
Country-specific trends	yes***	
Fixed country effects	yes***	
Fixed time effects	yes***	
Number of observations	406	
R^2	0.999	

Remarks: t-statistics based on Arellano (HAC) corrected standard errors. ***, ** and * indicate statistical significance at the 1%, 5% and 10% level, respectively.

The explanatory variables are the log of the labour costs per hour and the real final demand of private households for food and non-alcohol beverages. Thus, we exclude part of the total demand for food, beverages and tobacco, but assume that they are just a

shift either over time constantly of the final demand of the households or can be captured by country-specific trend variables, which are included in the model. Besides the just mentioned task, these country-specific trend variables should also approximate the impact of technological progress and the resulting medium-term trend in the development of employment in the food sector. Furthermore, we include fixed country and time effects in our model. The latter should mainly capture EU wide business cycle and crisis effects, which affect employment in all European food sectors in a similar way. According to the availability of data, 21 EU countries with a minimum of 6 and a maximum of 21 yearly observations were included in the analysis. Altogether, the labour demand functions are based on 406 or 410 observations. The results are displayed in Table 14.

The estimates for the coefficients of the real food expenditures are again elasticities. According to the estimate in the first panel of Table 14, a rise of real food expenditures by 1% would increase the number of persons employed in the food sector by 0.2%. The result in the second panel of the table is similar; an increase of real food expenditures by 1% would induce a rise of hours worked in the food sector by 0.25%.

These elasticities can be used to extend the analysis of the impact of changes in regulations in retail on the employment in the food sector. In the previous section we assessed the impact of changes in PMR on final demand for food and non-alcohol beverages by three as-if simulations assuming that the EU countries with PMR values above the average in 2013 move their regulations to the average level. Now, we can assess the impact on employment in the food sector resulting from these demand changes. Technically, we just have to multiply the demand changes (the lower bound, intermediate and upper bound values) by the elasticity of the real food expenditures with regard to employment. The results of this exercise are shown in Table 15.

Taking again Austria as an example, it can be expected that it would realise an increase of persons employed in the food sector between 0.38 % as a lower bound and 0.73 % as an upper bound if it would move to the EU average level of product market regulations. Similar increases of employment are found if hours worked in the food sectors are taken as the concerned variable. Hours worked in the Austrian food sector would increase between 0.46 % as a lower bound and 0.88 % as an upper bound.

Table 15. Impact of PMR reductions on employment in the food sector (in %)

	Employment growth (in %)					
	Persons employed			Hours worked		
	lower bound	intermediate	upper bound	lower bound	intermediate	upper bound
AUT	0.38	0.63	0.73	0.46	0.76	0.88
BEL	1.00	1.67	1.92	1.21	2.02	2.33
DEU	0.55	0.92	1.06	0.67	1.11	1.29
ESP	0.63	1.05	1.22	0.77	1.28	1.47
FIN	0.62	1.04	1.20	0.76	1.26	1.45
FRA	0.52	0.86	0.99	0.62	1.04	1.20
GRC	0.46	0.77	0.89	0.56	0.94	1.08
HUN	0.13	0.21	0.24	0.15	0.25	0.29
ITA	0.74	1.24	1.43	0.90	1.50	1.73
LUX	1.10	1.83	2.11	1.33	2.22	2.56
POL	0.47	0.78	0.90	0.57	0.94	1.09

Table 16. Impact of PMR reductions on employment in the food sector (absolute values)

	Employment growth (absolute values)								
	Persons employed			1000 hours worked			Persons (based on hours)		
	Lower bound	inter-mediate	upper bound	lower bound	inter-mediate	upper bound	lower bound	inter-mediate	upper bound
AUT	314	524	604	597	995	1147	381	635	732
BEL	950	1583	1825	1762	2937	3386	1151	1918	2211
DEU	5125	8542	9848	8800	14667	16910	6211	10351	11934
ESP	2686	4477	5162	6396	10660	12291	3256	5426	6256
FIN	235	391	451	442	737	850	284	474	546
FRA	3224	5373	6195	6132	10220	11784	3907	6511	7507
GRC	514	856	987	1320	2199	2536	623	1038	1197
HUN	152	253	292	320	534	615	184	307	353
ITA	3342	5569	6421	7303	12171	14032	4049	6749	7781
LUX	62	104	119	116	193	222	75	125	145
POL	2502	4170	4808	6332	10553	12167	3032	5053	5826
Total	19105	31842	36712	39520	65866	75940	23152	38587	44489

We use the absolute numbers for the year 2015 of persons employed and hours worked in the food sector to assess the absolute impact on employment. Columns 2 to 4 of Table 16 show the increase of persons employed based on the estimate with log persons employed as dependent variable. Columns 5 to 7 show the increase of hours worked in the food sector. In column 8 to 10 the increase of the number of persons employed displayed, which are calculated from the increase of hours worked using the average numbers of hours worked by an employed person in the food sector in each country considered in 2015. These numbers are always somewhat higher than the numbers from the direct assessment in columns 2 to 4. For the combined total of all eleven EU countries with above average PMR indexes, the increase in persons employed based on the first estimate would be between approximately 19,000 persons as a lower bound and 37,000 as an upper bound. Based on the second estimate, the increase of persons employed would be between 23,000 as a lower bound and 44,000 as an upper bound.

Again, these calculations show only the direct effects of reductions of regulations via food prices and final demand for food on employment in the food sector. Additional multiplier effects from the demand side and from the use of intermediate goods can be expected.

5 Conclusions

This technical report provides, on the one hand, a review of the theoretical literature with regard to the direct and indirect effects of product market regulations (PMR), which includes the general literature as well as approaches especially designed for the retail trade sector and its relationships with supplying manufacturing sectors. On the other hand, we analyse empirically, albeit in an exploratory manner, the effects of cross-country differences in retail trade PMR on the economic performance of this sector as well as the effects on the most important supplying sector, the food industry.

With regard to the direct effects of PMR reductions, the general theoretical literature mainly concludes that fiercer competition increases the allocative and productive efficiency and consequently the within-sector labour productivity. However, a positive link between dynamic efficiency and productivity is still a debated issues, as it seems to be dependent on the initial state of competition, with both high and low levels of competitive pressure being associated with low or even no gains in economic performance (Nicodème and Sauner-Leroy, 2007). Furthermore, countries far away from the technological frontier would not benefit from PMR reductions. These conclusions also hold for the indirect effects of PMR reductions on downstream and upstream industries (e.g. Bourlès et al., 2013).

The specific theoretical literature analysing the relationships between retail traders and their suppliers in the manufacturing sector also provides some ambiguous results. With regard to the effects of less PMR, the relevant question is whether less regulation will lead to consolidation and more concentration in the retail trade sector. Most of the retail trade literature considers larger retail trade units and more concentration as a prerequisite to realise economies of scale and to increase allocative as well as productive efficiency. However, more concentration will also increase retail buyer power. Here, one branch of the literature argues that reductions of regulations and an increased concentration of retail trade enable large retail trade firms to use their buyer power as a countervailing power to their suppliers from the manufacturing sectors. Another branch of the literature concludes that large retailers already possess too much buyer power. One important reason for this debate between the two branches is the introduction of slotting allowances and fees since the late 1980s, which now has become a widespread practice. These allowances are lump-sum up-front transfer payments from manufacturers to retailers in order to obtain shelf space for a product. Altogether, the theoretical literature with regard to the impact of entry and doing-business regulation in the retail trade sector is still underdeveloped, especially considering the importance of this sector in modern economies. E.g. the diffusion of e-commerce, which is associated with both the entry of new players and the expansion of the operations of incumbent firms, has been so far nearly ignored in the literature on the effects of entry regulations, although its implications might be game changing (Pozzi and Schivardi, 2015).

Due to the goal to analyse the impact of retail trade PMR for the group of EU countries with the very limited PMR indicator data for this sector, the empirical analysis can have only an exploratory character and the results have to be interpreted with caution. Nevertheless, the analysis of the development of the retail trade PMR shows that there is a certain convergence of these PMR for the 17 EU countries with data for 1998 and 2013. A decomposition analysis reveals that reductions of differences of overall regulation levels between 1998 and 2013 mainly came from the reduction of differences with regard to promotions and discounts, and to a lower extent from the reduction of differences with regard to permits and price controls. On the other hand, differences with regard to outlets and protection of incumbents moved in the opposite direction during this period.

The exploratory analysis of the relationship between PMR and the market structure in the retail sectors in the EU countries show that countries with higher levels of entry regulations (licenses and permits needed to engage in commercial activity and protection of existing firms) and stronger regulations of shop opening hours tend to have lower turnover rates of firms (entries and exits relative to the total number of firms) in their

retail trade sectors. The same holds for the entry rates. The latter result is also confirmed for a broader dataset of entry rates by two-sample t-tests for a difference in means.

Thus, there is obviously the possibility that less competition due to fewer entries and less firm fluctuation has a negative impact on productivity in EU countries with more restrictive PMR. Explaining labour productivity growth in the EU retail trade sectors directly by the initial productivity levels and the PMR indicators yields results that point in the same direction. The PMR main index as well as most of the subindices have a negative impact on labour productivity growth in the retail trade sector.

A very promising, but due to data limitations hindered field of further research is the link between PMR and ICT investment in the EU retail trade sectors. Our results, which are only based on observations for 9 or 10 EU countries, point to a strong negative correlation between entry as well as doing-business regulations and ICT investment.

In order to analyse the indirect effects of retail trade PMR, we choose the most important product group of the retail trade, food and beverages. Our three-step estimation procedure shows that PMR have a positive impact on consumer prices for food and thus a negative impact on food demand of households. We use the estimation results for a simple simulation exercise assuming that those EU countries with retail sector PMR values above the average in 2013 move their regulatory restrictions to the average level. For the combined total of all eleven EU countries with above average PMR indexes, the increase of real total final demand for food would be 18.5 billion Euros in the lower bound scenario, 30.9 billion Euros in the intermediate scenario and 36.6 billion Euros in the upper bound scenario. After estimating the elasticity of the impact of demand changes on employment in the food sector we can continue our simulation exercise with the same assumption. For the combined total of all eleven EU countries with above average PMR indices, the increase in persons employed in the food sector based on the first estimate of the demand elasticity of employment (based on the number of persons employed) would be between approximately 19,000 persons as a lower bound and 37,000 as an upper bound. Based on the second estimate (using hours worked as the dependent variable), the increase of persons employed would be between 23,000 as a lower bound and 44,000 as an upper bound. Our – somehow back of the envelope – calculations show only the direct effects of reductions of regulations via food prices and final demand for food on employment in the food sector. Additional multiplier effects from the demand side and from the use of intermediate goods can be expected.

Actually, some of the results of the exploratory data analysis look rather promising, but given its exploratory nature, further research is needed to check the robustness of the findings and to move to more elaborated statistical analyses for the 28 EU countries. However, this will be only feasible once more internationally comparable data of retail trade PMR will become available. In order to move from the observation of correlations for cross-sections of countries, data for a whole timespan of years and not only for five-year intervals is needed. Only yearly data would allow to identify the points in time of changes in regulations and to apply more sophisticated panel data approaches, like e.g. differences-in-differences estimators.

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